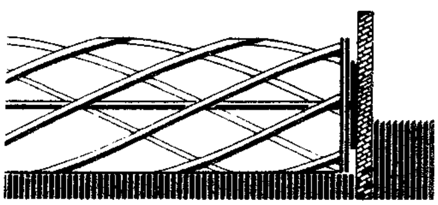
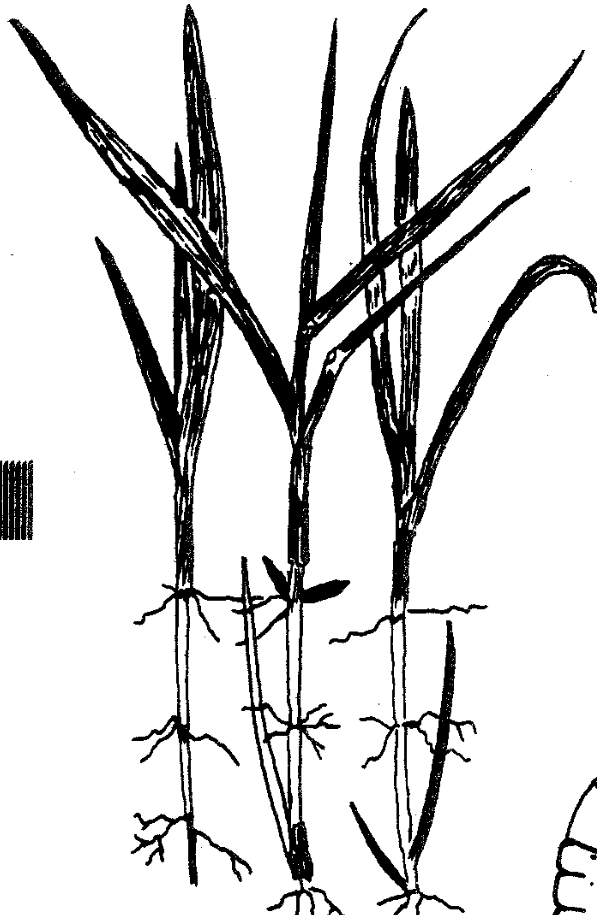
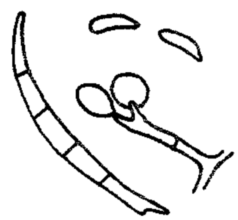
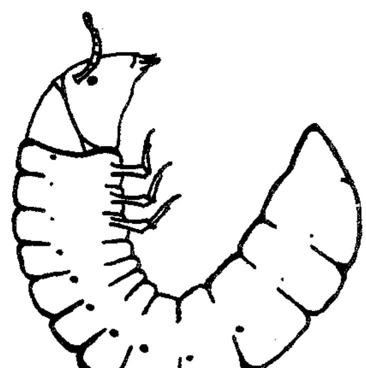
TURFGRASS RESEARCH

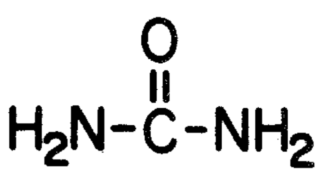
ANNUAL REPORT
Ontario Agricultural College
University of Guelph











1983

INTRODUCTION

The turfgrass research faculty of the O.A.C., University of Guelph take pleasure in presenting the second issue of Turfgrass Research, Annual Report for 1983. Again we emphasize that this is not a complete report as the data from some projects may not be complete or the projects are ongoing, long term research for which definitive results are not yet available. If more complete reports are desired on any of the subject matter please contact the authors of the reports.

A major undertaking in 1983 was the survey of the value of the turfgrass industry by Prof. Sears and Mr. Gimplej (see page 1) which was funded by the Ontario Turfgrass Research Foundation. This report, the first attempted for a Canadian province, places a dollar value on the turfgrass industry, an industry with significant social, esthetic, and recreational value. Whilst most agricultural commodities may be valued by the sale of a product, for the most part turfgrass is not a saleable commodity. It must be considered as a service industry which is valued on the basis of the cost of the labour, chemicals, seeds and equipment used in producing the service. As society achieves more leisure time the value of the service provided by turfgrass will become more significant.

The research group appreciate the co-operation and interaction with the Ontario Turfgrass Foundation, the Ontario Golf Course Superintendents Association, the Ontario Nursery Sod Growers Association and many others during the past year. We trust we will have your support in the years ahead and that we can provide the research and service you require.

R.W. Sheard,
Editor

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ACKNOWLEDGEMENTS

The Ontario Ministry of Agriculture and Food provide the research facilities at the Cambridge Research Station and the salaries of that portion of the faculty and staff of the University of Guelph who are associated with the turf research program.

The Ontario Turf Research Foundation has played a major role in funding turf research at Guelph, support which is greatly appreciated. Other support for specific research projects is received from the following agencies, industries and foundations which are listed in alphabetical order. This support is essential for the continuation of research in the area of turfgrass management and the support of graduate students - the researchers of tomorrow.

1) Canadian Industries Limited
2) Chemagro Canada Ltd.
3) Ciba-Geigy Canada Ltd.
4) Cyanamid Canada Ltd.
5) Dow Canada Ltd.
6) Duke Lawn Equipment Ltd.
7) Dupont
8) Eli Lily
9) Monsanto
10) O.M. Scott and Sons Inc.
11) Pickseed
12) SDS Biotech
13) The Quebec Sod Producers Assoc.
14) The Ontario Jockey Club
15) The Ontario Racing Commission
16) The Ontario Ministry of the Environment
17) Union Carbide
18) Upjohn
19) W.A. Cleary Corporation

Finally, thanks to Mrs. Denise Brenner whose patience with an uncooperative word processor, unintelligable handwriting of contributors and perfectionism of the Editor was exemplary.

TURFGRASS PRODUCTION AND MAINTENANCE COSTS IN ONTARIO

M.K. Sears and E.J. Gimplej

Department of Environmental Biology

RESEARCH PROCEDURE

Surveys by telephone and mailed questionnaires were conducted during spring and summer of 1983. Individuals, corporations, government departments and trade associations were contacted whose activities involve the production or maintenance of turfgrass, or the sale of products for use in turfgrass maintenance. Data for residential activities involved in turfgrass management were obtained by a door-to-door survey conducted in Guelph, Ontario. All of the data obtained were extrapolated to provide an estimate for total expenditures in Ontario during 1982.

RESULTS

Expenditures by those groups surveyed who maintain turfgrass in Ontario were estimated to be $245 million. Fifty-six percent of this total ($136 million) was spent by the residential segment, while an additional 331 ($82 million) was spent by golf courses. Sales of turf care products and commercial maintenance were estimated to be $193 million. Equipment items accounted for the greatest amount of expenditures, totalling $75 million, while fertilizers and commercial maintenance activities each represented $45 million in sales. Golf courses spent the greatest amount on turf maintenance at $4,464 per hectare ($1,785/acre), while government agencies spent the least ($190/ha or $75/acre) (Table 1). Homeowners spent $1,780 per hectare ($712 per acre) to maintain their lawns. On an average-sized lawn of 4,800 ft2, this was the equivalent of $80 per year spent on lawn care.

Table 1. The area and cost per unit area for turf maintenance in Ontario in 1982.

Category	Area (ha)	Maintenance Cost ($/ha)
Golf	18,322	4,463.70
Residential	76,498	1,780.95
Sod farms	9,736	1,667.60
Municipal	17,993	1,037.77
Parks	3,711	901.49
Airports	2,523	275.71
Highways	19,284	191.71
Military	5,923	187.90

If the estimated expenditures on lawn care in Ontario are compared to the farm-gate receipts for crops in Ontario, turfgrass production and maintenance ranks third behind grain corn and tobacco (Table 2). The value of turfgrass maintenance in Ontario represents a considerable proportion of the production of the agricultural industry.

Table 2. The area and farm value of selected Ontario crops* .

Crop	Area	Value
	(ha)	($)
Grain Corn	868,711	591,282,000
Tobacco	48,169	338,838,000
Turfgrass	153,990	244,932,062
Potatoes	14,508	46,814,000
Apples	10,348	36,119,000
Grapes	9,128	23,585,000

*From Agric. Stat. for Ont. 1981, O.M.A.F Publ. 20.

FAIRWAY OVERSEEDING WITH EMBARK

J.L. Eggens and C.M. Wright

Department of Horticultural Science

Research in field and greenhouse plots have shown that Embark applied prior to overseeding reduced competitive ability of the existing annual bluegrass plants and increased overseeding success. The main advantage is that the existing turf is not killed, but remains green.

RESEARCH PROCEDURE

Plots were established on #9 fairway at the Cutten Club, Guelph and were treated with Embark at 0, 0.1, 0.2 and 0.4 Kg/ha on 7 July. One week later, on 14 July one-half the plots were overseeded with a 50:50 (seed number) perennial ryegrass: Peancross mixture. Plot injury from Embark treatment was evaluated by visual evaluation using a scale of 0 to 10, (0 = dead and 10 = ideal turf). The effect of Embark on overseeding success was determined by the dry weight of perennial ryegrass per cm2 in each treatment as sampled on 14 September 1982.

RESULTS

There was significantly more perennial ryegrass in plots treated with Embark at 0.4 Kg/ha than in the untreated plots. The sward quality of plots treated at 0.1 and 0.4 Kg/ha Embark was significantly less than-the control plots but was considered to be acceptable for fairway use. By,14 September there was no difference in sward quality of the plots.

