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HYBRID BERMUDAGRASS WINTER OVERSEEDING

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Bermudagrass, a perennial warm season turfgrass, is grown extensively in California's semi-tropical regions from the low elevation of the Mexican border to the north end of the Sacramento Valley. It is also grown under the moderate climates of California coastal regions from the Mexican border to the San Francisco Bay area. Although common bermudagrass *[Cynodon dactylon L. (pers.)]*, a genetically variable seed propagated variety, has been and is presently grown, the bermudagrasses receiving the most attention in recent years are vegetatively propagated improved (hybrid) cultivars *(Cynodon sp.)*. Among the most commonly grown hybrid bermudagrasses in California are: 'Santa Ana,' 'Tifway' and 'Tifgreen.'

All bermudagrasses enter a dormancy period if grown where winter soil temperatures drop below 50 - 55°F The grass may remain dormant for up to 5 months (until the soil temperature rises above 50-55 F) depending on location and cultivar. When dormant, bermudagrass shoots lose their green color and both shoots and roots stop growing. Consequently, in most parts of California bermudagrass remains dormant, resembling a dead lawn, during winter. Depending on the use of the lawn, the straw color of dormant bermudagrass may be objectionable. This has been a limiting factor to the use of bermudagrass, even in areas where it is the most suitable turfgrass due to specific site or other limitations. However, turfgrass managers who are particularly interested in maintaining a bermudagrass lawn have options to overcome the dormancy problem. These include: (a) colorizing the dormant bermudagrass, using synthetic dyes or, (b) overseeding with a cool season grass for winter color.

Several turf dyes for dormant turf colorizing are on the market. Turf managers, however, should keep in mind that although turf dyes give a green color to turf, in reality the grass remains dormant and thus the turf stand will be susceptible to damage from heavy traffic.

Overseeding dormant bermudagrass with cool season grasses not only provides a year-round green but also protects dormant bermudagrass from wear-injury. It also masks the unsightly appearance of winter weeds. Many studies have reported on bermudagrass overseeding (primarily for short-cut bermudagrass golf greens, athletic fields, etc.) and much information is available in the turf literature. Choosing the right cool season turfgrass for bermudagrass overseeding, however, is not a simple decision. In choosing the cool season grass, consider the following:

1. Compatibility with bermudagrass regarding color, texture, density and habit of growth (mowing height);
2. A smooth and harmonious transition period while bermudagrass is going dormant and again when it greens and resumes growth;
3. Persistence of cool season grass for more than one season without affecting the growth of bermudagrass during summer which would reduce summer turf quality;
4. Tolerance of cool season grass to environmental and pathogenic stresses such as cold, drought, wear, disease, etc.;
5. The price of cool season grass seed.

During the past decade, many cool season turfgrasses have been evaluated for bermudagrass overseeding. At this time, perennial ryegrass *(Lolium perenne L.)* is the most popular and widely used species. Among its superior characteristics are: rapid germination and establishment; relatively fine texture; close mowing (short period) wear; and relatively high disease tolerance. However, high seed cost and seeding rate and persistence for only one season may deter some turf managers from its use, especially on low-budget turf sites. Also, perennial ryegrass is highly competitive with bermudagrass in the spring, and in some cases, causes difficulty in the transition back to bermuda. Likewise, in hotter regions perennial ryegrass may not persist well into the spring and thus the transition is not smooth.

The following study was undertaken to develop information of particular interest to turf managers maintaining high-cut hybrid bermudagrass turf as home lawns, parks, golf course fairways and rough, commercial turf who are interested in cool season grasses other than perennial ryegrass for winter overseeding.

The experiment was conducted on mature 'Tifway' bermudagrass turf growing on clay loam soil at the University of California Deciduous Fruit Field Station in San Jose, California. The bermudagrass had been established for six years when the study was initiated in October 1980. Cultural practices used on the plot during previous years included: weekly mowing at 1 inch; application of 4 - 6 pounds nitrogen per 1,000 sq. ft. per year; and irrigation as needed. The sward had never been dethatched or aerified.

