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1990 TURFGRASS RESEARCH

KANSAS TURFGRASS FOUNDATION

REPORT OF PROGRESS 603

Agricultural Experiment Station • Kansas State University, Manhattan • Walter R. Woods, Director

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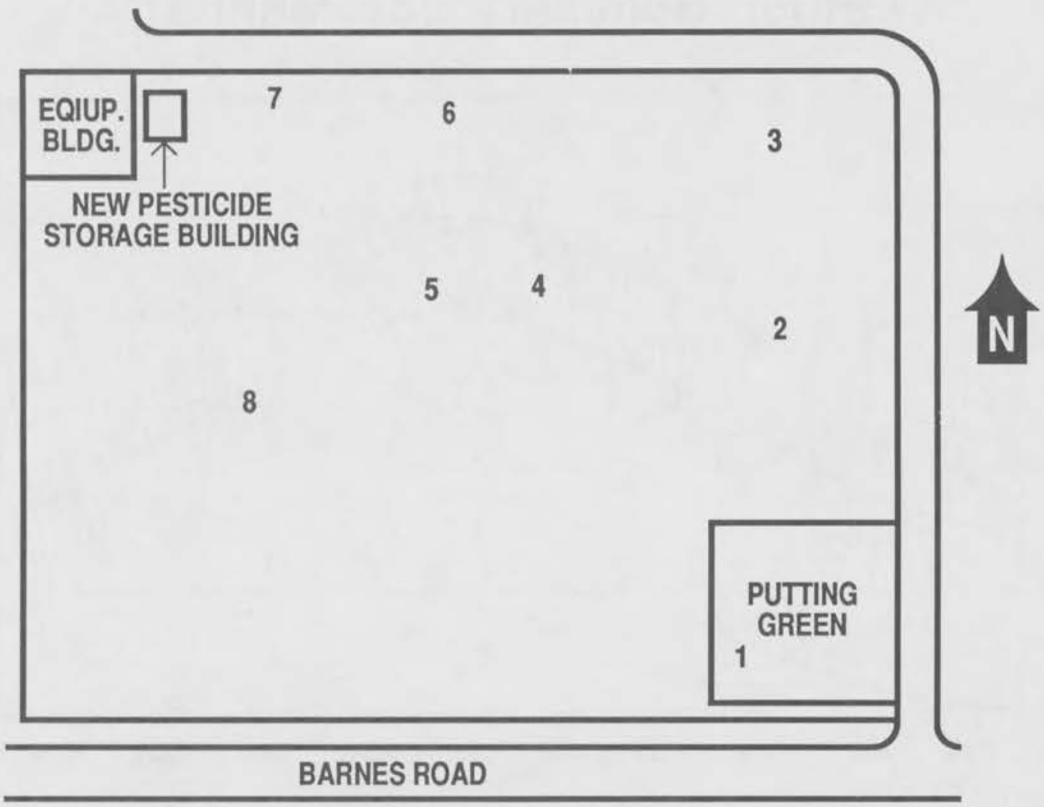

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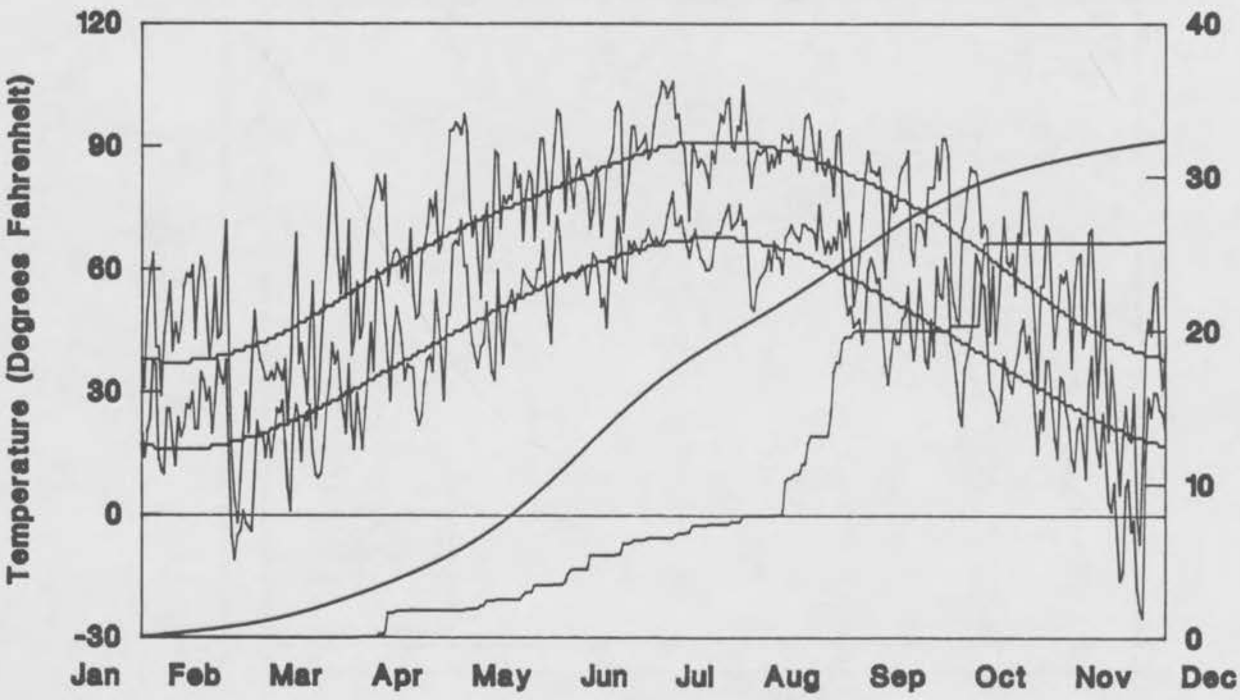


ANNUAL SUMMARY OF WEATHER DATA FOR MANHATTAN - 1989

1989 DATA

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG. MAX TEMPERATURE	50.4	33.4	60.1	73.8	78.5	84.1	91.9	89.5	78.4	72.9	59.5	36.6	67.6
AVG. MIN TEMPERATURE	26.2	14.3	31.8	47.5	53.9	61.1	68.5	66.3	53.8	47.3	27.6	12.7	42.8
AVG.MEAN TEMPERATURE	38.3	23.8	46	60.6	66.2	72.6	80.2	77.9	66.1	60.1	43.5	24.7	55.2
TOTAL PRECIPITATION	.90	.77	1.69	.45	2.21	3.35	1.57	5.33	9.14	6.12	.00	.86	32.39
TOTAL SNOWFALL	0	6.7	0	0	0	0	0	0	0	0	0	0	6.7
HEATING DEGREE DAYS	827.5	1153.	601	243	12	1.5	0	0	108.5	219	644	1251.	5059.5
COOLING DEGREE DAYS	0	0	10.5	112	5	229.5	472	400.5	141	67.5	0	0	1438

NORMAL VALUES (1951- 80 AVERAGE)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG. MAX TEMPERATURE	37.7	44.5	54.5	67.9	77.3	86.2	91.7	90.4	81.7	71.1	54.7	43.1	66.9
AVG. MIN TEMPERATURE	16.5	21.9	30.5	43.1	53.5	63.2	68.0	66.3	56.8	45.2	32.1	22.3	43.4
AVG.MEAN TEMPERATURE	27.1	33.2	42.5	55.5	65.4	74.7	79.9	78.4	69.3	58.2	43.4	32.7	55.1
TOTAL PRECIPITATION	.83	.95	2.08	2.79	4.50	5.29	3.96	3.18	4.04	2.89	1.46	.91	32.88
TOTAL SNOWFALL	5.9	5.5	3.4	.5	0	0	0	0	0	0	1.3	3.9	20.5
HEATING DEGREE DAYS	1168	884	692	305	95	8	0	1	50	248	644	993	5088
COOLING DEGREE DAYS	0	0	3	27	115	307	468	422	186	44	1	0	1573

1989 DEPARTURES FROM NORMAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG. MAX TEMPERATURE	12.7	-11.1	5.6	5.9	1.2	-2.1	.2	-.9	-3.3	1.8	4.8	-6.5	.8
AVG. MIN TEMPERATURE	9.7	-7.6	1.3	4.4	.4	-2.1	.5	.0	-3.0	2.1	-4.5	-9.6	-.6
AVG.MEAN TEMPERATURE	11.2	-9.4	3.5	5.1	.8	-2.1	.3	-.5	-3.2	1.9	.1	-8.0	.0
TOTAL PRECIPITATION	.0	-.2	-.4	-2.3	-2.3	-1.9	-2.4	2.2	5.1	3.2	-1.5	.0	-.49
TOTAL SNOWFALL	-5.9	1.2	-3.4	-.5	.0	.0	.0	.0	.0	.0	-1.3	-3.9	-13.8
HEATING DEGREE DAYS	-341	269	-91	-62	-83	-7	0	-1	59	-29	0	258	-29
COOLING DEGREE DAYS	0	0	8	85	-110	-78	4	-22	-45	24	-1	0	-135

TITLE: NTEP Bentgrass Cultivar Trial

OBJECTIVE: To evaluate new and existing bentgrass cultivars for performance at Manhattan and Wichita

PERSONNEL: Roch Gaussoin, Turfgrass Research and Teaching
John Pair, Turfgrass Research
Kevin Kamphaus, Turfgrass Technician

SPONSOR: Heart of America Golf Course Superintendent's Assn.
Kansas Turfgrass Foundation

INTRODUCTION:

Turfgrass plant breeders are currently developing new and experimental bentgrass cultivars for use on golf course greens, tees, and fairways. The National Turfgrass Evaluation Program (NTEP) has provided Kansas State University with many of the new bentgrass cultivars for regional evaluation in 1990. The NTEP trials are designed to evaluate new and/or experimental turfgrass cultivars for regional and national recommendations.

METHODS:

Two evaluations will be conducted. One will involve the establishment of 23 bentgrass cultivars on the recently completed USGA green located in Manhattan. The other test will include 20 entries established on a native soil at the same location. The native soil test will provide evaluation of bentgrass entries under fairway/tee management conditions. This test will be conducted in both Manhattan and Wichita. See Table 1 for a list of bentgrass cultivars. All tests were established in the fall of 1989, with treatments being initiated in the spring of 1990. Treatment at Manhattan will include two mowing heights. Mowing heights for the green trial will be 0.18 and 0.09 inch and for the fairway trial, 0.5 and 0.75 inch. Data will be collected on quality, density, ball speed, thatch build up, and weed encroachment.

RESULTS:

Wichita

Preliminary data indicated best seedling vigor in Emerald, National, and Penncross. Best winter color was recorded on Bardot, Forbes 89-12, SR 1020, Tracenta, and 88.CBL (Table 2).

Table 1. Bentgrass entries of NTEP Trials.

Name	Species	Sponsor
BR 1518	Agrostis castellana (dryland bent)	USGA Green Section
Carmen	Creeping	Van der Have Oregon
Tracenta	Colonial	Van der Have Oregon
Putter	Creeping	Jacklin Seed Co.
SR 1020	Creeping	Seed Research of Oregon
Providence	Creeping	Seed Research of Oregon
Bardot	Colonial	Barenbrug USA
Penncross	Creeping	Tee-2-Green Corp.
Pennlinks*	Creeping	Tee-2-Green Corp.
UM 84-01	Creeping	Johnson Seeds, Ltd.
Egmont	A. capillaris (browntop bent)	Olsen-Fennel Seed Co.
Normarc 101	Creeping	Normarc, Inc.
Forbes 89-12	Creeping	Forbes Seed and Grain
WVPB 89-D-15	Creeping	Willamette Valley Plant Breeders
National	Creeping	Pickseed West
88.CBE	Creeping	International Seeds
88.CBL	Creeping	International Seeds
Cobra	Creeping	International Seeds
Emerald	Creeping	International Seeds
TAMU 88-1	Creeping	Texas A&M University
Allure	Colonial	Willamette Seed Co.
MSCB-6*	Creeping	Mississippi St. Univ.
MSCB-8*	Creeping	Mississippi St. Univ.
Penneagle**	Creeping	Tee-2-Green Corp.

*Green Test Only
**Tee/Fairway Test Only

Table 2. Preliminary data on bentgrass cultivar performance at Wichita 1989-90[1]

Cultivar	Seedling vigor	Winter color	Visual quality 5-10-90
BR 1518	3.3	6.3	4.7
Carmen	2.0	7.0	7.3
Tracenta	4.0	8.7	6.7 BG
Putter	5.0	7.5	8.0
SR 1020	5.0	8.2	8.0
Providence	3.7	7.8	8.0 DG
Bardot	4.7	8.2 BP	6.3 BG
Penncross	5.0	7.7	7.8
Penneagle	4.3	6.8	7.3
Egmont	3.3	7.2 BG	6.3 BG
Normarc 101	4.0	7.0	7.2
Forbes 89-12	4.3	7.8 DG	8.0 DG
WVPB 89-D-15	4.3	7.2	7.5
National	5.3	5.3	6.3
88.CBL	3.7	8.2 DG	8.0 DG
Cobra	4.0	7.3	8.2
Emerald	5.7	4.7	7.5
TAMU 88-1	4.0	6.2 BP	7.2
Allure	3.7	6.3	5.7 BG

[1]Established Sept. 27, 1989 (mean of 3 replications). Symbols DG = Dark Green, BG = Bright Green, BP = Brown Patch

TITLE: Creeping Bentgrass Performance as Affected by Wetting Agents and Water-Absorbing Polymers

OBJECTIVE: To test the effects of a non-ionic wetting agent, starch polymers, and cross-linked polyacrylamide polymers added to a sand-based rootzone on moisture retention, temperature, and oxygen diffusion rate of the root zone and quality, color, density, water use, clipping yield, rooting capacity, canopy temperature, and pathogen activity of creeping bentgrass putting greens

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Dave Gerken, Turfgrass Masters candidate

INTRODUCTION:

Maintaining quality creeping bentgrass putting surfaces on golf courses located in the transition zone is difficult during the summer because the combination of hot, drying winds and localized dry spots in the root zone result in scattered moisture-deficient "hot spots" in the turf. Mid-day spraying and the use of non-ionic wetting agents are used by golf course superintendents to manage these "hot spots", but these techniques are labor intensive and require repeated applications, respectively.

The use of water-absorbing polymers mixed into the root zone is currently receiving attention as a possible means to relieve some of the moisture deficits that turfs experience diurnally during mid-summer. Recent advances in the water absorbing capacity of these polymers has made these materials feasible for agricultural use.

During periods of water shortage, which occur commonly in Kansas, most municipalities severely restrict or eliminate use of water for irrigating turf areas. Such drastic curtailment of water use can lead to disastrous consequences for golf courses. The use of these water absorbing polymers in golf course putting greens may mean their survival during such water rationing periods and thus avoid the extremely high costs of putting green re-establishment.

During 1988, the Heart of America Golf Course Superintendents Association combined its efforts with the Kansas Golf Course Superintendents Association and the Kansas Turfgrass Foundation to construct a 14,000 square foot addition of a United States Golf Association-specified putting green to the existing putting green at the Rocky Ford Turfgrass Research Plots in Manhattan, Kansas. This major expansion represents an unprecedented opportunity for putting green research at Kansas State University. This experiment is proposed to utilize approximately 5000 square feet of this new research putting green to pursue the objectives stated above.

MATERIALS AND METHODS:

Field Study

A randomized complete block experimental design will be utilized on two-year-old 'Penncross' creeping bentgrass at the Rocky Ford Turfgrass Research Plots involving six treatments replicated three times each. Plot size will be approximately 275 square feet each. Treatments include the following:

1. Control - no treatment.
2. Fine grade (powder) cross-linked polyacrylamide at 150 lbs. per acre applied once. Sod will be removed, polymer drop spread and tilled to a 6-8 inch depth, and sod replaced.
3. Coarse grade (granular) cross-linked polyacrylamide at 150 lbs. per acre applied once. Sod will be removed, polymer drop spread and tilled to a 6-8 inch depth, and sod replaced.
4. Non-ionic wetting agent applied as a liquid spray at 16 oz. (of material) at beginning of season, then 1/2 per month per 1000 sq. ft. in each growing month.
5. Fine grade (powder) starch polymer at 50 lbs per acre applied once. Sod will be removed, polymer drop spread and tilled to a 6-8 inch depth, and sod replaced.
6. Coarse grade (pelletized) starch polymer at 150 lbs per acre applied once. Sod will be removed, polymer drop spread and tilled to a 6-8 inch depth, and sod replaced.
7. Combined 2 and 4 at same rates (150 lbs + full wetting agents.

Data to be collected include the following:

1. Monthly quality, color, and density ratings
2. Wilting tendency
3. Monthly and seasonal water use determined from installed weighing lysimeters
4. Clipping yield (dry)
5. Root mass by 3-inch depth intervals (0-3, 3-6, and 6-9")
6. Rootzone soil moisture (continuous measurement)
7. Rootzone temperature at 1 and 2 inch depths (continuous measurement)
8. Canopy temperature (mid-day during July and August)
9. Pathogen activity with special emphasis on black layer

Lab Study

Using a Soil Moisture Equipment Corp. moisture extractor, moisture release curves will be established from cores taken at the end of the first and second growing seasons from field plots and lab-prepared mixes using the appropriate treatments.

In addition, oxygen diffusion rates will be monitored from lab-prepared mixes placed in large diameter (> 8 inches) PVC columns. 'Penncross' creeping bentgrass will be established on these columns prior to monitoring.

Note: Research is in progress, and results will be presented next year.

TITLE: Central Fiber Mulch Study

OBJECTIVES: To evaluate various commercial mulches for their efficacy in enhancing establishment of seeded Kentucky bluegrass

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching

INTRODUCTION:

Establishing cool-season turfgrasses in Kansas from seed is sometimes difficult because of the stress caused by persistent drying winds and high temperatures. Establishment success can be improved dramatically with the use of mulch materials over newly seeded areas. Several different mulch materials have been used to make the seedbed more favorable for seedling establishment. They include straw, wood chips, pine needles, excelsior, and various synthetic materials including protective covers. For a mulch to be effective, it must improve the establishment rate of the newly seeded turf, must not be too susceptible to loss from the wind, and be economical enough to be used over large areas. This study was designed to test various mulch materials provided by Central Fiber (Wellsville, KS) for their efficacy in promoting establishment rate of seeded Kentucky bluegrass.

MATERIALS AND METHODS:

'Baron' Kentucky bluegrass was seeded into an area approximately 3000 square feet at the rate of 2 lbs of seed per 1000 square feet in early June. Plot size was 2 by 4 meters. Immediately after seeding, the area was fertilized with diammonium phosphate at the rate of 1 lb of actual N per 1000 square feet. Four mulch materials supplied by Central Fiber were spread over the plots in a randomized complete block experimental design. These included Spray Mat, Missouri Mulch, Spray Sod, and Spray Sod 1000. Plastic netting was placed over the seeding to minimize loss of mulch materials by wind. Establishment ratings (1-9) were given to each plot 18, 24, 36, and 50 days after seeding. In addition, at 50 days, three standard-sized cup cores were taken from each plot and analyzed for number of shoots and biomass (oven dried). Statistical analyses were performed on all dependent variables using the MSTAT statistical program. Slides were taken at various dates through the project to photographically document the results.

RESULTS:

Table 1 shows the average establishment ratings for 'Baron' Kentucky bluegrass treated with the four mulch types versus a control with no mulch added after seeding. Spray Mat mulch provided the best establishment of any of the mulches tested. Missouri mulch, Spray Sod, and Spray Sod 1000 were less effective than Spray Mat, but all provided superior establishment compared to no mulch at all.

Table 2 shows the high variability exhibited by shoot number and biomass in these establishment plots. Spray Mat proved numerically superior to the other mulch types, but because of the large within-treatment variation, it wasn't significantly greater than Missouri Mulch or Spray Sod. Spray Sod 1000 provided the poorest biomass of any of the mulches tested.

Table 1. Average establishment ratings (1-9) of 'Baron' Kentucky Bluegrass using four Central Fiber mulch materials versus unmulched plots.

	Days After Seeding			
Mulch material	18	24	36	50
Missouri Mulch	2.0	4.5	5.3	6.2
Spray Sod	2.7	4.5	5.3	6.3
Spray Mat	3.3	6.0	6.7	7.3
Spray Sod 1000	2.0	3.8	4.8	6.0
Unmulched	1.3	2.5	3.5	4.5
LSD 0.05	0.65	1.55	1.32	0.95

Table 2. Average Kentucky Bluegrass shoot counts and shoot biomass for 3 cup samples per plot as affected by mulch types versus unmulched control, 50 days after seeding.

Mulch material	Average shoot counts	Average shoot biomass (dry, mg)
Missouri Mulch	101	2000
Spray Sod	101	2000
Unmulched	83	1540
Spray Mat	123	2480
Spray Sod 1000	87	1750
LSD 0.05	42	655

TITLE: Evaluation of New and Nonconventional Herbicide Application Equipment for Turfgrass Weed Control

OBJECTIVE: Investigate the potential of several new and non-conventional pesticide application systems for turfgrass weed control.

PERSONNEL: Roch Gaussoin, Turfgrass Research and Teaching
Larry Leuthold, Turfgrass Extension
Ward Upham, Turfgrass Technician

SPONSORS: Monsanto Chemical Company
North American Micron
Spraying Systems Incorporated

INTRODUCTION:

Traditional methods of pesticide application, such as the conventional boom-sprayer or lawn-care gun, have proven to be efficient. Shortcomings of these methods, however, range from their effectiveness for small area applications to how portable they are for use in limited access areas. New nozzle technology exists in the agricultural market that may have potential in the turf maintenance industry. Research was conducted to evaluate several variations in application technique that may prove beneficial to turfgrass pesticide applications.

METHODS:

Nozzle Test:

The standard nozzle for use on boom sprayers in turfgrass installations has been a single orifice flat fan nozzle. For agricultural no-till or conservation tillage systems, a nozzle, called a twin-jet, was developed with two orifices at oblique angles that hasten penetration of pesticide through the crop residue. These nozzles may also hasten penetration of preemergence herbicides through thatch into the soil or increase foliar coverage of broadleaf herbicides. Side by side comparisons of the standard flat fan nozzle vs. a twin-jet nozzle at the same carrier volume were conducted. Two preemergence herbicides at two rates and one three-way broadleaf herbicide were included in this investigation.

Controlled Droplet Applicators:

Controlled Droplet Applicators (CDA's) are application tools that distribute the pesticide in a very precise, uniform droplet pattern and size.

The "Herbi" manufactured by North American Micron is currently being utilized by lawn care companies in the Kansas City area. Advantages of this system include low carrier volume requirement and portability.

The "Expedite" system, manufactured by Monsanto Chemical

Company, is a relatively new addition to the application equipment arsenal. Advantages of this system include portability as well as minimal pesticide applicator exposure to chemicals being applied.

Both of these CDA's will be evaluated utilizing broadleaf weed control herbicides and compared with a conventional boom sprayer.

RESULTS:

To be discussed at the Turfgrass Field Day at Manhattan, KS June 19, 1990.

TITLE: Efficacy of Preemergence Annual Grass Herbicides in Kentucky Bluegrass

OBJECTIVE: To evaluate efficacy of registered and experimental herbicides for the control of grassy weeds in Kentucky bluegrass

PERSONNEL: Roch Gaussoin, Turfgrass Research and Teaching
Ward Upham, Turfgrass Technician

SPONSORS: Sandoz Crop Protection
Dow-Elanco Products Company
Ciba-Geigy Corporation
Monsanto Chemical Corporation

INTRODUCTION:

Numerous herbicides are available that are registered for use in the control of annual grassy weeds. In addition, companies have new herbicides and formulations that need to be evaluated. Research was conducted at the Rocky Ford Turfgrass Research Plots to evaluate a wide range of herbicides for the control of annual grassy weeds (primarily large crabgrass) in an established Kentucky bluegrass turf.

METHODS:

To supplement the native weed population, the experimental area was overseeded in March of 1990 with large crabgrass. Large crabgrass was seeded at 1 lb/1000 ft^2. Prior to overseeding, the area was mowed at 0.75" and verticut in two directions. All treatments were applied on April 11, 1989, except Premier, which was applied on April 18. All liquid formulations were applied with a compressed-air sprayer calibrated to deliver 77GPA at 30 PSI. Granular formulations were applied using a shaker-can. Preemergence treatments are listed in Table 1.

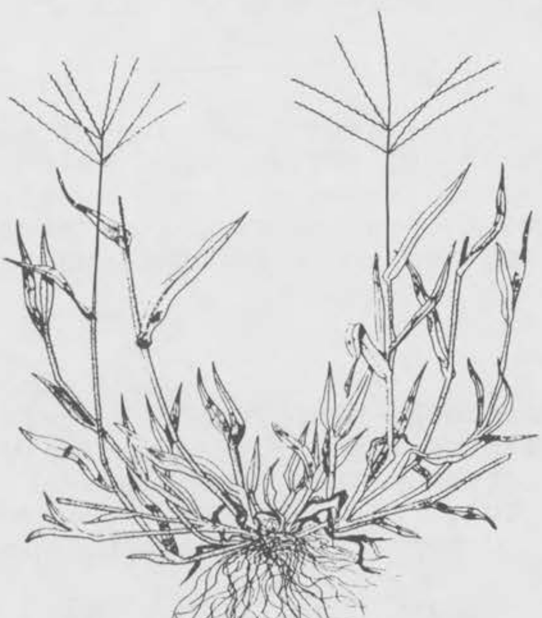
Data will be collected on crabgrass control plus control of any additional resident weeds. The experimental design is a randomized complete block with three replications.

RESULTS:

To be reported at the Turfgrass Field Day at Manhattan, KS, June 19, 1990.

Table 1. Preemergence herbicides for annual grassy weed control applied at Manhattan, KS - 1989.

Common Name	Trade Name	Company	Formulation	Rate
Prodiamine	--	Sandoz	65 WDG	0.75
Prodiamine	--	Sandoz	65 WDG	1.0
DCPA	Dacthal	Fermenta	75 WP	10.5
Benefin	Balan	Dow-Elanco	60 DF	2.0
Benefin	Balan	Dow-Elanco	60 DF	3.0
Benefin/ Trifluralin	Team	Dow-Elanco	2 G	2.0
Benefin/ Trifluralin	Team	Elanco	2 G	3.0
Oxadiazon	Ronstar	Rhone-Poulenc	50 WP	1.5
Oxadiazon	Ronstar	Rhone-Poulenc	50 WP	2.0
Pendimethalin	Pre-M	Lesco	60 WDG	1.5
Pendimethalin	Pre-M	Lesco	60 WDG	2.0
Bensulide	Betasan	ICI Americas	4 E	12.0
Dithiopyr	Dimension	Monsanto	0.25 G	0.5
Dithiopyr	Dimension	Monsanto	1 EC	0.5
----	Premier	Ciba-Geigy	1.2 EC	1.5
----	Premier	Ciba-Geigy	1.2 EC	2.0
Untreated Control				



TITLE: National Kentucky Bluegrass Cultivar Trial

OBJECTIVE: To evaluate commercial and experimental genotypes of Kentucky bluegrass for their adaptability under Kansas conditions

PERSONNEL: John Pair, Turfgrass Research
Roch Gaussoin, Turfgrass Research and Teaching
Jeff Nus, Turfgrass Research and Teaching

INTRODUCTION:

Kentucky bluegrass is one of the most widely used turfgrass species in the United States. It forms a dense, high quality sward of rich green color. Under Kansas conditions, however, it often does not perform well during mid-summer because it lacks a high degree of heat and drought tolerance. Trials were initiated in both Manhattan and Wichita to test Kentucky bluegrass genotypes from the National Turfgrass Evaluation Program for their adaptability to Kansas conditions.

MATERIALS AND METHODS:

Manhattan

Seventy-two Kentucky bluegrass cultivars were planted in Section II of the Rocky Ford Turfgrass Research Plots during the first week of March, 1986. The planting utilized a completely randomized block design with 72 cultivars replicated three times each into individual 1 X 2 meter plots. A complete (20-20-20) fertilizer was applied immediately after seeding at 1 lb N per 1000 sq ft. Plots received 4 lbs of nitrogen per 1000 sq ft per season and were irrigated to prevent severe water stress. Data collected included a subjective monthly quality rating (1-9, 9 = best).

Wichita

A trial of 72 cultivars and experimental numbers was established on September 18, 1985. Plots were maintained at 4 lbs N/1000 sq ft per year, mowed at 2 1/2 in with clippings removed, and irrigated to prevent excessive stress. Team (Balan/Treflan) was applied in April and June to prevent crabgrass.

RESULTS:

Performance of Kentucky bluegrass cultivars at Manhattan and Wichita is shown in Tables 1 and 2, respectively. Best performing cultivars at Manhattan were Midnight, Bristol, America, Blacksburg, Coventry, Chateau, Baron, Challenger, Cheri, Lofts 1757, Nassau, Sydsport, Able 1, Aspen, Gnome, and Ram I.

Best Kentucky bluegrass quality in Wichita was obtained with cultivars Midnight, P-104, Lofts 1757, Blacksburg, America, Merit, Eclipse, Bristol, Merion, Parade, Aspen, Challenger, Victa, F-1872, Trenton, Nassau, Georgetown, and Rugby.