Table 1. Effect of Embark* on Fiesta perennial ryegrass overseeding of a predominentely annual bluegrass fairway.

Embark application rate	Perennial ryegrass dry weight on 14 Sept 82	Sward quality**		
		12 July	23 July	14 Sept
(Kg/ha)	(mg/cm^2)	(0-10, 10 = ideal turf)		
0.0	50 b***	9.6 a	9.3 a	8.0 a
0.1	55 ab	8.0 ab	8.8 a	8.3 a
0.2	68 ab	6.4 b	7.4 b	8.2 a
0.4	103 a	6.4 b	7.1 b	8.5 a

*Treated 7 July, overseeded 14 July 1982.

**Visual evaluation on a scale of 0-10, 10 ideal turf with 6.0 representing acceptable turf quality.

***a-b Means within colums followed by the same letter are not significantly different at the 5% level.

The amount of creeping bentgrass present in plots as the result of overseeding is exceedingly difficult to evaluate for at least the first year after overseeding. It is anticipated that some indication on the effects of Embark on Penncross overseeding will be available by summer 1984.

EFFECT OF ETHEPHON ON KENTUCKY BLUEGRASS, ANNUAL BLUEGRASS AND CREEPING BENTGRASS GROWTH

J.L. Eggens and C.H. Wright

Department of Horticultural Science

Currently available post-emergence herbicides cause significant injury to perennial turf without selectively removing annual bluegrass. Ethephon, sold as Ethrel by Union Carbide, has been shown to decrease annual bluegrass seedhead production and tolerance to mowing stress. With regular use ethephon might serve to reduce annual bluegrass competitive ability and allow the perennial turfgrasses to dominate.

RESEARCH PROCEDURE

Field plots were established on #3 fairway at the Cutten Club, Guelph and on the University of Guelph grounds and were treated with ethephon at 0, 1, 2 and 4 Kg/ha and 0, 1, 2, 4 and 8 Kg/ha respectively. The effect of ethephon on seedhead suppression, and amount of anthracnose injury was evaluated visually. The botanical composition was determined by the dry weight of Kentucky bluegrass and annual bluegrass per cm 2 within each treatment plot.

RESULTS

Annual bluegrass seedhead production was significantly reduced with some decrease in turf quality of the mixed annual bluegrass-creeping bentgrass turf (Table 1). The decrease in turf quality was the result of an increased susceptibility of annual bluegrass to anthracnose while no injury was noted on the creeping bentgrass.

Table 1. Effect of ethephon on an annual bluegrass-creeping bentgrass fairway.

Ethephon application rate	Seedhead Production	Turf Quality
(Kg/ha)	(% of plot coverage)	(0-10, 10 = ideal turf)
0	50	8.6
1	21	8.2
2	17	6.4
4	8	6.0

In the Kentucky bluegrass-annual bluegrass sward there was a decrease in annual bluegrass and an increase in the Kentucky bluegrass content (Table 2). The ethephon treatments caused greater internode elongation of the annual bluegrass plants, causing the anual bluegrass leaves to be raised above the Kentucky bluegrass leaves resulting in more leaf removal from the annual bluegrass plants during mowing. The stressed annual bluegrass plants showed increased susceptibility to anthracnose during August. The Kentucky bluegrass plants showed little injury at the 4 Kg ha^{-1} rate. Ethephon treatment must be combined with a preemergence program to prevent annual bluegrass germination and reestablishment in the sward.

Table 2. Effect of Ethephon on a 50 - 50 Kentucky bluegrass – annual bluegrass sod.

Ethephon Application Rate	Botanical Composition		Plant Height	
	Annual Bluegrass	Kentucky Bluegrass	Annual Bluegrass	Kentucky Bluegrass
(Kg/ha)	(mg dry wt/cm^2)		(cm)	
0	426	393	10.7	11.6
1	442	448	9.7	8.8
2	278	481	9.9	9.0
4	279	606	9.3	7.7
8	233	593	8.1	6.6

TIMING " WINTERIZER" NITROGEN APPLICATIONS

R.W. Sheard and J.A. Ferguson

Department of Land Resource Science

It has been demonstrated that nitrogen is the primary nutrient in the "Winterizer" fertilizer effect on turf (Sheard, R.W., Highlights, Vol. 5 No. 3, 1982). Information on the target date for making the nitrogen application is limited as is the effect on spring color of delaying the nitrogen application until mid-April of the following year. U.S. data suggest the nitrogen should be applied at least two weeks prior to soil freeze-up where soluble materials are used and ten days earlier than that date where slow release materials are used. The study reported herein provides some data for Ontario conditions on a bluegrass turf maintained as a home lawn.

RESEARCH PROCEDURE

Rates of urea and of sulphur coated urea (S.C.U.) were applied to separate plots on four dates in October and November, 1982 and on April 12, 1983. Color evaluations were made on Dec. 12, 1982 and at frequent intervals during April, May and June, 1983 and on Aug. 31, 1983. Clipping weights were obtained on several of these dates and the clippings were analyzed for total nitrogen.

RESULTS

Applications of nitrogen prior to Nov. 1 had a major influence on late fall color as evaluated in mid December whereas November applications were one-half as effective (Table 1). There was little difference between urea and S.C.U. at this stage. In contrast, early spring color was best

Table 1. The influence of date of application of urea and S.C.U. as "winterizer" nitrogen on the color of bluegrass during the following season.

Date of Color Evaluation	Date of Material Application*									
	Urea					S.C.U.				
	Oct. 19	Oct. 81	Nov. 8	Nov. 18	Apr. 12	Oct. 19	Oct. 28	Nov. 8	Nov. 18	Apr. 12
	(Scale 1-10; 1 = poor, 10 = excessive)									
82 12 06	6.7	5.9	3.4	3.5	1.9	7.0	5.5	2.9	2.9	1.6
83 04 12	1.8	2.5	3.5	4.0	0.5	1.9	2.4	2.2	2.2	0.5
83 04 06	7.0	7.8	8.4	8.1	6.9	7.7	6.7	6.1	6.6	4.8
83 05 27	7.3	7.4	6.9	7.7	8.8	7.5	7.3	7.0	7.1	8.5
83 06 17	5.7	5.0	5.1	5.9	8.4	6.2	6.9	5.6	6.2	7.1
83 06 30	5.2	4.5	4.3	5.2	7.3	5.4	6.6	5.6	6.5	7.1
83 08 31	2.3	2.2	2.3	2.9	4.7	3.8	4.4	4.6	5.2	6.7

*Applied at 2.0 Kg N/100 m^2.

with the Nov. 18 applications of urea, in part due to the canopy of taller, wind desicated grass resulting from the early October applications which masked the new spring growth. Early May color was superior where fall applications of urea were made in contrast to a mid-April application, with the November timing of the applications ranking highest. By June the April applications were superior, with the S.C.U. treatments providing better color than urea, a superiority which carried through until the end of August.

Clipping weights did not show a heavier spring growth from an April application of nitrogen than from "Winterizer treatments (Table 2). Clipping weights from S.C.U. tended to be less than where urea had been

Table 2. The influence of date of application of urea and S.C.U as "Winterizer" nitrogen on clipping weights of bluegrass.

	Date of Material Application*									
	Urea					S.C.U.				
Date of Sampling	Oct. 19	Oct. 28	Nov. 8	Nov. 18	Apr. 12	Oct. 19	Oct. 28	Nov. 8	Nov. 18	Apr. 12
	(gm dry wt/m2)									
83 05 09	9.4	12.8	16.8	15.1	12.5	13.9	6.7	6.1	8.1	10.0
83 05 27	31.5	36.6	42.0	37.5	37.3	31.3	24.6	22.8	23.1	26.4
83 06 17	23.0	24.1	30.2	23.5	33.7	30.2	27.8	30.0	23.5	28.9
83 06 30	6.7	6.9	7.4	14.6	9.2	8.6	8.6	7.5	7.2	8.0
83 08 31	9.3	10.2	9.7	10.0	12.4	16.1	12.5	9.1	12.6	12.7

*Applied at 2.0 Kg N/100 m^2.

applied. During May the clipping weights from the mid-October applications of urea were less than from later applications indicating more nitrogen had been consumed in fall growth or lost before spring growth commenced.

It is concluded that the "Winterizer" application of nitrogen must be made at least three weeks prior to soil freeze-up. Early November mowing to shorten the turf or late April mowing to remove vegetation which-has been dessicated by spring winds will be necessary to realize full advantage of early spring growth and color. Delaying the nitrogen application until April may delay spring green-up by three weeks.

FREQUENCY OF APPLICATION OF NITROGEN CARRIERS FOR BENTGRASS PRODUCTION

R.W. Sheard

Department of Land Resource Science

New nitrogen carriers continue to be produced as manufacturers strive to develop more efficient systems of controlling the rate of release of nitrogen to the grass root. The materials require evaluation in comparative studies which are uncomplicated by the inclusion of phosphorus and potassium in the fertilizer mix. An objective of controlling the rate of release of the nitrogen carriers is to reduce the number of applications per season required to maintain uniform color.

RESEARCH PROCEDURE

The data reported from this study summarizes a four year comparison of rates of five slow-release materials applied at three or six applications per year to Penncross creeping bentgrass. All materials were applied with a precision fertilizer spreader and were followed by irrigation.