On Oct. 1, 1980, the lawn was cut as closely as possible and intensively dethatched in several directions. The massive removed

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thatch was then raked out. A starter fertilizer of 1 pound each of nitrogen, phosphorus and potasssium per 1,000 sq. ft. was applied. The seeds of seven cool season turfgrasses were hand distributed uniformly over 5 ft. x 10 ft. plots. Each seedling treatment was replicated four times in a randomized complete block design. Check plots had no overseeding. Table 1 lists the cool season grasses used in this experiment with their seeding rates. Seed was pushed into the turf by gently brushing a leaf rake on the surface of dormant bermudagrass. Turf plots were subsequently lightly topdressed with pure sand, thoroughly irrigated and kept moist until seeds germinated and seedlings were well established. No seedling disease developed. One month after seeding, 1 pound of nitrogen (ammonium nitrate) per 1,000 square feet was again applied. Mowing was resumed 20 - 45 days after seeding depending on the cool season grass involved. (Annual ryegrass was first to be mowed followed by the fescues and then the bentgrasses.) During the course of the experiment, plants were mowed weekly to a height of 1 inch with a reel mower and clippings were returned. Plots were watered as needed.

No dethatching or aerification was practiced, and no pesticide was applied during the entire period of study. Plots received 4 pounds of nitrogen per 1,000 square feet per year (March through October) for the rest of the study.

During the period of study, from Oct. 1, 1980 to March 30, 1985, plots were visually evaluated for quality and cool season grass cover on a semi-regular basis (Table 1). Soil and air temperature data during the course of this study are summarized in Table 2. Table 3 summarizes the results of a soil analysis performed at the beginning of the study; soil was assumed to be uniform throughout the plots.

RESULTS AND DISCUSSION

First Season

All grasses germinated and seedlings emerged within the first week after seeding. They were visually ranked as to speed of germination and seedling emergence from fastest to slowest as: annual ryegrass> fescues> bentgrasses. This ranking held for the seedling growth rate as well. After three weeks, annual ryegrass had grown tall enough to require mowing. It took another three weeks for other grasses to achieve such a height. All grasses were mowed to a height of 1 inch; mowing frequency to maintain that height was almost twice for annual ryegrass what it was for bentgrasses. Fescues fell in between the two.

Bermudagrass which was straw-colored at the time of seeding (due to scalping and dethatching) regreened in approximately three weeks but its growth did not resume. It went dormant approximately seven weeks after seeding, coinciding with the last week of November. Nitrogen fertilization at seeding and during seedling establishment apparently postponed bermuda dormancy, which occurred a bit later into the season than usual. Nine weeks after seeding, when the bermuda was entirely dormant and a better evaluation of cool season grasses was possible, the seeding rate used in this study (Table 1) for all grasses appeared low and none of the plots had a complete, dense cover of cool season grass. Annual ryegrass cover appeared densest and most complete, primarily because it grew faster and produced more shoots and was better able to mask the thinned appearance of the plot than grasses with fewer, less vigorous shoots. The author estimated that twice the seeding rate would produce a more satisfactory (appropriately dense) turf cover.

Table 1 summarizes the quality ratings during the first winter season for all grasses. 'Penncross' creeping bentgrass was clearly the best performer throughout the first winter season, followed closely by 'Emerald' and 'Seaside' creeping bentgrasses. Overall evaluation ranked the fescues next with 'Highland' Colonial bentgrass and annual ryegrass in last place. Quality ratings presented in Table 1 are based on turf scores which combined the quality components of color, density, uniformity, growth rate and texture compatibility with bermudagrass. Severe annual bluegrass *(Poa annua L.)* infestation occurred on check plots while all overseeded plots were completely Poa-free regardless of cover density. Shading by the cool season grasses was probably the primary reason for lack of Poa in overseeding plots.

Throughout the plots, strips of dormant bermudagrass appeared in mower tire marks. Perhaps some seedlings, not in full contact with the soil during their earliest stages of growth, could not tolerate the weight of the mower, died, and left these strips cover-free for the rest of the first season. A higher seeding rate could prevent this problem. The first mowing might also have been delayed until seedlings were well anchored in the soil and better able to take the traffic. It is also likely that if thatch is removed entirely, and the bermudagrass is well scalped at the time of overseeding, this problem will be minimized.

Cool season grasses clearly differed in color. Bentgrasses appeared bluish to greyish green, fescues were dark glossy green, while annual ryegrass was light green. Texture-wise, bentgrasses resembled bermudagrass much more closely than the other three grasses.