Table 1. Mean turfgrass quality ratings of Kentucky Bluegrass cultivars in the 1985 National Kentucky Bluegrass test at Manhattan, KS - 1989 data

Turfgrass quality ratings 1-9; 9 = ideal turf

Name	APR	MAY	JUN	JULY	AUG	SEP	NOV	MEAN
Midnight	8.3	7.7	8.7	8.3	6.7	7.0	6.3	7.6
Bristol	7.3	6.3	7.7	7.0	7.0	7.3	7.7	7.2
America	8.0	7.3	7.0	6.7	6.7	7.0	7.0	7.1
Blacksburg	6.7	7.7	8.3	7.3	6.3	6.7	7.0	7.1
BA 70-139 (Coventry)	7.7	6.7	7.0	7.0	6.7	7.0	6.7	7.0
BA 72-500 (Chateau)	6.7	6.7	7.3	7.0	7.0	7.3	6.7	7.0
Baron	7.7	6.3	7.7	7.3	6.7	6.7	6.3	7.0
Challenger	7.0	6.7	8.0	8.0	6.0	6.0	7.3	7.0
Cheri	7.0	6.7	7.7	7.3	6.7	7.0	7.0	7.0
Lofts 1757	7.0	6.7	7.3	7.7	6.7	7.0	6.7	7.0
Nassau	8.3	5.3	7.7	6.3	7.0	7.0	7.0	7.0
Sydsport	6.7	7.3	7.7	7.3	7.0	7.0	6.3	7.0
Able I	7.3	8.0	8.0	7.0	6.0	6.0	6.0	6.9
Aspen	6.3	7.0	7.3	6.7	7.0	7.0	7.0	6.9
Gnome	7.3	6.0	7.3	7.7	7.0	7.0	6.0	6.9
Ram-1	7.3	7.7	7.7	8.3	5.3	5.7	6.3	6.9
Asset	6.7	6.3	7.7	7.0	6.3	6.3	7.0	6.8
BA 73-540	6.7	7.0	7.3	7.0	6.3	6.7	6.7	6.8
Eclipse	6.7	6.0	7.0	8.0	6.7	7.0	6.0	6.8
Harmony	7.0	6.3	7.0	7.0	6.7	6.7	6.7	6.8
Ikone	7.0	6.3	7.3	7.7	6.3	6.7	6.0	6.8
P-104(Princeton 104)	7.3	6.7	6.3	6.7	6.7	7.3	6.7	6.8
Victa	6.3	7.3	6.7	7.3	6.7	7.0	6.3	6.8
Bar VB 577	7.3	6.0	7.3	7.3	6.3	6.7	5.7	6.7
Glade	7.3	6.7	7.3	7.3	6.3	6.3	5.7	6.7
Merit	6.7	6.7	6.7	7.7	6.3	7.0	6.0	6.7
BA 69-82	7.0	6.3	6.7	7.3	6.3	6.7	6.0	6.6
BA 73-626 (Kelly)	6.3	6.7	6.7	7.7	6.0	7.0	6.0	6.6
Barzan	6.0	7.0	8.0	7.0	6.7	6.3	5.3	6.6
Georgetown	6.0	6.0	6.7	6.3	7.0	7.3	6.7	6.6
Liberty	6.0	6.3	8.0	6.3	6.3	6.7	6.3	6.6
Merion	6.7	7.0	7.7	7.0	5.3	6.0	6.7	6.6
PST-CB1	6.7	6.0	7.3	7.0	6.0	6.7	6.7	6.6
Tendos	6.0	6.3	7.3	7.0	5.7	6.3	7.3	6.6
239 (Suffolk)	6.0	5.7	6.7	6.7	6.7	6.7	7.0	6.5
BA 70-242	7.0	7.3	7.3	6.3	5.7	6.0	5.7	6.5
Classic	6.0	5.7	6.7	7.0	6.3	6.7	7.3	6.5
Dawn	6.7	6.7	7.0	5.3	6.3	6.7	7.0	6.5
HAGA	6.7	6.0	7.0	6.3	6.3	7.0	6.3	6.5
K1-152	7.0	6.0	6.7	5.3	7.0	7.3	6.0	6.5
K3-178	6.0	6.0	6.7	6.7	7.0	7.0	6.0	6.5
Parade	6.3	5.7	7.0	6.3	6.7	7.0	6.3	6.5
Welcome	7.0	6.7	7.0	7.3	6.3	6.3	50.	6.5
BA 72-441 (Abbey)	6.0	6.3	7.3	6.7	6.3	6.7	5.7	6.4
BA 72-492 (Estate)	6.0	6.3	7.0	6.7	6.3	6.7	6.0	6.4

(cont.)

Name	APR	MAY	JUN	JULY	AUG	SEP	NOV	MEAN
Somerset	6.3	6.0	6.7	6.3	6.3	6.7	6.3	6.4
Cynthia	5.3	6.7	7.7	7.3	5.3	5.3	6.7	6.3
Mystic	6.3	7.3	7.0	7.0	6.0	5.3	5.3	6.3
Rugby	6.3	5.7	6.0	6.7	6.3	6.3	7.0	6.3
Trenton	6.0	6.7	6.3	6.3	6.0	6.0	6.7	6.3
A-34	5.7	6.0	6.3	6.7	6.7	6.7	6.0	6.2
HV 97	7.0	6.7	7.0	6.0	5.7	5.7	4.7	6.1
Wabash	5.0	6.3	6.0	6.0	6.3	6.7	6.3	6.1
Monopoly	5.7	6.0	6.0	6.0	6.3	6.3	5.3	6.0
Joy	5.0	5.0	5.9	5,3	5.3	5.9	5,3	5,5
S.D. Cert.	6.3	4.7	6.0	6.0	5.7	6.3	4.3	5.6
Compact	4.0	5.3	4.7	6.0	6.0	6.0	5.7	5.4
Kenblue	5.3	5.0	6.0	6.0	5.3	5.0	5.3	5.4

Table 2 .Performance of Kentucky Bluegrass cultivars, Wichita, KS 1989 1/.

Cultivar	Quality rating by dates (0-9 w/9 = best) 6-19	7-26	8-30	Season Avg.
Midnight	8.0 DG	8.7	8.3 DG	8.3
P-104	7.8 DG	8.7 DG	8.2 DG	8.2
Lofts 1757	7.5	8.2	8.2 DG	8.0
Blacksburg	8.0 DG	7.7 DG	7.7	7.8
America	7.8 DG	7.8	7.3	7.6
Merit	7.5	7.8 DG	7.3	7.5
Eclipse	7.3	7.7	7.2	7.4
Bristol	7.3	7.3 $	7.0	7.2
Merion	7.5	7.2 $	6.8	7.2
Parade	7.5	7.0 LG	7.2	7.2
Aspen	7.5	7.0	7.0	7.2
Challenger	7.7	7.3 $	6.7	7.2
Victa	6.8	7.8	6.8	7.1
F-1872	7.0	7.0 LG	7.2	7.1
Trenton	7.2 LG	7.0 LG	7.0	7.1
Nassau	7.2	7.2	6.5 W	7.0
Georgetown	7.5	7.0	6.5 $	7.0
Rugby	6.8	7.3	7.0	7.0
Ba 73-626	6.5	7.3	6.8	6.9
K3-178	6.8 LG	6.8 LG	7.0	6.9
Tendos	7.2	7.3	6.2	6.9
239	7.0	7.0 LG	6.8	6.9
K1-152	7.2	6.7 LG	6.7	6.9
Haga	7.3	6.7 LG	6.7	6.9
Glade	6.8	7.2 $	6.3 $	6.8
Liberty	6.7 LG	7.3	6.2	6.7
Gnome	6.7	7.0	6.5	6.7
Ba 72-441	6.7	7.3	6.2	6.7
Somerset	6.8 LG	6.8	6.5	6.7
Classic	6.7	7.0 LG	6.5	6.7
Baron	6.7	6.8 $	6.2	6.7
WW Ag 496	7.0	6.7 $	6.2	6.6
Destiny	7.3	6.5 $	6.0 D	6.6

(Bluegrass Table 1 cont'd.)

Cultivar	Quality rating by dates (0-9 w/9 = best)			
	6-19	7-26	8-30	Season Avg.
PST-CB1	7.5	7.0	5.2 D	6.6
Amazon 239	6.5	6.8	6.3 W	6.5
Ba 70-242	6.8	6.8	5.7	6.4
A-34	6.7	6.2 $	6.3	6.4
WW Ag 468	7.2	6.5 $	5.0	6.2
Asset	7.2 LG	6.2 $	5.3 D	6.2
Huntsville	6.7	5.5 $	5.8 $,W	6.0
Sydsport	6.7 $	5.3 $	6.0 $	6.0
Barzan	6.0	6.5 $	5.5	6.0
Annika	7.0	5.7 $	5.3 D	6.0
Able I	6.5	6.0 $	5.3	5.9
Wabash	5.8 LG	6.0 $	6.0 $	5.9
Dawn 6.5	5.7 $	5.3 D	5.8	
Ba 72-500	6.2	4.3 $	5.3 D	5.7
Mystic	5.3	5.7 $	6.2	5.7
Cheri	5.8 $	5.3 $	5.3 D	5.7
Compact	5.8	5.8	5.5 D	5.7
HV 97	6.2	5.5 $	5.5 D	5.7
BAR VB 534	5.3	5.7 $	6.0 $	5.7
BAR VB 577	7.2	5.7 $	4.0 D	5.6
Welcome	6.7	5.5 $	4.7 D	5.6
NE 80-88	6.5 $	5.3 $	5.0 D	5.6
Harmony	6.2 $	5.3 $	4.7 D	5.4
Ram-1	7.0	5.2 $	4.0	5.4
Julia	6.8 DG	5.3 $	4.0 D	5.4
Ikone	6.3 $	5.2 $	4.7	5.4
Cynthia	5.5	5.0 $	5.5	5.3
Ba 72-492	5.7 $	4.3 $	6.0 $	5.3
Kenblue	5.3	5.2 $	5.2	5.2
WW Ag 495	5.7	4.7 $	5.0 D	5.1
Monopoly	5.7 $	5.0 $	4.5 $	5.1
WW Ag 491	5.8 $	4.3 $	5.0 D	5.0
Conni	6.0	5.0 $	4.0 D	5.0
South Dakota Cet.	5.0	5.0	4.7 D	4.9
Joy	5.3	5.0 $	4.5 D,W	4.9
Ba 69-82	6.0	3.7 $	5.0 $	4.9
Aquila	5.7 $	4.0 $	4.0 D	4.6
Ba 73-540	5.5 $	3.3 $	4.7 G	4.5
70-139	5.0 $	3.2 $	4.3	4.2

1/ Planted Sept. 18, 1985. Maintained at 4 lbs. N/1000 sq. ft. Mowing height was 2.5" with clippings removed. Symbols: D = Dense, DG = Dark Green, $ = Dollar Spot, LG = Light Green, W = Weeds.

TITLE: Effect of Plant Growth Regulator Compounds on Development of Brown Patch, Caused by Rhizoctonia solani, on Kentucky Bluegrass in Greenhouse Tests

OBJECTIVE: To test the fungicidal properties of plant growth regulators on the development of brown patch.

PERSONNEL: Ned Tisserat, Dept. of Plant Pathology
Roch Gaussoin, Dept. of Horticulture
Ann Nus, Dept. of Plant Pathology

INTRODUCTION:

Plant growth regulators (PGR's) are used on turfgrass to reduce the amount of foliage growth and, thus, reduce the frequency of mowing. These compounds may have other effects on the plant and the microflora associated with the leaves or roots of the turfgrass plant. For example, the chemical structure of the PGR paclobutrazol (the active ingredient in Scott's TGR) is similar to the sterol inhibitor fungicide fenarimol (Rubigan), indicating the potential for fungicidal activity.

METHODS:

Foliage of Kentucky bluegrass 'Park", grown in 10-cm diameter pots in the greenhouse, was treated with the PGR's Mefluidide (.25 lb ai/acre), Paclobutrazol (.33 lb ai/acre), or Flurprimidol (.6 lb ai/acre). Other pots received treatments of Propiconazol (Banner 1.1EC 2 oz/1000 sq. ft), Fenarimol (Rubigan 50 WP .4 oz/1000 sq ft, or sterile water only. Chemicals were applied to 4 or 8 pots (two experiments) in a completely randomized or randomized block design. After 3 days, .2 g of oat inoculum infested with R. solani was added to the foliage of each pot in a uniform manner. Pots were misted, covered with plastic, and placed in a growth chamber 30^{o}C for 3-7 days. Disease ratings were made daily on a 0-5 scale, where 0 = no disease, 1 = 1-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61-80%, and 5 = >80% of the foliage discolored.

RESULTS:

Results of the two experiments differed (Table 1). In experiment 1, the fungicide Banner and the PGR paclobutrazol reduced ($P<0.05$) the severity of brown patch on Kentucky bluegrass. The other PGR's also tended to decrease disease severity. However, these differences were not detected in the second experiment. Only Banner significantly controlled the development of brown patch.

These results suggest that certain PGR's may have some fungicidal activity on Rhizoctonia solani in vivo. Whether this activity is sufficient to prevent development of brown patch under field conditions remains uncertain. Further testing in the greenhouse and field is planned.

Table 1. Effect of PGR's and sterol-inhibiting fungicides on development of Brown patch on Kentucky bluegrass after inoculation with <u>Rhizoctonia solani</u> (Experiments 1 & 2).

Treatment	Severity rating Experiment 1	Experiment 2
Propiconazol (Banner)	1.5	1.8
Paclobutrizol	1.6	2.6
Mefluidide	2.1	3.8
Flurprimidol	2.8	2.6
Control (water only)	3.1	2.4
Fenarimol (Rubigan)	3.3	2.8
LSD .05	1.0	0.5

Severity ratings taken 7 days after inoculation where 0 = no disease, 5 = turfgrass completely killed.

TITLE: Water Use of Hydroponically Grown Kentucky Bluegrass as Affected by Various Levels of Potassium

OBJECTIVE: To investigate whether water use of Kentucky bluegrass was affected by potassium rates

PERSONNEL: Michael A. Sandburg, MS Student
Jeff Nus, Turfgrass Research and Teaching

FUNDING: Kansas Turfgrass Foundation

INTRODUCTION:

The turfgrass industry is pushing to find ways to reduce water use for turf. Potassium has been touted as an aid to reduce water use. The amount of potassium absorbed is related to the plant's ability to retain moisture. The following studies look at water use as affected by potassium level.

METHODS:

Single plants of Kentucky bluegrass (Poa pratensis cv. Ram I) were grown in a growth chamber in hydroponic solutions. The solutions included a control and various potassium levels (12.5 mg, 25 mg, 50 mg, 100 mg, and 200 mg potassium/liter). All environmental conditions were controlled.

Water Use

Plants were grown for 2 weeks. Twice per week, the solutions were measured and replaced. The amount of liquid gone was the amount used by the plant and the amount evaporated from the jar. A study was also done without plants to find the evaporation rate of the jars. The water use rate was calculated as the average amount used per day from the jar minus the average amount evaporated per day.

Diffusive Resistance

Plants were grown for 2 weeks. Diffusive resistance was recorded on the second fully expanded leaf. The readings were taken over a 24 hr cycle.

RESULTS:

This study was completed in the winter of 1989 and the following data contain all statistical values.

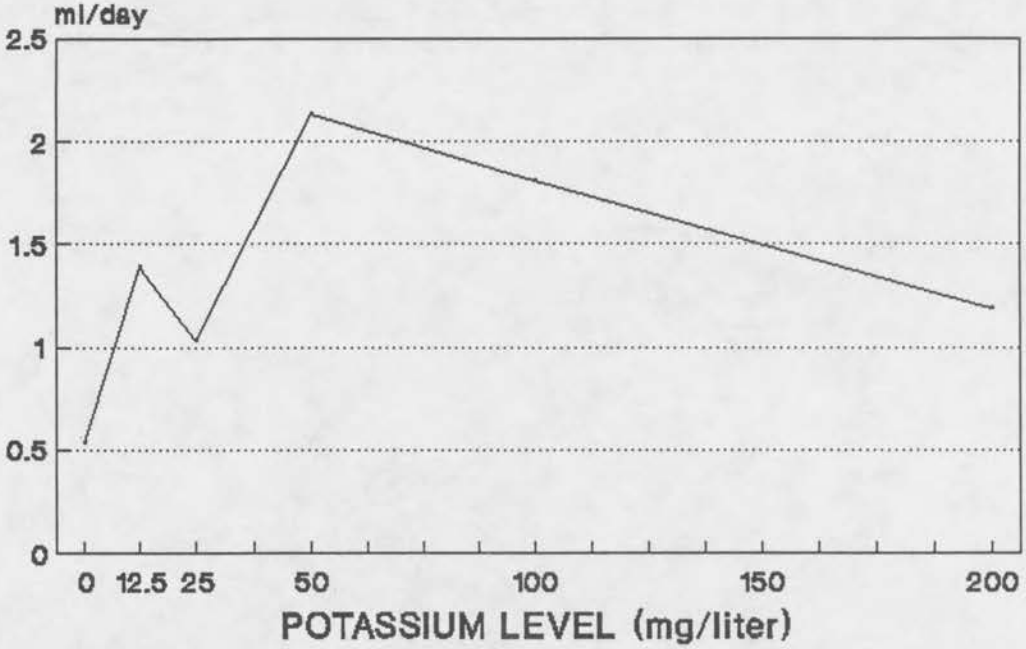
Water Use

Average water use per day was affected by the potassium level (Fig. 1). Potassium was shown to increase water use as level increased, until it peaked at the 50 mg K level. As potassium increased above 50 mg, the water use rate decreased. Previous experiments showed that the rate of growth increased to the 100 mg K level; thus, water use efficiency is greatest at the 100 mg K level.

<u>Diffusive Resistance</u>

Diffusive resistance was not significantly affected by potassium. With no potassium, the plant had erratic stomatal control (Fig. 2).

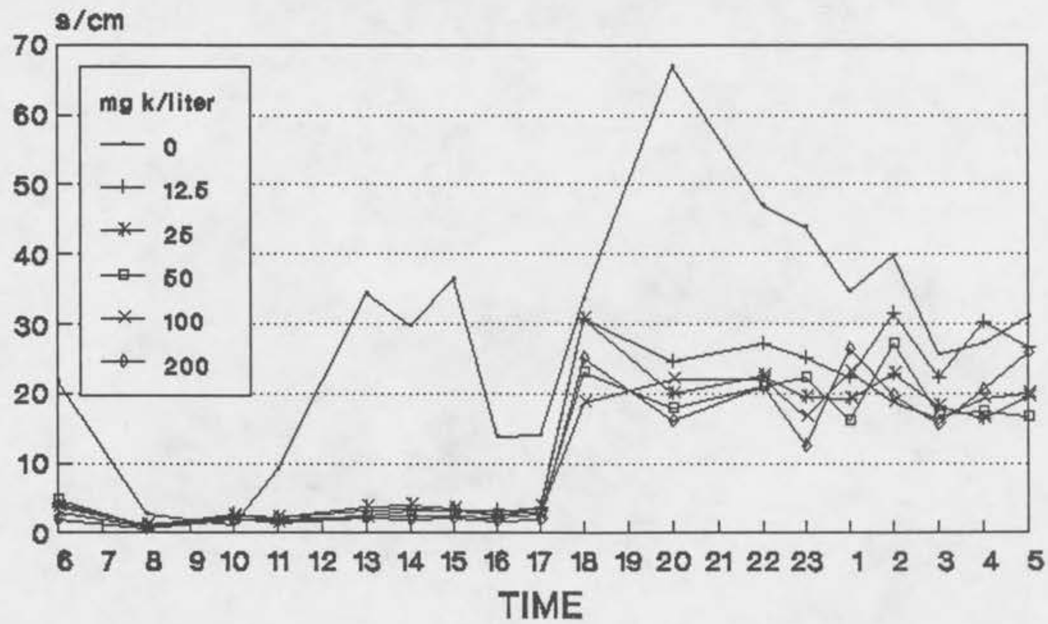
AVERAGE WATER USE PER DAY AT VARIOUS POTASSIUM LEVELS



alpha = 0.05 LSD = 0.5961

FIG. 1

LEAF DIFFUSIVE RESISTANCE UNDER VARIOUS LEVELS OF POTASSIUM



LIGHT 06:00-18:00
DARK 18:00-06:00

FIG. 2

TITLE: Water Use of Field Grown Kentucky Bluegrass as Affected by Various Levels of Potassium

OBJECTIVE: To investigate whether water use of Kentucky bluegrass was affected by potassium rates

PERSONNEL: Michael A. Sandburg, MS Student
Jeff Nus, Turfgrass Research and Teaching

FUNDING: Kansas Turfgrass Foundation

INTRODUCTION:

One of the USGA's goal for the 1990's is reduced water use; thus, all ways must be explored. The effect of potassium on turfgrass is one avenue to explore. The amount of potassium affects a plant's ability to retain moisture.

METHODS:

Twelve plots 15' by 15' were established at Kansas State University, Rocky Ford Turfgrass Research Plots with Kentucky bluegrass (Poa pratensis cv. Ram I). Each plot had an independent irrigation system that delivered 1.33" of water per hour. The plots were divided into four treatments (0 kg, 98 kg, 195 kg, and 293 kg potassium/ha/yr or 0 lb, 2 lbs, 4 lbs, and 6 lbs potassium/1000 sq ft/yr). All treatments, except controls, included four applications per year (March, June, Sept., and Nov.).

Water Use

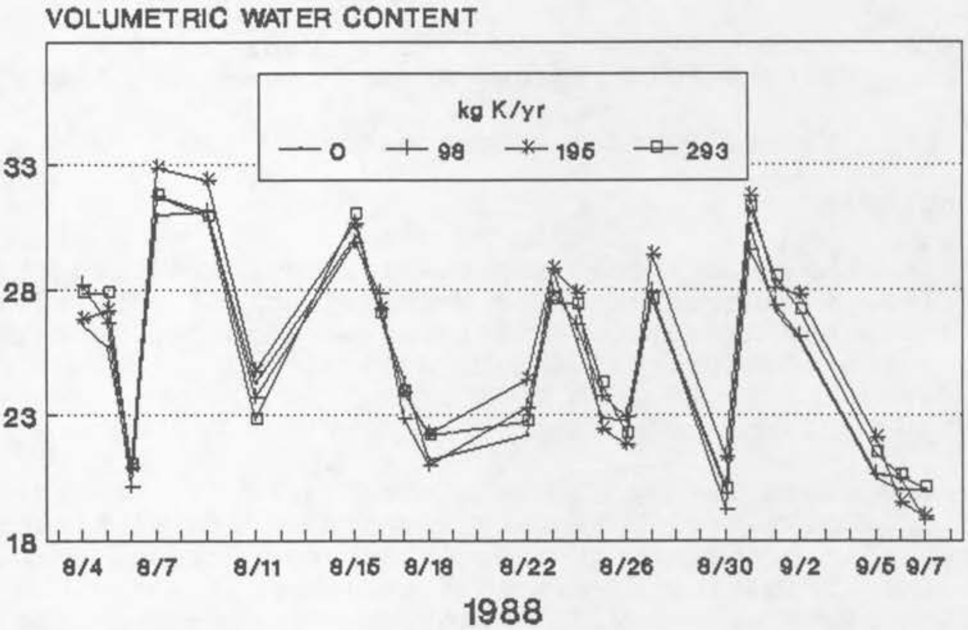
An Irams 500 Time Domain Reflectometer (TDR) was used to record daily soil moisture to a depth of 15 cm in each plot. Irrigation cycles were initiated when soil moisture readings were 2% above wilting point. Soil dry down cycles also were plotted for each potassium treatment.

RESULTS:

The study described above was completed in the fall of 1989 and the following data contain all statistical values.

There was no effect of potassium on water use, as shown in Figures 1 and 2.

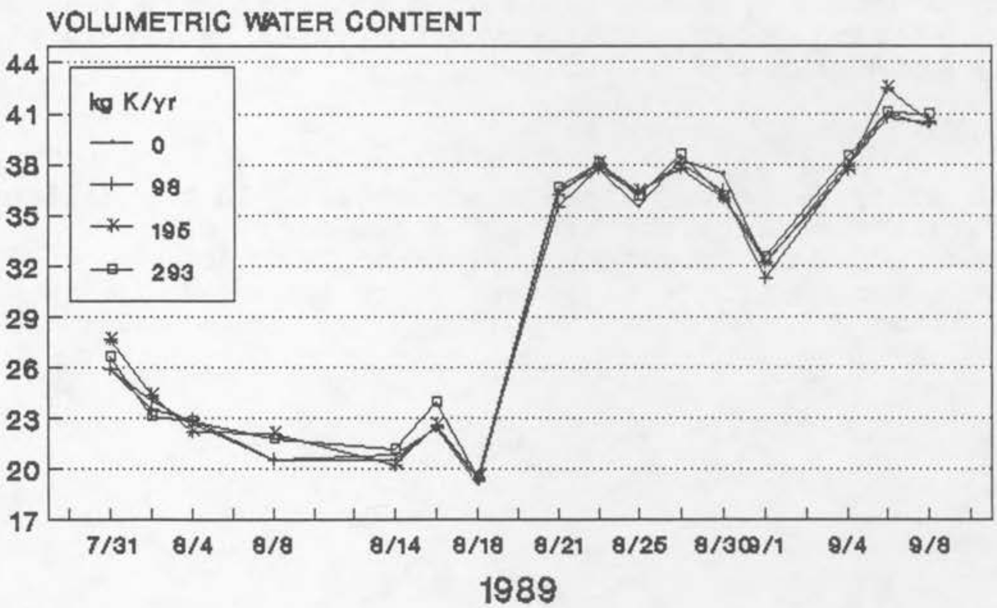
FIELD WATER CONTENT
1988 ROCKY FORD



alpha = 0.05, LSD 8/27, 1.0

FIG. 1

FIELD WATER CONTENT
1989 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 2

TITLE: Efficacy of Chemical and Biological Controls of White Grubs in Kentucky Bluegrass

OBJECTIVES: To compare various insecticides with predatory nematodes (Neoplectana carpocapsae) for the control of white grubs in Kentucky bluegrass

PERSONNEL: Jim Nechols, Entomology Research and Teaching
Jeff Nus, Turfgrass Research and Teaching
Bonnie Cupit, Entomology Technician

INTRODUCTION:

White grub is a collective term used to describe the soil-borne larvae of various beetles. Larvae of these beetles feed on roots of growing turfgrasses. Two of the more important beetle pests in Kansas turf are the southern masked chafer and the May beetle, sometimes referred to as a June bug. Feeding activities of larvae of both species can lead to widespread severe damage. Various insecticides have been used to control white grubs, but for reasons not completely understood, control is sometimes erratic. In addition, heightened public sensitivity to the use of pesticides (especially in the urban environment), warrants the investigation of alternative approaches to chemical grub control.

Neoplectana carpocapsae is a species of nematode that has been used as a form of biological control of soft-bodied, soil-borne insects. This nematode is capable of finding potential hosts in the soil and parasitizing them. Death of the host occurs from egg laying and subsequent secondary infections. Preliminary work with other predatory nematodes (e.g., Heterorhabditis sp.) has shown their ability to greatly reduce the population of white grubs in treated plots. This study was initiated to test N. carpocapsae against various insecticides for the control of southern masked chafer and May beetle larvae in Kentucky bluegrass.

MATERIALS AND METHODS:

The study utilized a randomized complete block design where half of each plot was left untreated in an effort to quantify variation in natural grub populations across the experimental area. Nine treatments included an untreated control, Triumph 4E at 2212 and 1106 g a.i. ha^{-1}, Triumph 1G at 2212 and 1106 g a.i. ha^{-1}, Oftanol 1.5G at 2212 g a.i. ha^{-1}, Sevimol 4L at 8968 a.i. ha^{-1}, and Neoplectana carpocapsae predatory nematodes at 25,000,000 per 1000 square feet.

Data were obtained in two ways: (1) numbers of southern masked chafer and May beetle grubs were counted for both the treated and untreated half of each plot and expressed as actual counts or as a percentage of the untreated sub-plot and (2) PVC cylinders were buried in each treated half plot (and control), and each PVC cylinder was "seeded" with 10 southern masked chafer grubs in an effort to eliminate between-plot variation in the number of grubs. Southern masked chafer grubs were dug on August 2 and held under cool, moist conditions until August 3, when they were placed beneath the sod into the PVC cylinders. Chemical and nematode treatments were applied on August 5, and grub counts were made on August 30 through Sept 7.

RESULTS:

Results from this study were very disappointing. Unfortunately, natural grub populations across the experiment area were extremely variable (e.g., extremely high coefficient of variations in untreated plots and highly variable actual counts in untreated sub-plots). The data for grub counts on treated plots are summarized in Table 1. There was so much within-treatment variability in this experiment that valid mean separations could not be made. Little, if any, interpretation should be attempted with these data.

The results of the associated experiment utilizing PVC cylinders and a known number of "seeded" grubs were equaling disappointing (Table 2). Extremely high mortality in the control (untreated) plots make interpretation of this data very tenuous. Although the results of this experiment are shown, no conclusive interpretation should be attempted because of the level of within-treatment variation and high "seeded" grub mortality. Further work with predatory nematodes will be attempted in 1990.

Table 1. Mean white grubs (no. and %) and coefficients of variation in treated subplots at Rocky Ford Turfgrass Research Plots, Manhattan, KS. August 30 through September 7, 1989.

		Mean Grubs		Coeff. of Variation %	
Treatment	Grub class[1]	(A) No./Treat. Subplot	(B) % (No. Treat./ No. Cont. x 100)	(A)	(B)
Control	Total	8.7	65.6	106	258
	SMC	0.7	21.6	123	546
	JB	2.0	100	145	226
Triumph 4E 2212 g ai/ha	Total	4.3	39.4		
	SMC	1.3	*[2]		
	JB	0.3	*		
Triumph 1G 2212 g ai/ha	Total	7.3	47.5		
	SMC	3.0	21.8		
	JB	0.7	*		
Oftanol 1.5G 2212 g ai/ha	Total	0.3	4.2		
	SMC	1.7	*		
	JB	2.3	*		
Mocap 5G 5605 g ai/ha	Total	3.3	14.4		
	SMC	1.0	4.8		
	JB	0.3	33.3		
Sevin SL 8968 g ai/ha	Total	5.7	37.9		
	SMC	2.3	31.9		
	JB	1.3	*		
Sevinol 4L 8968 g ai/ha	Total	4.0	99.6		
	SMC	0.7	7.3		
	JB	0.7	*		
Nematodes 25 mil/1000	Total	9.0	100		
	SMC	3.3	*		
	JB	2.0	72.2		

[1]SMC - Southern masked chafer; JB - June bug; SMC + JB + indistinguishable grubs (head capsule found without body)

[2]* - Control numbers greater than treatment numbers; % data not computed.

Table 2. Number of live southern masked chafer grubs sampled from PVC cylinders.

Treatment	Rate g ai/ha	No. alive grubs Rep 1	Rep 2	Rep 3	Mean per
Control	--	2	0	0	.66
Triumph 4EC	2212	0	0	0	0
Triumph 4EC	1106	1	0	0	.33
Triumph 1G	1106	4	0	0	1.33
Triumph 1G	2212	2	0	4	2
Oftanol 1.5G	2212	5	1	0	2
Mocap 5G	5605	1	1	4	2
Sevin SL	8968	2	1	1	1.33
Sevimol 4L	8968	0	0	0	0
Nematodes	25 mil per 1000 sq ft	1	2	2	1.66

TITLE: Growth of Hydroponically Grown Kentucky Bluegrass as Affected by Various Levels of Potassium

OBJECTIVE: To investigate whether growth of Kentucky bluegrass was affected by potassium rates

PERSONNEL: Michael A. Sandburg, MS Student
Jeff Nus, Turfgrass Research and Teaching

FUNDING: Kansas Turfgrass Foundation

INTRODUCTION:

Municipalities across the United States are asking for reduced water consumption. The turfgrass industry thus needs to find ways to reduce water use for turf. Potassium may aid in reducing water use. The amount of potassium absorbed is related to the plant's ability to retain moisture. This study looked at growth as affected by potassium level alone or combined with various stress levels.

METHODS:

Single plants of Kentucky bluegrass (Poa pratensis cv. Ram I) were grown in a growth chamber in hydroponic solutions. The solutions included a control and various potassium levels (12.5 mg, 25 mg, 50 mg, 100 mg, and 200 mg potassium/liter). All environmental conditions were controlled.

Non-stressed Growth

Plants were grown for 4 weeks in the six solutions. During each week, plants were selected and dissected into leaf, tiller, rhizome, root, and crown sections. Each section was dried (60^{o}C, 48 hrs) and weighed; weights were recorded for each potassium level used. Root:shoot ratios were calculated (shoots included leaf, tiller, rhizome, and crown).