Because color of turf fades with increasing time from the previous application of nitrogen the color evaluations recorded in Table I were made just prior to the next application of the material to reflect the ability of each material to maintain color. The data for August was chosen to give a time when a uniform 2.6 Kg N/100 m^2 had been applied to all treatments and to compare the materials at a point in the season when maximum stress occurs with Penncross. The plots were maintained as a bentgrass green with all clippings removed.

RESULTS

Although the data for the carriers varied from season to season it is apparent that many of the carriers were unable to maintain a color rating of 7.0 with only two applications (Table 1). Furthermore, four applications of urea at 0.66 Kg N/100 m^2 and several of the slow-release carriers were also unable to maintain a standard of 7.0 between applications. S.C.U. and I.B.D.U. were the superior materials throughout the four years whereas U.F. and sewage sludge never performed as well as the other materials.

A significant feature was the general superiority obtained from more frequent applications. This improved color would suggest equal color can be obtained at lower rates of nitrogen by increasing the number of applications. It is recommended that the frequency of application of nitrogen carriers be at least once every four weeks.

Table 1. Color ratings of Penncross bentgrass resulting from two frequencies of applications of six nitrogen carriers.

Material	Date of Evaluation and Frequency of Application								4 Year Ave.	
	78 08 21		79 08 17		80 08 29		81 08 18			
	2X*	4X	2X	4X	2X	4X	2X	4X	2X	4X
	(Rating 1 to 10; 1 = poor, 7 = satisfactory)									
Urea	-	6.5	-	5.2	-	6.6	-	5.9	-	6.0
I.B.D.U.	9.1	9.3	5.3	8.4	6.2	7.4	6.5	6.9	6.8	8.0
S.C.U.	7.7	8.6	5.7	7.1	7.4	8.4	7.4	7.2	7.0	7.8
Scotts	7.4	8.9	4.5	5.2	4.8	6.0	5.5	5.9	5.5	6.5
U.F.	4.7	6.2	3.9	4.7	5.4	4.9	5.7	6.0	4.9	5.4
Sludge	4.3	4.8	3.7	4.3	5.7	7.1	5.9	6.2	4.9	5.6
(C.D.U.) **										

* Applied at 1.33 (2X) or 0.66 Kg (4X) N/100 m2 per application

** Changed to C.D.U. (crotonyl diurea) in 1980

THE NUTRITIONAL REQUIREMENTS OF BENTGRASS ON ALL-SAND ROOTING MEDIA

R.W. Sheard, M.A. Haw and G.B. Johnson

Department of Land Resource Science

Studies of the mineral nutrition of bentgrass growing on an all-sand rooting media were continued in 1983. The data recorded herein, however, applies only to the 1982 season because the analysis of the clippings and water samples for 1983 have not been completed.

The objectives of the project are two-fold: 1) To measure the availability, retention and leaching losses of N, P, and K and trace elements from an alkine and an acid sand rooting media, and 2) to develop an irrigation scheduling system for sand rooting media based on rainfall and evaporation measurements from a free water surface.

RESEARCH PROCEDURE

Twelve, 0.65 m^2 micro-greens of an alkaline sand and 12 of an acid sand, contained within fiberglass tanks, were equipped with a drainline permitting the collection of all drainage water. The greens were seeded to Penncross bentgrass on May 2, 1982 and were clipped at a 1.25 cm height on 13 occasions during the season. Drainage loss measurements were made on 44 occasions. All clipping and drainage water samples were retained for chemical analysis. An initial application of 5.0 Kg P/100 m^2 as 0-46-0 and 1.0 Kg K/100 m^2 as 0-0-60 was made prior to seeding followed by 3.0 Kg N, 2.0 Kg P and 4.0 Kg K/100 m^2 during the remainder of the season. They were applied as urea, sulphur-coated urea, 0-46-0, muriate of potash (0-0-60) and sulphur-coated potash.

RESULTS

The potassium removed in the clippings and leached through the sand into the drainage water from the application of 5.0 Kg K/100 m^2 was calculated for the 1982 season and tabulated as a percent of that applied (Table 1). The percentage of the applied potassium removed in the clippings was increased by the use of urea in contrast to sulphur-coated urea whereas the acidity of the sand and the potassium carrier had no significant effect. Loss of potassium in the drainage water was primarily influenced by the pH of the sand with 4.5 times more potassium leaching through the acid sand than the alkaline sand. As a result an average 85.3% of the applied potassium was retained in the alkaline sand in contrast to 65.4% retained in the acid sand.

Table 1: The removal of potassium from all-sand rooting systems by plant uptake and leaching during 1982.

Location of K	Type of Sand	Source of Nitrogen	Source of Potassium	
			KCl	Sulphur-coated KC1
			(%)	
Plant	Acid	Urea	10.0*	12.1
		S.C.U.	7.6	7.8
	Alkaline	Urea	11.3	10.8
Drainage		S.C.U.	6.7	7.4
Water	Acid	Urea	28.8	18.5
		S.C.U.	28.1	25.5
	Alkaline	Urea	6.9	4.9
Retained		S.C.U.	5.4	5.4
	Acid	Urea	61.2	69.4
		S.C.U.	64.3	66.7
	Alkaline	Urea	81.8	84.3

*% of 5 Kg K/100 m^2 applied throughout the season.

Table 2. The removal of phosphorus from all sand rooting systems by plant uptake and leaching during 1982.

Location of P	Type of Sand	Source of Nitrogen	Source of Potassium	
			KC1	Sulphur-coated KC1
			(%)	
Plant	Acid	Urea	1.20*	1.46
		S.C.U.	0.94	0.90
	Alkaline	Urea	1.31	1.22
		S.C.U.	0.78	0.81
Drainage	Acid	Urea	1.65	1.37
Water		S.C.U.	1.70	1.67
	Alkaline	Urea	0.45	0.40
		S.C.U.	0.50	0.50
Retained	Acid	Urea	97.15	97.17
		S.C.U.	97.36	97.43
	Alkaline	Urea	98.24	98.38
		S.C.U.	98.72	98.69

*% of 7.0 Kg P/100 m^2 applied throughout the season

A similar analysis was made of the phosphorus removed in the clippings and leached through the sand (Table 2). Relative to potassium, very small amounts of phosphorus were taken up by the clippings or leached in the drainage water. As a result 97 to 98% of the phosphorus remained in the rooting zone to be used the following season. Nevertheless 57% more phosphorus was removed in clippings from the urea treated turf than from the S.C.U. treated turf, primarily because of the greater top growth. The major factor affecting phosphorus removal through the drainage water was pH where 3.4 times more phosphorus was leached from the acid sand than from the alkaline sand.

Limited data is available, at this time on the leaching of nitrogen from the sand rooting zone. As would be expected the soluble urea form of nitrogen resulted in the greatest concentration of total nitrogen in the drainage water whereas S.C.U. exhibited minimal levels (Table 3).

Table 3. The average concentration of total nitrogen from four leaching events in July, 1982 following an application of 0.5 Kg N/100 m^2.

Type of Sand	Source of Nitrogen	Source of Potassium	
		KC1	Sulphur-coated KC1
		(ppm N)	
Acid	Urea	32.2	10.4
	S.C.U.	1.2	1.6
Alkaline	Urea	7.0	4.8
	S.C.U.	0.8	0.8

Furthermore the acid sand permitted two to four times more leaching of nitrogen than the alkaline sand. There appeared to be a reduction in leaching of nitrogen from urea when it was used in combination with sulphurcoated potassium.

The data demonstrates an advantage for the choice of alkaline sands for all sand rooting systems through the reduction in the leaching of nitrogen, phosphorus and potassium. At this time no deliterious effects on bentgrass growth have been demonstrated, therefore alkaline sands are recommended for greens construction and topdressing.

HARDNESS AND ELASTICITY OF SOIL AND SAND ROOTING ZONES

R.W. Sheard and B. Zebarth

Department of Land Resource Science

Considerable contraversy exists regarding the hardness of greens constructed from various soil materials. The principal factor influencing hardness on soil-based rooting zones is compaction resulting in the use of sand for topdressing or construction to alleviate or avoid the problem. Sand-based greens, however, have been reported to lack ball holding ability, that is they lack elasticity. Soil elasticity is a measure of the energy returned to the golf ball which causes it to bounce following impact.

RESEARCH PROCEDURE

Electronic equipment was developed to measure the hardness of a surface in terms of the rate at which a golf ball stops using a deaccelerometer attached to a lead weight. The lead weight was cast with a face identical in size and shape to a golf ball and having a mass which, when dropped from one meter, was equivalent to a standard golf ball falling from 20 meters. Elasticity or the ability of the surface to hold the ball was similtaneously recorded and reported as the rebound height, a percent of the initial drop height. Five measurements were made on each of three sandbased greens and three soil-based greens at the Cutten Club, Guelph, in August, 1983.

RESULTS

The sand-based greens averaged 191 harder than the soil-based greens that is, upon impact the ball stopped moving more quickly. The soil based green, #8, however, was found to approach the same degree of hardness as the sand-based greens.

Table 1. The influence of construction material on the hardness and elasticity of bentgrass greens.