TABLE I

Cool Season Grasses: Seeding Rates, Quality, Transition Quality and % Cover During Bermudagrass Overseeding Trial*

Cool Season Turfgrasses			Seeding Rate lb/1000 sq. ft.	1+ 1st Season Quality	2+ 1st Season Transition Quality	% Cover 3+ 2nd Season	4+ 3rd Season	5+ 4th Season	5t Sea
'Emerald'	Creeping bentgrass	(*Agrostis palustris*)	4	7.3 b	7.2 b	32 b	32 bc	26 ab	60
'Penncross'	Creeping bentgrass	(*Agrostis palustris*)	4	7.6 a	7.9 a	42 a	60 a	40 a	76
'Seaside'	Creeping bentgrass	(*Agrostis palustris*)	4	7.0 c	7.2 b	32 b	50 ab	35 a	58
'Highland'	Colonial bentgrass	(*Agrostis tenuis*)	4	6.0 e	7.2 b	18 c	45 ab	28 a	50
'Pennlawn'	Creeping red fescue	(*Festuca rubra*)	10	6.3 d	6.7 c	8 cd	17 cd	12 bc	23
Ensylva'	red fescue	(*Festuca rubra*)	10	6.3 d	6.7 c	15 c	16 cd	LO c	36
Annual ryegrass		(*Lolium moltiflorum*)	10	5.6 f	5.2 e	2 d	2 d	O c	0
Check			--	2.6 g	5.5 d	--	--	--	•

*Quality and transition quality are visual ratings based on a scale of 1-9, with 9 being highest turf and transition quality. Percent Cover ratings are based on visual ratings 100 representing a plot covered entirely with cool season grass. Values followed by si letter(s) are not significantly different from each other (DMR at 5% level within colum

+All ratings are averages of 4 replications and several rating dates . . follows:
1. Three rating. (12/11/80, 1123 ● d 2/19/81)
2. Pour ratings (2/26 3/31, 5/1 ● d 5/20/81)
3. Four ratings (12/8/81, 1/12, 1/21 and 2/24/82
4. one rating (2/17/83)
5. Two ratings (2/16 and 3/30
6. One rating (2/5/85)

Bermudagrass broke dormancy by mid-February 1981 (4.5 months after seeding, a total of three months actual dormancy period), and by March 1, it had fully greened up. Annual bluegrass, however, persisted in check plots well into summer and reduced bermudagrass quality considerably.

Six months after seeding (April 1, 1981) all grasses were growing, including annual ryegrass which still required more frequent mowing than the other cool season grasses. Bermudagrass also had commenced growth. This transition period, during which environmental factors increasingly favor bermudagrass over cool season grasses, is an important period in the overseeding process. In an ideal situation, the cool season grass smoothly slows its growth while the bermudagrass gradually initiates vigorous growth, taking over with no noticeably abrupt change in turf appearance. In this study, 'Penncross' creeping bentgrass performed best during the transition period, followed closely by other bentgrasses (Table 1). They were all followed by fescues. Annual ryegrass turned yellow and died out abruptly by the beginning of the seventh month after seeding, and, for about one month, plots overseeded with it exhibited a very inferior cover. During this period, check plots, where not infested with annual bluegrass, produced a better quality turf than plots overseeded with annual ryegrass.

By the beginning of the eighth month after seeding (June 1, 1981) annual ryegrass had disappeared, bentgrasses were not visible except under close examination, while small patches of fine textured, glossy, dark green fescue shoots were visible from a distance, which detracted from the bermudagrass quality in these plots.

Table 2

Average Monthly Air and Soil Temperatures at Deciduous Fruit Field Station, San Jose, California (1981 - 1984)

Months	Air Temperature (F)			Soil Temperature* (F)		
	Avg. Max.	Avg. Min.	Mean	Max.	Min.	Mean
anuary	59.8	44.0	51.9	47.5	39.5	43.5
February	64.3	48.7	56.5	48.7	42.0	45.3
March	64.9	48.8	56.9	50.7	46.2	48.5
April 1	68.8	40.2	58.5	59.0	48.5	53.7
May	77.6	54.0	65.8	64.0	56.0	60.0
June	82.1	57.3	69.7	66.2	60.7	63.5
July	86.3	59.7	73.1	68.2	63.5	65.8
August t	84.7	59.1	71.9	67.7	64.0	65.8
September	85.6	59.1	72.4	66.5	59.2	62.8
October	74.9	53.6	64.2	60.5	53.5	57.0
November	63.4	48.6	56.0	55.0	46.5	50.7
December	58.8	45.4	52.1	49.2	44.2	46.7

*Soil temperature measured 4 inches below surface. Maximum and minimum are highest and lowest figures for the month.