Drought-stressed Growth

Plants were grown for 4 weeks in the six solutions with four levels of simulated drought stress (-0.06, -0.2, -0.4, -0.6 MPa). At the end of the fourth week, the plants were dissected into tops (leaf, tiller, and rhizome), roots and crowns. These three sections were dried (60^{o}C, 48 hrs) and weighed; weights were recorded for each potassium by stress level used. Root:shoot ratios were calculated (shoots included tops and crown).

RESULTS:

This study was completed in the spring of 1990, and the following data contain all statistical values.

Non-stressed Growth

Leaf growth of Kentucky bluegrass was affected by potassium level (Fig. 1). The greatest growth occurred at the 100 mg K level. At the 200 mg K level, growth was similar to that at the 50 mg K level, thus indicating that potassium may have been inhibiting further growth.

Similar trends were observed for root growth (Fig. 2). More root growth was associated with the 100 mg K level than 200 and 50 mg K levels, implying that potassium may also inhibit root growth.

Tiller and rhizome growth were affected only by a deficiency of potassium and not by any of the other levels (Figs. 3 and 4).

Crown production was different only in the last week of the study (Fig. 5).

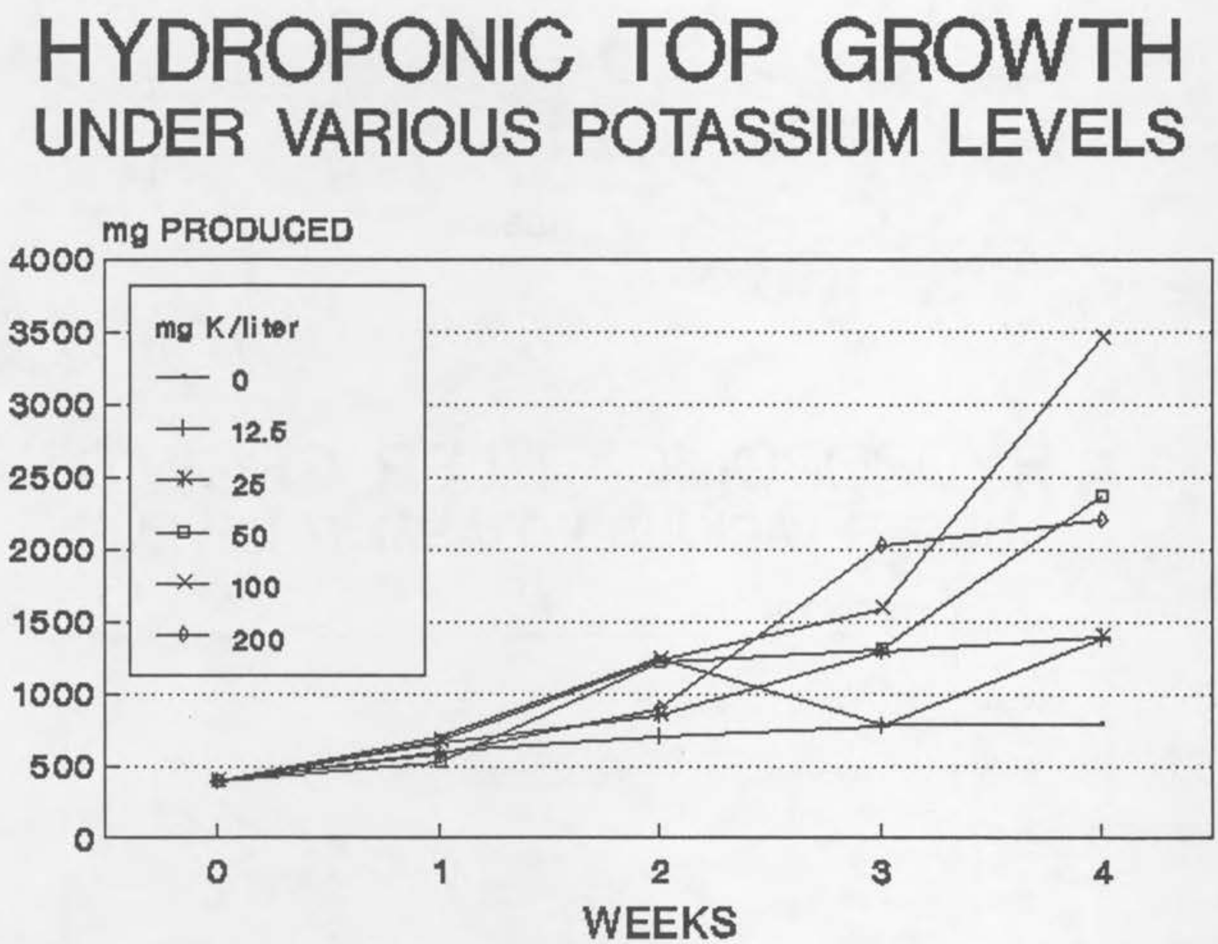
Root:shoot ratios were different throughout the study (Fig. 6). The major difference occurred at the fourth week, showing that the root:shoot ratio is affected only by potassium deficiency and not by added potassium.

Drought-stressed Growth

The interaction of potassium and stress in top growth showed significant differences (Fig. 7). Top growth was reduced as drought stress increased for each potassium level. Growth was consistent for the -0.6 and -0.4 MPa at each potassium level. The growth at lower stress levels (-0.06 and -0.2) increased at the higher potassium levels compared to the control.

No significant interaction occurred between potassium and drought stress for root production. A significant difference occurred when root production was averaged across all stress levels (Fig. 8). Root production was affected by potassium available, but there was no difference at the 50, 100, or 200 mg K levels. When root production was averaged across all potassium levels, there was a significant difference (Fig. 9). As stress started to increase, the root production also increased. When stress continued to increase, root production decreased. Therefore, a little drought stress will increase root production.

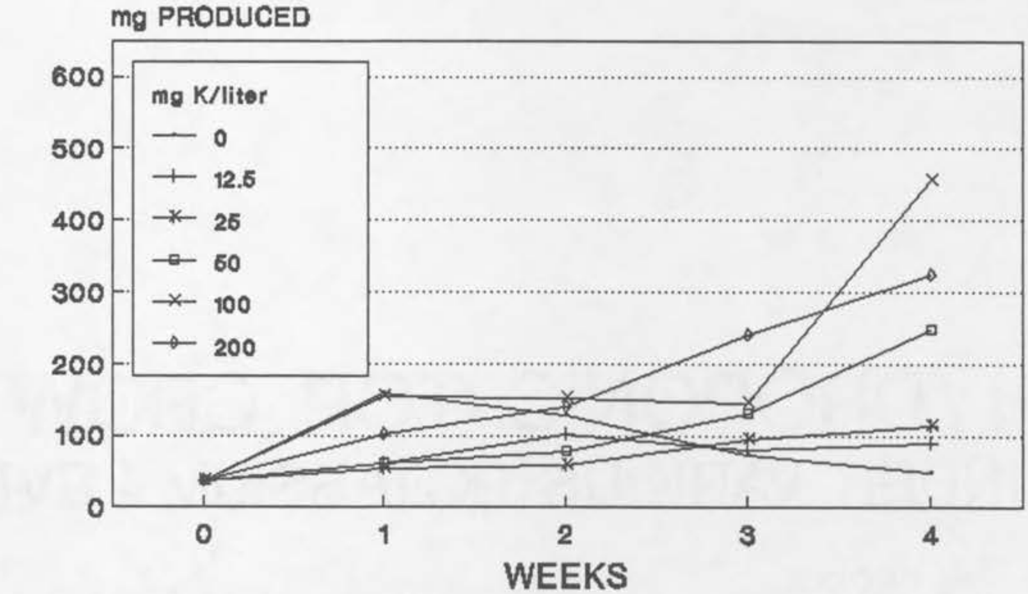
The root:shoot ratio was not different for the interaction of potassium and drought stress and was not significantly different averaged across stress levels. The only significant difference occurred when the radio was averaged across potassium levels (Fig. 9). This shows that as drought stress increased, the root:shoot ratio also increased.



alpha = 0.05 LSD WK #2, 323.6;
WK #3, 560.9; WK #4, 833.5

FIG. 1

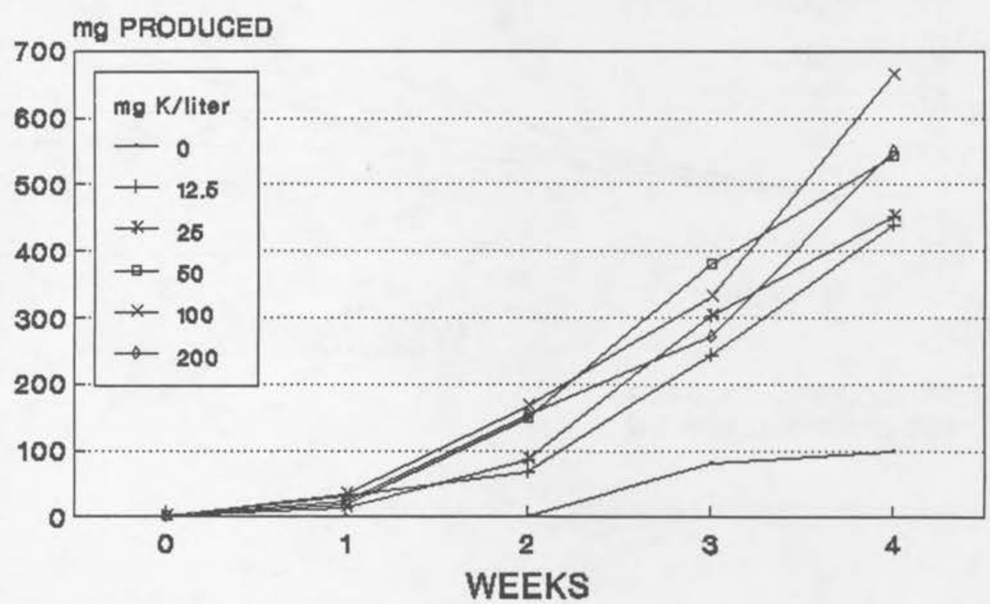
HYDROPONIC ROOT GROWTH
UNDER VARIOUS POTASSIUM LEVELS



alpha = 0.05 LSD WK #2, 48.78;
WK #3, 65.3; WK #4, 106.4

FIG. 2

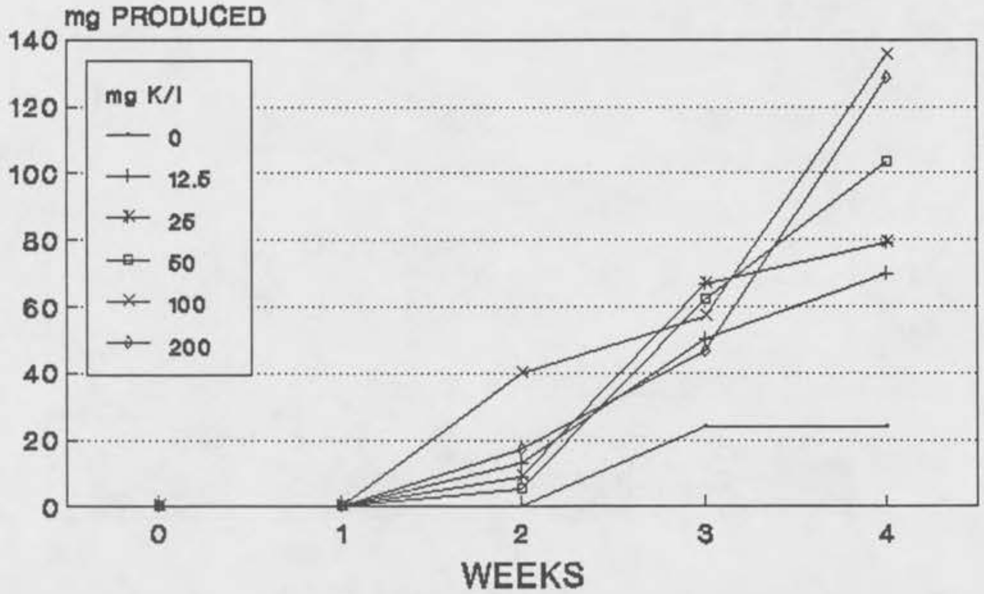
HYDROPONIC TILLER GROWTH
UNDER VARIOUS POTASSIUM LEVELS



alpha = 0.05 LSD Wk #1, 17.34;
WK #2, 49.6; WK #3, 127.8; WK #4, 249.1

FIG. 3

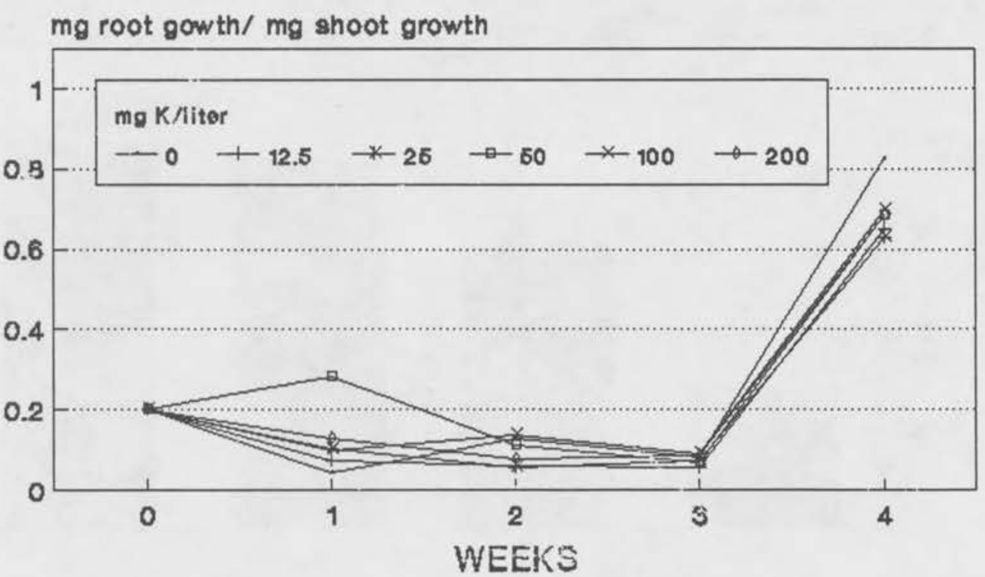
HYDROPONIC RHIZ. GROWTH
UNDER VARIOUS POTASSIUM LEVELS



alpha = 0.05
LSD WK #2, 18.2; WK #4, 68.1

FIG. 4

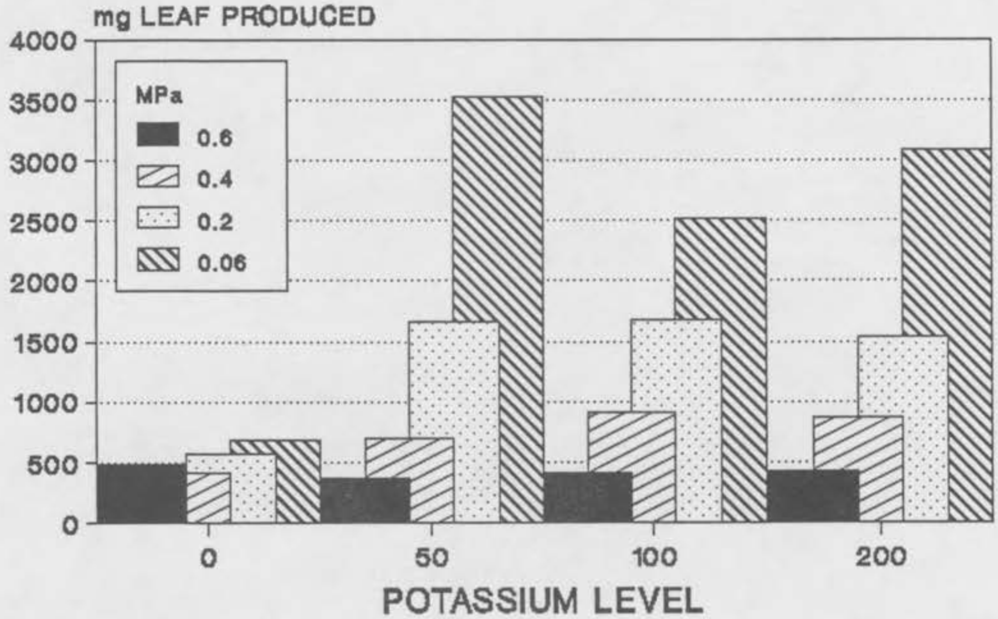
HYDROPONIC ROOT:SHOOT
UNDER VARIOUS POTASSIUM LEVELS



alpha = 0.05 LSD WK #1, 0.126;
WK #2, 0.046; WK #3, 0.023; WK #4, 0.086
top growth = leaf+tiller+rhizome+residal

FIG. 5

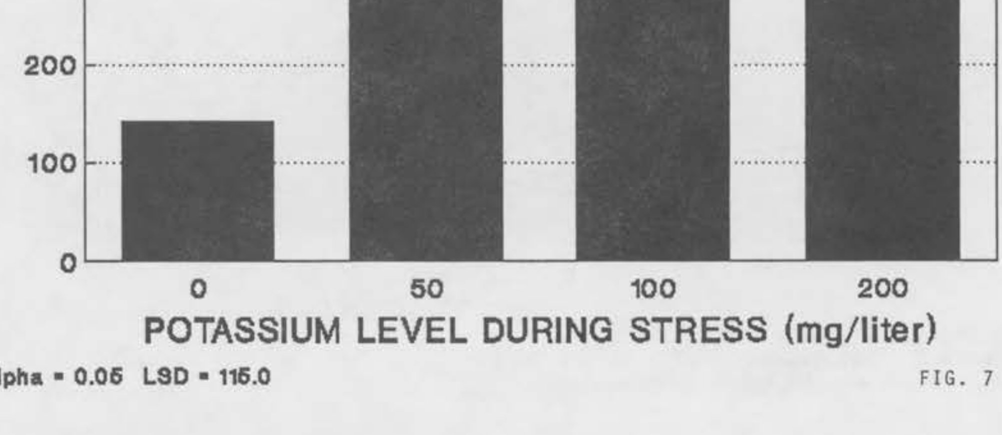
INTERACTION OF POTASSIUM
AND STRESS IN LEAF PRODUCTION



alpha = 0.05 LSD = 541.2

FIG. 6

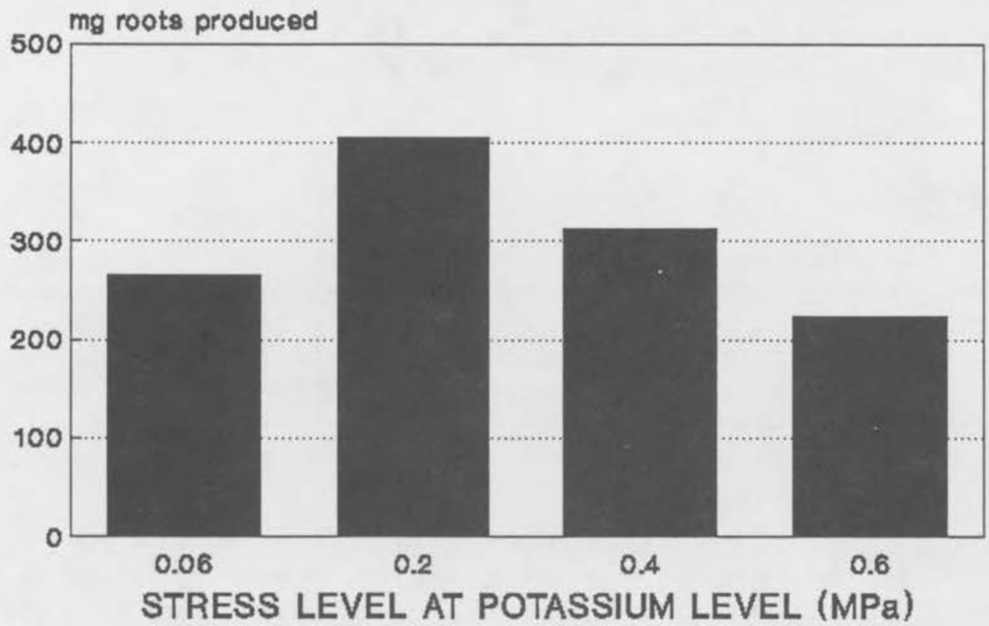
POTASSIUM EFFECT OVER ALL
STRESS LEVELS IN ROOT PRODUCTION



alpha = 0.05 LSD = 115.0

FIG. 7

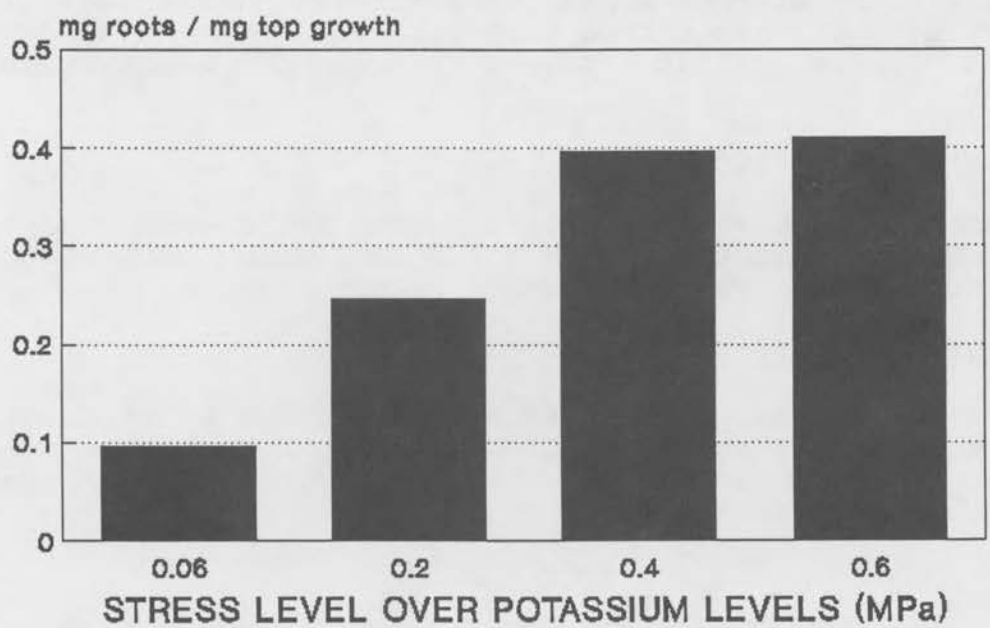
STRESS EFFECT OVER ALL K LEVELS IN ROOT PRODUCTION



alpha = 0.05 LSD = 115.0

FIG. 8

STRESS EFFECT OVER ALL K LEVELS FOR ROOT:SHOOT RATIO



alpha = 0.05 LSD = 0.09785

FIG. 9

TITLE: Growth and Performance of Field Grown Kentucky Bluegrass as Affected by Various Levels of Potassium

OBJECTIVE: To investigate whether growth and performance of Kentucky bluegrass was affected by potassium rates

PERSONNEL: Michael A. Sandburg, M.S. Student
Jeff Nus, Turfgrass Research and Teaching

FUNDING: Kansas Turfgrass Foundation

INTRODUCTION:

With the drought conditions during the past few years and the USGA's goal for reduced water use, all ways of reducing water need to be explored. One of these ways involves the effects of potassium fertility on turfgrass. A plant's ability to retina moisture in stressed conditions is influenced partly by the amount of potassium available for it to absorb.

METHODS:

Twelve plots 15' by 15' were established at Kansas State University, Rocky Ford Turfgrass Research Plots with Kentucky bluegrass (Poa pratensis cv. Ram I). Each plot had an independent irrigation system that delivered 1.33" of water per hour. The plots were divided into four treatments (0 kg, 98 kg, 195 kg, and 293 kg potassium/ha/yr or 0 lb, 2 lbs, 4 lbs, and 6 lbs potassium/1000 sq ft/yr). These treatments included four applications per year (March, June, Sept., and Nov.).

Top Growth Production

The plots were mowed as needed at 3" with a frequency sufficient to never remove more than a third of the leaf blade at any one time. Clippings from each plot were oven dried ($60^{o}C$, 48 hrs), and clipping yields (g) were recorded for each potassium treatment.

Root Growth Production

Roots were sampled five times during the 2-year study. Samples were removed to a depth of 15 cm, washed, dried (60^{o}, 48 hrs.), and recorded for each potassium treatment.

Qualitative Parameters

Quality ratings of the "Ram I" Kentucky bluegrass plots were taken monthly. The ratings included color, density and overall quality on a scale from 1-9 (9 = excellent). Means for each monthly quality parameter were recorded.

RESULTS:

This study was completed in the fall of 1989 and the following data contain all statistical values.

<u>Top Growth Production</u>

Potassium had only minimal effect on top growth as shown by Figures 1 and 2. Potassium at the higher rates (195 and 293 kg K) gave more top growth on some dates but not on others.

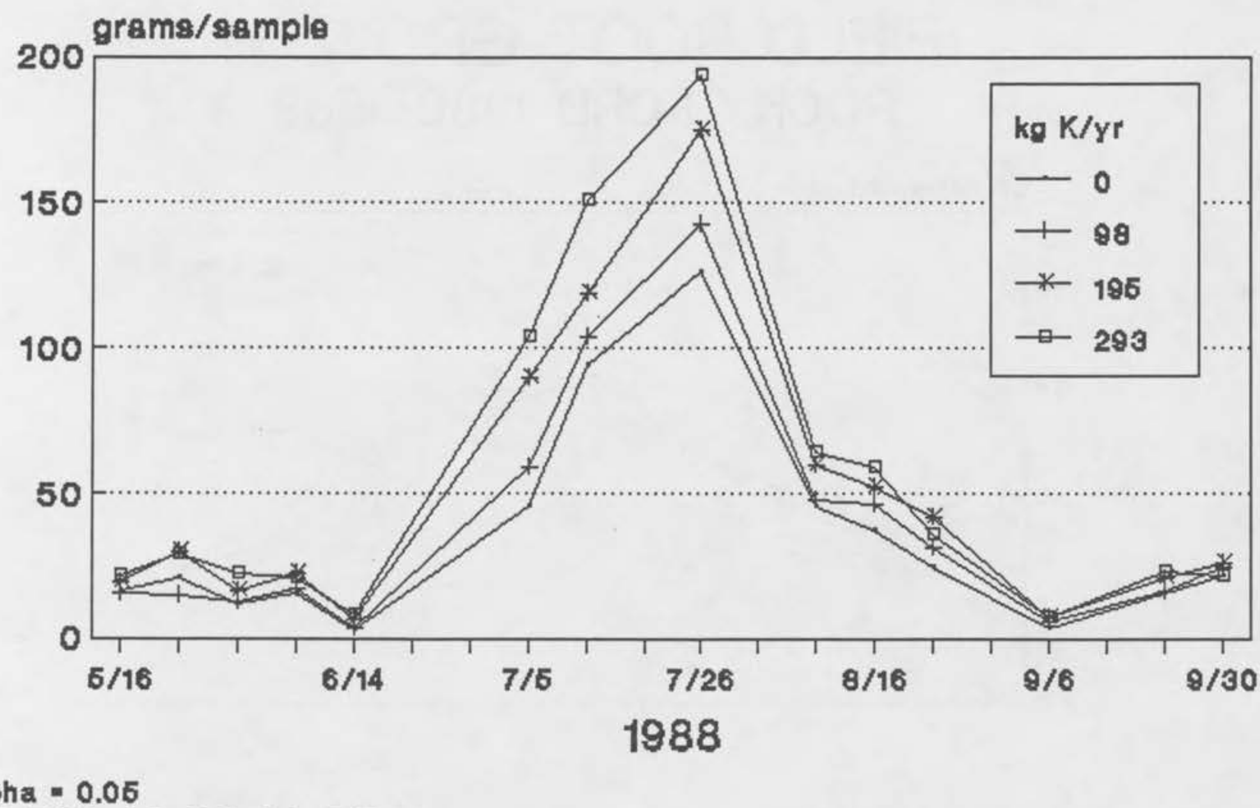
<u>Root Growth Production</u>

Potassium affected root growth on only one date (9/88 from Fig. 3). This indicates no effect of potassium on rooting.

<u>Qualitative Parameters</u>

As shown by Figures 4-9, there was no effect on color, density, and overall quality for any of the potassium treatments.