Green	Construction	Hardness		Elasticity	
No.	Material	Ave*	Range	Ave*	Range
		(g**)		(%)	
4	Sand	128	119-144	1.37	0.93-1.51
6	Sand	129	119-135	—	—
7	Sand	121	112-130	2.37	2.17-2.49
Ave.		126		1.87	
2	Soil	102		4.98	4.71-5.25
3	Soil	97		5.73	5.51-6.15
8	Soil	118		7.25	7.00-7.69
Ave.		106		5.99	

*Ave. of 5 measurement
**g - gravity units

Although the sand-based greens were found to be harder, more of the energy of the initial impact was dissipated in the sand so that there was three-fold less rebound than on soil-based greens. In other words, the soil based greens were more elastic and as a result the golf ball should bounce more after impact. Further studies using this instrumentation to determine golf ball behavior upon impact with a greens surface are planned for 1984.

CHEMICAL CONTROL OF GERLACHIA PATCH ON CREEPING BENTGRASS

L.L. Burpee and L.G. Goulty

Department of Environmental Biology

Gerlachia patch disease (=Fusarium patch) is diagnosed frequently in southern Ontario on close-cut creeping bentgrass and annual bluegrass in late fall (Oct.-Nov.) and early spring (April-May). The fungicides Rovral, PMAS, Tersan 1991, and Easout have been recommended for control of this disease. However, the specific dosages that are required to achieve satisfactory control are subject to some debate. The following research was designed to test the efficacy of these and other fungicides for control of *Gerlachip nivalis* (=*Fusarium nivale*) on creeping bentgrass.

RESEARCH PROCEDURE

A six year old stand of creeping bentgrass cv. Penncross was maintained at a five mm cutting height at the Univ. of Guelph Horticulture Research Station, Cambridge, Ontario. Cultural practices were similar to those used for maintenance of golf course putting greens in Ontario. The experimental design consisted of a randomized complete block with four replications. Twenty-five fungicide treatments plus a non-treated control were included in each block. Each treatment plot measured 1 x 2 m. Fungicides were applied on 10 May and 27 May in 7 1 of water per 100 m^2 with a wheel-mounted compressed air boom sprayer at 30 psi pressure. The turfgrass was inoculated on 11 May with autoclaved rye grain infested with three isolates of *Gerlachia nivalis*. Disease intensity was estimated on 6 June using the Horsfall-Barratt rating scale.

RESULTS

All treatments, except Actidione TGF at 60 g/100 m^2, provided a significant level of disease control (Table 1). However, only Rovral, Dithane, and Thiram at 180 g/100 m 2 and CGA 64250 at 30 and 60 ml/100 m^2 provided acceptable control (<3% disease) for fine turf areas. Quintozene applied at 120 g/100 m^2 was phytotoxic.

Table 1. Influence of fungicides on the intensity of Gerlachia patch disease of creeping bentgrass.

Treatment	Dosage	Disease
	(Product/100 m^2)	(%)
Rovral	180 g	2.3*
Dithane M-45	180 g	2.3*
Thiram	180 g	2.3*
CGA 64250	30 ml	2.9*
CGA 64250	60 ml	2.9*
Daconil 2787	175 ml	3.5*
Quintozene	120 g	P 3.5*
Arrest	180 g	3.5*
C-486	107 g	4.1*
Quintozene	90 g	4.1*
Scotts Broad Spectrum	1x	4.1*
Captan	180 g	4.7*
Thiran	60 g	4.7*
Actidione RZ	30 g	4.7*
Tersan 1991	60 g	4.7*
Arrest	240 g	5.3*
Tersan 1991	30 g	5.3*
Easout 50 F	60 g	5.3*
Actidione TGF	30 g	5.9*
Easout 84 ml	84 ml	5.9*
Actidione RZ	60 g	7.0*
Thiram	120 g	7.0*
Fungicide VII	1x	8.2*
PMAS	30 ml	8.8*
Actidione TGF	60 g	9.4
Control	-	12.9

*Statistically significant from control (P.0.05)
P=phytotoxicity resulting in foliar chlorosis

CONTROL OF DOLLARSPOT ON CREEPING BENTGRASS

L.L. Burpee and L.G. Goulty

Department of Environmental Biology

More fungicides are applied per year on creeping bentgrass and annual bluegrass for control of dollar spot disease than for control of all other turfgrass diseases combined. Several contact and systemic fungicides provide acceptable control; however, residual activity varies considerably among the chemicals. Current research was conducted in an attempt to improve the efficacy of registered fungicides and to compare experimental chemicals with those that are used commonly.

RESEARCH PROCEDURE

Treatments were applied to a six year old stand of creeping bentgrass maintained at the Univ. of Guelph Horticultural Research Station, Cambridge, Ontario. Cultural practices were simialr to those used for maintenance of golf course putting greens in Ontario. The experimental design consisted of a randomized complete block with four replications. Twenty-eight fungicide treatments and a non-treated control were included in each block. Each treatment plot measured 1 x 3 m. Wettable powder and liquid formulations were applied in 7 1 of water per 100 m^2 with a wheel mounted compressed air boom sprayer at 30 psi pressure. O.M. Scotts materials were applied with a Scotts drop spreader. Fungicides were applied on 12 July. Twenty-four hours prior to fungicide application, 0.45 Kg N/100 m^2 (as NH_4NO_3) was applied to three Daconil treatment plots in each replicate. The turf grass was inoculated with autoclaved rye grain infested with three isolates of *Scleratinia homeocarpa* on 13 July. Disease intensity was estimated at seven day intervals, beginning 22 July, using the Horsfall-Barratt rating scale. Fungicides were reapplied if the mean percent disease was > 3.0%.

RESULTS

All treatments, except C-486, provided significant control (Table 1). However, only treatments resulting in < 3.0% disease are considered acceptable for fine turf. Duration of acceptable control ranged from < 7 to > 28 days. The application of additional soluble N, just prior to infection, significantly improved the efficacy of Daconil, particularly at the low dosage of 30 ml.

Table 1. Influence of fungicides on intensity of dollar spot disease creeping bentgrass.

Treatment	Dosage	Percent Disease	Duration Control
	(Product/100 m^2)	(%)	(Days)#
CGA 64250	15 ml	0.6*	14-21
Scotts F-8359	6 3/4+	1.2*	7-14
Easout 50 F	84 ml	1.2*	14-21
BAS 436	60 g	1.8*	>28
BAS 436	90 g	1.8*	>28
Scotts F-96	6 3/4+	1.8*	7-14
CGA 64250	30 ml	1.8*	>28
Easout 70 wp	60 g	1.8*	14-21
Actidione-Thiram	120 g	P 1.8	7-14
Scotts Fungicide VII	5 3/4+	1.8*	>28
Rovral	60 g	2.3*	21-28
Actidione TGF	60 g	2.3*	5-7
Actidione RZ	80 g	P 2.3*	7-14
Scotts S-804	5 1/4+	2.9*	21-28
Scotts Fungicide VII	4 1/4+	2.9*	21-28
Actidione-Thiram	60 g	3.5*	<7
Actidione TGF	30 g	4.7*	<7
Actidione RZ	40 g	P 4.7*	<7
C-486	53 g	14.1	-
C-486	75 g	11.7	-
Control	-	15.2	-
Daconil 2787	95 ml	2.9*	7-14
Daconil 2787	135 ml	2.3*	21-28
Daconil 2787	30 ml	10.5*	-
Daconil 2787 + N	30 ml + 0.45 Kg	2.9*	7-14
Daconil 2787	60 ml	4.1*	5-7
Daconil 2787 + N	60 ml + 0.45 Kg	2.9*	7-14
Daconil 2787	120 ml	2.3*	7-14
Daconil 2787 + N	120 ml + 0.45 Kg	1.2*	7-14

+Scott spreader settings
#Number of days, post application, with-mean disease severity < 3.0%
*Statistically significant from control (P=0.05)

EVALUATION OF FUNGICIDES FOR CONTROL OF PINK SNOW MOLD ON CREEPING BENTGRASS

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Pink snow mold, caused by *Gerlachia nivalis* (=*Fusarium nivale*), is the predominant winter disease of creeping bentgrass and annual bluegrass in southern Ontario. Commonly used fungicides include Scotts FF11, Mersil and other inorganic mercury products, and Arrest. For the most part, these fungicides provide acceptable control of pink snow mold; however, specific problems have been associated with each of these chemicals. For example, FFII may cause stunting and discoloration of creeping bentgrass, inorganic mercuries may be associated with human health and environmental hazards, and the efficacy of Arrest may be seriously reduced by rain or melting snow. Therefore, field trials continue to be conducted in order to solve these problems and to select a broader range of fungicides for control of snow mold.

RESEARCH PROCEDURE

A six year old stand of creeping bentgrass cv. Penncross was maintained at a five mm cutting height at the Univ. of Guelph Horticultural Research-Station, Cambridge, Ontario. Cultural practices were similar to those used for maintenance of golf course putting greens in Ontario. The experimental design consisted of a randomized complete block with four replications. Twenty-four fungicide treatments plus a non-treated control were included in each block. 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 30 psi pressure. A Scotts drop spreader was used to apply Scotts FFII and Scotts Fungicide VII. Treatments were applied on 8 Nov., 1982. The turfgrass was inoculated with autoclaved rye grain infested with three isolates of *Gerlachia nivalis* on 10 Nov. Disease intensity was estimated on 4 April, 1983 using the Horsfall-Barratt rating scale.

RESULTS

All treatments, except Actidione-Thiram at 120 g/100 m^2 yd all dosages of Arrest resulted in significant levels of disease control (Table 1). However, only Scotts FFII and Tersan SP at 240 g/100 $m^{2,}$ and Mersil at 125 g/100 m^2 provided acceptable control (< 31 diseased) for fine turf areas. Creeping bentgrass treated with Scotts FFII was stunted and chlorotic in May. The addition of the residue extender Exhatt 800 to tank mixes of contact fungicides did not improve efficacy.