Table 3

Analysis of a Composite Soil Sample* from 'Tifway' Bermudagrass Plot**

Texture	PH	(m mhos/cm)	Nutrient Content						
			N03-N	P	K	B	Ca	Mg	Na
			ppm				me/1		
Silt Loam	5.9	1.38	45	68	635	0.21	6.0	5.2	2.6

* Taken to a depth of 5 inches.

** Analysis done by UC Cooperative Extension Agricultural Laboratory, Davis.

Second Season

To evaluate the persistence of cool season grasses in the second and subsequent seasons, no overseeding or dethatching was performed on plots during the remainder of the study (terminated in March 1985). In the second winter season, bermudagrass did not go dormant until the first week of December 1981. Bentgrasses and fescues were, however, detectable from a distance during early November and both performed well during the transition period as bermudagrass initiated dormancy. Very little annual ryegrass appeared during this period or during the rest of the study. Although annual bluegrass was germinating sparsely in all plots, the percentage was much higher in check plots than in others. Percent coverage by cool season grasses (evaluated by visual observations) appears in Table 1. Creeping bentgrasses received the highest rating for percent cover, with 'Penncross' receiving a statistically higher rating than the other two. 'Highland bentgrass and fescues had significantly less coverage than creeping bentgrasses.

Third, Fourth and Fifth Seasons

The study continued for three more seasons to evaluate the persistence of cool season grasses. Percent cool season grass cover during the three winters is summarized in Table 1. The percent grass cover for all grasses (except annual ryegrass) increased considerably by the fifth winter season; the cover actually doubled for some of these grasses. 'Penncross' creeping bentgrass consistently had the highest coverage (76 percent by the fifth season) followed by 'Emerald' and 'Seaside: The increase in cool season grasses coverage did not appear to affect the bermudagrass turf quality during its growing periods.

SUMMARYOFRESULTS

All overseeded cool season grasses germinated within the first week after seeding.

They differed, however, in germination speed:

annual ryegrass) fescues> bentgrasses

This ranking was repeated for seedling growth rate. Annual ryegrass was the first grass to be mowed, 20 days after seeding. The other grasses did not grow tall enough to be mowed until 45 days after seeding when they were mowed to a height of 1 inch. Regular mowing of plots to this height continued on a regular basis. The frequency of mowing needed to keep the grass at 1 inch height varied significantly, and grasses were ranked on mowing frequency as:

annual ryegrass) fescues > bentgrasses

Annual ryegrass needed mowing approximately twice as often as the bentgrasses. Bermudagrass, which exhibited a straw color due to dethatching/scalping immediately before overseeding, greened up 20 days after seeding (Dec. 15) stayed green for 50 days, and then went dormant.

The quality ratings, combining color, density, uniformity, growth rate and texture compatibility with the bermudagrass, ranked 'Penncross' creeping bentgrass as the best performer during the first winter season after overseeding followed closely by 'Emerald' and 'Seaside' creeping bentgrasses. Fescues ranked next with 'Highland' bentgrass and annual ryegrass occupying the last two places.

Visual evaluations of the percent cover of cool season grasses indicated a gradual increase in cover in subsequent winter Seasons for all grasses except annual ryegrass, which persisted for only one season. By the fifth winter season, all creeping bentgrasses had a cover greater than 50 percent.

'Penncross' creeping bentgrass, with a 76 percent turf cover, was the most persistent grass followed closely by 'Emerald' and 'Seaside' with 60 and 58 percent cover, respectively.

Results of this study suggest that (a) a higher rate of seeding of all cool season grasses (approximately twice that used in this study) may produce a better quality turf; (b) creeping bentgrass, especially 'Pencross: can provide a satisfactory cover for more than one season per seeding; (c) annual ryegrass, creeping red fescues and 'Highland' bentgrass will probably produce acceptable cover for only one season; (d) of all grasses evaluated, creeping bentgrasses were similar to the bermudagrass in leaf texture and visual appearance which contributed to a visually smooth transition from one grass to the other; (e) creeping bentgrasses required less frequent mowing that the other grasses studied. Several words of caution: (a) Bentgrasses are sensitive to traffic; therefore, use of them for overseeding highly trafficked bermudagrass (i.e., athletic fields) is not recommended . In such situations, perennial or annual ryegrass may be the better choice; (b) If dethatching is performed on bermudagrass, it may well be necessary to overseed annually, regardless of the kind of grass used and its persistence characteristics; (c) Where persistence of overseeded grass for more than one season is undesirable, bentgrasses and fescues are poor choices for bermudagrass overseeding.