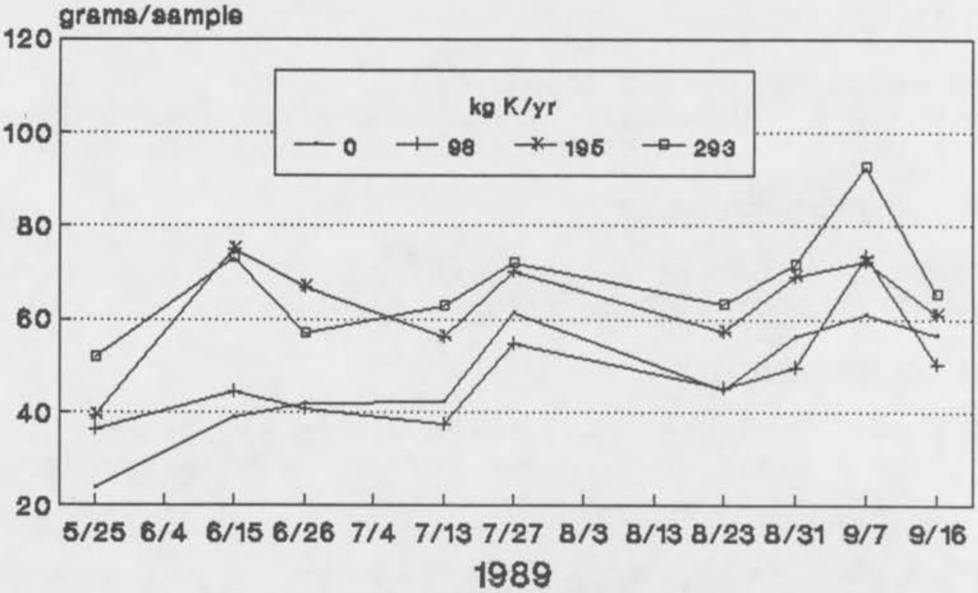
TOP GROWTH PRODUCTION
1988 FIELD STUDY



alpha = 0.05
LSD 5/24,10.6; 5/31,5.8; 7/5,33.3

FIG. 1

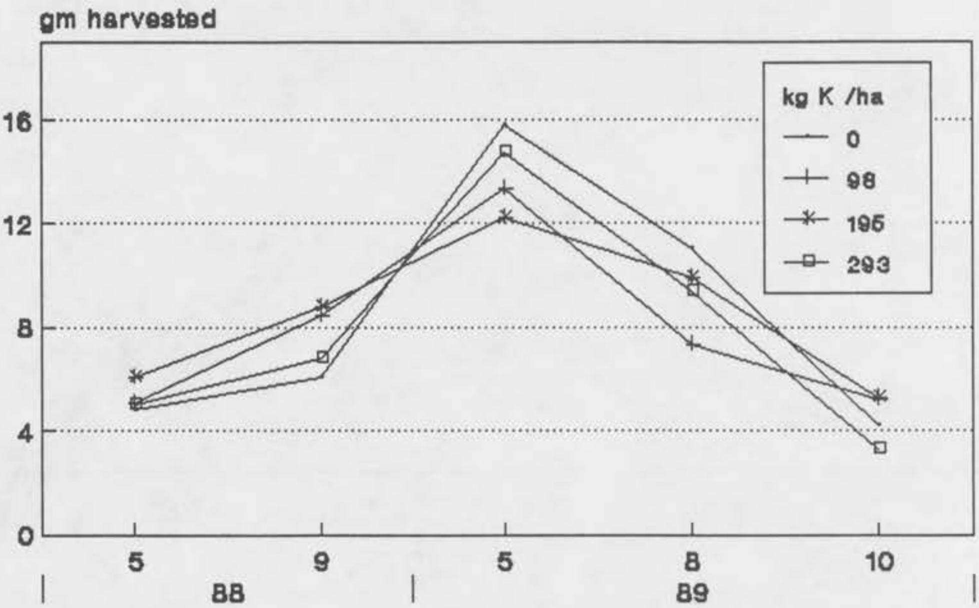
TOP GROWTH PRODUCTION
1989 FIELD STUDY



alpha = 0.05
LSD 6/15,21.8; 6/26,13.6; 7/13,15.3;

FIG. 2

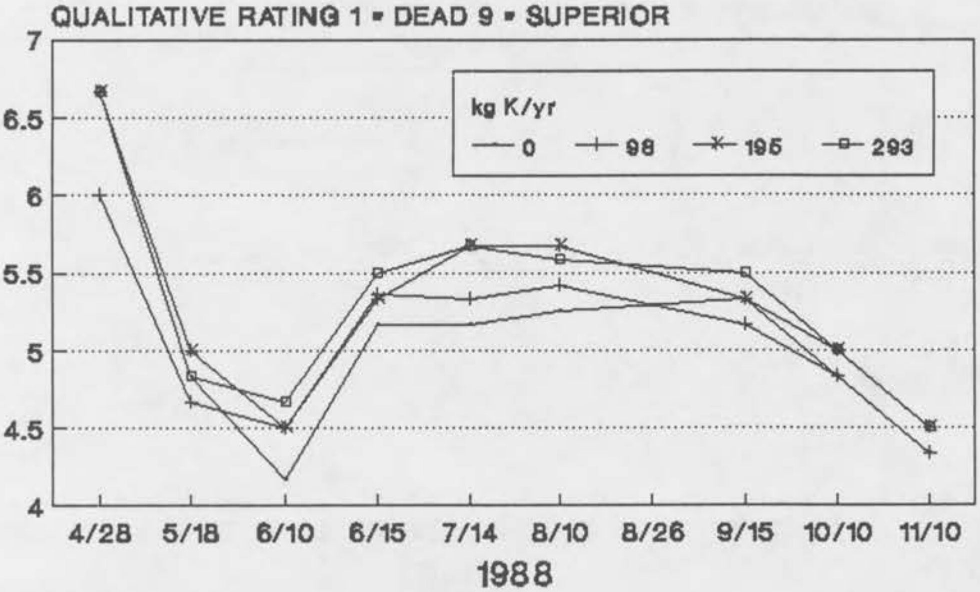
FIELD ROOT GROWTH
ROCKY FORD 1988-1989



alpha = 0.05 LSD 9/88 = 1.652

FIG. 3

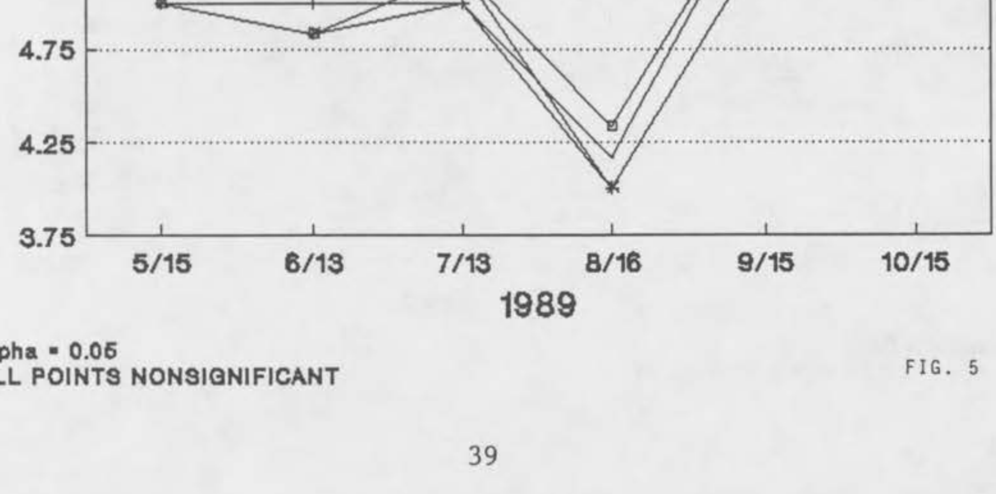
FIELD QUALITY
1988 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 4

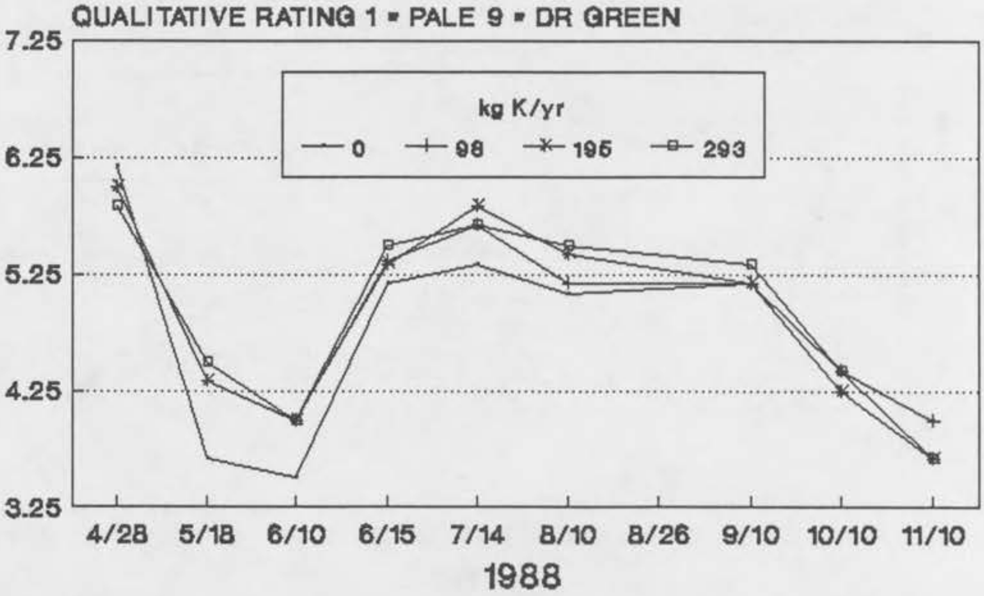
FIELD QUALITY
1989 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 5

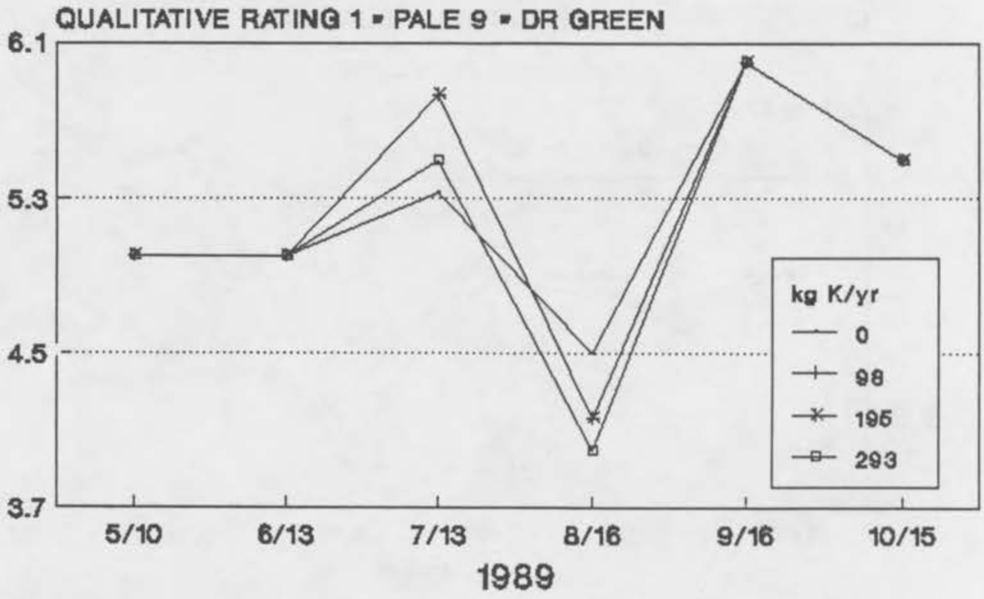
FIELD COLOR
1988 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 6

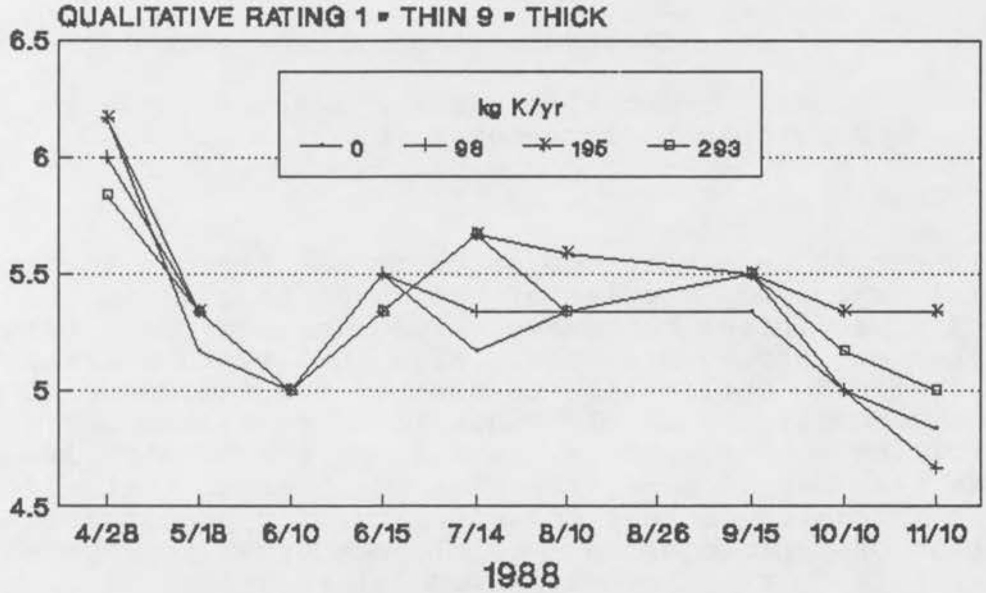
FIELD COLOR
1989 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 7

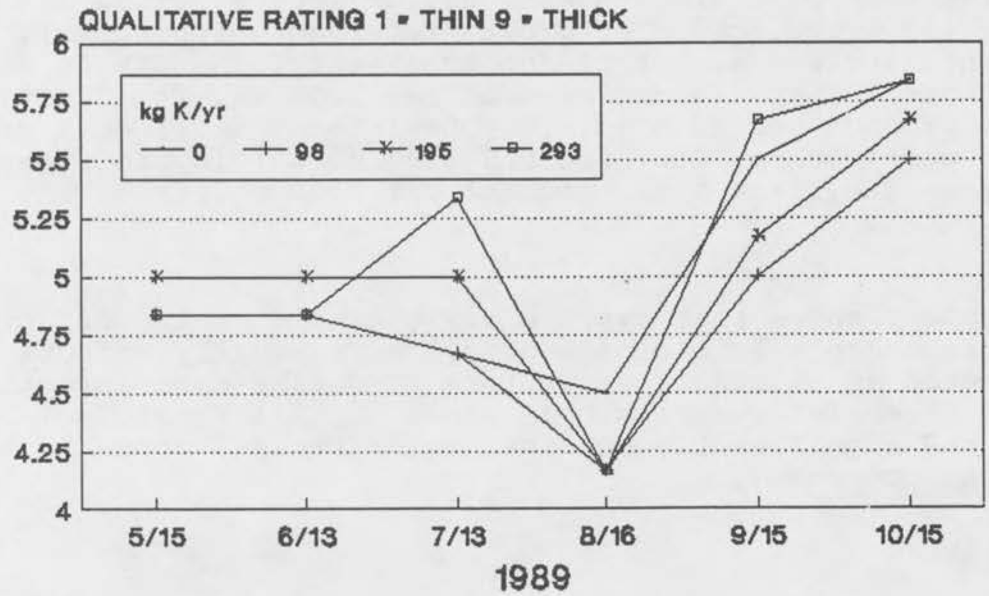
FIELD DENSITY
1988 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 8

FIELD DENSITY
1989 ROCKY FORD



alpha = 0.05
ALL POINTS NONSIGNIFICANT

FIG. 9

TITLE: Sandoz Fungicide Trial

OBJECTIVE: To evaluate new experimental fungicides for effective control of dollar spot in perennial ryegrass

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching

SPONSOR: Sandoz Corporation, John Fenderson, Research and Development Representative

INTRODUCTION:

Dollar spot is a very common turfgrass disease in Kansas. The causal organisms, species of the fungi Lanzia and Moellerodiscus, infect bentgrass, bluegrass, fescues, ryegrasses, bermudagrasses, and zoysiagrass. High quality turf areas may require fungicide application to control the incidence of dollar spot. Commercially available fungicides are reasonably effective in controlling dollar spot, but the fungi are constantly evolving new races that may be more resistant to chemical control. This study was initiated to test the efficacy of cyproconazole and a combination of cyproconazole + tolclofos-methyl for controlling dollar spot in fairway height, perennial ryegrass.

MATERIALS AND METHODS:

The study was a randomized complete block design with 5 treatments that were replicated 8 times each. Spray volume was 100 gallons per acre and applied with CO_2 backpack plot sprayer of 1 x 2 meter plots. 'Gator' perennial ryegrass (2 years old) was used, and no nitrogen fertilizer was applied during the 1989 growing season to promote symptom development. Treatments were applied at 21-day intervals beginning on June 17. Data collected including % of plot area showing dollar spot symptoms and color ratings (as a reflection of growth retardant properties). Treatments include a control (no treatment), SAN 619 40 WG (cyproconazole) at 1/8 oz. product per 1000 sq. ft, SAN 619 at 1/6 oz. product per 1000 sq. ft., Bayleton (25 DF) at 1 oz. product per 1000 sq. ft., and SAN 839 (50 WP) (cyproconazole + tolclofos-methyl) at 3 oz. product per 1000 sq. ft.

RESULTS:

Table 1 shows that cyproconazole at 1/6 or 1/8 oz. product and cyproconazole + tolclofos-methyl were equally effective as triadimeton at eliminating symptoms of dollar spot infection from 'Gator' perennial ryegrass. In addition, all fungicidal treatments significantly enhanced color ratings compared to untreated controls.

Table 1. Area (% of plot) showing dollar spot activity and color ratings (1-9) of 'Gator' perennial ryegrass as affected by various fungicidal treatments

Treatment	Rate oz/mft^2	Disease severity (% of plot affected) 6-17	7-9	7-18	7-25	8-3	8-25	Color rating (1-9; 7-22)
SAN 619 (cyproconazole)	1/8	8.1	2.5	3.8	0.6	2.5	0.6	7.3
SAN 619 (cyproconazole)	1/6	11.3	1.9	1.9	0	0	0	7.5
SAN 832 (cyproconazole + tolclofos-methyl	3	6.3	3.8	1.3	1.9	0.6	1.9	6.9
Bayleton (triademefon)	1	8.8	2.5	1.3	0	1.3	0	7.2
Control	-	14.4	31.9	32.5	41.9	56.3	78.8	6.1
LSD (0.05)		5.4	11.1	9.5	9.5	6.8	6.9	0.5

TITLE: NTEP Perennial Ryegrass Cultivar Trial

OBJECTIVE: To evaluate several perennial ryegrass genotypes for their adaptability and performance under east central Kansas conditions.

PERSONNEL: John Pair, Turfgrass Research
Roch Gaussoin, Turfgrass Research and Teaching
Jeff Nus, Turfgrass Research and Teaching

INTRODUCTION:

Perennial ryegrasses are used widely in most areas of the United States because they germinate very quickly, cover rapidly, and possess good wear tolerance and a rich deep color. Efforts to improve perennial ryegrasses include selecting for better mowing quality, disease resistance, and environmental stress tolerance. It is important to supply the Kansas turfgrass manager with performance evaluations of commercial and experimental ryegrass genotypes, so he can make the best choice of ryegrasses for Kansas conditions.

MATERIALS AND METHODS:

<u>Manhattan</u>
Sixty-five commercial and experimental ryegrass genotypes were received from the National Turfgrass Evaluation Program and planted in Section II of the Rocky Ford Turfgrass Research Plots on March 16, 1987. Seeding rate was 6 lbs. per 1000 sq. ft., and a balanced (20-20-20) fertilizer was applied immediately after seeding at the rate of 1 lb. N/1000 sq. ft. Monthly quality ratings (1-9, 9 = superb quality) are being recorded for each genotype, which is replicated three times in a randomized complete block experimental design. Plot size is 1 by 2 m. Plots are mowed at 3 inches and fertilized with 4 lb. N, 1 lb. of P205, and 1 lb. of K20 per year.

<u>Wichita</u>
A trials of 65 cultivars and experimental numbers was established on September 12, 1986. Maintenance includes 4 lbs. N/1000 sq. ft. per year and a mowing height of 2 1/2 in. with clippings removed. Balan/Treflan combination (Team) was applied in April and June for crabgrass prevention.

RESULTS:

Performance of the NTEP perennial ryegrass cultivar trials at Manhattan and Wichita are shown in Tables 1 and 2, respectively. Best performing ryegrasses in Manhattan rated 6.9 to 6.8, and those in Wichita rated 7.6 - 6.9. See tables for cultivar names.

Table 1. Mean turfgrass quality ratings of perennial ryegrass cultivars in the 1986 national perennial ryegrass test at Manhattan, KS - 1989 data

Turfgrass quality ratings: 1-9; 9 = best

Name	APR	JUN	JUL	AUG	SEP	OCT	MEAN
Delray	7.3	7.3	7.7	6.0	7.0	6.0	6.9
Pick 233 (Dasher II)	5.7	6.7	7.7	7.3	7.3	7.0	6.9
PSU-333	6.3	7.3	6.3	7.0	7.3	7.0	6.9
Rival	7.0	7.7	6.3	6.3	7.0	7.0	6.9
SR 4100	6.7	7.3	7.7	6.7	6.7	6.7	6.9
Bar LP 410	6.7	7.3	7.0	6.7	6.7	6.3	6.8
Caliente	5.7	8.0	7.0	6.3	7.0	6.7	6.8
ISI-K2 (Dillon)	5.7	7.3	6.7	7.0	7.0	7.0	6.8
Pick 600 (Fiesta II)	5.0	7.7	7.7	6.7	7.3	6.7	6.8
Pick 715	6.0	8.0	7.0	6.7	7.0	6.3	6.8
PSI-259 (Commander)	7.0	7.0	6.0	7.0	7.0	6.7	6.8
PST-M2E	6.0	7.7	6.0	7.3	7.0	7.0	6.8
SR 4031	6.7	7.7	6.3	6.7	7.0	6.3	6.8
Tara	5.0	7.7	7.0	6.3	7.7	7.0	6.0
246	5.7	7.7	6.7	6.7	7.0	6.7	6.7
Bar LP 454	6.7	7.7	5.0	6.7	7.0	7.0	6.7
Del 946	6.3	7.7	6.7	6.3	7.0	6.3	6.7
KWS-AL-2 (Aquarius)	6.7	7.7	7.0	6.3	6.3	6.0	6.7
Pick 300 (Blazer II)	5.7	7.3	4.7	7.3	7.7	7.3	6.7
PSU 222	6.0	7.0	5.7	7.0	7.3	7.3	6.7
SR 4000	5.3	7.0	7.0	6.3	7.3	7.0	6.7
Vintage-2DF	7.0	7.7	6.0	6.7	6.7	6.0	6.7
Allaire	5.0	7.0	6.7	6.7	7.0	7.0	6.6
Brenda	6.3	8.0	7.0	6.7	6.0	5.3	6.6
Citation II	6.0	7.3	6.3	6.7	6.7	6.3	6.6
Cowboy	5.3	8.0	7.0	6.3	6.7	6.3	6.6
Goalie	6.3	7.0	6.7	6.3	7.0	6.3	6.6
ISI-851 (Lindsay)	5.3	7.0	7.0	6.7	6.7	6.7	6.6
Ovation	6.7	7.0	5.7	6.7	6.7	6.7	6.6
Pavo	6.3	6.7	6.7	6.7	6.7	6.3	6.6
Pennant	5.7	8.0	7.0	6.0	6.7	6.3	6.6
PST-2H7	6.3	7.7	7.0	6.3	6.3	6.0	6.6
PST-2PM (Saturn)	6.3	7.3	6.3	6.7	6.7	6.0	6.6
Yorktown II	4.3	7.3	6.7	7.0	7.3	7.0	6.6
Barry	6.3	7.0	6.7	6.3	6.3	6.3	6.5
Diplomat	6.3	7.3	5.0	6.3	7.0	7.0	6.5
Omega II	5.3	6.7	6.7	6.3	7.0	7.0	6.5
Prelude	5.7	7.3	5.3	7.0	7.0	6.7	6.5
PST-250 (Competitor)	7.0	7.7	6.3	5.7	6.3	6.0	6.5
Regal	6.7	7.7	7.3	6.0	5.7	5.7	6.5
Rodeo	6.0	7.7	6.3	6.0	6.7	6.3	6.5
Birdie II	6.7	6.3	5.7	6.7	6.7	6.7	6.4
Pennfine	7.3	7.3	6.7	5.7	6.0	5.7	6.4
PST-2HH (Charger)	3.7	7.0	7.3	6.7	7.0	6.7	6.4
Ranger	5.7	7.7	7.0	6.0	6.0	6.0	6.4
Ronja	5.7	7.7	5.7	6.7	7.0	6.0	6.4

(cont.)

Name	APR	JUN	JUL	AUG	SEP	OCT	MEAN
Acrobat	6.3	6.0	6.7	6.7	6.3	5.7	6.3
Belle	6.3	6.7	6.3	6.7	6.0	6.0	6.3
Derby	6.7	7.3	7.3	5.0	5.7	5.7	6.3
Gator	6.0	7.0	6.0	6.3	6.3	6.3	6.3
MOM LP 763	5.7	7.3	5.3	6.3	6.7	6.3	6.3
Palmer	5.7	6.3	6.0	6.7	7.0	6.3	6.3
Pick 647 (Riviera)	4.7	7.7	6.3	6.3	6.7	6.3	6.3
Repell	6.3	7.0	5.7	6.3	6.3	6.3	6.3
Runaway	4.7	7.7	6.7	6.3	6.3	6.0	6.3
Manhattan II	5.7	8.0	5.3	6.0	6.3	6.0	6.2
Regency	6.3	7.0	5.3	6.0	6.3	6.0	6.2
J207	4.7	7.3	6.0	6.0	6.3	6.0	6.1
NK 80389	5.0	7.0	6.3	6.0	6.0	6.3	6.1
Patriot	5.3	7.3	6.0	5.3	6.3	6.3	6.1
PST-2DD	5.3	7.0	5.3	6.0	6.0	6.0	5.9
Sheriff	6.0	7.0	5.3	6.0	6.0	5.3	5.9
J208	5.3	8.0	4.7	5.7	5.7	5.3	5.8
Linn	4.7	7.7	3.3	6.0	6.3	6.0	5.7
Manhattan	5.3	7.0	4.7	5.7	5.0	5.3	5.5

Table 2. Performance of Ryegrass Cultivars, Wichita, KS[1]

Quality rating by date (0-9 w/9 = best)

Cultivar	7-18-89	8-22-89	10-12-89	Season Avg.
Regal	7.2 DG	7.3	8.2	7.6
PST-2PM	7.3 DG	6.8	8.2 DG	7.4
Pick 233	7.2	6.7	7.5	7.1
PST 259	6.7	7.0	7.7 DG	7.1
PST M2E	7.5	6.0	7.7	7.1
Sunrye (246)	6.8	6.5	8.0	7.1
Patriot	7.2	6.5	7.3	7.0
PST-2H7	6.7 $	6.5	7.8 DG	7.0
Belle	6.2 $	6.7	8.2 DG	7.0
Delray	6.7	6.3	7.7	6.9
Pick 647	6.7	6.3	7.7	6.9
Citation II	6.3	6.8	7.7	6.9
Manhattan II	6.5	6.5	7.7	6.9
Allaire	6.5	6.0	8.2 DG	6.9
PST-2HH	7.0	6.0	7.8	6.9
Pennant	6.8	5.8	7.7	6.8
Goalie	6.3 $	6.7	7.7	6.8
Prelude	6.7	6.7	7.0	6.8
PSU-333	6.5 $	6.8	7.2	6.8
PST-250	6.5 $	6.3	7.5	6.8
Ronja (WW E 31)	4.8	4.2	6.3 W	6.8

(cont.)

Table 2. (cont.)

Cultivar	7-18-89	8-22-89	10-12-89	Season Avg.
Omega II	6.7	5.7	8.0	6.8
Caliente	6.5	6.0	7.3	6.8
Barry	6.7	5.8 W	7.3	6.6
SR 4100	6.7	5.8	7.2	6.6
Brenda	6.0	6.2	7.0	6.5
Birdie II	6.5 $	5.7	7.2	6.5
Pick 715	6.5	5.5	7.5	6.5
Repell	6.3	6.0	7.3 W	6.5
SR 4000	6.2 $	5.3	8.0	6.5
Pennfine	6.3	5.7	7.3	6.4
Regency	6.2 $	5.7	7.2	6.4
DEL 946	5.7 $	5.7	7.8 W	6.4
ISI-851	6.3 $	5.3	7.2	6.3
PSU-222	5.5 $	6.0	7.3	6.3
Vintage-2DF	6.3	6.2	6.5	6.3
KWS-Al-2	6.0 $	4.8	8.0	6.2
Cowboy	6.5	4.5	7.5	6.2
Pick 600	5.7 $	5.0	7.8	6.2
Derby	6.0 $	5.0	7.3	6.2
SR 4031	6.3	5.0	7.3	6.2
Palmer	5.8 $	4.7	7.7	6.1
Runaway (HE 145)	4.3 $	5.0	7.7	6.0
Pavo (WW E 14)	6.0	5.7	7.3	6.0
BAR Lp 410	5.5 $	5.2	7.3	6.0
NK 80389	5.2 $	5.3	7.2 W	5.9
PST-2DD	5.7 $	4.5	7.2 DG	5.8
Acrobat (HE 177)	4.8 $	5.2	7.5	5.8
Yorktown II	5.0 $	5.3	6.8	5.7
Rodeo	6.0	4.7	6.5 W	5.7
Mom Lp 763	5.0 $	4.7	7.3	5.7
BAR Lp 454	5.0 $	4.8	7.2	5.7
J207	5.3 $	5.0	6.8 W	5.7
Rival (HE 178)	5.0 $	4.8	7.3	5.6
Ranger	5.3	4.2	7.3	5.6
Pick 300	5.3	4.3	7.2	5.6
Tara	5.3	4.3	7.3	5.6
Gator	5.0 $	5.0	6.8	5.6
Diplomat	5.3	4.2	7.7	5.6
Ovation	5.0 $	4.5	7.0	5.5
ISI-K2	5.3 $	4.3	6.8	5.5
J208	4.7 $	4.8	6.8 LG	5.4
Sheriff	5.5 $	4.0	6.8 W	5.4
Manhattan	4.7 $	4.5	6.8 W	5.3
Linn	3.5	3.7 W	5.0 L, GW	4.1

[1]Planted September 9, 1986. Maintained at 4 lbs. N/1000 sq. ft. per year. Mowing height was 2 1/2 inches with clippings removed. Symbols: DG = Dark Green, LG = Light Green, $ = Dollar Spot, W = Weeds.

TITLE: Effect of Cultivation Technique and Polyacrylamide Gels on Quality and Safety Factors of Sports Turf

OBJECTIVES:

1) To determine whether the addition of cross-linked polyacrylamide gels to sports turf root zones may affect moisture retention, expansion properties, oxygen availability, and supplemental irrigation requirements of the turf.

2) To determine if power grooving alone or in combination with the use of polyacrylamide gels may reduce field hardness and enhance turf quality compared to conventional hollow tine aerification.

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Mike Boaz, Turfgrass Masters Degree Candidate

FUNDING: Olathe Manufacturing, Inc.

OTHER SPONSORS: Western Polyacrylamide, Inc.
Pickseed West

INTRODUCTION:

Quality and safety characteristics are prime concerns of managers of sports turf. Quality sports turfs are difficult to maintain because of the high degree of wear damage and soil compaction that occurs with moderate to heavy use. The cushioning effect of a quality turf, field hardness, and compaction and their relationships with soil water and irrigation management are of great concern to the field manager. Often the manager is under rigid, incompatible schedules for field use and turf management.

Cross-linked polyacrylmide has been used as a soil conditioner in containerized plant production to greatly increase the amount of plant-available water. Methods for lengthening irrigation cycles while maintaining quality would be beneficial to sports turf management.

Recent research indicates that traditional coring techniques of aerification tend to create a deeper compaction zone just below the level of penetration. A machine that does not depend upon a downward motion may eliminate this problem.

METHODS:

<u>Frank Anneberg Sports Field</u>

This project incorporates "real life" testing on a soccer field at the Frank Anneberg Sports Complex, which is managed by the Manhattan Parks and Recreation Commission. The experiment was initiated in the summer of 1989, and utilizes a completely randomized design with 4 replications and 4 treatments.

Treatments include a control (no aerification treatment), hollow tine coring, grooving alone, and grooving in combination with the use of cross-linked polyacrylamide (170 lbs/acre). The focus is application of polymers as a softener in sports fields, which may eventually lead to a reduction in field-related sports injuries. Parameters being monitored include monthy turf quality, bulk density of the upper 10 cm of soil, penetrometer resistance to a 20 cm depth, and rooting at two depths (0-4", 4-8"). The 1990 and 1991 data will include impact absorption as well. Other than the aerification and polymer treatments, the maintenance of the field is the same as all of the fields used by the City of Manhattan Parks and Recreation Department -- 3 lbs nitrogen/1000 sq ft applied in split fall applications and mowing and watering as determined by the park manager.

The plots are 30' x 30' arranged in a randomized complete block design in the center of the soccer field. This was a new field, and no prior aerification treatments have been performed. The field was used during the summer months for informal practice by adult and children's soccer teams and batting practice by softball teams. During the fall season, it was the main practice field for the high school soccer team, as well as adult soccer teams. Summer use was considered moderate; fall use was very heavy.

Toro Research Irrigation System

The Toro Research Irrigation System is a series of 88 15 x 15 plots located at the Rocky Ford Turfgrass Research Plots 3 miles north of Manhattan. Each of these plots can be irrigated independently. Twenty-four of these plots are currently being used to investigate the effects of incorporating polyacrylamide into the root zone on supplemental irrigation requirement and quality of 'Mustang' tall fescue. The treatments include a control (no polymer), 20, 40, 80, 160, and 320 lbs per acre cross-linked polyacrylamide (Western Polyacrylamide, Inc., Castle Rock, CO). Parameters being monitored include monthly quality, density, seasonal rooting at two depths (0-4", 4-8"), and supplemental irrigation requirement. Each treatment is replicated 3 times in a completely randomized design.