Table 1. Effect of fungicide treatments on the intensity of pink snow mold on creeping bentgrass.

Treatment	Dosage (product/100 m^2)	Disease (%)
Scotts FFII	240 g	P 0.0*
Tersan SP	240 g	2.1*
Daconil 2787	637 ml	2.3*
Daconil 2787	319 ml	2.3*
Mersil	125 g	2.3*
Bas 436	122 g	2.9*
Daconil 2787 + Exhalt 800	319 ml + 10 ml	2.9*
Mersil	63 g	4.1*
Mersil + Exhalt 800	63 g + 10 ml	5.3*
Tersan SP + Exhalt 800	120 g + 10 ml	6.4*
Tersan SP	120 g	7.6*
CGA 64250	120 ml	8.2*
Daconil 90 DG	153 g	8.2*
Daconil 90 DG + Exhalt 800	153 g + 10 ml	8.2*
Scotts Fungicide VII	7 1/4+	12.3*
Scotts Fungicide VII	4 1/4+	14.1*
Actidione Thiram	60 g	15.2*
Scotts Fungicide VII	5 3/4+	15.2*
CGA 64250	60 ml	16.2*
Exhalt 800	10 ml	16.4*
Arrest	140 g	17.4
Actidione Thiram	120 g	22.3
Arrest	280 g	25.8
Arrest + Exhalt 800	140 g + 10 ml	30.5
Control	-	30.5

+Scotts spreader settings
*Statistically significant from control (P=0.05)
P=phytotoxic reaction resulting in foliar chlorosis

EFFICACY OF INSECTICIDES USED TO CONTROL EUROPEAN CHAFER LARVAE in 1982

M.K. Sears and R.R. McGraw

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RESEARCH PROCEDURE

An area of turfgrass, approximately 25 m x 45 m, and heavily infested with larvae of the European chafer was selected for treatment at Fairview Cemetery in Niagara Falls, Ontario. Pretreatment samples taken on Sept. 15, 1982 indicated a population of 8.5. grubs per 0.1 m^2. The grubs were primarily (90%) second-instar larvae with the remaining individuals first instar. Because of the very dry soil conditions, grubs were located about 5 cm below the soil surface in cells they had formed in the sandy loam soil.

Insecticides were applied on Sept. 29 after rainfall provided enough moisture in the thatch to cause the grubs to resume feeding. Granular insecticides were applied with a drop-type spreader and liquid formulations with a $C0_2$ powered, hand-held boom sprayer. Plots (10 m^2) were arranged in a completely randomized design and each treatment was replicated four times.

Treatments were evaluated twice, once on November 9, 1982 and again on May 2, 1983. Three samples (0.16 m^2) in each plot were examined for the presence of larvae.

RESULTS

None of the insecticides were shown to be effective during the first 6 weeks of the trial (Table 1). This resulted from the dry soil conditions that persisted during the fall and to the great variation in numbers of grubs recovered in the non-sprayed plots. By the following spring, plots treated with products containing isofenphos, diazinon and chlorpyrifos, CGA 12223 and one rate of CGA 73102 had significantly fewer grubs than did the non-sprayed plots and plots that had been treated with chlordane. Despite the poor test conditions of the previous fall, there was an effective carryover of most of the materials examined. Chlordane proved ineffective as was the case in previous years and it is apparent that it should no longer be recommended for control of European chafers.

Table 1. Insecticide efficacy for European chafer of materials applied on September 29, 1982 at Fairview Cemetery, Niagara Falls, Ontario.

Insecticide	Formulation	Rate	Evaluation Date Nov. 9, 1983	Evaluation Date May 2, 1983
		(Kg Ai/ha)	(No. of grubs/0.5 m^2)	
Isofenphos	2F	2	8.8b-e	0 d
(Oftanol)		4	2.8e	0 d
Isofenphos	5G	2	11.0b-e	2.0cd
(Oftanol)		4	8.3c-e	0.5d
Scotts F6457	3.6G	4	9.8b-e	0.8d
Scotts S390	2G	1.8	8.5c-e	0.8d
Diazinon	5G	4	10.0b-e	0.8d
(Basudin)		6	5.0e	0 d
Diazinon	50EC	4	14.8a-e	2.3cd
(Basudin		6	9.0b-e	5.0cd
CGA 12223	5G	2	14.8a-e	5.3cd
Chlorpyrifos	2.5G	4	9.8b-e	4.3cd
(Dursban)		6	19.8a-e	4.5cd
Chlorpyrifos	4E	4	14.5a-e	5.3cd
		6	7.0de	3.3cd
CGA 73102	5G	2	20.5a-e	8.8bc
		4	12.3a-e	3.8cd
Chlordane	25G	6	26.5ab	7.8bc
		10	29.3a	12.5ab
Chlordane	40EC	6	25.8a-c	17.3a
		10	23.8a-d	12.3ab
CHECK		-	18.0a-e	13.0ab

*Means followed by the same letters are not significantly different (P = 0.05), Duncan's Multiple Range Test.

EFFICACY OF INSECTICIDES USED TO CONTROL EUROPEAN CHAFER LARVAE IN 1983

M.K. Sears and R.R. McGraw

Department of Environmental Biology

RESEARCH PROCEDURE

An area of turfgrass measuring 10 m x 20 m and moderately infested with larvae of the European chafer was selected for treatment at Fairview Cemetery, Niagara Falls, Ontario. Pretreatment samples taken on May 2, 1983 indicated a population of 4.4 grubs per 0.1 m^2. The grubs were all in the 3rd instar and located in the thatch or just below it indicating that they were actively feeding.

Insecticides were applied on May 3, 1983. Granular products were applied with a drop-type spreader and liquid formulations with a CO_2 powered, hand-held boom sprayer. Plots (10 m^2) were arranged in a completely randomized design with each treatment replicated four times.

Treatments were evaluated twice; the first on June 10 just before the larvae would normally pupate and again on September 29 after the subsequent generation had a chance to become established in the plot area. Three samples (0.16 m^2 each) were taken from each plot and examined for the presence of larvae.

RESULTS

None of the insecticides caused significant mortality of grubs within the first six weeks of the experiment (Table 1). At the time of treatment, in a very mild spring, grubs were quite mature and many probably did not feed to a great extent. After adults emerged during the latter half of June and reinfested the plot area, significant differences among the treatments were observed. Plots treated with either granular or liquid formulations of isofenphos were relatively free of infestation, while the plots treated with chlorpyrifos provided no protection from the reinfestation. The persistence of isofenphos is such that it prevented further infestation following a spring application.

Table 1. Insecticide efficacy for European chafer of materials applied May 3, 1983 at Fairview Cemetery, Niagara Falls, Ontario.

Insecticide	Formulation	Rate	Evaluation Date	
			June 10	Sept. 28
		(Kg Ai/ha)	(No. of grubs/0.5 m2)	
Isofenphos (Oftanol)	2F	2	15.8a	0.8d
Isofenphos (Oftanol)	5G 4E	2	12.8a	6.5c
Chlorpyrifos (Dursban)		4	17.8a	18.5a
Check		-	19.3a	13.8ab

*Means followed by the same letters are not significantly different (P = 0.05), Duncan's Multiple Range Test.

BIOLOGY OF THE TURFGRASS SCALE INSECT, *LECANOPSIS FORMICARUM*

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RESEARCH PROCEDURE

Three sites on a homeowner's lawn in Guelph, Ontario were sampled intensively for scale insects from May 9 until December 1, 1983 to determine the life cycle of this species. Quadrats (1 m x 1 m) were divided in 100 subdivisions and 30 of these were sampled each week during the sampling period. A single, three cm^2 in area , thatch and soil core was removed from each of the 30 subdivisions.

Samples were taken to the laboratory where they were examined under the microscope for the presence of scale insects. Measurements of the body length, antennal length and width of the base of the mouthparts of the nymphs and adults were recorded.

RESULTS

A single generation of the scale insect, *Lecanopsis formicarum*, was observed (Fig. 1). Adult females began to appear in the samples in early May. Cottony masses of silk-containing eggs were first seen at the beginning of June. Each mass contained an average of 102 eggs (range 68 to 167). No males were found in any samples and it is assumed that females reproduce asexually. Minute, reddish colored crawlers appeared in mid-June and were present until mid-July. At the peak of their activity, crawlers migrated to the tips of grass blades causing the turf to appear reddish in color. Crawlers were dispersed by the wind and settled in new areas. Small, 1st-instar nymphs become sessile and feed on grass stems, usually under the protective cover of grass blades. As the nymphs grow in size during the remainder of the season they undergo a series of molts. The exact number of molts has not been determined from our data.

The density of various stages of scale insects varied considerably throughout the season (Table 1). Adult numbers varied from 4 to 6 individuals per 10 cm^2 while only 2 to 4 egg masses were recorded in the same area. Females only produce one egg mass so that some females did not reproduce. An average of 200-350 eggs per 10 cm^2 were found in the samples, but only 10-50 crawlers were recovered from samples. The discrepancy was due in part of egg viability and to the extreme degree of dispersal of crawlers during this time. The density of nymphs slowly declined through August and September and more markedly after October to levels seen in the spring. Nearly mature nymphs were present in December and thus represent the overwintering stage.