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ANNUAL BLUEGRASS CONTROL IN DICHONDRA-PROGRESS REPORT

M. Ali Harivandi and Clyde L. Elmore[1]

Dichondra *(Dichondra micrantha Urb)* is a low-growing herb often used for lawns in the subtropical regions of California. A member of the morning glory family *(Convolvulaceae),* dichondra is the only broad-leaf species used as a lawn; thus, annual bluegrass *(Poa annua L.)* control in dichondra lawns is quite different than its control in grass lawns.

Although proper cultural practices often produce a strong, dense turf and, thus, reduce annual bluegrass infestations, it is not always possible to limit its control by good cultural practices. Annual bluegrass is spread by birds, people walking on the turf after being in a weedy area, or by the wind. Where a chemical control approach is called for, pre- or post emergence herbicides may be used to contain annual bluegrass. Several herbicides are registered for annual bluegrass control in dichondra. The study described here evaluated several herbicides for post emergence control of established annual bluegrass in an experimental dichondra plot at the University of California San Jose Deciduous Fruit Field Station. The herbicides diphenamid (Enide 9OW) at rates of 6 and 10 lb ai/A; pronamide (Kerb 50W) and methazole (Probe 75 WDG) at rates of 1 and 2 lb ai/A; DOWCO 453 (experimental) at rates of 0.5 and 1 lb ai/A; diuron (Karmex 8OW) and fluazifop butyl (Fusilade) +X77 at 1 lb ai/A were applied to 15 ft plots of dichondra on Jan. 23, 1985, using an air pressurized sprayer in 50 gallons liquid per acre.

Each treatment and a check plot were replicated four times in a randomized complete block design. Plots were watered thoroughly 24 hours after the application of herbicides. The herbicide treatments were repeated two weeks later on Feb. 6, 1985. Plots were visually rated three times: immediately prior to the second herbicide applications, on March 7 and on March 29, 1985. The phytotoxicity of these herbicides on dichondra and the degree of post emergence control of annual bluegrass are summarized in Table 1.

Data from Table 1 indicate that none of the herbicides caused injury to either annual bluegrass or dichondra up to two weeks after the first treatment. One month after the second treatment, slight but insignificant phytotoxicity appeared on dichondra treated that observation, however, herbicide effects on annual bluegrass were significantly different, with greatest effects achieved with methazole, diuron and DOWCO 453 (at 1,2, and 1 lb ai/A respectively).

Visual observations seven weeks after the second herbicide application showed severe phytotoxicity on dichondra treated with pronamide at both rates. Diuron caused less severe phytotoxicity. At this observation, dichondra exhibited no phytotoxicity to any other herbicide used in this study. In addition to the dichondra-damaging herbicides pronamide and diuron, all other herbicides and rates except methazole and fluazifop butyl (both at the rate of 1 lb ai/A) provided effective post emergence control of annual bluegrass.

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Table 1.

Effects of herbicides on Dichondra and Annual Bluegrass (Poa annua L.)

Visual Ratings **

Herbicides	lb ai/A	2/6/85 Poa Control	2/6/85 Phyto-toxicity	3/7/85 Poa Control	3/7/85 Phyto-toxicity	3/29/85 Poa Control	3/29/85 Phyto-toxicity
Diphenamid	6	1	1	5 c	1	9 a	1 c
Diphenamid	10	1	2	5 c	1	8 a	1 c
Pronamide	1	1	2	6 c	2	10 a	7 a
Pronamide	2	1	2	5 c	2	9 a	7 a
Methazole	1	1	2	5 c	1	5 b	1 c
Methazole	2	1	1	9 a	1	8 a	1 c
Diuron	1	1	2	9 a	2	10 a	3 b
DOWCO 453	0.5	1	1	6 bc	1	10 a	1 c
DOWCO 453	1	1	1	8 ab	1	10 a	1 c
Fluazifop butvl +X77	1	1	1	5 c	1	5 b	1 c
Check	--	1	1	2 d	1	3 b	1 c

* First application: 1/23/85. Second application: 2/6/85.

** Visual ratings ar mean values on a scale of 1-10. with 10 being: Complete kill of Poa, or highest phytotoxicity (complete dichondra kill). Values followed by similar letter(s) are not significantly different from each other (DMR at 5% lavel)

c No significant dif ference among treatments.