PRELIMINARY RESULTS:

Frank Anneberg Sports Field

Bulk density is a measure of the compactness of the soil and is expressed in grams/cubic centimeters. The greater the compaction, the greater the bulk density value. As shown in Figure 1, there was a significant decrease in bulk density between the control and the cultivated plots. It is interesting to note that after drying, the samples containing polymer had cavities where the hydrated polymer had been, yet the bulk density was nearly identical to that of grooved cores without polymer. When these soils became quite dry, parallel cracks were evident at 6-inch intervals. This is the distance between the blades of the polymer planter. Some cracks were noticed in the grooved-only plots also. Evidence of this soil fracturing warrants a water infiltration test during the 1990 and 1991 growing seasons.

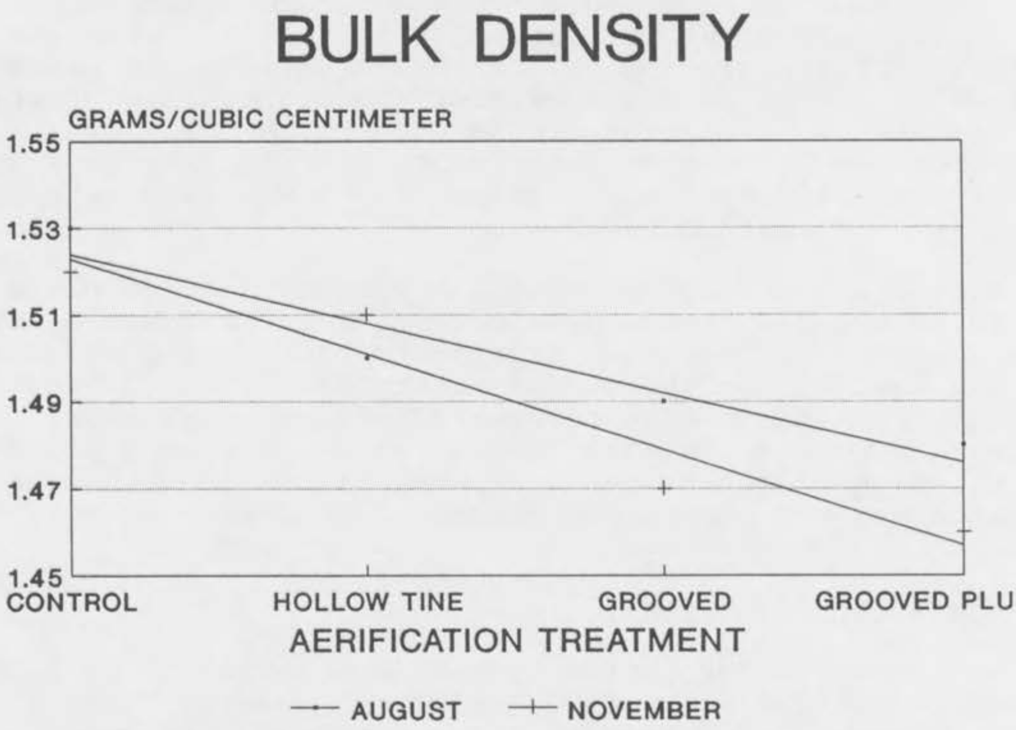


FIGURE 1.

Moisture content can influence bulk density and penetrometer resistance, so these values are also included in Fig. 2-4. Fig. 2 shows a trend for all cultivation treatments resulting in higher soil moisture content during both the August and November sampling dates. Both grooving alone and in combination with the polymer gave slightly higher moisture content than hollow coring. Very surprisingly, the plots receiving polymer did not exhibit increased water content over the plots that received grooving only. It should be noted, however, that the Anneberg field has a high clay content. Clays have a much higher water-holding capacity than more coarsely textured soils. Low rates (e.g., less than 200 lbs/acre) of polymer might have a much greater impact on moisture content of sandy soils.

Fig. 3 and 4 exhibit penetrometer resistance by depth during August and November of 1989, respectively. Both graphs show quite conclusively that the grooving techniques (with or without the polymer) resulted in less penetrometer resistance than hollow tine aerification or no aerification at all.

This information is particularly important to sports field safety because harder, more compacted (greater penetrometer resistance) fields may lead to increased player injury.

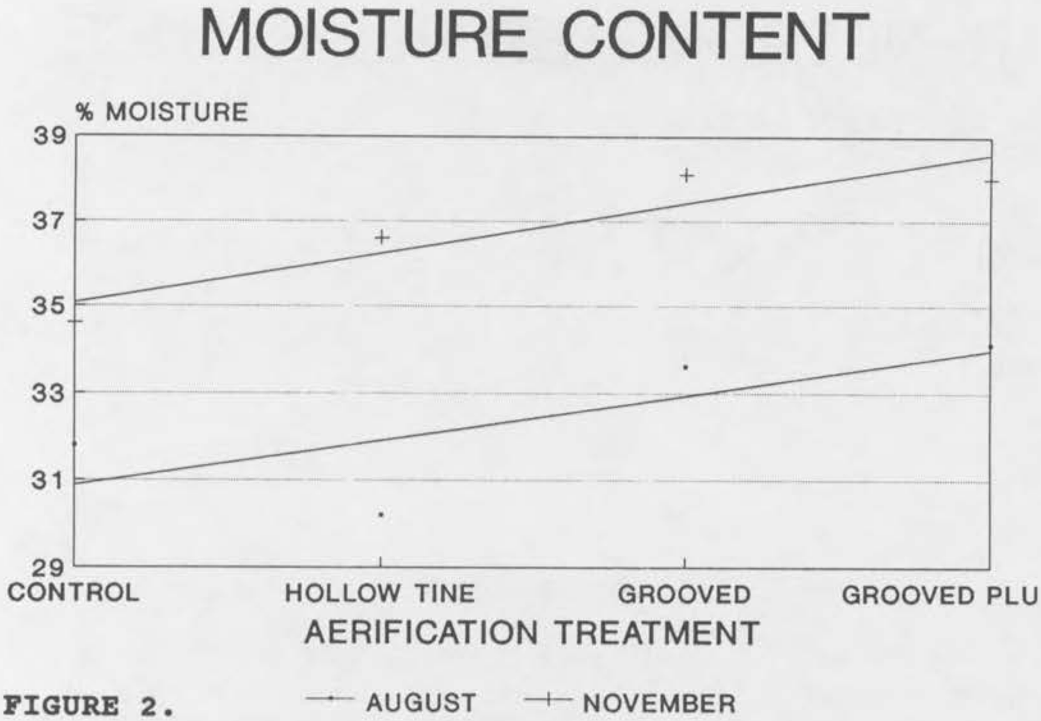


FIGURE 2.

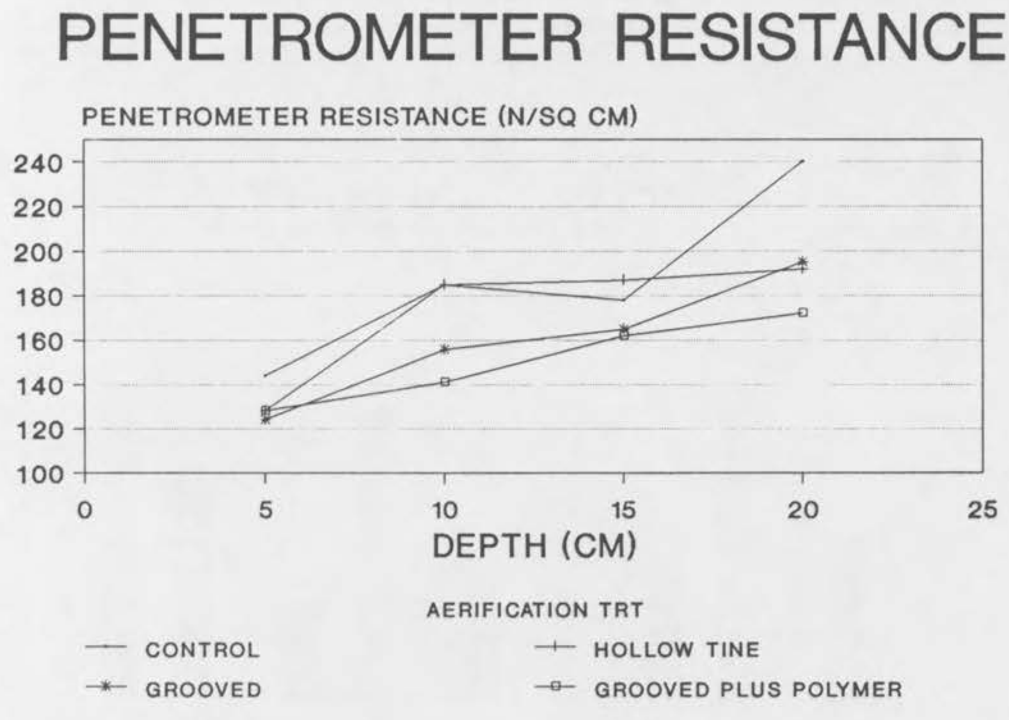


FIGURE 3.

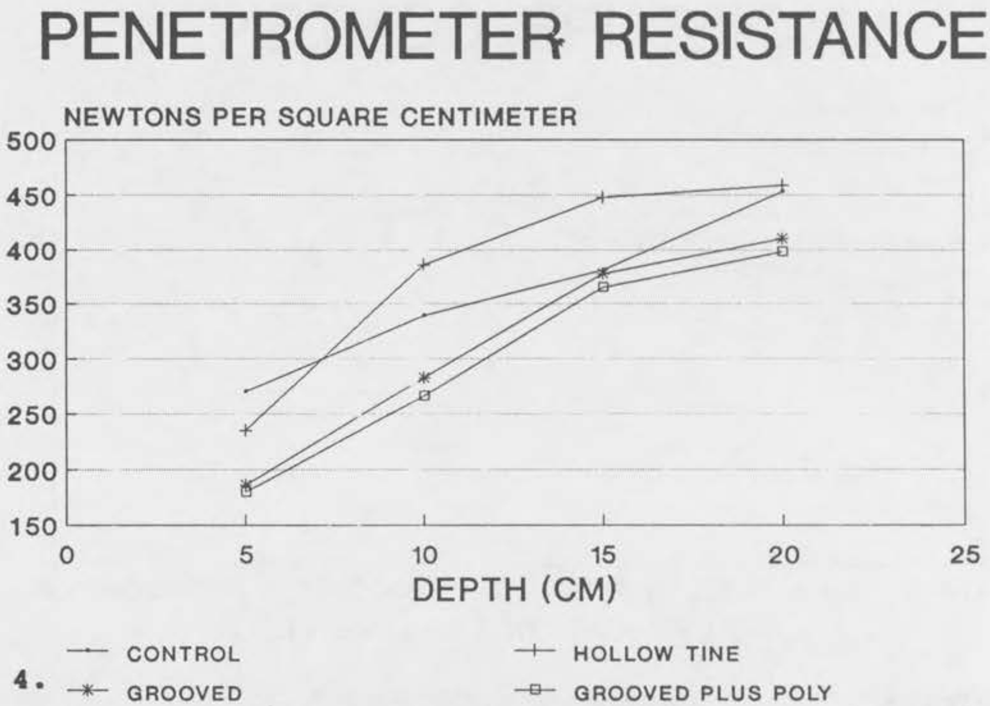


FIGURE 4.

Turfgrass quality of the Anneberg plots as affected by different aerification treatments is shown in Fig. 5. In general, all aerification treatments improved monthly turfgrass quality (except during November) in 1989. Grooving and grooving with polyacrylamide, however, were superior to hollow tine aerification in 4 out of the 5 months. These preliminary results suggest that grooving may prove to be a favorable alternative to conventional hollow tine coring for the aerification of sports fields.

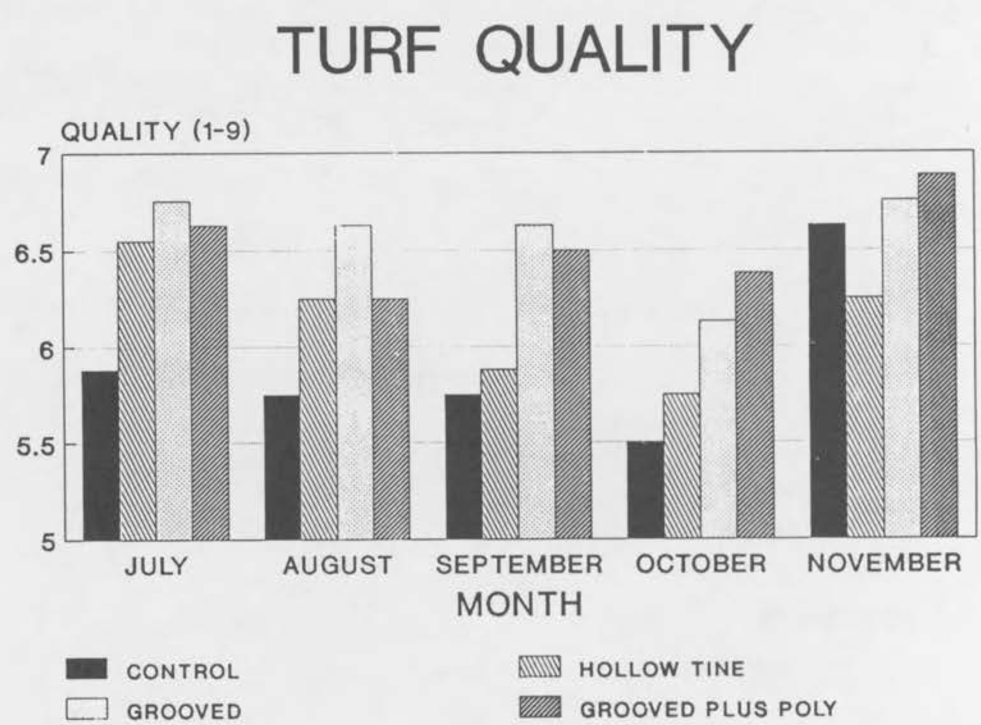


FIGURE 5.

Table 1 shows average root mass washed from 1 inch diameter cores at 0-4 and 4-8 inch depths as affected by aerification treatment and the addition of cross-linked polyacrylamide. Although hollow tine coring resulted in the highest root mass from a 0-4 inch depth, at deeper depth grooving and grooving plus the addition of water absorbing polymer resulted in greatest root mass. However, there was a lot of variation between plots during this sampling. During 1990, many more cores will be taken to reduce the effect of this between-plot variation.

Table 1. Average root mass (dry wt., mg) of cores taken from a tall fescue soccer field as affected by aerification treatment and the addition of cross-linked polyacrylamide.

Treatment	Depth of core 0-4"	4-8"
Control	392	308
Hollow tine coring	507	360
Grooving	396	435
Grooving plus polymer	760	476
LSD (0.05)	459	372

Toro Research Irrigation Plots

Preliminary results from these plots are shown in Fig. 6 and 7. Turfgrass quality (1-9) of plots treated with 0 to 320 lbs of cross-linked polymer is shown in Fig. 6. Unfortunately, although differences in quality can be seen between months, no immediate enhancement of turfgrass quality can be seen from the addition of water absorbing polymer. It will be interesting to see if the second and third growing seasons will yield favorable information concerning possible turfgrass quality enhancement by the polymer.

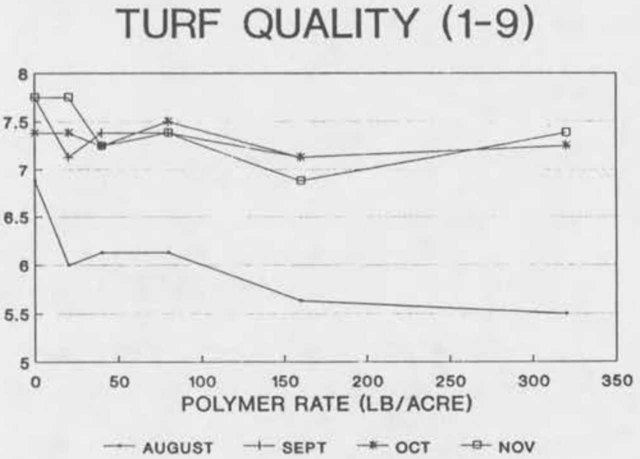


FIGURE 6.

Table 2 shows average root mass of tall fescue washed from soil cores of 0-4 and 4-8 inches deep as affected by the addition of increasing rates of cross-linked polyacrylamide. Again, much within-treatment variation precluded statistical significance. Data collection will continue through the 1990 growing season.

Table 2. Average root mass (dry wt. mg) of tall fescue as affected by the addition of cross-linked polyacrylamide to the rootzone.

Treatment	Depth of core 0-4"	0-8"
Control	359	166
20 lbs/A	389	200
40 lbs/A	404	86
80 lbs/A	264	97
160 lbs/A	334	109
320 lbs/A	268	78
LSD (0.05)	229	161

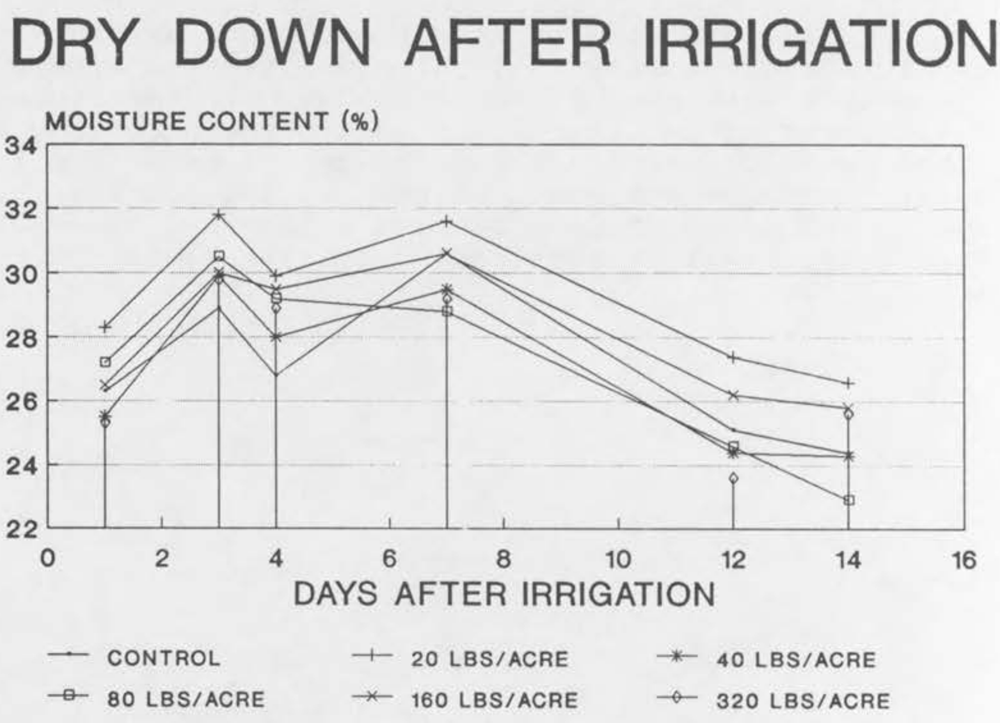


FIGURE 7.

TITLE: Selective Removal of Common Bermudagrass from Tall Fescue

OBJECTIVE: To evaluate the efficacy of four chemicals and five application timings for the selective control of common bermudagrass in tall fescue

PERSONNEL: Roch Gaussoin, Turfgrass Research & Teaching
Larry Leuthold, Turfgrass Extension
Ward Upham, Turfgrass Technician

SPONSOR: Hoechst-Roussel Agri-Vet Company

INTRODUCTION:

Bermudagrass is a troublesome weed in cool-season turfgrass stands. To date, attempts at selective control have been unsuccessful. New herbicide chemistry, however, may alleviate this problem. Research will be initiated in the summer of 1990 to evaluate several herbicides for this purpose.

METHODS:

In the spring of 1990, a mature stand of Rebel tall fescue was overseeded with Arizona common bermudagrass. Herbicide applications will be initiated in July or August. Treatments will include two rates of the following herbicides; Ignite (Hoechst-Rouseel Agri-Vet Co.), Round-Up (Monsanto Chemical Co.), Prograss (NorAm Chemical Co.), and Fusilade 2000 (ICI Americas Inc.). These chemicals will be applied in the summer when the bermudagrass is actively growing and the tall fescue is semidormant, in the fall prior to bermudagrass dormancy, or in the spring when the bermudagrass has broken winter dormancy. Data will be collected on bermudagrass control, as well as toxicity to the tall fescue.

Note: Research is in progress, and results will be prestend next year.

TITLE: National Tall Fescue Cultivar Trial

OBJECTIVE: To evaluate commercial and experimental tall fescue genotypes under Kansas conditions and provide that data to the National Turfgrass Evaluation Program

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
John Pair, Turfgrass Research

INTRODUCTION:

Tall fescue is the best adapted, cool-season turfgrasses for use in the transition zone because of its greater drought and heat tolerance. Although tall fescue has few serious insect and disease problems, it possesses a coarse leaf texture and does not recover from injury because it lacks stolons and has only very short rhizomes. Efforts to improve tall fescue cultivars include selection for finer leaf blades, good mowing quality, a rich green color, and better sward density, while maintaining good stress tolerance characteristics.

MATERIALS AND METHODS:

Manhattan

Sixty-five commercial and experimental tall fescue genotypes were provided by the National Turfgrass Evaluation Program in the fall of 1987 (Table 1). They were planted in Section I of the Rocky Ford Turfgrass Research Plots during the first week of September. Each genotype was replicated three times in a randomized complete block experimental design. Seeding was done by hand at the rate of 8 lbs of seed per 1000 sq ft. Monthly quality ratings are being recorded for each genotype.

Wichita

A new, national trial of 65 cultivars and experimental numbers was established on September 10, 1987. Plots were maintained at 4 lbs N/1000 sq ft per year, mowed at 2 1/2 in with clippings removed, and irrigated to alleviate stress. Team (Balan/Treflan) was applied in April and June to prevent crabgrass

RESULTS:

Performance of the NTEP tall fescue cultivar trials at Manhattan and Wichita is shown in Tables 1 and 2, respectively. Best performing cultivars at Manhattan were Twilight, Avanti, Aztec, Crossfire, BEL 86-2, Shortstop, Hubbard 87, Normarc 99, Guardian, Trailblazer, PE-7, Eldorado, Amigo, Shenandoah, Emperor, PST-SAG, Silverado, PST-SMW, Tribute, Carefree, KWS-DUR, Normarc 25, and Cohise.

Best performing selections at Wichita were Pick TF 9, Aztec, Pick 127, Monarch, PE-7, PE-7E, Pick 845PN, PST-5AP, Pick SLD, PST-5MW, Pick DM< Hubbard 87, Hieftan, PST-5F2, Pick GH6, Cimmaron, Tribute, PST-5HF, PST-501, PST-5BL, Mesa, Trailblazer,

Table 1. Mean turfgrass quality ratings of Tall Fescue cultivars in the 1987 National Tall Fescue test at Manhattan, KS. 1988 data.

Turfgrass Quality Ratings 1-9; 9 = Best

Name	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	MEAN
KWS-BG-6	8.3	8.7	8.3	8.0	8.3	8.0	7.3	7.0	8.0
Pick DM (Avanti)	8.0	8.0	7.3	8.0	8.3	8.3	8.0	7.7	8.0
Aztec	8.3	8.3	7.7	7.3	7.7	7.7	7.7	7.0	7.7
Pick TF9 (Crossfire)	7.7	8.3	7.7	7.0	8.0	8.0	7.7	7.0	7.7
Bel 86-2	7.3	7.7	7.0	8.0	8.0	8.0	7.3	7.3	7.6
Pick DDF (Shortstop)	8.3	7.7	8.0	7.3	7.3	7.7	7.7	7.0	7.6
Hubbard 87	7.3	7.3	7.7	8.0	7.7	7.7	7.7	7.0	7.5
Normarc 99	7.0	8.0	7.7	8.0	7.7	8.0	7.3	6.7	7.5
Pick 845PN (Guardian)	7.7	7.7	7.7	7.3	7.0	7.7	7.3	7.3	7.5
Trailblazer	8.0	7.0	7.3	8.0	7.0	7.7	7.3	7.3	7.5
PE-7	7.3	7.3	7.3	7.3	7.3	7.7	7.3	7.3	7.4
PST-5D1 (Eldorado)	7.3	7.3	8.0	7.3	7.3	7.7	7.3	7.0	7.4
PST-5HF (Amigo)	7.7	7.7	7.0	7.3	7.3	7.7	7.3	7.3	7.4
PE-7E (Shenandoah)	7.7	7.3	7.0	7.3	7.0	7.0	7.7	7.3	7.3
Pick SLD (Emperor)	7.3	7.3	7.0	7.3	7.0	7.3	7.7	7.3	7.3
PST-5AG	7.0	7.3	7.0	7.7	7.0	7.0	7.7	7.3	7.3
PST-5BL (Silverado)	7.3	7.7	7.3	7.7	7.0	7.7	7.0	7.0	7.3
PST-5MW	7.7	7.3	7.3	7.3	7.3	7.3	7.0	7.0	7.3
Tribute	6.7	7.0	7.0	8.0	7.3	7.3	7.7	7.0	7.3
Carefree	7.0	7.3	6.7	7.7	7.0	7.7	7.0	7.0	7.2
KWS-DUR	7.3	7.3	7.0	7.7	6.7	7.3	7.0	7.0	7.2
Normarc 25	7.7	7.0	7.0	7.0	7.3	7.7	7.0	7.0	7.2
Pick 127 (Cochise)	7.3	7.7	7.3	7.0	6.7	7.3	7.0	7.0	7.2
Apache	7.0	7.3	7.0	7.0	7.3	7.3	7.0	7.0	7.1
Chieftain	7.3	7.3	7.0	6.7	7.0	7.0	7.3	7.0	7.1
Legend	7.3	7.0	7.0	7.0	7.0	7.3	7.0	7.3	7.1
Mesa	6.7	7.0	7.3	7.0	7.3	7.0	7.3	7.3	7.1
Normarc 77	7.0	7.0	7.0	7.3	7.0	7.3	7.0	7.0	7.1
PST-5AP	7.0	7.3	7.0	7.0	7.0	7.3	7.0	7.3	7.1
PST-5D7 (Murietta)	7.0	7.7	6.7	7.3	7.0	7.0	7.0	7.0	7.1
PST-50L	7.0	7.7	6.3	7.3	7.0	7.3	7.0	7.0	7.1
Monarch	7.3	7.0	7.0	7.3	7.0	7.0	7.0	6.7	7.0
Olympic	7.0	7.0	6.7	7.0	7.0	7.0	7.0	7.0	7.0
Pick GH6 (Maverick II)	7.0	7.3	7.0	7.3	6.7	7.3	6.7	6.7	7.0
PST-DBC	6.7	7.3	6.7	7.7	7.0	7.0	7.0	7.0	7.0
Sundance	7.0	7.0	7.0	7.0	7.0	7.0	7.3	7.0	7.0
Thoroughbred	7.0	7.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Titan	7.0	7.0	7.0	7.0	7.0	6.7	7.0	7.0	7.0
Wrangler	7.0	7.0	6.7	6.7	7.3	7.0	7.0	7.0	7.0
Adventure	6.7	7.0	6.7	7.0	6.7	7.0	6.7	7.3	6.9

(cont.)

Name	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	MEAN
Bar FA 7851 (Barnone)	7.3	6.7	6.7	7.0	6.7	7.0	7.0	7.0	6.9
Cimmaron	7.0	6.7	7.0	7.0	6.7	6.7	7.0	7.0	6.9
Jaguar	6.7	7.0	6.7	7.3	6.7	7.0	7.0	7.0	6.9
JB-2	6.7	7.0	6.3	7.0	7.0	7.3	7.0	7.0	6.9
PST-5DM	7.0	6.7	7.3	6.7	6.7	7.0	7.0	7.0	6.9
PST-5EN	6.7	7.0	6.7	7.0	7.0	7.0	7.0	7.0	6.9
PST-5F2 (Winchester)	7.0	7.0	7.0	7.0	7.0	7.0	6.7	6.3	6.9
Bonanza	7.0	6.3	6.7	7.0	7.0	6.7	6.7	7.0	6.8
Jaguar II	6.7	6.7	6.7	7.0	7.0	7.0	7.0	6.7	6.8
Rebel II	7.0	6.7	6.7	7.0	6.7	6.7	7.0	7.0	6.8
Arid	6.0	6.3	6.7	6.7	7.0	6.7	7.0	7.0	6.7
Finelawn 5GL	6.3	6.7	7.0	6.7	6.7	6.7	6.7	6.7	6.7
Rebel	6.7	7.0	6.3	6.7	6.3	6.7	6.7	7.0	6.7
Bel 86-1	7.0	7.0	6.3	6.3	6.7	6.7	6.3	6.3	6.6
Falcon	7.0	6.7	6.0	7.0	6.3	6.3	7.0	6.7	6.6
Taurus	6.7	6.7	6.7	6.3	6.3	6.3	7.0	7.0	6.6
Trident	6.3	6.7	7.0	6.7	6.3	6.7	6.3	7.0	6.6
SYN GA	7.0	6.7	6.3	6.7	6.3	6.3	6.3	6.7	6.5
Pacer	6.7	6.3	6.0	7.0	6.0	6.3	6.3	6.7	6.4
Richmond	6.3	6.0	6.0	6.3	6.0	6.3	6.3	6.7	6.3
Finelawn I	5.7	6.7	5.7	6.7	6.3	6.3	6.0	6.3	6.2
Tip	6.0	6.3	6.0	6.7	6.0	6.0	6.3	6.3	6.s
Willamette	6.0	5.7	6.3	6.3	6.3	6.3	6.0	6.7	6.2
Fatima	6.0	5.7	5.7	6.7	6.0	6.0	6.3	6.7	6.1
KY-31	5.3	5.0	5.0	5.3	5.7	5.3	5.7	5.7	5.4

Table 2. Performance of tall fescue cultivars, Wichita, KS, 1989 1/.

Cultivar	Quality rating by dates (0-9 w/9= best)				Season avg.
	6-9	7-27	8-31	9-30	
Pick TF9	8.3 DG	7.7 DG	7.5 DG	7.2	7.7
Aztec	8.0 DG	7.3	7.3 DG	7.3	7.5
Pick 127	8.2 DG	7.7	7.2 DG	6.8	7.5
Monarch	7.8	7.5 DG	7.5 DG	7.2	7.5
PE-7	7.7	7.5	7.2	7.7	7.5
PE-7E	7.7	7.7	7.3 DG	6.8	7.4
Pick 845PN	7.7	7.5	7.2	7.2	7.4
PST-5AP	7.7	7.3 DG	7.7	7.0	7.4
Pick SLD	7.8	7.2	7.7 DG	6.8	7.4
PST-5MW	7.8	7.2	7.5	7.0	7.4
Pick DM	7.5	7.0 DG	7.7	7.3 DG	7.4
Hubbard 87	7.7	7.3	7.3	6.7	7.3
Chieftan	7.5	7.2	7.2	7.2	7.3
PST-5F2	7.7	7.2	6.8	7.3	7.3
Pick GH6	7.5	7.2	7.3	7.2	7.3
Cimmaron	7.7	7.0	7.5 DG	6.8	7.3
Tribute	7.5	7.5	7.3	6.5	7.2
PST-5HF	7.8	7.5 LG	6.7	6.8	7.2
PST-5D1	7.3	7.3	7.3	6.7	7.2
PST-5BL	7.7	7.3	7.0	6.8	7.2
Mesa	7.2	7.2	7.0	7.2	7.2

(cont.)