Table 1. Population density of *Lecanopsis formicarum* in a Guelph lawn during 1983.

Stage	Date	Population Density (No./10 cm^2)
Mature nymphs	Sept-May	5-25
Adults	May-June	4-6
Egg masses	June	2-4
(Eggs)		(200-350)
Crawlers	June-July	10-50
1st-instar nymphs	July-Aug	50
Intermediate stage nymphs	Aug-Oct	20-50

Scale insects were observed on a number of lawns during the season. They occurred on most grass species found in lawns including perennial bluegrass, red tescue and creeping bentgrass. No scales insects were found on annual bluegrass.

At the present time scales insects are being reared in the laboratory to determine their rate of development on each of the turfgrass species.

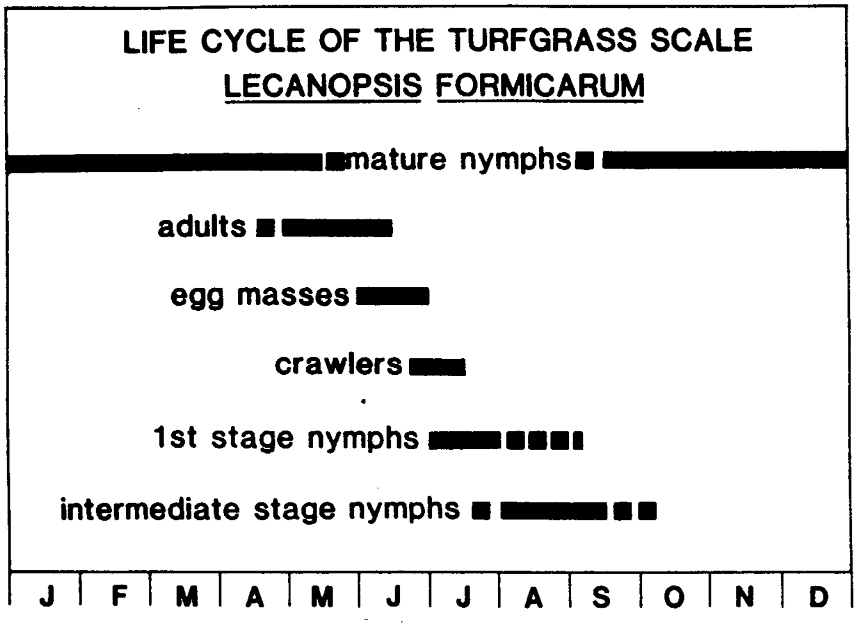

Figure 1. Generalized life cycle of the turfgrass scale, *Lecanopsis formicarum* in Guelph, Ontario, 1983.

DISLODGEABLE RESIDUES AND PERSISTENCE OF DIAZINON FOLLOWING APPLICATION TO TURFGRASS

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INTRODUCTION

The fate of diazinon applied to turfgrass for insect pest control by commercial applicators and homeowners has recently become of concern to environmentalists. The risk of human exposure to this chemical is in question and was the object of this study. The persistence of diazinon in turfgrass and the extent of dislodgable residues was examined following application to field plots.

RESEARCH PROCEDURE

Diazinon, at approximately 5 Kg AI/ha, was applied to plots of bluegrass turf and the dislodgeable portion was sampled by walking on the plots using cloth coverings over boots. Samples were taken on the initial day of application and at daily intervals up to 2 weeks following application. The effects of rainfall and of mowing the turfgrass on the degree of dislodging was examined.

RESULTS

The dislodgeable fraction of diazinon applied to turfgrass degraded rapidly (within one day) under conditions tested in the field (Fig. 1, 2). The total insecticide recovered from the cloths immediately following application was 14-20 yg/cm^2 (Tables 1, 2, 3). The recoverable material represents 100-350 times less than the acute dermal LD_{50} to white rats.

Table 1: The effect of 18 mm rainfall following the application of 5.13 Kg Ai/ha diazinon on the retained and dislodgeable insecticide.

Days post-application	Residue on Leaves and Thatch			Dislodgeable Fraction
	Diazinon	Diazoxon*	Total	
		(µg/m^2)		(µg/cm^2 cloth)
0	4167	-	4167	13.9
1	37	2.6	40	0.1
3	31	4.5	36	0.1
5	13	4.2	17	0.1
7	6	2.2	8	<0.1
11	3	1.7	5	<0.1
15	0.5	0.3	0.8	<0.1

*Metabolite of diazinon

Table 2: The effect of mowing following the application of diazonin on the retained and dislodgeable insecticide.

Turf Management	Days Post-Application	Residue on Leaves and Thatch: Diazinon	Diazoxon	Total	Dislodgeable Fraction
			(μg/m^2)		(μg/cm^2 cloth)
Not Mowed**	0	5991	-	5991	20
	1	412	-	412	1.4
	2	158	14.1	172	0.6
	3	22	1.1	23	0.1
	7	11	1	12	<0.1
	10	5	0.4	5	<0.1
	17	2	0.5	2	<0.1
Mowed***	0	4483	<0.4	4483	14.9
	1	246	1.3	247	0.8
	2	183	7.2	190	0.6
	3	30	0.8	31	0.1
	7	24	0.8	25	0.1
	10	9	0.4	9	<0.1
	17	6	<0.4	6	<0.1

*Metabolite of diazonin
**Application rate 4.75 Kg Ai/ha
***Application rate = 4.87 Kg Ai/ha

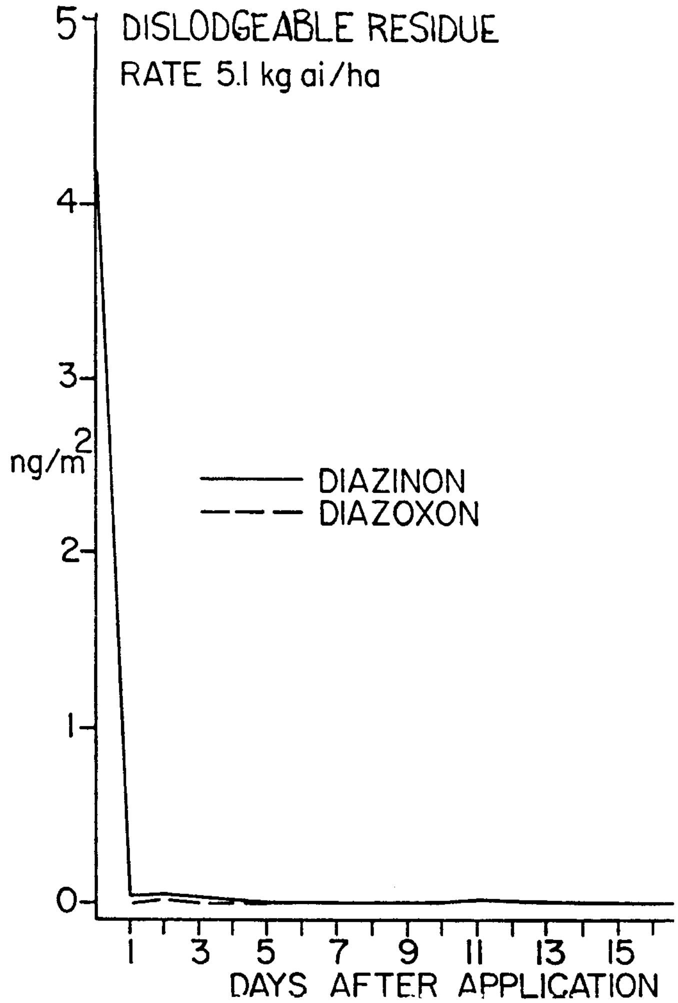

Figure 1. Dislodgeable residues of diazinon applied to turfgrass under conditions of heavy rainfall (1.8 cm following application).

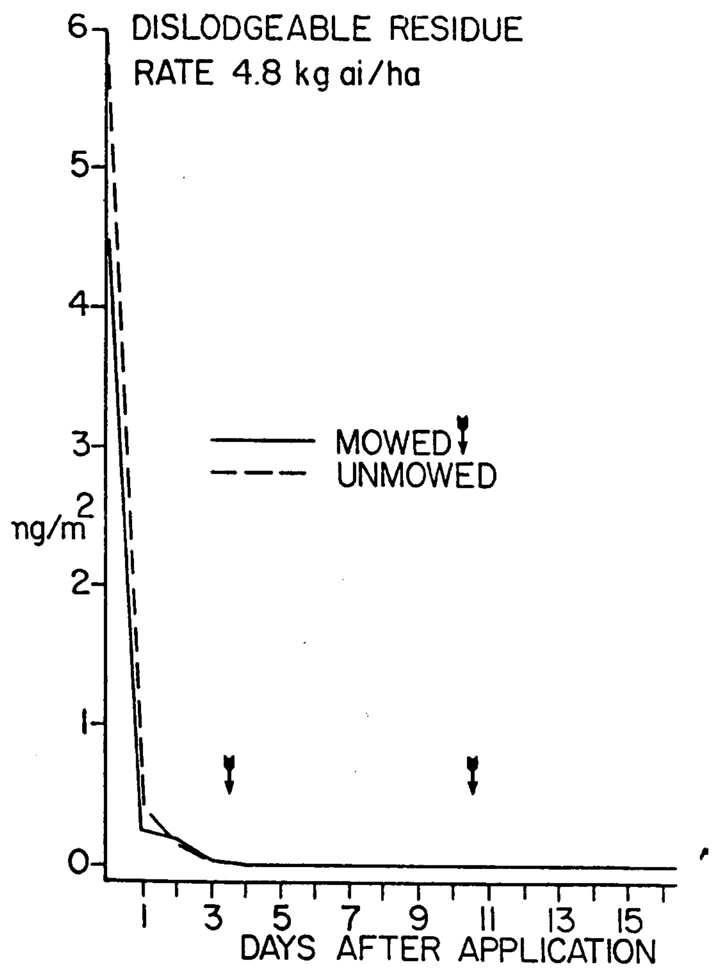

Figure 2. Dislodgeable residues of diazinon applied to turfgrass in which half the replicates were mowed and half were not mowed.