Results from this study indicate that two treatments of pronamide at 1 and 2 lb ai/A and diuron at 1 lb ai/A 14 days apart to dichondra lawns would be harmful to them and suggest that post emergence control of annual bluegrass in dichondra lawns by two applications at intervals of 14 days of diphenamid (6 lb ai/A), methazole (2 lb ai/A) and DOWCO 453 (0.5 lb ai/A) may be possible.

NOTE: Data in this progress report do not constitute recommendations for use. Until the chemicals with their uses appear on a registered pesticide label or other legal form of instructions, it is illegal to use them as described herein. References to commercial names do not constitute a University of California recommendation or discrimination, implied or otherwise.

Acknowledgements

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UC TURF CORNER

UC Turf Corner contains summaries of recently reported research results, abstracts of certain conference presentations and announcements of new turf management publications. The source of each summary is given for the purpose of further reference.

TALL FESCUE RESPONSE TO GROWTH RETARDANTS, FERTILIZERS STUDIED

A study reported upon by North Carolina State University researchers was designed to evaluate the effects of selected growth retardants and fertilizers on the turf color, height, seedhead suppression, root growth and stand density of ‘Kentucky 31’ tall fescue.

The three, spring-applied growth retardants tested were mefluidide at 0.14 kg ha^{-1}, maleic hydrayide at 4.5 kg ha-l, and a combination of mefluidide plus flurprimidol at 0.3 + 0.8 kg ha-l. The three fertilizers were 2-l-l ratio ammonium sulfate blend at 160 g N kg^{-1}, ammonium nitrate at 330 g N kg^{-1}, and ammonium sulfate liquor (ASL) at 70 g N kg^{-1}. Each fertilizer was applied at 39 and 78 kg N ha^{-1} in October of 1981 and 1982. A single ASL treatment also was applied in 1981 at 78 kg N ha-l.

Mefluidide plus flurprimidol and maleic hydrayide treatments reduced cumulative turf height 40 percent and suppressed seedhead formation up to 95 percent for six to eight weeks. Mefluidide alone reduced turf height by 20 percent during this period.

Fall fertilization of tall fescue improved turf color following spring growth retardant application. No interactions between fertilizer sources and growth retardant treatments were observed except for cumulative turf height at seven and nine weeks after treatment in 1983.

Turf responses to fertilizer sources were equivalent, but higher rates of application improved color and increased turf height and seedhead numbers.

(See “Tall Fescue Response to Plant Growth Retardants and Fertilizer Sources," by L.B. McCarty, J.M. DiPaola, W.M. Lewis and W.B. Gilbert, Agronomy Journal, Vol. 77, No. 3, May-June 1985.)

INFLUENCE OF PREEMERGENCE HERBICIDES ON TURFGRASS ESTABLISHMENT

Annual grasses can create serious problems during turfgrass establishment from sod and from seed. Researchers at Virginia Polytechnic Institute and State University recently field-tested three herbicides used for crabgrass and goosegrass control with two objectives in mind:

1. To determine the influence of oxadiazon, prosulfalin, and siduron-used for crabgrass and goosegrass control-on bermudagrass sod establishment;
2. To determine the time lapse required between an herbicide application for goosegrass and annual bluegrass control before a cool season turfgrass may be seeded successfully.

The Virginia scientists report that excellent root growth occurred from sod of the three bermudagrasses-'Midron', 'Tufcote', and 'Tifway'-immediately after application of oxadiazon at its normal use rate. Root development was reduced at double the normal use rate of oxadiazon but satisfactory root growth was still apparent.

Prosulfalin and siduron at their normal use rates severely inhibited rooting of the three bermudagrasses from sod, according to the field test's findings.

The Virginia researchers report that perennial ryegrass establishment in the fall was inhibited when seeded within five weeks after oxadiazon treatment at more than its normal use rate. Both oxadiazon and prosulfalin at their normal use rates reduced perennial ryegrass seedling establishment when the application was within one week prior to seeding.

They say that normal seedling development did occur when perennial ryegrass was seeded at ten weeks after prosulfalin or oxadiazon applications and that siduron had no effect on perennial ryegrass seedling growth and development.

(See "Turfgrass Establishment after Application of Preemergence Herbicides',' by S.W. Bingham and R.F. Schmidt, Apronomy Journal, Vol. 75, No. 6, November-December 1983.)