Table 2. (cont.)

Cultivar	Quality rating by dates (0-9 w/9= best) 6-9	7-27	8-31	9-30	Season avg.
Trailblazer	7.7	7.0 BP	6.8	7.2	7.2
Legend	7.0	7.0	7.3	7.5	7.2
Bonanza	7.5	7.5	6.8	6.7	7.1
Sundance	7.5	7.2	7.2	6.3	7.1
Wrangler	7.0	7.2	7.0	7.0	7.1
Normarc 25	7.3	7.2	7.0	6.7	7.1
Pick DDF	7.5	7.0	7.2	6.7	7.1
Bel 86-2	7.3	7.0	6.8 LG	7.3	7.1
PST-5D7	7.5	7.0	7.0	6.8	7.1
Bel 86-1	7.3	7.0	7.2	7.0	7.1
Apache	7.3	7.2	6.8	6.8	7.0
Titan	7.5	7.0	6.8	6.8	7.0
PST-5EN	7.2	7.0	7.0	6.8	7.0
Mormarc 99	7.7	6.2 LG	6.8	6.3	7.0
PST-5DM	7.2	7.2	6.7 LG	6.5	6.9
Trident	7.2	7.2	6.5	7.0	6.9
KWS-DUR	7.2	7.0	7.0	6.3	6.9
Finelawn 5GL	7.3	6.8	6.8	6.7	6.9
PST-DBC	7.0	6.7	7.0	6.7	6.9
KWS-BG-6	8.2 DG	6.5 BP	6.3	6.5	6.9
Thoroughbred	7.0	6.5	7.2	6.7	6.9
Jaguar II	7.2	6.8	6.5	6.7	6.8
BAR Fa 7851	7.0	6.8	6.5	6.8	6.8
Taurus	7.2	6.8	6.5	6.7	6.8
JB-2	7.3	6.7	6.3	6.7	6.8
PST-5AG	7.3	6.7	6.5	6.7	6.8
Finelawn I	6.8	6.8 LG	6.5	6.5	6.7
Carefree	7.2	6.7	6.5	6.5	6.7
Jaguar	7.5	6.7 LG	6.0 LG	6.5	6.7
Olympic	7.0	6.5	6.3	6.8	6.7
Rebel	6.8	6.8	6.0 LG,$	6.8	6.6
Syn Ga	7.0	6.5 LG	6.2 LG	6.7	6.6
Adventure	6.7	6.3	6.3 LG	6.7	6.5
Richmond	6.3	6.8	6.0	6.5	6.4
Falcon	6.7	6.3 LG	6.5	6.2	6.4
Premium blend	7.1	6.2 LG,BP	6.2	6.2	6.4
Arid	6.3	6.3 LG	6.2 LG	6.3	6.3
Pacer	6.2	6.2 LG	6.3	6.3	6.3
Fatima	6.3	6.3 LG	5.8 LG	6.3	6.2
Willamette	6.3	6.2	6.0	6.2	6.2
Tip	5.0 LG	5.3 LG	5.0 C,LG	6.0 LG	5.3
Ky-31	5.0 LG	5.3 LG	4.7 T,LG	5.7 TC	5.2

1/ Planted Sept. 10, 1987. Maintained at 4 lbs. N/1000 sq. ft/yr. Mowing height was 2 1/2 inches with clippings removed. Symbols: BP = Brown Patch, C = Coarse, $ = Dollar Spot, D = Dense, DG = Dark Green, LG = Light Green, T = Thin stand.

TITLE: National Turfgrass Evaluation Program Fine Fescue Trial

OBJECTIVE: To evaluate commercial and experimental genotypes of hard, chewings, and creeping red fescue for their performance under Kansas conditions.

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Kevin Kamphaus, Turfgrass Technician

INTRODUCTION:

Fine fescues is a collective term used to describe hard, chewings, and creeping red fescues. Fine fescues are often added to home lawn turfgrass seed mixtures because they possess good shade tolerance. Other desirable characteristics of fine fescues include excellent drought tolerance and a very fine leaf texture. Although fine fescues have not been widely promoted for use in Kansas, previous work at Rocky Ford with Ensylva showed excellent performance where adequate fertility and irrigation were maintained. This experiment was initiated to test the performance of 93 NTEP entries under central Kansas conditions.

MATERIALS AND METHODS:

Ninety-three fine fescue cultivars were planted in Section I of the Rocky Ford Turfgrass Research plots in early September, 1989, for evaluation as part of the National Turfgrass Evaluation Program national cultivar trials. The planting utilized a randomized complete block design with each cultivar replicated three times on 1 X 1 meter plots. Seeding rate was 6 lbs of seed per 1000 sq. ft., and a complete (20-20-20) fertilizer was applied immediately after seeding. Plots are to received 3-4 lbs of actual nitrogen per 1000 sq. ft. per season. No phosphorous or potassium will be applied. Data collected include a subjective monthly quality rating (1-9, where 9 = best).

RESULTS:

Table 1 shows names of commercial and experimental fine fescue genotypes, their sponsors, and April and May average quality ratings. Although ratings are completed for only two months at the time of this writing, cultivars that are performing very well include Flyer, PST-SHE, NK 82492, SRX 89-31, Banner, Marker, PST-4C8, OFI 89-200, BAR Fr 9F, Atlanta, FRT-30149, Valda, Belmont, Jamestown, PST 43F, Raymond, and Rainbow.

Table 1. 1989 National Fineleaf Fescue Test

Name	Species	Sponsor	April	May
Serra	Hard	Willamette Seed Co.	5.67	7.00
Elanor	Creeping red	Production Service	5.83	7.50
NK 82492	Chewings	Northrup King. CO.	5.17	7.83
Franklin	Creeping red	Van der Have Oregon, Inc.	5.67	7.17
Camaro	Chewings	Van der Have Oregon, Inc.	4.83	6.83
Sylvester	Creeping red	Van der Have Oregon, Inc.	4.83	6.83
Molinda	Chewings	Van der Have Oregon, Inc.	5.83	7.50
Melody	Hard	Van der Have Oregon, Inc.	5.17	7.50
WW Rs 130	Creeping red	E.F. Burlingham & Son	5..17	6.67
WW Rs 143	Creeping red	E.F. Burlingham & Son	6.50	7.17
WW Rs 138	Creeping red	E.F. Burlingham & Son	6.17	7.50
Mx 86	Sheep	Jacklin Seed Co.	5.00	6.83
Scaldis	Hard	Northrup King Co.	5.50	7.33
Attila	Hard	KWS Seeds	5.83	7.50
BAR Fr 9p	Slender creeping	Barenbrug USA	5.50	7.33
Barlotte	Slender creeping	Barenbrug USA	5.67	6.67
Bargreen	Chewings	Barenbrug USA	5.83	7.33
Barcrown	Slender creeping	Barenbrug USA	5.00	7.33
Barnica	Chewings	Barenbrug USA	5.83	6.83
BAR Fr 9F	Chewings	Barenbrug USA	5.50	7.67
ZW 42-148	Creeping red	Green Genetics Inter.	5.83	6.83
ZW 42-160	Slender creeping	Green Genetics Inter.	5.33	7.50
SRX 89-31	Hard	Seed Research of Oregon	5.50	7.83
SR 3000	Hard	Seed Research of Oregon	5.00	7.00
SR 5000	Chewings	Seed Research of Oregon	5.83	7.33
Barreppo	Hard	Barenbrug USA	5.67	7.33
BAR Fo 9A2	Hard	Barenbrug USA	5.27	7.33
JMB-89	Chewings	Reed Funk-Rutgers Univ.	5.67	7.50
Shademaster	Creeping red	Turf-Seed, Inc.	5.67	7.50
PST-4HD	Hard	Pure-Seed Testing	4.67	7.00
PST-4AG	Hard	Pure-Seed Testing	5.00	7.33
PST-4R3	Creeping red	Pure-Seed Testing	5.50	7.33
PST-43F	Creeping red	Pure-Seed Testing	6.50	7.67
Aurora	Hard	Turf-Seed, Inc.	5.50	7.33
PST-AUE	Hard	Turf-Seed, Inc.	5.33	7.00
PST-SHE	Chewings	Turf-Seed, Inc.	5.83	7.83
Frt-30149	Slender creeping	Pure-Seed Testing	5.67	7.67
PST-4NI	Creeping red	Pure-Seed Testing	6.33	7.50
PST-4FE	Chewings	Pure-Seed Testing	5.00	7.00
Bighorn	Sheep	Turf-Seed, Inc.	5.17	7.33
PST-4C8	Creeping red	Pure-Seed Testing	5.67	7.83
Shadow	Chewings	Turf-Seed, Inc.	5.83	7.33
PST-4CD	Chewings	Pure-Seed Testing	5.83	7.50
Belvedere	Creeping red	Michigan State Univ.	5.33	6.83
Flyer	Creeping red	Pennington Seed	6.17	8.00
Atlanta	Chewings	Van der Have Oregon, Inc.	5.33	7.67
Scarlet	Chewings	Van der Have Oregon, Inc.	6.00	7.33
Mary	Chewings	Van der Have Oregon, Inc.	5.83	7.33
HF 102	Slender creeping	Van der Have Oregon, Inc.	5.67	7.17
HF 112 (Fernando)	Chewings	Van der Have Oregon, Inc.	5.67	7.00

(cont.)

Table 1. (cont.)

Name	Species	Sponsor	April	May
HF 138	Slender creeping	Van der Have Oregon, Inc.	5.17	7.00
Jamestown	Chewings	Loft's Seed Co.	5.67	7.67
Jamestown II	Chewings	Loft's Seed Co.	6.00	6.83
Reliant w/o endo[1]	Hard	Loft's Seed Co.	5.00	7.17
Reliant w/endo[2]	Hard	Loft's Seed Co.	5.00	6.67
Dawson	Slender creeping	Van der Have Oregon, Inc.	4.67	7.00
Silvana	Hard	Van der Have Oregon, Inc.	4.33	6.83
Biljart	Hard	Van der Have Oregon, Inc.	4.67	6.67
Waldorf	Chewings	Van der Have Oregon, Inc.	4.67	6.67
Epsom	Chewings	Van der Have Oregon, Inc.	5.17	7.00
Bargena	Creeping red	Barenbrug USA	6.33	6.83
BAR Fr8RC3	Creeping red	Barenbrug USA	6.17	7.00
Vista	Creeping red	Zajac Performance Seeds	6.50	7.00
Belmont	Chewings	Normarc, Inc.	5.17	7.67
NK 88001	Creeping red	Northrup King Co.	5.83	7.00
Southport	Chewings	Jonathan Green & Son	5.17	7.17
Salem	Creeping red	Jonathan Green & Son	5.00	7.33
Rainbow	Chewings	Van der Have Oregon, Inc.	6.00	7.67
Raymond	Chewings	Van der Have Oregon, Inc.	5.67	7.67
Estoril	Chewings	International Seeds	6.00	7.50
Valda	Hard	International Seeds	5.33	7.67
Capitol	Chewings	International Seeds	5.83	7.33
Eureka	Sheep	International Seeds	5.17	7.00
Herald	Creeping red	International Seeds	5.83	7.00
Caludia	Creeping red	International Seeds	5.00	6.83
Cindy	Creeping red	International Seeds	6.00	6.83
Longfellow	Chewings	International Seeds	5.33	7.00
Ensylva	Creeping red	International Seeds	6.33	7.00
Enjoy	Chewings	International Seeds	5.17	7.50
Marker	Slender creeping	International Seeds	6.00	7.83
Jasper	Creeping red	Pickseed West	6.17	7.17
ERG 1143	Chewings	International Seeds	4.83	6.50
Boreal	Creeping red	-	5.17	6.83
Koket	Chewings	E.F. Burlingham & Son	4.50	6.33
Wilma	Chewings	E.F. Burlingham & Son	4.67	7.17
Banner	Chewings	E.F. Burlingham & Son	5.00	7.83
OFI 89-200	Chewings	Olsen-Fennel Seed Co.	5.50	7.83
LD 3414	Creeping red	Daehnfeldt	5.67	7.17
LD 3438	Creeping red	Daehnfeldt	5.33	7.00
LD 3485	Chewings	Daehnfeldt	5.50	7.00
LD 3488	Slender creeping	Daehnfeldt	5.83	7.50
Puma	Chewings	Daehnfeldt	5.33	7.00
89.LKR	Chewings	International Seeds	5.67	7.33

TITLE: Screening Bermudagrass Genotypes for Resistance to Spring Dead Spot.

OBJECTIVE: To evaluate selected bermudagrass genotypes for their suseptibility to spring dead spot infection caused by Ophiosphaerella herpotricha.

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching.
Kala Mahadeva,Turfgrass Ph.D candidate.

INTRODUCTION:

Eight cultivars of the 28 entries of the NTEP bermudagrass cultivar trial were selected and established in 1987 to study their suseptibility to SDS infection. During October of that year, three replications of each clone were inoculated with O. herpotricha, the cause of SDS of bermudagrass in Kansas. Each genotype was rated for quality, density, and percentage area killed after spring greenup through summer and fall.

RESULTS:

There were distinct cultivar differences in all three parameters measured during the month of May 1989 after intial green-up of the turf. Cultivars A-22 and Midiron were superior in terms of quality , density, and % area kill, followed closely by Vamont,Arizona Common,Gymon and NM43. Tifway and Tifgreen showed the lowest rating among the cultivars (Tables 1, 2, and 3). The same trend was seen in the monthes of June and July.

There were significant differences (P < 0.5) among the inoculated and uninoculated turf in all three parameters measured. The unioculated plots showed superior turf quality, density and low % kill compared to the inoculated plots during the months of May and June.

Table 1: Quality ratings of bermudagrass genotypes as affected by spread dead spot fungus.

CULTIVAR	MAY 18	MAY 26	JUNE	JULY	AUG	SEPT
NM43	3.8	3.8	5.0	5.3	5.5	5.2
VAMONT	4.7	4.7	5.4	5.3	5.5	6.1
A-22	6.2	5.8	6.2	6.0	6.0	6.1
MIDIRON	5.3	5.9	6.5	6.8	7.1	6.7
TIFGREEN	3.3	3.0	4.7	5.5	6.5	6.3
TIFWAY	3.8	2.7	4.7	6.0	6.1	6.3
ARIZ.COMM	4.8	4.3	5.3	4.8	6.0	6.0
GUYMON	3.6	3.1	5.0	5.3	6.1	6.7
	NS	NS	NS	NS	NS	NS
INOCULATED	4.1	3.3	5.3	5.7	6.1	6.2
CONTROL	4.8	5.0	5.4	5.5	6.1	6.2
	*	*	*	NS	NS	NS

* - significant differences , NS- Non-significant differences.

TABLE 2: Density ratings of bermudagrass genotypes as affected by spring dead spot fungus. Rating (1-9).

CULTIVAR	MAY18	MAY26	JUNE	JULY	AUG	SEPT
NM43	3.8	3.5	5.0	4.9	5.5	5.0
VAMONT	4.0	4.8	4.9	5.3	5.5	6.3
A-22	5.8	5.8	6.3	5.8	6.0	6.1
MIDIRON	4.8	6.2	6.5	6.8	7.1	6.3
TFGREEN	3.1	2.7	4.4	5.4	6.5	6.5
TIFWAY	3.8	2.6	4.6	5.8	6.1	6.3
ARIZ.COMM	4.8	4.6	4.7	4.7	6.0	5.8
GUYMON	3.5	3.5	4.6	5.2	6.1	6.6
	NS	*	*	NS	NS	NS
INOCULATED	3.6	3.4	5.1	5.4	6.1	6.1
CONTROL	4.7	5.1	5.1	5.6	6.1	6.1
	*	*	NS	NS	NS	NS

* - Significant differences NS- Non-significant differences

TABLE 3: Percent area kill after spring kgreen-up of bermudagrass genotypes as affected by spring dead spot fungus. Rating (1-100).

CULTIVAR	MAY 18	MAY26
NM43	46.7	46.7
VAMONT	39.1	30.8
A-22	20.8	15.0
MIDIRON	16.6	7.5
TIFGREEN	49.2	46.7
TIFWAY	60.0	60.0
ARIZ COMM	32.5	29.2
GUYMON	43.3	26.7
	*	*
INOCULATED	47.0	42.7
CONTROL	30.0	22.9
	*	*

TITLE: NTEP National Bermudagrass Cultivar Trial

OBJECTIVE: To test several bermudagrass genotypes for their performance at Manhattan and Wichita

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
John Pair, Turfgrass Researcher
Kala Mhadeva, Turfgrass Ph.D. Candidate

INTRODUCTION:

Much of Kansas is located in the transition zone for turfgrass adaptation. Cool-season grasses are severely stressed by mid-summer high temperatures, and warm-season grasses are often killed by winter low temperatures. Bermudagrass is susceptible to winter kill, and efforts to breed for improved germplasm require evaluation of new cultivars for turf quality and winter survival.

Winter covers to prevent damage by desiccation and low temperatures have been used on bentgrass, but their use is largely uninvestigated with bermudagrass. One drawback with the use of winter protective covers is enhancement of disease activity. This experiment was designed to investigate the efficacy of such protective covers alone and in combination with mid-fall application of fungicide with known activity against the suspected causal organism of spring dead spot.

MATERIALS AND METHODS:

Manhattan

Sprigs were received from the National Turfgrass Evaluation Program in early 1986 and planted into flats in the greenhouse. Several flats of each genotype were vegetatively propagated from new stolons. A complete set was also generated for the Horticulture Research Center in Wichita.

Plugs were transplanted to the field in mid-May 1986 in 10 x 10 foot plots. The planting utilized a randomized complete block design with 28 treatments and three replications. The plots were fertilized with 1 lb. of N per 1000 sq. ft. per growing month in a urea form.

Data that are being collected include monthly quality and green-up, texture ratings, color ratings, and percent cover.

Wichita

Twenty-eight accessions of bermudagrass were established in the spring of 1986. Several selections are seeded types, but all were planted in the greenhouse either from seed or sprigs in the previous fall, then transplanted to the field on May 20 to compare growth, hardiness, and turf qualities. Maintenance consisted of mowing at 1 inch with clippings removed, 4 pounds of nitrogen per 1000 sq. ft. per year, and irrigation to alleviate stress.

RESULTS:

Manhattan

Mean monthly quality ratings for NTEP bermudagrasses are shown in Table 1. Best performers were MSB-10, NM43, Tifway, Tifway II, A-22, Tufcote, Tifgreen, and Texturf 10.

Wichita

Relatively mild temperatures during the first two winters after establishment allowed even the southern bermudagrass selections to overwinter successfully during 1987 and 1988. However, differences in hardiness were nevertheless visible as indicated by green-up ratings. Hardiest selections included Midiron, E-29, A-22, A-29, and RS-1. Guymon, established from seed, also survived well. Highest turf quality was exhibited by E-29, A-22, A-29, MSB-10, MSB-20, Tifway, Tifway II, and Midiron (Table 2).

Several accessions, including CT-23, NM 43, NM 375, NM 72, MSB-10, MSB-20, MSB-30, Tifway, Tifway II, Tifgreen, FB-119 and Common, developed spring dead spot from earlier inoculations by Extension Plant Pathologist, Ned Tisserat (Table 2). Best spring green-up in 1989 after a very dry winter with widely fluctuating temperatures was shown by Midiron, A-29, E-29, A-22, MSB-20, RS-1, Tifgreen, Tufcote, Guymon, and Vamont.

Following the coldest December on record, with a low of -18^{O}F, significant injury occurred to bermudagrass selections and green-up was very late following a cold May in 1990. Hardiest accessions appear to be Guymon, A-29, E-29, and Midiron. Also, surviving this record cold winter was A-22, RS-1, CT-23, Texturf 10, and Vamont.

Table 1 Mean turfgrass quality ratings of bermudagrass cultivars in the 1986 National Bermudagrass Test at Manhattan, KS - 1989 Data

Turfgrass Quality Ratings - 1-9; 9 = Best

Name	JUN	JUL	AUG	SEP	MEAN
MSB-10	7.3	8.0	8.0	8.0	7.8
NM 43	7.3	8.3	8.0	7.3	7.8
Tifway	7.0	8.0	8.7	7.7	7.8
Tifway II	6.7	8.0	8.3	7.7	7.7
A-22	8.0	7.7	7.3	7.3	7.6
Tufcote	8.0	7.7	7.3	7.3	7.6
Tifgreen	7.0	8.0	7.7	7.3	7.5
Texturf 10	6.0	8.3	7.7	7.3	7.4
MSB-20	6.7	7.7	7.7	7.3	7.3
MSB-30	5.7	8.3	8.0	7.3	7.3
A-29	7.0	7.7	7.0	7.0	7.2
CT-23	6.0	7.3	7.3	7.0	6.9
E-29	7.3	7.0	6.7	6.7	6.9
Midiron	7.0	7.0	7.0	6.7	6.9
RS-1	6.3	7.0	6.7	6.7	6.7
NM 375	4.7	7.0	7.0	6.7	6.3
Vamont	6.3	6.0	6.0	6.0	6.1
NMS 4	3.7	6.3	7.0	6.7	5.9
NMS 3	3.3	6.0	7.0	6.7	5.8
NMS 1 (Numex-Sahara)	3.7	6.3	6.0	6.0	5.5
NMS 14	3.7	6.0	6.3	6.0	5.5
FB-119	2.7	6.3	6.3	6.0	5.3
NM 471	4.0	5.7	6.0	5.7	5.3
NMS 2	3.3	5.7	6.0	6.0	5.3
Guymon	3.7	5.0	6.0	5.7	5.1
NM 72	4.3	5.0	5.7	5.3	5.1
AZ Common	2.0	4.3	4.7	4.7	3.9
NM 507	1.7	3.3	5.0	4.7	3.7

Table 2. Performance of bermudagrass cultivars at Wichita, KS[1].

Cultivar	Green-up 5-8-89	Visual quality (0-9 w/9=best) 5-30-89	7-18-89	8-30-89	Season avg.	Green-up 5-9-90
CT-23	4.0	5.3 SDS	7.8	8.5 No SH	7.2	1.3
NM 43	5.7	6.5 SDS	7.7	7.5 SH,LG	7.2	0
NM 72	1.0	2.0 SDS	6.3 SH	7.3 SH,W	5.2	0
NM 375	4.7	5.3 SDS	8.2 DG	8.2 SH,DG	7.2	0
NM 471	1.0	1.7	8.0 DG,SDS	8.2 DG	6.0	0
NM 507	1.0	2.0	8.3 DG,SDS	8.5 DG	6.3	0
Vamont	6.3	5.7	7.0	6.8 C	6.5	0.7
E-29	9.0	8.5	8.3	8.3 Few SH	8.4	6.0
A-29	8.3	8.5	7.8	7.7 SH	8.0	6.0
RS-1	7.3	7.5	8.0	8.2 Few SH	7.9	2.3
MSB-10	4.0	6.8 SDS	8.2 DG,SDS	8.3 DG	7.7	0
MSB-20	6.7	7.0 SDS	7.7	7.5 SH	9.5	0
MSB-30	5.0	6.5 SDS	9.0 DG	9.0 DG	8.2	0.3
A-22	8.3	8.2	8.7	8.3 Few SH	8.4	3.7
Texturf 10	6.3	6.8 SDS	8.3	8.0 SH	7.7	1.3
Midiron	9.0	9.0	8.3	8.0 SH	8.4	3.3
Tufcote	6.7	7.5	7.8	8.2	7.8	0
Tifgreen	6.7	7.7 SDS	8.0	7.7 SH	7.8	0
Tifway	4.0	6.0 SDS	8.0	8.5 F	7.5	0
Tifway II	5.0	6.5 SDS	8.3	8.5 DG,F	7.8	0
NMS 1	3.0	3.3	6.8 W	6.8 W	5.6	0
NMS 2	1.7	3.3	5.7 W	6.7 W	5.2	0
NMS 3	1.0	1.3	6.5 W	7.8 DG	5.2	0
NMS 4	2.0	2.7	7.0 W	7.8 DG	5.8	0
NMS 14	2.3	4.0	7.0 W	7.2 W	6.1	0
Arizona Common	2.0	3.0 SDS	6.2 W	6.5 W	5.2	0
Guymon	6.7	5.7	6.7	6.3 C	6.2	6.3
FB-119	2.0	3.0 SDS	7.3	8.0 Few SH	6.1	0

Symbols: SDS = Spring Dead Spot, DG = Dark Green, LG = Light Green, SH = Seed Heads, F = Fine Texture, C = Coarse Texture and WK = Winterkill.

TITLE: Management of Overseeded Guymon Bermudagrass on Athletic Field Turf

OBJECTIVES: To evaluate Guymon bermudagrass for potential use on high school athletic fields and compare effects of mowing heights and fertilizer programs on overseeding with tall fescue and perennial ryegrass to provide a combination warm/cool-season turf for year-round play

PERSONNEL: John C. Pair, Turfgrass Researcher

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

Although warm-season turf species, such as bermudagrass, offer excellent recuperative potential for repair of injury during sports activities, the season of play usually continues after frost stops top growth. Overseeding with a cool-season species offers additional seasonal color, protection for players, and possible benefit toward overwintering of the bermudagrass. Guymon bermuda, a recent hardy introduction, is rather open growing, and allows easy overseeding of cool-season species. However, management of the combination of warm- and cool-season turf involves attention to the fertility and mowing height requirements of both species.

METHODS:

A 2,500 sq ft area was sown to Guymon bermudagrass on May 6, 1988 at the rate of 2 lbs seed per 1000 sq ft. The area was mowed at 1 1/2 in and fertilized with urea at 1 lb N per 1000 sq ft on July 8 to encourage rapid establishment. On Sept. 16, three replications each of perennial rye and turf type fescue were overseeded by light power raking, and of 18-46-0 at 1/2 lb N per 1000 sq ft was applied. On Nov. 4, all plots were given 6-24-24 at 1/2 lb N per 1000 sq ft. In the meantime, uniform compaction was begun over the entire area by means of a studded roller applied four times weekly across from Oct. 13 through November to simulate a football season.

In the spring of 1989, mowing heights of 1, 1 1/2, and 2 1/2 in were imposed across fertilizer treatments consisting of 3, 3 1/2, and 4 lbs of N per 1000 sq ft per year in a factorial experiment. Frequency of mowing was every other day at 1 in, twice weekly at 1 1/2, in and weekly at 2 1/2 in.

RESULTS:

Guymon bermudagrass was well established by overseeding time in September. The low rate of nitrogen (1/2 lb N per 1000 sq ft) and light power raking when sowing fescue and ryegrass did not appear to induce any winter injury to the bermudagrass. The nitrogen level was not entirely adequate for the proper growth of fescue and ryegrass, so an additional 1/2 lb of N was applied after the Guymon went dormant in November to improve growth and color of cool-season species during compaction treatments.

Distribution of nitrogen in the three treatments is designed to obtain adequate growth but not over-stimulate ryegrass in summer, and mowing heights are designed to accommodate both species and the sport requirements.

Following an establishment period and one season of maintenance at 3 levels of fertility and 3 mowing heights, quality of turf was rated on Aug. 16, 1989, and percent cover of cool season grasses was estimated on Oct. 2, 1989.

Turf quality of Guymon bermudagrass generally improved as nitrogen level increased and mowing height was raised. Likewise, both overseed cool-season species improved with increasing fertility but turf quality of the warm- and cool-season mixtures was rated highest at the 1 1/2 inch mowing height. However, even tall fescue survived the 1 inch mowing height, which was rated higher than that mowed at 2 1/2 inches perhaps because of the frequency of cut (Table 1).

At the end of the first summer season, a higher percentage of ryegrass and fescue was surviving at 3 and 3 1/2 lbs. N per 1000 sq. ft. than at the 4 lb. rate, especially at the closer mowing heights. Surprisingly, less than 50% of the cool-season grass survived when mowed at the 2 1/2 inch height. Overall, ryegrass survived better than tall fescue at the 1 and 1 1/2 inch mowing heights. Approximately 50% cover of ryegrass was noted with only 3 lbs. N per 1000 sq. ft. and mowing at 2 1/2 inches.

Table 1. Performance of overseeded Guymon bermudagrass maintained at three mowing heights and three nitrogen levels 1/.

Turf Cultivar	N level	Quality at mowing heights (0-9 w/9=best) 2 1/2 inches	1 1/2 inches	1 inch
Guymon only	3 lbs.	5.0	5.8	5.7
	3 1/2 lbs.	5.7	5.8	5.7
	4 lbs.	6.0	5.7	5.3
Guymon + ryegrass	3 lbs.	6.2	6.7	6.5
	3 1/2 lbs.	6.2	6.8	6.5
	4 lbs.	7.2	7.5	7.2
Guymon + tall fescue	3 lbs.	6.8	7.2	6.8
	3 1/2 lbs.	6.8	7.3	7.5
	4 lbs.	7.3	8.0	7.7

1/ Guymon seeded May 6, 1988. Overseeding done the following fall. Quality rating on Aug. 16, 1989 (average of 3 replication)

TITLE: Effect of three levels of soil compaction on the performance of six bermudagrass cultivars

OBJECTIVES:
1. To screen various bermudagrasses under typical sports field conditions and
2. To mesure physical effects of compaction as influenced by core aerification

PERSONNEL: John C. Pair and Jeff Nus

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

For most high school sports fields and municipal recreation areas, bermudagrass is the most wear- resistant turf species available. However, damage from winter injury and the effects of compaction severely reduce survival and hinder recovery and repair of the playing surface in the following season. The following experiment offers a screening mechanism for comparing hardiness and resistance to compaction of various bermudagrass selections.

METHODS:

Sprigs of vegetative bermudagrass clones, Midiron, A-29, Westwood, and were compared with seeded types, Guymon and Common (hulled bermuda). All grasses were established on June 4, 1986 and compaction treatments, consisting of weekly applications of 4, 8, and 12 times across with a modified Kisgen aerator, began on September 24. Foot traffic was simulated by replacing aerator tines with steel "feet" on which were attached five football cleats to approximate actual and compaction equal to actual sports play. Half of each plot was core aerated to alleviate the effects of foot traffic, and physical effects were measured by a penetrometer before and after compaction.

RESULTS:

After two seasons of simulated traffic, considerable differences were apparent at various treatment levels and especially among cultivars. The most wear-resistant, vegetative selections were A29, Midiron, and Westwood. Poorest survival occurred in plots of Common hulled bermuda (Table 1). Complete winter kill occurred in those seeded plots receiving the most traffic treatments (12 times across), and considerable injury occurred at the moderate rate (8 times across). Guymon bermudagrass, also seeded, sustained less winter injury and survived all levels of compaction.