CONTROL OF BROADLEAVED WEEDS IN ESTABLISHED TURF

C.M. Switzer and A. Darlington

Department of Environmental Biology

Several herbicides were applied in comparison with the recommended mixture of 2,4-D/mecoprop/dicamba for the control of broadleaved weeds in turf.

RESEARCH PROCEDURE

Herbicides were applied to plots of mixed turf (bluegrass and creeping red fescue) at the Cambridge Research Station on May 27, 1983. Liquids were applied in 830 1/ha of spray solution and granulars by means of a hand shaker to 6 m^2 plots. Weeds present at the time of application included dandelion, thyme speedwell, corn speedwell, black medick, mouse-eared chick-weed, white clover and wood-sorrel. Weeds were counted on June 1 and June 29 and the percent weed control estimated on August 29.

RESULTS

The effects of the herbicides are shown in Table 1 in terms of a 0-100 rating where 100 indicates perfect control (no weeds in the plot). The new herbicide DPX-T6376 was particularly effective.

Table 1. Effect of several herbicides on broadleaved weeds in turf.

Treatment	Dosage	Control on Aug. 29, 1983
	(Kg/ha)	(%)
MCPA	0.5	50
Chlorosulfuron + MCPA	0.01 + 0.5	60
Chlorosulfuron + Mecoprop	0.01 + 0.5	80
Mecoprop	0.5	70
Chlorosulfuron	0.01	60
Chlorosulfuron	0.015	40
DPX-T6376	0.01	100
DPX-T6376	0.015	100
DPX-T6376 + MCPA	(0.01 + 0.5)	90
DPX-T6376 + Mecoprop	(0.01 + 0.5)	100
2, 4-D + Mecoprop + Dicamba	1.68	90

CONTROL OF CRABGRASS IN ESTABLISHED TURF

C.M. Switzer and A. Darlington

Department of Environmental Biology

Several new herbicides were evaluated at the Cambridge Research Station in comparison with registered compounds.

RESEARCH PROCEDURE

An area of mixed turf (bluegrass and creeping red fescue) was overseeded with crabgrass on April 29, 1983. Herbicide treatments were applied to triplicated 6 m^2 plots on May 6. The plots were rated on August 29. At that time there was a dense stand of crabgrass in all the untreated plots in the area.

RESULTS

The results of the experiment are presented in Table 1. Herbicide effectiveness was rated on a scale of 0 to 100 with 100 representing perfect control (no crabgrass present). Chlorsulfuron gave no control of crabgrass. The new herbicide UC77892 was very effective although post emergence applications were relatively ineffective. Excellent results were also obtained by the use of the recommended materials, bensulide and chlorthal dimethyl.

Table 1. Effect of various herbicides on crabgrass emergence in established turf.

Treatment	Dosage	Control
	(Kg ha)	(Rating:0-100)
EL-500 (50w)	1.5	60
EL-500 (50w)	2.0	70
EL-500 (IG)	1.5	80
EL-500 (IG)	2.0	80
Chlorsulfuron (75DF)	0.05	0
Chlorsulfuron (75DF)	0.075	0
Ethalfluralin*	1.0	95
Ethalfluralin*	1.0	90
Trifluralin*	0.75	80
Trifluralin*	0.75	60
UC 77892 (80 wp)	4.0	90
UC 77892 (80 wp)	4.5	100
UC 77892 (80 wp)	5.0	100
UC 77892 (80 wp)	5.5	100
UC 77892 (80 wp)	6.0	100
UC 77892 (80 wp)	7.0	100
UC 77892 (80 wp)**	4.0	10
UC 77892 (80 wp)**	5.0	55
UC 77892 (80 wp)**	6.0	30
Chlorthal dimethyl (wp)	10.5	100
Chlorthal dimethyl (wp)	12.5	100
Bensulide (4.78 g)	10.0	100
Bensulide (4.8 ec)	7.5	90
Bensulide (4.8 ec)	10.0	100
Bensulide (4.8 ec)	12.0	100
Napropramide (50 w)	0.5	60
Napropramide (50 w)	1.0	90
UC 77892 (4F)	4.0	100
UC 77892 (4F)	6.0	100
Chlorthal dimethyl (4G)	12.5	100

*washed in with 6.5 $1/m^2$ of water.

**applied early post-emergence (June 24, 1983).

DISLODGEABLE RESIDUES AND PERSISTENCE OF 2,4-D FOLLOWING APPLICATION TO TURFGRASS

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Recent criticism of the use of 2,4-D for weed control in parks and school yards has led to discontinuation of its use in some areas. The need for suitable re-entry times into sprayed areas has been suggested. Information regarding the persistence of residues on turfgrass surfaces is lacking.

RESEARCH PROCEDURE

A series of experiments were conducted to determine the longevity of dislodgeable surface residues of 2,4-D following application to turfgrass (*Poa pratensis*) under. typical field conditions of southern Ontario. Dislodgeable residues were estimated by vigorous wiping of one m^2 areas with moistened cheesecloth. Analysis of sample extract was performed using gas-liquid chromatography with electron capture detection of the methyl ester derivative of 2,4-D.

RESULTS

Results indicated that less than 5% of material applied on a mass basis is easily dislodgeable at zero time. Of the material originally applied, less than 1% was dislodgeable after five days and only 0.003% after eleven days.

Rainfall had a significant effect on reducing the amount of residue recovered (Fig. 1). Less than 0.05 mg/m^2 were recovered after a heavy rainfall of 18 mm. Mowing had essentially no effect on the persistence of dislodgeable 2,4-D on the turfgrass (Fig. 2).

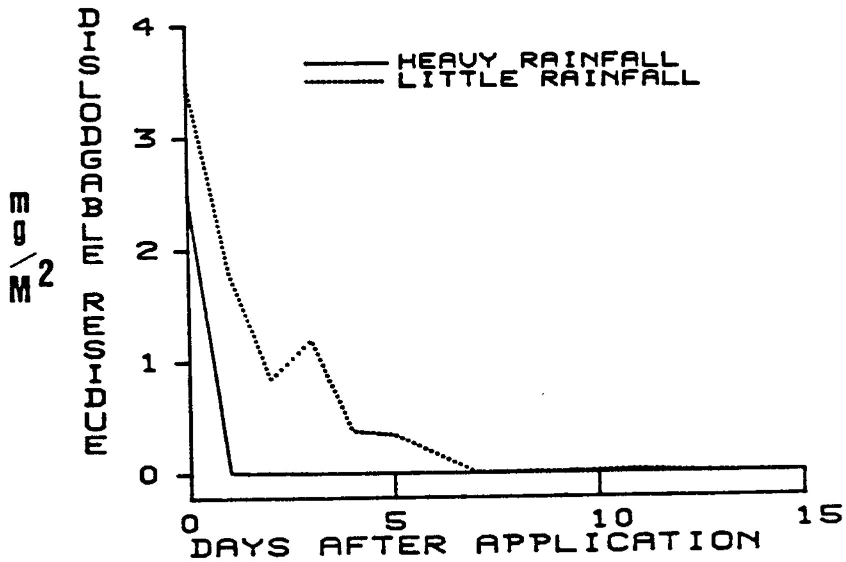

Figure 1. Dislodgeable residues of 2,4-D applied to turfgrass under conditions of heavy rainfall (1.8 cm following application) and of little rainfall.

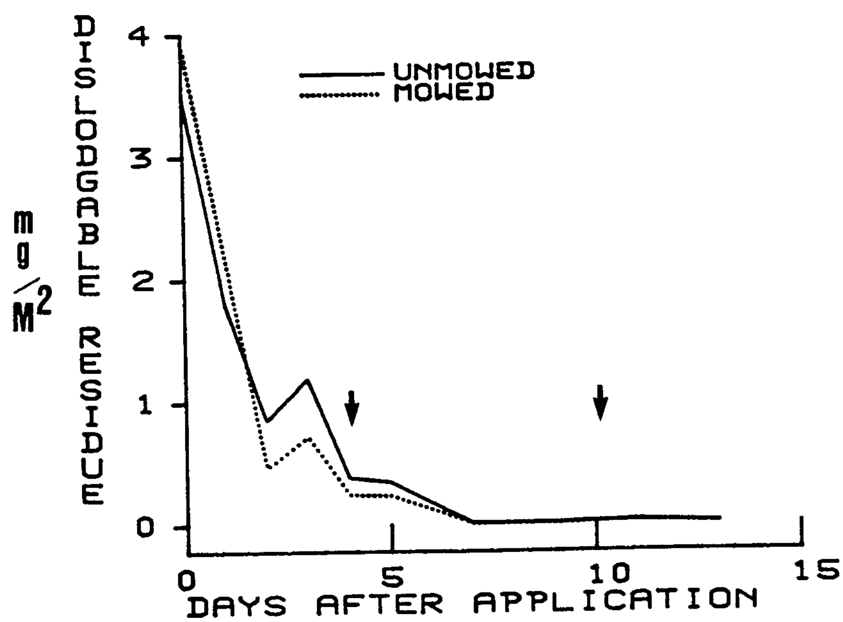

Figure 2. Dislodgeable residues of 2,4-D applied to turfgrass. One-half of the replicates were mowed (arrows) while the others were left unmowed.