FUNGICIDE EFFECTS ON KENTUCKY BLUEGRASS THATCH DEPTH, DECOMPOSITION RATE

Fungicides appeared to induce thatchiness in Kentucky bluegrass by increasing the rates of root and rhizome production and not by reducing the rate of litter decomposition in a Cornell University study. Fourteen fungicides, one nematicide and five mixed-fungacide programs were applied repeatedly (up to nine times per year), over a four-year period to field-grown Kentucky bluegrass turf.

Measurements were made of thatch depths, root and leaf clipping weights, shear strength of sod, and decomposition rates for thatch implanted into the turfs. Compounds that caused thatch to become deeper than in the untreated control included benomyl, cadmium succinate, fenamiphos, iprodione, and manocozeb. Treatments in which these pesticides were used were characterized by sod shear strengths greater than in the control.

Thatch accumulations were related mostly to the amounts of roots in the surface 4 centimeters. None of the fungicides studied significantly reduced the apparent rate of thatch decomposition.

(See "Fungicide Effects on Thatch Depth, Thatch Decomposition Rate, and Growth of Kentucky Bluegrass:' by R.W. Smiley, M. Craven Fowler, R.T. Kane, A.M. Petrovic and R.A. White, Agronomy Journal, Vol. 77, No. 4, July-August 1985.)

EFFECTS OF CULTURAL PRACTICES ON BERMUDAGRASS THATCH BUILDUP

The relationship between different cultural practices and thatch accumulation was studied recently on a putting green planted to three bermudagrass cultivars on Dorhan sand loam at the Auburn University Turfgrass Research Area in Alabama.

Practices evaluated incIuded nitrogen source, core aerification, vertical mowing and sand topdressing. Effects of treatments on thatch were determined by measuring thatch depth and the compressibility of the turf surface with a thatch compression meter.

Thatch accumulation in the three bermudagrass cultivars included in the study, after three seasons, increased in this order: 'Tifgreen: 'Dothan', 'Tifdwarf! The effects of treatments on thatch accumulation were similar for all three cultivars.

Four topdressings per year reduced thatch accumulation more than a single topdressing and increased mat depth. Neither monthly aerification nor biweekly vertical mowing provided more thatch control than twice yearly application of the respective cultural practice.

Fertilization with activated sewage sludge resulted in 14 percent more thatch than when NH_4NO_3 was the nitrogen source. Within a given topdressing frequency, no differences in thatch accumulation occurred among the nitrogen sources, levels of aerification, or vertical mowing.

The regression of millimeters compressibility on thatch depth was not significant. Turf quality was not correlated with thatch depth. 'Tifdwarf' had the most thatch accumulation and also produced high turf quality ratings. Nitrogen source influenced turf quality more than other treatments. Activated sludge produced superior turf quality, although more thatch was produced than when NH_4NO_3 was applied.

Cultural practices had no consistent effect on establishment of 'Pennfine' perennial ryegrass overseeded on the experimental green. Ammonium nitrate produced better ryegrass quality than activated sewage sludge. Plots fertilized with activated sludge had significantly more annual bluegrass than those receiving NH_4NO_3 Core aerification, topdressing and vertical mowing frequency didn't affect ryegrass quality or annual bluegrass occurrence.

(See "Thatch Accumulation in Bermudagrass as Influenced by Cultural Practices',' by R.H. White and Ray Dickens, Agronomy Journal, Vol. 76, No. 1, January- February 1984.)

EFFECT OF NITROGEN FERTILIZATION ON EARTHWORMS, MICROARTHROPODS IN TURF

Results from a University of Kentucky field study indicate that when nitrogen fertilizer is applied to Kentucky bluegrass at rates sufficient to cause soil acidification, populations of earthworms and other invertebrates that decompose thatch and aid in nutrient recycling can be severely reduced.

Purpose of the study was to investigate the possible association between prolonged nitrogen fertilization, thatch development and changes in population levels of invertebrates involved in decomposition processes in Kentucky bluegrass.

Six rates of ammonium nitrate fertilizer ranging from 0 to 25 g of nitrogen per square meter were applied annually for seven years to replicated plots of 'Kenblue' Kentucky bluegrass growing on a Maury silt loam.

The Kentucky scientists report these findings from their study: Increasing the rate of nitrogen fertilization resulted in a significant decline in soil and thatch pH and in exchangeable calcium and potassium and caused a significant increase in thatch.