Core aerificaiton appeared to only partially reduce injury from compaction and, in fact, appeared to only move the compaction layer down to a depth of 10 to 15 cm. This study will continue for one more year.

Table 1. Bermudgrass cultivar performance under three ompaction levels

Cultivar	Comp.[1] Level	Visual Quality Rate 9-18-89[2]	Visual Quality Aerated/Non-aerated 10-17-89	
Midiron	4 X	6.3	6.3	6.3
	8 X	5.3	5.7	5.3
	12 X	5.0	4.7	4.3
	Control	8.3	7.7	7.2
Common (sprigs)	4 X	5.5	5.5	5.0
	8 X	4.5	4.7	4.3
	12 X	3.7	4.0	3.7
	Control	6.0	6.5	5.8
A-29	4 X	6.7	6.7	6.5
	8 X	5.5	5.3	5.5
	12 X	5.0	5.0	5.0
	Control	7.8	7.7	7.5
Westwood	4 X	6.3	6.5	6.2
	8 X	5.5	5.8	5.5
	12 X	5.0	5.0	4.7
	Control	7.8	7.0	6.7
Guymon (seed)	4 X	5.5	5.7	5.7
	8 X	5.3	4.8	4.8
	12 X	4.7	4.3	4.3
	Control	7.7	6.7	6.7
Common (seed)	4 X	5.2	5.3	5.0
	8 X	4.0	4.3	4.3
	12 X	2.8	3.0	2.8
	Control	6.7	6.2	6.0

[1]Number of times over by traffice simulator
[2]Based on visual quality (0-9 w/9 = best). Mean of 3 replications. No distinction between aerated and non-aerated on 9-18-89.

TITLE: Influence of Spring Dead Spot Infection on Cold Acclimation of A-22 Cultivar of Bermudagrass

OBJECTIVE: To study the effect of infection of Leptospharia korrae and Ophiosphaerella herpotricha (SDS causing fungi) on the cold acclimation of A-22 bermudagrass

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Kala Mahadeva, Turfgrass Ph.D. candidate

INTRODUCTION:

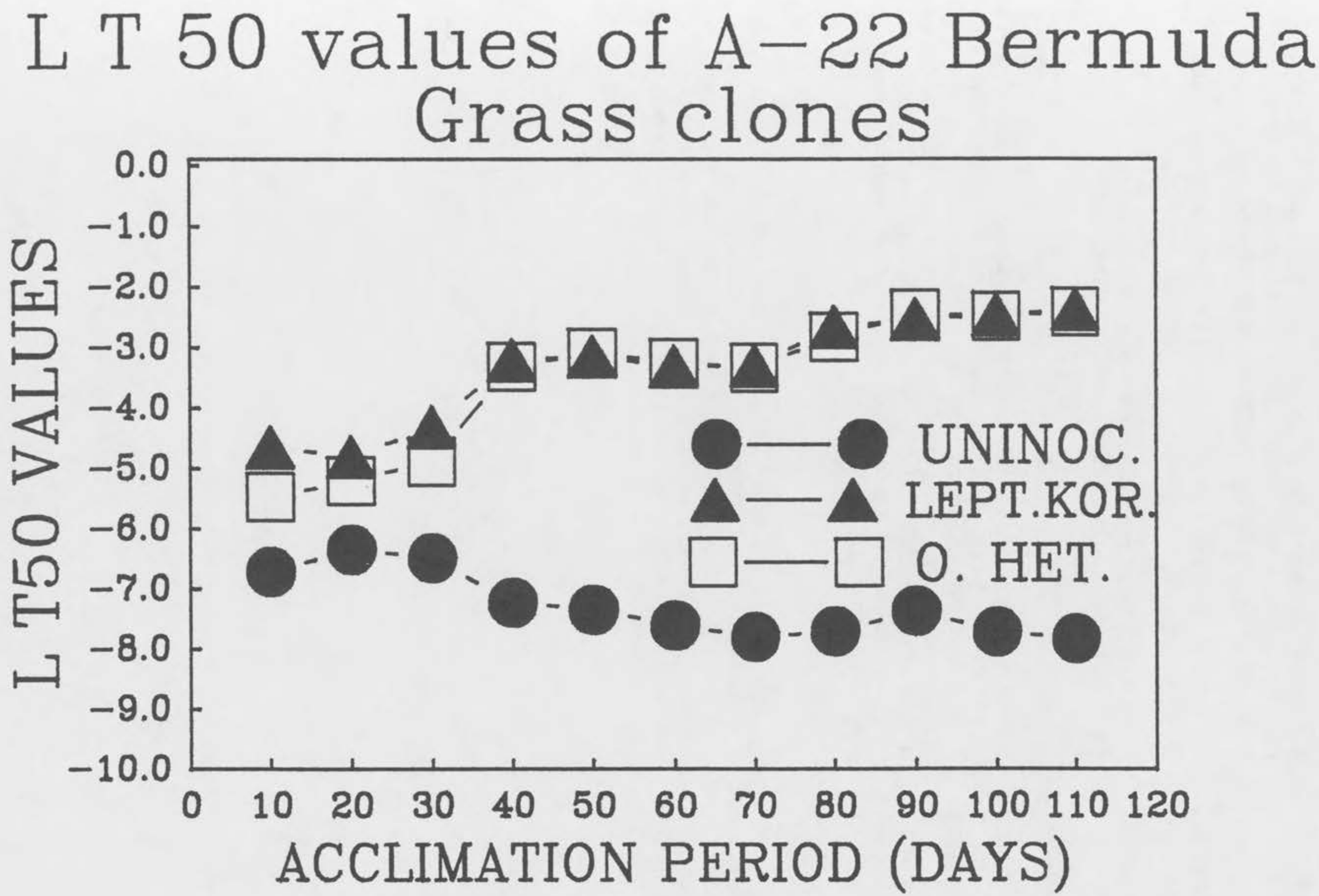
A-22 clone of bermudagrass was inoculated with the two SDS causal fungi in the greenhouse and cold acclimated through a range of temperatures. Plants were maintained at 35^{o}C in the greenhouse for initial establishment, transferred to a growth chamber at 15^{o}C for a month, and then maintained at 4^{o}C throughout the experiment under controlled conditions of light and relative humidity.

Electrolyte leakage tests were used to estimate the cold hardiness levels of the inoculated A-22 turf in comparison to the uninoculated control The LT-50 values (the temperature at which >50% of electrolyte loss occurs) were used to compare the results.

RESULTS:

There were highly significant differences between the LT-50 values of the inoculated crowns in comparison to the uninoculated controls on all the sampling dates. The uninoculated control had a higher capacity to cold acclimate, showing higher LT-50 values of -6.00 to -7.83^{o}C compared to the inoculated turf, which showed low values of -2.42 to 5.48^{o}C on all sampling dates.

The results clearly show that inoculation by both fungi reduces the capacity of the turf to cold acclimate and exhibit cold hardiness.


L T 50 values of A-22 Bermuda
Grass clones
L T50 VALUES
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
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20
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40
50
60
70
80
90
100
110
120
ACCLIMATION PERIOD (DAYS)
UNINOC.
LEPT.KOR.
O. HET.

TITLE: National Bermudagrass Trial: Effect of Protective Winter Covers and Fungicidal Treatment on Development of SDS in Bermudagrass Genotypes.

OBJECTIVE: To screen covered and uncovered NTEP ermudagrass genotypes for incidence of spring dead spot

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Kala Mahadeva, Turfgrass Ph.D. Candidate

INTRODUCTION:

Winter covers on turfgrass to prevent damage by desiccation and low temperatures have been largely uninvestigated with bermudagrass. Disease enhancement is one drawback of using such covers. This experiment was designed to investigate the efficacy of protective covers alone and in combination with mid-fall application of fungicide in order to study the enhancement of spring dead spot disease (SDS).

RESULTS:

Distinct differences in the number of SDS patches were observed among cultivars. Midiron and A-22 showed no SDS patches compared to a higher incidence among the New Mexico series. Significant differences among the fungicide-treated turf and the untreated control proved that fungicidal application limited the development of SDS patches.

Table 1. Effect of protective winter covers and fungicidal treatment on the development of SDS patches on bermudagrass genotypes.

Cultivar	No. patches May, 1989	Treatment	Means & satistical significance
CT-23	0.00		
NM-43	0.83	Covered	0.423
NM-72	1.42		
NM-375	0.41	Uncovered	0.446
NM-471	1.25		N.S.
NM-507	0.58		
Vamont	0.00		
F-29	0.00	Fungicide	0.363
A-29	0.50		
RS-1	0.00	No fungicide	0.506
MSB-10	0.75		*
MSB-20	0.41		
A-22	0.08		
Texturf	0.50		
Midiron	0.00		
Tufcote	0.00		
Tifgreen	0.00		
Tifway	0.91		
Tifway II	1.33		
NMS-1	1.00		
NMS-2	0.00		
NMS-3	1.75		
NMS-4	0.75		
NMS-14	0.08		
A2-LOMM	0.00		
Guymon	0.16		
FB-119	0.16		
	N.S.		

TITLE: Development of Winter Hardy Bermudagrass for Use on Southern Golf Course Putting Greens from Selections of Midiron Mutants Produced by Cobalt 60 Gamma Rays

OBJECTIVE: To develop winter hardy selections from 'Midiron' bermudagrass that will tolerate putting green mowing height.

PERSONNEL: Wayne Hanna, Research Geneticist, Coastal Plain Research Station, Tifton, GA
Jeff Nus, Turfgrass Research & Teaching, KSU
Terry Riordan, Turfgrass Scientist, Univ. Nebraska
Bob Carrow, Turfgrass Scientist, Univ. Georgia
Joel Barber, Turfgrass Research & Teaching, Oklahoma State Univ.

INTRODUCTION:

Maintaining quality bentgrass putting greens on deep-South golf courses is very difficult because bentgrass is a cool-season species that is not well adapted to such year-round high temperatures.

Although putting quality is inferior to bentgrass, bermudagrasses are used in such southern locations. Even in southern latitudes, however, bermudagrass greens may be damaged by unseasonably cold temperatures. What is needed is a very fine textured, cold tolerant bermudagrass that is able to tolerate mowing heights of 3/16" or less. This study was initiated in 1983 at the Coastal Plain Research Station, Tifton, GA with those objectives in mind.

MATERIALS AND METHODS:

Midiron rhizomes were irradiated with gamma rays using Cobalt 60 in 1983 at the Forage and Turf Research Center, Coastal Plains Experiment Station in Tifton, GA.

Treated rhizomes were then planted in flats and allowed to grow out under greenhouse conditions. Seventy-eight selections were made for very fine leaf texture and planted in two reps in 1983 at Tifton.

In 1987, additional selections were made from the Tifton plots and plots established at fairway height at a Highlands, N.C. Country Club.

From these, six selections were chosen to be field tested at the Univ. of Nebraska, Kansas State University, Oklahoma State University, and the Univ. of Georgia.

Winter hardiness evaluations of these six selections will be made over the next 2-3 years from plots growing on natural soil and maintained at 0.25 inch.

TITLE: Etiology of Zoysia Patch

OBJECTIVE: To determine the cause of zoysia patch disease on golf course fairways and home lawns.

PERSONNEL: Ned Tisserat and Ann Nus, Dept. of Plant Pathology

INTRODUCTION:

For the past several years, a patch disease of zoysiagrass has been noted on golf courses and home lawns in many areas of Kansas. Symptoms of the disease are similar to those of Spring Dead Spot of bermudagrass. Affected turf fails to break dormancy during the spring green-up period. This results in roughly circular areas of dead turf. In some cases, the turf is not completely killed, but is very slow to resume spring growth. Symptoms also occur in the fall. Our objective is to determine the cause(s) of this disease.

METHODS:

Samples of diseased turf were collected from several golf courses in northeastern Kansas. Two fungi, Gaeumannomyces incrustans and Ophiosphaerella herpotricha, were isolated from roots. Pathogenicity of these fungi to zoysiagrass was tested in greenhouse trials. Field plots have also been established in Wichita and Rocky Ford.

RESULTS:

Both O. herpotricha and G. incrustans caused root rot and root weight reduction to zoysiagrass in greenhouse experiments (Tables 1 & 2). Although both of these fungi are capable of causing root rot on zoysiagrass, reproduction of all symptoms of zoysia patch in field plots has not yet been completed. Development of zoysia patch may take several years following inoculation. We will continue to monitor field inoculations through 1990.

Table 1. Root dry weight of zoysiagrass 3 months after inoculation with isolates of *Gaeumannomyces incrustans* at two soil temperatures in greenhouse experiments.

Isolate	Temperature (C)	Root dry weight (g)
G. incrustans 1	15	4.2
G. incrustans 2	15	4.4
Not inoculated	15	5.9
G. incrustans 1	25	4.0
G. incrustans 2	25	4.8
Not inoculated	25	10.0
LSD (0.05)		1.8

Table 2. Root dry weight of zoysiagrass 3 months after inoculation with isolates of *Ophiosphaerella herpotricha* at two soil temperatures in greenhouse experiments.

Treatment	Temperature (C)	Root dry weight (g)
O. herpotricha 4	15	0.8
O. herpotricha 29	15	1.2
Not inoculated	15	2.0
O. herpotricha 4	25	1.5
O. herpotricha 29	25	2.0
Not inoculated	25	2.3
LSD (0.05)		0.5

TITLE: Topsoil Replacement Study

OBJECTIVE: To investigate the minimum topsoil replacement requirement for establishing and maintaining tall fescue or Kentucky bluegrass from seed or sod on disturbed sites

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching
Mike Sandburg, Turfgrass M.S. candidate
Mike Boaz, Turfgrass M.S. candidate

INTRODUCTION:

Establishing and maintaining quality turfgrass on disturbed building sites is a difficult task. Traffic from excavation and construction equipment results in soil compaction, and often much (if not all) of the topsoil is removed before construction begins. Subsoil is generally a much poorer rooting medium for turfgrasses than topsoil because of reduced fertility, aeration, and drainage, as well as a greater compaction tendency. This study was initiated to investigate the minimum topsoil replacement requirements when all of the existing topsoil has been removed. This information is needed by turfgrass professionals whose task is to convince the developer of the need for replacement topsoil to establish and maintain turfgrasses that enhance property value.

MATERIALS AND METHODS:

Excavation began in early July of 1988 to remove the topsoil from a 32 by 72 ft rectangle from Section II of the Rocky Ford Turfgrass Research Plots. After topsoil was removed, the resultant "dish" was back-filled with subsoil to grade, or 2 in or 4 in below grade in a randomized complete block experimental design. Topsoil that was initially removed was replaced on the plots that are sub-soil back-filled to 2 and 4 in below grade. Plots that are sub-soil back-filled to grade received no topsoil replacement.

In early September, plots were seeded with K-31 tall fescue and 'Baron' Kentucky bluegrass. In addition, plots were sodded with the same cultivars of tall fescue and Kentucky bluegrass. Data are being taken on speed of establishment, quality, density, and penetrometer resistance by depth. Comparisons will be made for those plots being established on subsoil only, subsoil with 2 in of topsoil, and subsoil with 4 in of replacement topsoil, as well as species (tall fescue versus Kentucky bluegrass) and establishment method (seed versus sod).

RESULTS:

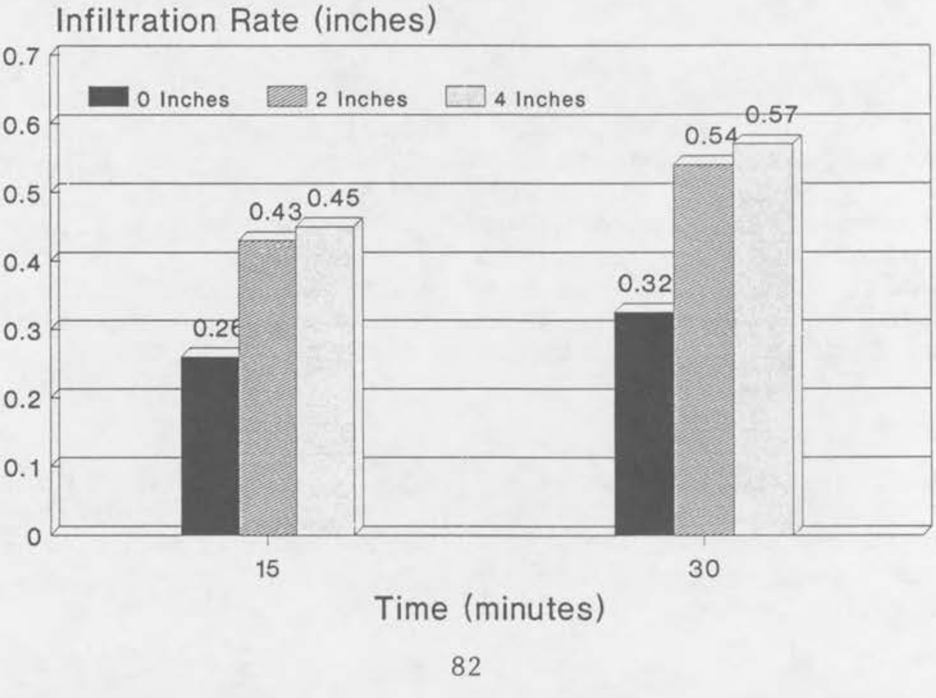
Table 1 shows the effects of topsoil replacement depth, species, and establishment method on monthly turf quality during the 1989 growing season. Depth of replacement topsoil and establishment method had dominant effects on turf quality throughout the 1989 growing season. Although tall fescue showed superior quality early in the 1989 season, Kentucky bluegrass gradually overtook and surpassed tall fescue from July until late in the 1989 growing season. On sites where topsoil is limited, these data show that sodding is much superior to seeding, 2 inches of replacement topsoil is as effective as 4 inches, and tall fescue will show better initial quality, but is gradually surpassed by Kentucky bluegrass the longer you are able to maintain the sward.

Table 2 and Figures 1-3 show density ratings and infiltration rates as affected by replacement topsoil depth, species, and establishment method. All treatments receiving either 2 or 4 inches of replacement topsoil exhibited significantly higher density than those without, throughout the 1989 growing season. There was little added density for 4 inch compared to 2 inch replacement topsoil plots, however. Although tall fescue showed significantly higher density than Kentucky bluegrass during the May ratings, no differences were evident from the July rating period on. In all cases, both sodded tall fescue and Kentucky bluegrass exhibited higher density than seeded plots.

Figures 1-3 show water infiltration timed at 15 and 30 minutes as affected by topsoil replacement depth, species, and establishment method. Plots receiving either 2 or 4 inches of replacement topsoil exhibited significantly higher infiltration rates than plots with no replacement topsoil (Fig. 1). Little difference in infiltration was detected between turf species (Fig. 2). In all cases where sodding was the establishment method, however, infiltration was significantly higher than in seeded plots (Fig. 3).

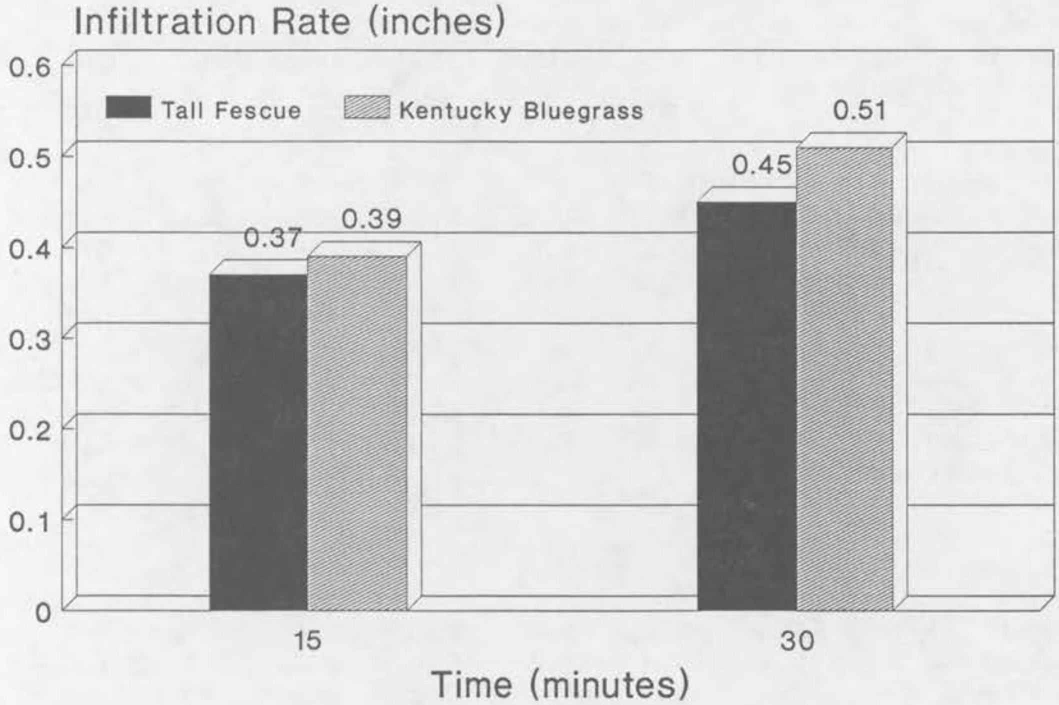
Infiltration Rate As Affected by Topsoil Replacement Depth

FIG. 1



Infiltration Rate As Affected by Turfgrass Species

FIG. 2



Infiltration Rate As Affected by Establishment Method

FIG. 3

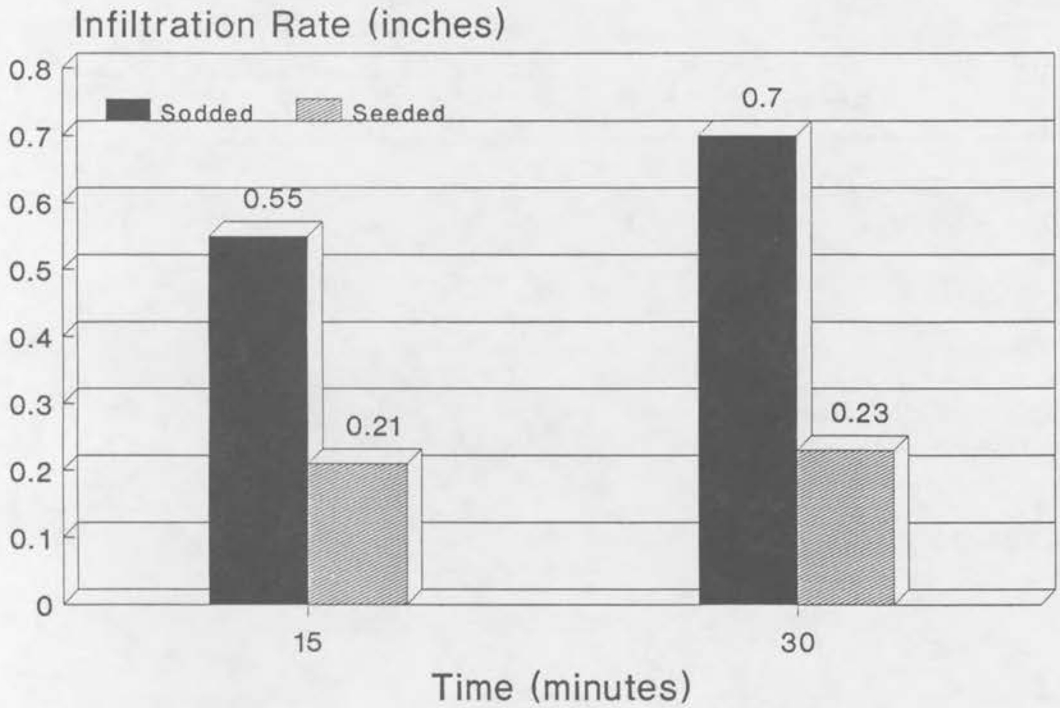


Table 1. Effect of topsoil replacement depth, species, and establishment method on monthly turf quality (1-9) during the 1989 growing season

Treatment & Species		Quality							
		April	May	June	July	Aug	Sept	Oct	Nov
Replacement Topsoil Depth Inches	0	3.5	4.7	4.9	5.2	5.6	5.4	5.2	5.0
	2	5.3	6.2	6.5	6.7	6.9	6.7	6.8	6.5
	4	5.5	6.4	6.5	7.1	7.1	6.9	6.8	6.8
		*	**	**	**	**	**	**	**
Species									
Tall Fescue		5.0	5.8	6.0	6.1	6.3	6.2	6.1	6.1
Kentucky Bluegrass		4.5	5.8	5.9	6.6	6.8	6.5	6.4	6.2
		**	N.S.	N.S.	**	**	*	*	N.S.
Establishment Method									
Sod		5.7	7.2	6.9	7.0	7.4	7.0	6.9	6.7
Seed		3.8	4.4	5.1	5.6	5.6	5.7	5.6	5.5
		**	**	**	N.S.	**	**	**	**

Table 2. Effect of topsoil replacement depth, species, and establishment method on density rating (% plot coverage) during the 1989 growing season.

Treatment and Species		Density Ratings (%)			
		May	July	Aug	Nov
Replacement Topsoil Depth (inches)	0	66	70	75	84
	2	91	90	96	98
	4	91	96	97	99
		**	**	**	**
Species					
Tall Fescue		87	86	90	95
Kentucky Bluegrass		79	85	89	93
		**	N.S.	N.S.	N.S.
Establishment Method					
Sod		99	99	96	100
Seed		67	73	82	87
		**	**	**	**

TITLE: Use of Degree Day Models for Application Timing of Herbicides

OBJECTIVE: To use Growing Degree Days (GDD) to determine window for application of non-selective herbicides to dormant and semi-dormant warm-season turfgrasses for effective weed control

PERSONNEL: J. Bryan Unruh, Turfgrass Graduate Student
Roch Gaussoin, Turfgrass Research & Teaching
John Pair, Turfgrass Research

INTRODUCTION:

Winter annuals and early summer annuals in warm-season turfgrass can be a major weed problem. Winter annuals germinate in early fall after a period of several cool nights and grow until warm weather in the spring, whereas summer annuals germinate in the spring and grow until the first hard frost. Weeds will dominate the turfgrass during the winter and early spring. This is aesthetically unpleasing and disrupts the functional ability of playing fields. The weeds are more competitive in a dormant bermudagrass than in an actively-growing, cool-season turf. RoundUp has proven to give good control, but applications must be made to dormant or semi-dormant turf. Actively growing turf will sustain injury.

The timing of non-selective herbicides to dormant and semi-dormant warm-season turfgrasses is determined by temperature dependent growth initiation. By accurately determining base temperatures and using growing degree day (GDD) models, a safe application window can be determined for using RoundUp on dormant and semi-dormant warm-season turfgrasses. This window would allow for more confident use of RoundUp with less injury to desired turf.

METHODS:

This research will be conducted at two locations: Rocky Ford Turfgrass Research Center and Wichita Horticulture Research Center. Both sites have mature stands of 'Kansas Common' buffalograss and 'Meyer' zoysiagrass. RoundUp will be applied at 1 and 2 lbs a.i./A at 45, 90, 180, and 360 GDD's. Degree day accumulation, utilizing maximum and minimum temperatures recorded on site, will be determined by the use of a computer program specifically written for this study. Visual quality and green-up of turf will be estimated, along with quantitative measurements of phytotoxicity using infrared thermometry and digital imagery and chlorophyll content of the leaves. This study will be conducted for two years.

Note: Research is in progress, and results will be presented next year.

TITLE: Passive Conversion from Common Kentucky Bluegrass to Tall Fescue

OBJECTIVE: To develop a management program for the gradual conversion from Kentucky bluegrass to tall fescue through the use of plant growth regulating chemicals, overseeding methods, and tall fescue varieties and seeding rates.

PERSONNEL: J. Bryan Unruh, Turfgrass Graduate Student
Roch Gaussoin, Turfgrass Research & Teaching

SPONSOR: Kansas Turfgrass Foundation

INTRODUCTION:

In the past, the wide leaf blade and upright growth habit of tall fescue made it an unacceptable choice for highly maintained turfgrass installations. Recent genetic improvements, as well as questionable water availability, have spawned a strong interest in such use of tall fescue. Many of these areas were originally planted to Kentucky bluegrass, and conversion to tall fescue can be troublesome. Complete renovation utilizing non-selective herbicides can be successful but requires the installation to be inaccessible for use for up to a year. Removal of the Kentucky bluegrass and resodding is possible, but may be cost prohibitive. However, the gradual conversion from Kentucky bluegrass stands to tall fescue does not limit utilization of the turfgrass during the transition process and may be economically acceptable.

METHODS:

The experiment was initiated on a mature stand of common Kentucky bluegrass in August, 1989, utilizing a four factor randomized complete block design. Chemical treatments included Limit (amidochlor) at 6 lb. a.i./A, Embark (mefluidide) at 0.25 lb a.i./A, and RoundUp (glyphosate) .09 lb a.i./A and an untreated control. Twenty days after treatment, the plots were mowed to 1 inch tall. Appropriate plots were then overseeded using an Olathe 84 slit-seeder or broadcast method following verticutting. Cultivars chosen were 'Rebel' and 'Arid' tall fescue at rates of 6 and 12 lbs/1000 sq. ft. Plots have been mowed weekly and received late-season fertilization (1 lb N/1000 sq. ft. in November) as well as preemergent weed control Data being collected include quality, visual tall fescue density, and counted tall fescue density. Quality data were based on a scale of 1 to 9, with 9 indicating best quality. Counted density data were obtained by use of a 1 x 2 meter template with a monofilament string grid system with 100 intersections randomly selected and marked. With the template overlaying the plot, species determination could be made and expressed on a percentage basis.

RESULTS:

Effect of chemical treatments on the quality of the Kentucky bluegrass are shown in Figure 1. Ratings were taken on August 21, 1989, 2 weeks after treatment. All chemical treatments exhibited significant differences when compared to the untreated control. Embark plots showed the greatest decrease in quality, followed by RoundUp and Limit.

Figure 2 shows the effect of seeding method on visual and counted density of tall fescue. Visual estimates taken in the fall indicated a 49.6% conversion to tall fescue using a slitseeder as compared to 27% conversion following verticutting and broadcast seeding. Counted density numbers for slitseeding and verticutting/broadcast show only 29.1% and 13.7% conversions, respectively. The differences between visual and counted density might be explained by winter kill caused by the cold, dry weather.

Effect of chemical treatments on the density of tall fescue are shown in Figure 3. The use of plant growth regulating chemicals did not facilitate the conversion process, and Embark appeared to hinder the conversion.

Figure 1.