DISTRIBUTION OF 2,4-D AND DIAZINON APPLIED TO TURFGRASS GROWING UNDER CONTROLLED ENVIRONMENTAL CONDITIONS

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Diazinon and 2,4-D are two of the most commonly applied chemicals in turfgrass maintenance programs. As such they are environmental contaminants and there may be some risk of human exposure in public areas. The most probable exposure route for humans following application of these chemicals is through dislodgement and subsequent dermal absorption.

RESEARCH PROCEDURE

Laboratory studies have been conducted utilizing transplanted Bluegrass (*Poa pratensis*) grown under controlled environmental conditions. The objectives of the studies were to determine the distribution of 2,4-D and diazinon through the leaf-surface, leaf tissue, thatch and soil at various times following application of commercially formulated products at typical field rates (1.0 Kg AI/ha and 4.5 Kg AI/ha, respectively).

Vigorous wiping of leaf surfaces with moistened cheesecloth, washing the leaf tissue with various solvents and extracting mascerated tissue and soil provided samples which were subsequently analyzed for chemical residues. Analysis was performed utilizing gas-liquid chromatography with electron capture detection of 2,4-D and n/P flame photometric detection of diazinon.

RESULTS

The greatest proportion of 2,4-D residues remained on the surface of the leaf blades (Fig. 1). With time increasing amounts became bound to the surface or were translocated into the, leaf tissue. An unexpected results was the persistence of the dislodgeable fraction which remained constant over the duration of the experiment.

Diazinon residues were much shorter lived (Fig. 2). Dislodgeable fractions were significant for only six hours after application, and significant total residues were recovered for only three days after applications.

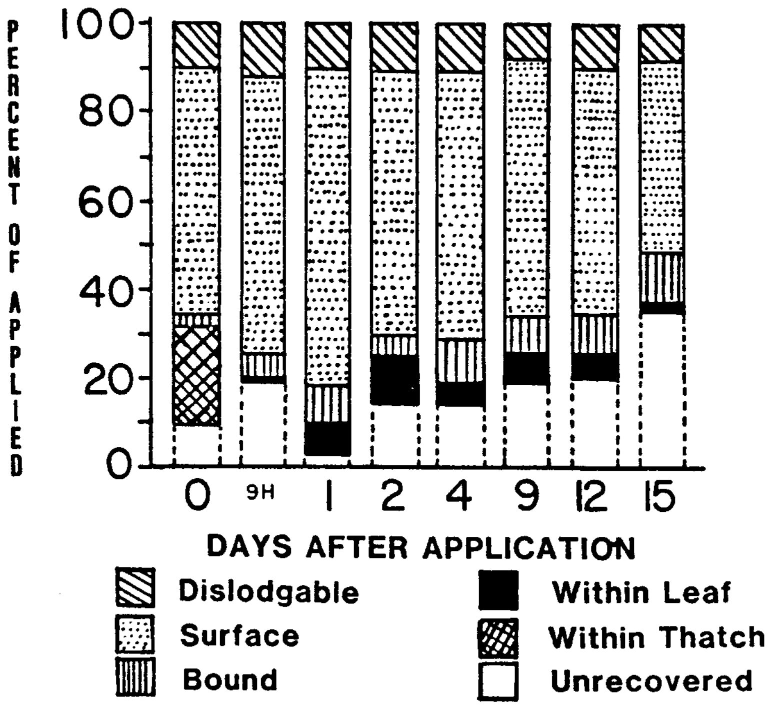

Figure 1. Distribution and persistence of 2,4-D residues on turfgrass maintained in a controlled environment.

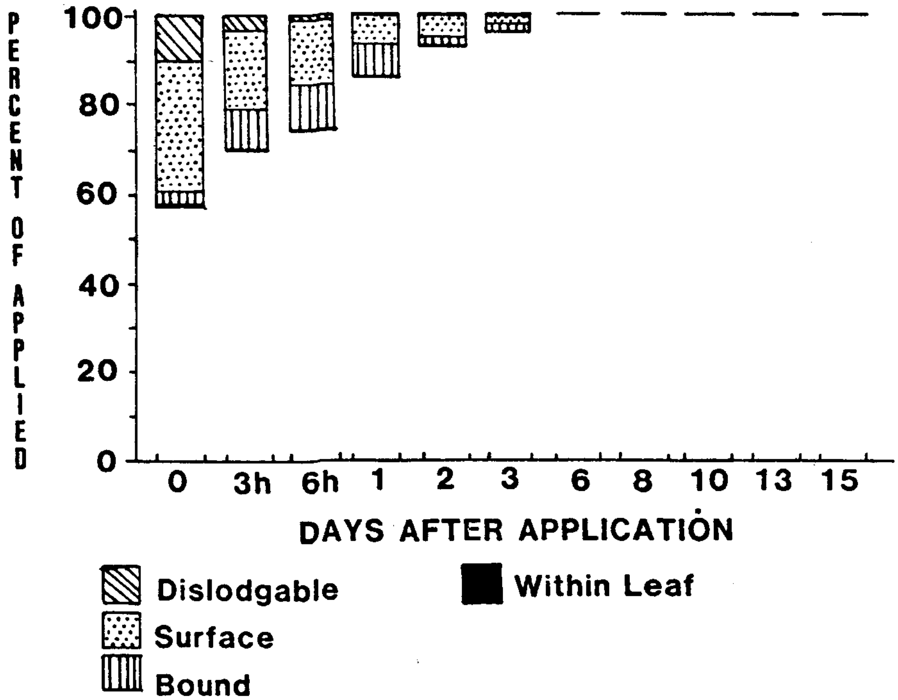

Figure 2. Distribution and persistence of diazinon residues on turfgrass maintained in a controlled environment.

TURFGRASS CULTIVAR EVALUATION 1983

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A continuing evaluation of cultivars of the turfgrass species is conducted to provide data on their relative performance under Southern Ontario growing conditions.

We wish to inform the recipients of this report that it is not a complete report but rather a summary of a few cultivars and they may write the Dept. of Horticultural Science for a full evaluation report for year 1983.

RESEARCH PROCEDURE

The cultivars were grown on a Fox sandy loam. The plot size was usually 6 m^2 and were arranged in randomized complete block design with four replications. All plots were mowed twice weekly at either a two or a four cm height with the clippings returned.

The plots were evaluated in April for winter hardiness and once each month (April - November) for vigor using a scale of 1 to 10 with 0 representing bare ground and 10 representing ideal turf.

RESULTS

Once again the turf type perennial rye grass have performed exceptionally well particularly under the two cm mowing height. Some of the most common and noteworthy bluegrasses, fine leaved fescues and perennial rye grasses that have preformed well under a medium fertility management have been listed (Table 1, 2, 3).

Table 1. Average of monthly evaluation (1983) of some Kentucky bluegrass cultivars at the Cambridge Research Station.

Cultivar	Year of Establishment			
	1978	1979	1980	1981
	(Rating 1 to 10)			
A34	-	8.6	-	-
Adelphi	-	-	7.7	-
Ag 480	-	7.8	-	-
Baron	-	8.3	7.9	-
Birka	-	7.0	-	-
Fylking	-	6.6	-	-
Glade	-	7.7	-	-
Haga	-	6.3	-	-
Merion	7.9	7.5	-	-
Mosa	-	-	7.9	-
Nugget	-	8.4	-	-
Park	-	6.9	6.3	6.7
Plush	8.2	7.3	-	-
Ram I	-	-	7.9	-
Sydsport	8.3	7.7	-	-
Touchdown	-	7.2	-	-
Victa	-	-	8.0	-
Welcome	-	-	7.7	-

Table 2. Average of monthly evaluation (1983) of some perennial ryegrass cultivars grown at the Cambridge Research Station.

	Year of Establishment			
Cultivar	1978	1979	1980	1981
		(Rating 1 to 10)		
Acclaim	8.5	-	-	-
Barry	-	-	7.4	-
Hunter	-	8.6	-	-
Loretta	-	9.3	-	-
Manhatten	8.9	8.6	7.9	6.4
Norlea	-	6.5	6.8	-
Omega	-	-	7.1	-
Pennfine	-	8.3	-	6.1
Player	-	9.3	-	-
Score	-	-	6.9	-
Yorktown II	8.8	9.6	7.6	-

Table 3. Average of monthly evaluation (1983) of some fine leaved fescue cultivars grown at the Cambridge Research Station.

	Year of Establishment		
Cultivar	1979	1980	1981
		(Rating 1 to 10)	
Banner	5.6	7.8	-
Barfalla	6.2	-	-
Biljart	-	7.3	-
Bingo	-	7.8	-
Fortress	6.6	-	-
Highlight	6.7	8.0	7.3
Jamestown	6.5	-	-
Ky 31*	-	6.6	-
Luster		7.6	-
Pennlawn	6.5	-	6.4
Polar	-	8.3	-
Rebel*	-	7.2	-

**Festuca arundinaceae* (tall fescue)