Regression analyses showed a highly significant linear decrease in earthworm density and biomass as annual rates of nitrogen fertilization increased. Springtails (Collembolar) were more abundant at an intermediate fertilizer rate, whereas populations of an unidentified acarid mite were unaffected by nitrogen fertilization.

Oribatid mites were the most abundant arthropod decomposers in the turf. Each of the seven oribatid mite species differed in its response to nitrogen fertilization.

Thatch accumulation was negatively correlated with earthworm density and biomass, although other factors probably also contributed to thatch development.

(See "Effect of N Fertilization on Earthworm and Microarthropod Populations in Kentucky Bluegrass Turf:' by D.A. Potter, B.L. Bridges, and F.C. Gordon, *Agronomy Journal,* Vol. 77, No. 3, May - June 1985.)

BERMUDAGRASS ROOT-RHIZOME RESPONSES TO NITROGEN, SEASON STUDIED

The effects of four nitrogen levels on root-rhizome organic matter, root viability and turf color of five bermudagrass cultivars for two spring shoot initiation periods were determined recently in a Texas A&M University field study.

The researchers who conducted the study report there were significant differences in the rate of decline during spring and increase during the summer growing season in root-rhizome organic matter for 'Common: 'Tifgreen: 'Santa Ana', 'FB-49' and 'Texturf-10' cultivars. 'Tifgreen' was the most responsive and 'Common' the least to changes in season and nitrogen fertilizer levels. Root viability scores of the five cultivars increased during the first spring of the study, declined slightly during the summer, and declined moderately from 3.5 to 2.7 during the following spring. Nitrogen application reduced the rate of decline the second spring. The Texas researchers report there was no significant interaction of bermudagrass cultivar x nitrogen level for root-rhizome organic matter, visual root viability or turf color.

(See "Effects of N and Growing Season on Root-Rhizome Characteristics of Turf-Type Bermudagrasses',' by G.H. Horst, A.A. Baltensperger, and M.D. Finkner, Agronomy Journal, Vol. 77, No. 2, March-April 1985.)

RESULTS OF KENTUCKY BLUEGRASS HEAT TOLERANCE STUDY REPORTED

Knowledge of the natural variation in heat tolerance of a turfgrass during its growing season is necessary if management strategies are to be developed that will increase its heat tolerance.

Toward that end, University of Maryland scientists evaluated the heat tolerance of 'Adelphi' Kentucky bluegrass fertilized at two different nitrogen levels and determined the effect of post-stress environment on its recovery from heat stress.

Field-grown plants were exposed to heat stress on eleven dates over two growing seasons by immersion in a water bath for 30 minutes at 42, 44, or 46°C and then placed in a greenhouse or one of two growth chamber environments (35/22 or 22/15°C day/night temperatures) for a two-week recovery period. The dry weight of the stressed plants, expressed as a percentage of the controls (recovery weight), was used as a measure of heat tolerance.

Heat tolerance increased from May to July and then decreased from August to October. A significant relationship existed between heat tolerance, day length, and average low temperature for the sampling dates, the Maryland researchers report. Recovery weights for plants in the greenhouse didn't differ significantly from those for plants in either of the other two recovery environments on ten of the eleven sampling dates.

(See "Heat Tolerance of Kentucky Bluegrass as Influenced by Pre- and Post-Stress Environment',' by D.J. Wehner, D.D. Minner, P. H. Demoeden, and MS. McIntosh, Agronomy Journal, Vol. 77, No. 3, May-June, 1985.)

WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label Store all chemicals in their original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons. pets, and livestock.

Recommendations are based on the best information currently available, and treatments based on then should not leave residues exceeding the tolerance established for any particular chwwal Confine chemicals to the area being treated THE GROWER IS LEGALLY RESPONSIBLE for residues on his crops as well as for problems caused by drift from his property to other properties or crops.

Consult your County Agricultural Commissioner for correct methods of disposing of leftover spray material and empty containers Never bum pesticide containers.

PHYTOTOXICITY: Certain chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high Injury may also result from excessive amounts or the wrong formulation or from mixing incompatible material. Inert ingredietnts. such as wetters, spreaders. emulisfiers, diluents, and solvents. can cause plant injury. Since formulations are often changed by manufacturers. it is possi-Me that plant injury may occur, even though no injury was noted i" previosu seasons.

NOTE: Progress reports give experimental data that should not be considered as recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal. supplementary firection for use, i is illegal to use the chemicals as described.

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