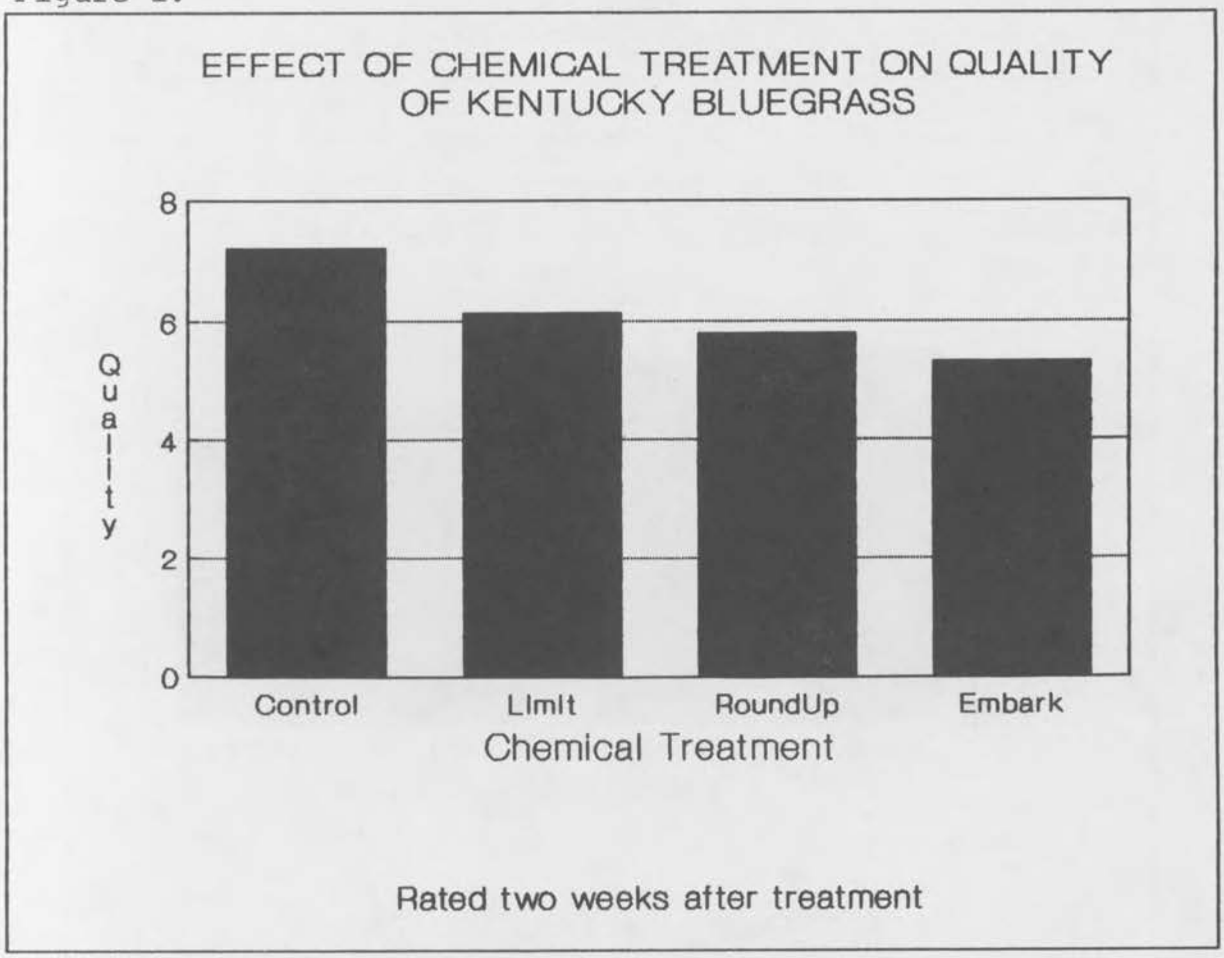


Figure 2.

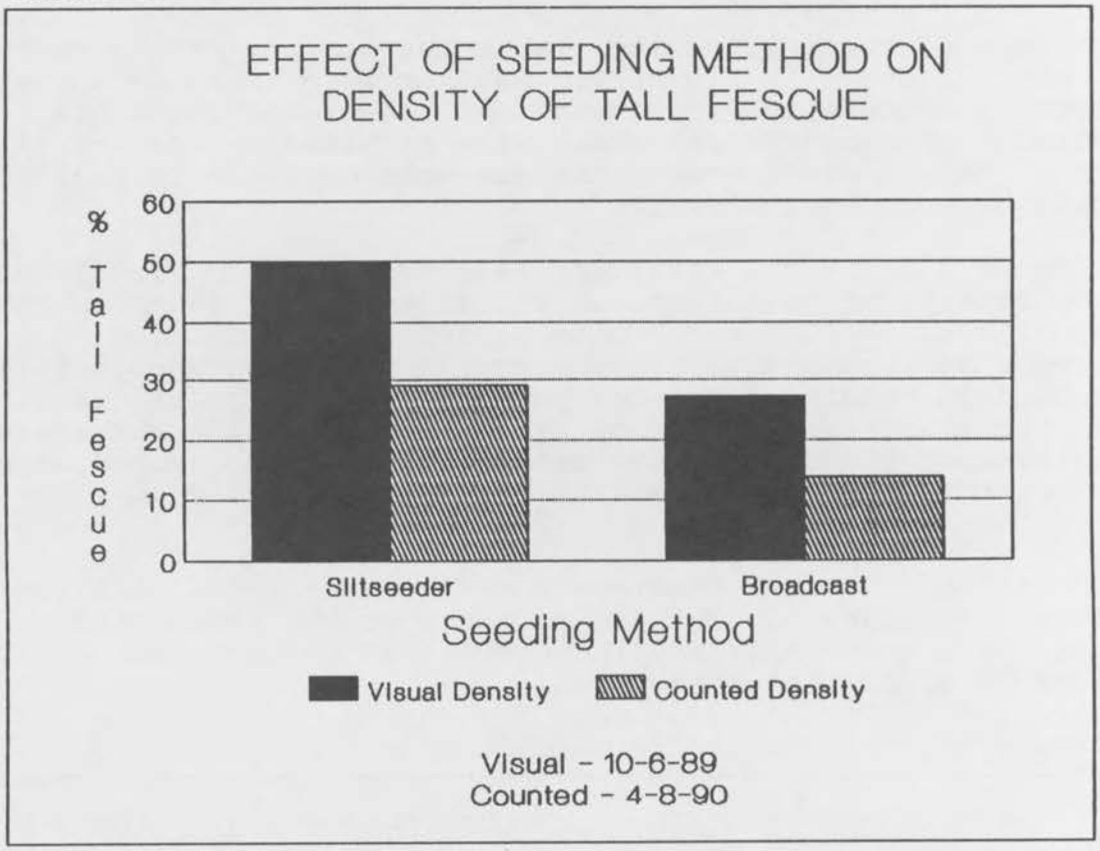
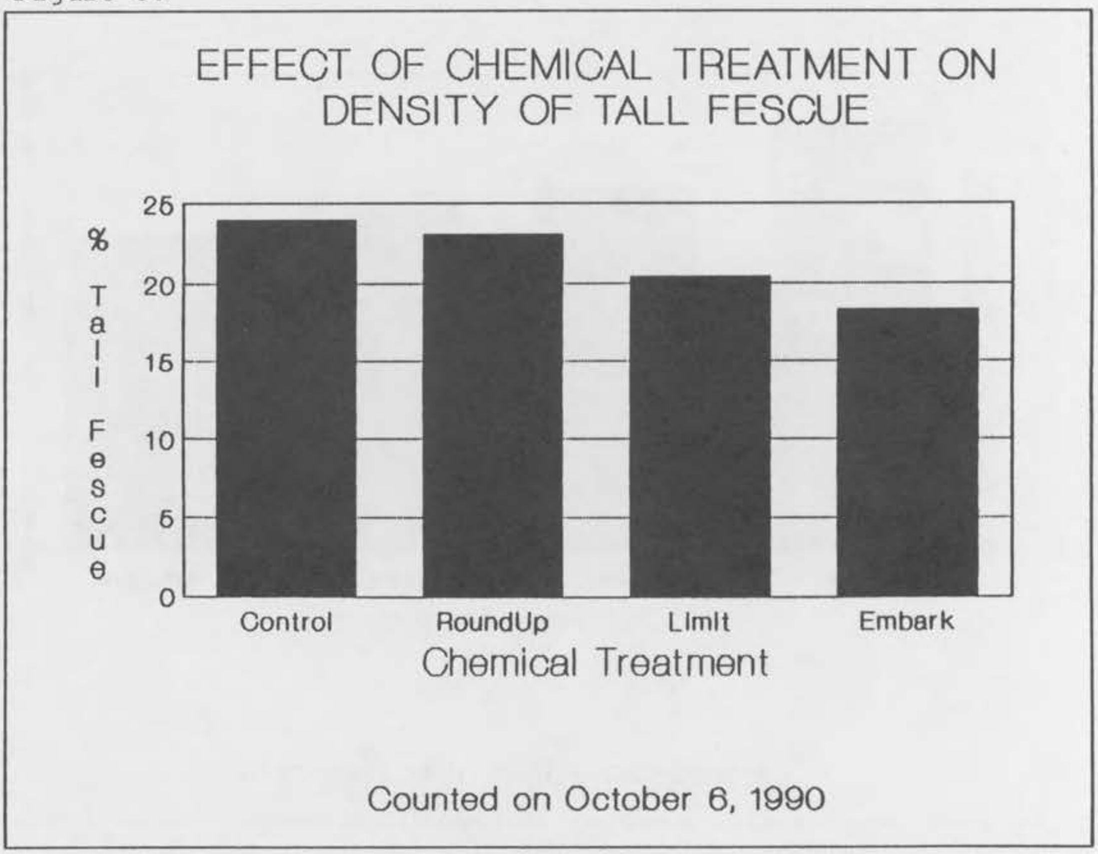


Figure 3.



TITLE: Identification of Leptosphaeria korrae and Ophiosphaerella herpotricha, Two Turfgrass Patch Pathogens, with Cloned DNA probes.

OBJECTIVE: To develop a diagnostic procedure for identifying fungi associated with patch diseases of turf

PERSONNEL: N. Tisserat, S. Hulbert, and A. Nus, Dept. of Plant Pathology

INTRODUCTION:

The isolation and identification of fungi associated with patch diseases of turfgrass (spring dead spot, zoysia patch, summer patch and necrotic ringspot) is difficult and time-consuming. Accurate diagnosis of the pathogen may take several weeks. In addition, differentiation of the patch organisms is complicated by similarities in colony morphology in culture and the inability to induce fruiting structures necessary for accurate identification. A more reliable means of identification was developed using a DNA fingerprinting technique.

RESULTS:

Two different DNA fragments were cloned from L. korrae into the bacterium Escherichia coli. The probes, 0.8 and 1.2 Kb in size, were specific to L. korrae and did not hybridize to genomic DNA of other patch disease-causing fungi, including L. narmari, Gaeumannomyces incrustans, G. graminis v. graminis., G. graminis v. tritici, G. graminis v. avenae, Magnaporthe poae, Ophiosphaerella herpotricha, and Rhizoctonia solani. The DNA probes did not cross-hybridize, but hybridization patterns frm Eco RI digest of genomic L. korrae DNA implied that they belonged to the same repetitive element family. No polymorphisms were detected among L. korrae isolates with either probe.

We hope to develop a technique whereby these probes can be used on turf samples to rapidly and accurately identify pathogens associated with patch diseases.

TITLE: Species Water Use

OBJECTIVE: To determine the consumptive water use and supplemental irrigation requirement for an acceptable level of quality for cool- and warm-season turfgrass species commonly grown in Kansas.

PERSONNEL: Jeff Nus, Research and Teaching
Dave Fox, Turfgrass Ph.D. Student

INTRODUCTION:

As ground water levels continue to decrease and municipal water sources become more expensive, it is essential that the Kansas turfgrass manager have the information necessary to effectively manage turfgrass areas with the minimum amount of irrigation water necessary to maintain an acceptable turf quality. Using species that possess the lowest water use and highest drought tolerance offers the best strategy for reducing irrigation needs.

Although some information is available concerning water use by turfgrass species, it has been generated in other parts of the country where environmental conditions are usually less stressful and often uses the species tested are not widely used in Kansas. Information is needed concerning consumptive water use for those species commonly used in Kansas and grown under conditions of persistent hot summer winds that result in excessive evaporative demand.

MATERIALS AND METHODS:

The determination of minimum water requirements for major turfgrass species in Kansas will be done in a field study at the Rocky Ford Turfgrass Research Plots in Manhattan. Each of four species has been established in Section E of the Toro Research Irrigation System on 10 4.6 x 4.6 m plots. Each of the 40 plots can be irrigated independently. Species include 'Rebel' tall fescue, 'Midiron' bermudagrass, 'Meyer' zoysiagrass, and 'Texoka' buffalograss.

Irrigation will be initiated when the average soil water content (v/v) to a depth of 150 mm, as determined by time domain reflectometry (TDR), reaches a critical level of soil moisture depletion. Preliminary data suggest that critical volumetric water contents resulting in wilting of Kentucky bluegrass are approximately 16% on the existing Chase silt clay loam (Nus, unpublished data). Dry-down cycles will be used to determine critical volumetric water contents inducing wilting for the study species.

The experiment will utilize a completely randomized design with treatments arranged factorially (4 species, 2 mowing heights). Each species will be mowed at both high and low cutting heights for that species. Tall fescue and buffalograss will be mowed at 50 and 100 mm. Bermudagrass and zoysiagrass will be mowed at 13 and 26 mm. Each species by mowing treatment combination will be replicated five times. Each plot will be irrigated independently via pop-up, quarter circle, spray heads when critical soil moisture depletions have been reached.

Total water received by irrigation and precipitation will be recorded. Water use for monthly and seasonal periods will be determined, but this will include the fraction leached as well as evapotranspiration (ET). In order to determine actual ET (consumptive water use), weighing lysimeters installed in each plot will be weighed daily throughout the season. Weight recordings will be taken after mowing to minimize any confounding by differential clipping yield during the weighing period.

Root weights by soil depth will be obtained during the dry-down periods in order to relate rooting patterns to water extraction for each species. The Chase silty clay loom extends for at least 300 mm without any layers. Thus, rooting patterns for each species should be typical of unlayered soil conditions. Monitoring total clipping yield during the dry-down periods will allow water use efficiency to be calculated. Other plant growth measurements to be made include monthly visual quality, shoot density, and verdure. Incidences of disease and weed infestation will be noted.

<u>Note</u>: Research is in progress, and results will be presented next year.

TITLE: Physiological and Morphological Adaptations and Responses to Water Stress in Warm- and Cool-Season Turfgrass Cultivars

OBJECTIVES: To investigate interspecific and intraspecific variation in physiological and morphological drought tolerance mechanisms such as turgor maintenance by osmotic adjustment, stomatal conductance, cell wall elasticity, biomass partitioning, and stomatal and non-stomatal water loss of warm- and cool-season turfgrasses as they are subjected to laboratory-simulated drought conditions.

PERSONNEL: Jeff Nus, Research and Teaching
Dave Fox, Turfgrass Ph.D. Student

INTRODUCTION:

In an attempt to gain an understanding of turfgrass response to prolonged water stress and factors important in determining turfgrass irrigation needs, it is essential that drought resistance mechanisms be identified and that inter- and intraspecific variation in drought resistance mechanisms and overall water use be investigated.

Turgor maintenance by osmotic adjustment has been listed as a drought tolerance mechanism, because it enables certain plants to maintain turgor-mediated processes such as growth and stomatal conductance as water deficits develop. Although most osmotic adjustment research has been done on cereal grains, turfgrass researchers are beginning to adopt techniques for this type of research. Identification of such an adaptive response among cultivars of a species would be of prime interest to turfgrass breeders. Such information could be incorporated into future breeding/selection programs for which identification of drought tolerant germplasm is desired.

Because stomatal function, as an adaptive response, plays a major role in determining overall water use and stomatal conductance is turgor-mediated, establishing the relationship between capacity for turgor maintenance and water use requirement is essential. Physiologically, the effects of drought on the relationship between leaf water potential, cell wall elasticity, and stomatal conductance are of prime importance in the determination of overall water use.

Drought resistant plants often have high root:shoot ratios. That is, a greater proportion of a drought resistant plant's biomass is partitioned into below-ground organs. It is important to quantify any inter- or intraspecific variation in biomass partitioning in an effort to establish root:shoot ratios as a selection criterion that turfgrass breeders may use to increase drought resistance of improved germplasm.

MATERIALS AND METHODS:

Laboratory experiments will be used to study inter- and intraspecific differences of various adaptive responses of warm- and cool-season turfgrasses to simulated drought conditions. Physiological and morphological parameters that will be evaluated in these studies include turgor maintenance by osmotic adjustment, stomatal conductance, cell wall elasticity, biomass partitioning, and stomatal and non-stomatal water loss.

Capacity for turgor maintenance by osmotic adjustment and cell wall elasticity shifts, in response to increased water stress, of four cultivars each of zoysiagrass, bermudagrass, buffalograss, tall fescue, Kentucky bluegrass, and perennial ryegrass will be evaluated from moisture release curves of excised leaves before and after controlled drought simulation. Drought conditions will be produced in the growth chamber on hydroponically grown plants by using nutrient solutions containing successively more concentrated polyethylene glycol (PEG). A steady-state porometer will be used to assess stomatal and non-stomatal water loss and stomatal conductance in response to increasing water stress. Biomass partitioning will be evaluated from leaf, root, tiller, and rhizome dry weights. Overall water use will also be determined photometrically by treating individual nutrient culture jars as mini-lysimeters. Water use efficiency for each species and cultivar will be calculated.

Note: Research is in progress, and results will be presented next year.

TITLE: Alternative Turf Species Study

OBJECTIVE: To test various grass species for their adaptability for use as turfgrasses under Kansas conditions

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching and 10 other cooperators
Kevin Kamphaus, Turfgrass Technician

INTRODUCTION:

Many turf managers are surprised to learn that of all the species used as turfgrasses, only one (buffalograss) is native to the U.S. All other currently utilized turfgrass species, such as bermudagrass, bluegrass, etc. are native to Europe, Africa, or Asia. Most breeding programs, however, have developed improved cultivars for use in high maintenance conditions, where adequate moisture and fertility are available. In recent years, this approach has been challenged. Additional emphasis is now being placed on developing turfgrass cultivars specifically for low maintenance conditions. It is very rare that a cultivar selected under high maintenance conditions will perform well in low maintenance sites. It may prove beneficial to look at other species that have not been used extensively as turfgrass in an effort to identify those that might be adaptable to low maintenance conditions. This project is part of a regional effort to evaluate several species for use under such conditions.

MATERIALS AND METHODS:

Seed was received from Dr. Nick Christians, Iowa State University and plugs of buffalograss from Dr. Ed Kinbacher, University of Nebraska. The experiment was arranged in randomized complete block with main plots (species) split into 2 in, 4 in, or unmowed mowing treatments. Sixteen species were used and are shown with their seeding rates in Table 1. Two pounds of P_20^5 and 1.0 lb of N per 1000 ft^2 were applied at seeding. Irrigation was applied only for establishment. Quality ratings (1-9) are being given to each mowing height x species combination.

RESULTS:

Table 1 shows the monthly quality of 16 species of the Alternate Species Study through the growing season of 1989. Best performers in this test included Fairway Crested Wheatgrass, Alta tall fescue, and Ephraim Crested wheatgrass. Table 2 show the means of all species as affected by mowing height. These low maintenance species prefer very high mowing heights or no mowing at all to maintain maximum quality with no irrigation and very little fertilizer.

Table 1. Monthly quality (1-9) of entries in the NCR-10 Alternate Species Study.

Species	APR	MAY	JUN	JUL	AUG	SEP	OCT	Season Mean
Fairway Crested wheatgrass	4.3	4.1	3.7	4.9	4.3	4.4	4.7	4.3
Ephraim Crested wheatgrass	3.9	3.4	3.1	3.8	3.5	3.7	4.0	3.6
Sodar Streambank wheatgrass	3.8	3.2	2.9	3.3	2.4	2.6	2.3	2.9
Ruff Crested wheatgrass	1.0	1.0	1.0	1.2	1.1	1.1	1.3	1.1
Reubens Canada bluegrass	3.8	2.8	1.8	1.2	1.1	1.6	2.1	2.1
Durar Hard fescue	2.1	2.4	2.9	3.3	3.2	3.7	4.8	3.2
Covar Sheep fescue	3.4	3.3	3.1	3.3	2.8	3.7	4.4	3.4
Alta Tall fescue	2.7	3.5	4.2	4.8	4.2	4.6	4.8	4.1
Sheep fescue	2.4	2.6	2.6	2.9	2.4	2.8	2.9	2.7
Bulbous bluegrass	1.1	1.0	1.0	1.0	1.0	2.0	3.0	1.4
<u>Poa alpina</u>	1.7	1.3	1.2	1.3	1.0	1.0	1.0	1.2
Reton Red Top	3.4	2.6	2.0	2.0	1.3	1.7	2.3	2.2
Colt <u>Poa trivialis</u>	1.7	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Exter Colonial bentgrass	2.0	2.1	1.9	1.9	1.7	2.3	3.3	2.2
Texoka buffalograss	1.0	1.6	1.8	2.3	2.2	2.1	1.9	1.8
NE 84-315 buffalograss	1.3	1.4	1.6	1.8	1.2	1.3	1.7	1.5
Statistical significance	**	**	**	**	**	**	*8	*8

Table 2. Monthly quality of entries in the NCR-10 Alternate Species Study as affected by mowing height.

Mowing height	APR	MAY	JUN	JUL	AUG	SEP	OCT	Seasonal Mean
2 inches	2.1	2.0	1.8	2.1	1.9	2.3	2.8	2.1
4 inches	2.6	2.4	2.3	2.5	2.1	2.4	2.8	2.4
Unmowed	2.6	2.6	2.6	2.9	2.4	2.7	3.0	2.7
Statistical significance	**	**	**	**	**	*8	N.S.	**

TITLE: National Prairie Wildflower Test

OBJECTIVE: To evaluate 50 annual and 50 perennial wildflower species for the performance under eastcentral Kansas conditions and supply information for national compilation.

PERSONNEL: Jeff Nus, Turfgrass Research and Teaching

INTRODUCTION:

According to Crystal Rose-Fricker of Pure Seed Testing, Inc. of Hubbard, Oregon, wildflowers are gaining popularity across the United States for uses in parks, along roadsides, and in background areas of golf courses. Unfortunately, much information concerning species survival, performance, and maintenance is lacking. Because the federal government has initiated a program whereby roadside budgets must include wildflowers to help reduce mowing requirements and costs, it is necessary to establish basic survival, maintenance, and performance data for annual and perennial wildflower species that may be used in such settings.

MATERIALS AND METHODS:

Seeds of 50 annual and 50 perennial wildflower species were supplied to the Kansas State turfgrass program by Pure Seed Testing, Inc. of Hubbard, Oregon. Both annuals and perennials were planted in late April. Data on emergence, blooming period, and most serious weed pests are being recorded.

RESULTS:

Tables 1 and 2 show the blooming period for annual and perennial prairie wildflowers, respectively, for the 1989 growing season. Some annual species, including baby's breath, catchfly, corn poppy, globe gilia, mountain phlox, pimpernel, and sweet alyssum, did not emerge from seed supplied for the second year of the test. Perennial prairie wildflower species that did not emerge during the 1989 growing season included Siberian wallflower, forget-me-not, creeping zinnia, and English wallflower. Tables 3 and 4 give overall success ratings (1-5; 5 = excellent, 1 = dead) for annual and perennial species, respectively. Annual prairie wildflower species that performed well under Kansas conditions included African daisy, dwarf cornflower, mountain garland, scarlet flax, spurred snapdragon, tall plains correopsis, cosmos, California poppy, and garland chrysanthemum.

Perennial prairie wildflower species that performed well under Kansas conditions included black-eyed Susan, blue flax, dwarf lance-leaf coreopsis, prairie coneflower, purple coneflower, sweet William, white yarrow, dames rocket, red yarrow, and Roman chamomile.

Table 1. Blooming period for annual prairie wildflowers planted in Manhattan, Kansas. 1989 season.

Common Name	May	June	July	Aug	Sept	Oct
African Daisy		XXXXXXXXXXXXXXXXXX				
Baby's Breath		Did not emerge				
Catchfly		Did not emerge				
Corn Poppy		Did not emerge				
Dwarf Cornflower		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
Globe Gilia		Did not emerge				
Mountain Garland		XXXXXXXXXXXX				
Mountain Phlox		Did not emerge				
Pimpernel		Did not emerge				
Rocket Larkspur			XXXXXXXXXXXXX			
Scarlet Flax			XXXXXXXXXXXXXXXXXXXXXXXXXXX			
Spurred Snapdragon		XXXXXXXXXXXXXXX				
Sweet Alyssum		Did not emerge				
Tall Plains Coreopsis		XXXXXXXXXXXXXXX				
Lemon Mint			XXXXXXXXXXXXXXXXXXXXXXXXXXX			
Cosmos		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
Starflower			XXXXXXXXXXX			
California Poppy		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
Baby Blue Eyes			XXXXXXXXXX			
Garland Chrys.			XXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Blue Bells	XXXXXXXXXXXXXXXXXXXXXXXXX					
Tidy Tips	XXXXXXXXXXXX					
Indian Blanket	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX					
Bird's Eyes		Did not emerge				
Tall Godetia		Did not emerge				

Table 2. Blooming period for perennial prairie wildflowers planted in Manhattan, Kansas. 1989 season.

Common Name	April May June July Aug Sept Oct
Black-Eyed Susan	XXXXXXXXXXXXXXXXXXX
Blue Flax	XXXXXXXXXXXXXXXXXXXX
Dwarf Columbine	XXXXXXXXXXXXXXXXX
Johnny Jump-Up	XXXXXXXXXXXXXXXXXXXXXXXX
Dwf Lance-Leaved Coreopsis	XXXXXXXXXXXXXXXXXXX
Maiden Pinks	XXXXXXXXX
Missouri Primrose	XXXXXXXXXXXXXXXXXXXXXX
Prairie Coneflower	XXXXXXXXXXXXXXXXXXXXXXXXXXX
Purple Coneflower	XXXXXXXXXXXXXXXXXXXXXXXXXXX
Siberian Wallflower	Did not emerge
Sweet William	XXXXXXXXXXX
Soapwort	XXXXXXX
Snow in Summer	XXXXXX
White Yarrow	XXXXXXXXXXXXXXXXXXXXXXXXXXX
Dames Rocket	XXXXXXXXX
Forget-Me-Not	Did not emerge
Creeping Zinnia	Did not emerge
Tall Evening Primrose	XXXXX
Small Burnert	XXXXXXXXXXX
Red Yarrow	XXXXXXXXXXXXXXXXXXXXX
Gilia	XXXXXXXXXXXXXXXXXXXX
Wild Thyme	XXXXXXXXXXXXXXXXXXXXX
Rocky Mtn Penstemon	XXXXXXXXXXX
English Wallflower	Did not emerge
Roman Chamomile	XXXXXXXXXXXXXXXXXXXXXXXXXXXX

Table 3. Evaluation of annual prairie wildflowers planted in Manhattan, Kansas. 1989 season.

Common Name	Emergence	Flowering Dates	Overall success rating Rep 1	Rep 2	Mean
1. African Daisy	Yes	6/20 - 8/10	5	5	5
2. Baby's Breath	No	--	1	1	1
3. Catchfly	No	--	1	1	1
4. Corn Poppy	No	--	1	1	1
5. Dwarf Cornflower	Yes	6/20 - frost	5	5	5
6. Globe Gilia	No	--	1	1	1
7. Mountain Garland	Yes	6/15 - 7/10	4	4	4
8. Mountain Phlox	No	--	1	1	1
9. Pimpernel	No	--	1	1	1
10. Rocket Larkspur	Yes	7/10 - 8/10	1	2	1.5
11. Scarlet Flax	Yes	7/10 - frost	4	4	4
12. Spurred Snapdragon	Yes	6/10 - 8/1	4	5	4.5
13. Sweet Alyssum	No	--	1	1	1
14. Tall Plains Coreopsis	Yes	6/20 - 8/10	5	5	5
15. Lemon Mint	Yes	7/10 - frost	2	1	1.5
16. Cosmos	Yes	6/20 - frost	5	5	5
17. Starflower	Yes	7/1 - 9/1	4	3	3.5
18. California Poppy	Yes	6/15 - frost	5	5	5
19. Baby Blue Eyes	Yes	7/1 - 8/1	2	2	2
20. Garland Chyrsanthemum	Yes	7/1 - frost	5	5	5
21. Blue Bells	Yes	6/15 - 9/1	3	2	2.5
22. Tidy Tips	Yes	6/15 - 7/15	1	2	1.5
23. Annual Indian Blanket	Yes	7/1 - frost	3	3	3
24. Birds Eyes	No	--	1	1	1
25. Tall Godetia	No	--	1	1	1

Were there any weed problems?

Yes, although we mulched heavily. Puncture vine, prostate spurge, crabgrass, and pigweed were present.

Table 4. Evaluation of perennial prairie wildflowers planted in Manhattan, Kansas. 1989 season.

Common Name	Emergence	Flowering Dates	Overall success rating Rep 1	Rep 2	Mean
26. Black-Eyed Susan	Yes	6/10 - 8/11	4	5	4.5
27. Blue Flax	Yes	5/10 - 8/11	5	3	4
28. Dwarf Columbine	Yes	4/20 - 6/10	3	2	2.5
29. Johnny Jump Up	Yes	4/15 - 8/1	2	2	2
30. Dwf. Lance-Lvd Coreopsis	Yes	5/20 - 8/1	5	5	5
31. Maiden Pinks	Yes	5/1 - 6/20	2	2	2
32. Missouri Primrose	Yes	5/15 - 8/1	3	3	3
33. Prairie Coneflower	Yes	6/15 - 10/1	5	4	4.5
34. Purple Coneflower	Yes	6/20 - 10/1	5	4	4.5
35. Siberian Wallflower	No	--	1	1	1
36. Sweet William	Yes	5/5 - 8/1	5	3	4
37. Soapwort	Yes	5/5 - 7/1	4	3	3.5
38. Snow in Summer	Yes	5/10 - 6/5	2	2	2
39. White Yarrow	Yes	5/20 - 8/1	5	5	5
40. Dames Rocket	Yes	5/1 - 6/5	4	5	4.5
41. Forget-Me-Not	No	--	1	1	1
42. Creeping Zinnia	No	--	1	1	1
43. Tall Evening Primrose	Yes	5/20 - 6/15	4	2	3
44. Small Burnet	Yes	4/20 - 6/1	4	2	3
45. Red Yarrow	Yes	5/20 - 8/1	5	4	4.5
46. Gilia	Yes	6/5 - 8/10	3	2	2.5
47. Wild Thyme	Yes	6/5 - 8/10	2	2	2
48. Rocky Mountain Penstemon	Yes	5/10 - 7/1	2	1	1.5
49. English Wallflower	No	-	1	1	1
50. Roman Chamomile	Yes	5/25 - 8/1	5	5	5

Were there any weed problems?

Yes, although we mulched heavily. Puncture vine, prostate spurge, crabgrass, and pigweed were present.

THANKS!!!

The following companies and organizations have contributed to the turfgrass research effort of Kansas State University, and we express our sincere appreciation for their support. Without their generosity, the scope of our turfgrass research would be greatly curtailed.

Kansas Turfgrass Foundation

Heart of America Golf Course Superintendents Association

Kansas Golf Course Superintendents Association

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