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The Soccer Fieldgauge: Measuring Field Performance

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Introduction

To the athletes of World Cup USA 1994, the soccer fields performed and felt as near alike as is possible for different grasses in varying climates. A simple, practical apparatus for measuring the factors of performance and feel made that possible.

Field Performance

Soccer players associate the performance of a field with the real or perceived influence of their play. The field characteristics that the players notice are surface uniformity, elasticity, and speed.

Uniformity. The uniformity of the turf is the foremost image the athlete has of a sports field. The quality of surface trueness is implied and the impression affects most of the other evaluations of playability. Uniformity can be measured as well as defined.

Elasticity. Players associate the feel of the elasticity or spring of the turf with the enhancement of their performance. Turf elasticity ranges from hard to snongv.

Speed. The speed of the playing surface is both real and perceived. Real speed for the runner is related to the elasticity and thickness of the total turf mat. Perceived speed links elasticity to the players' impression of overall uniformity and turf appearance.

Field Performance Measurement

The Soccer Fieldgauge was developed as a simple means to quantify an evaluation of the uniformity, elasticity, and speed of the turfgrass playing surface (Figures 3-6). The measured field characteristics are ball hop, ball roll, and ball deflection.

Ball Hop. The bounce of the ball at an angle to the surface or ball hop reflects the surface elasticity. The measurement of ball hop quantifies the response of the soccer ball to the turf and the spring of the turf to the running player.

Ball Roll. The roll of the ball across the surface is a measure of the speed. The turf uniformity, surface trueness, crown or slope, canopy density, and elasticity influence the speed of the rolling ball.

Ball Deflection. The tendency of the rolling ball to consistently roll true or veer from a straight line indicates surface trueness and crown or slope. Inconsistent ball deflection suggests a lack of surface uniformity.

Soccer Fieldgauge

The Soccer Fieldgauge is an aluminum ramp 3 meters (10 ft.) long elevated 2.1 meters (7 ft.) at 45° (Figure 1). The ramp provides consistent ball speed for the respective measurements. A ball release is located at the top of the ramp and a tape measure loop on the ramp base. The ball rolls along the two side rails of the channel for minimal friction. The ramp sections and the telescoped vertical support fit into a rigid golf travel case.

The Ball Hop Indicator (BHI) is a stationary pedestal, set 1 m. (3.3 ft.) from the ramp base, with pivoting bars 2 cm. (.8 in.) apart calibrated in centimeters above the ground. Ball hop is measured by the struck bars pivoting away and recording the highest (Figure 2). The BHI fits into a small briefcase.

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Figure 1. Soccer Fieldgauge ramp and ball hop indicator.

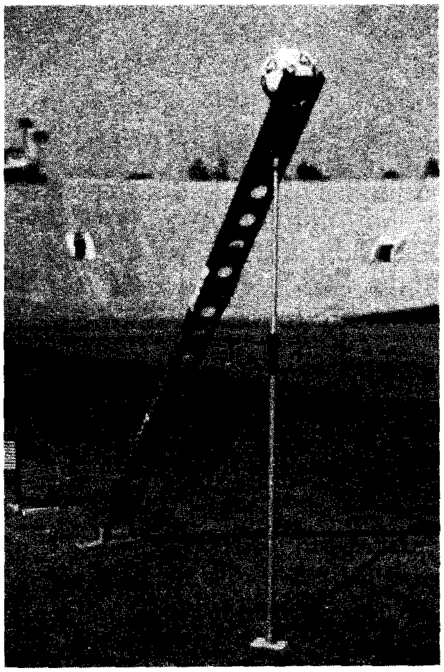
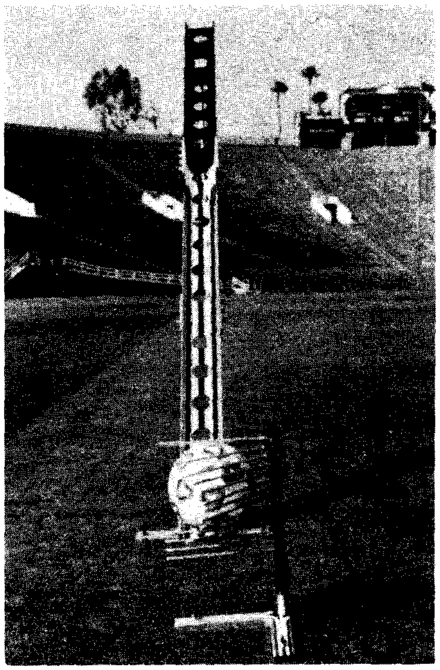


Figure 2. Ball passing through ball hop indicator of Soccer Fieldgauge.



Field Measuring Procedure

The soccer ball rolls down the ramp striking the BHI bars at the apex of the first hop. For consistent measurements, the ball is inflated to 0.6 kg. sq. cm. (0.6 atm.; 8.5 psi) and placed with the valve positioned the same each time.

Roll and deflection are measured by allowing the ball to bypass the BHI and roll freely down a straight line marked with a measuring tape. The distance from the foot of the ramp and the deflection the ball takes from the line are measured and recorded.

Evaluations are repeated a minimum of ten times (ten ball hop and ten roll/deflection). High and low readings are thrown out, and the remaining eight averaged. Measurements in two opposite directions are taken in a minimum of three sites on the playing field.

Cultural Practice Modification

The cultural practices that have the greatest short term affect on the ball hop and roll of the sports field are mowing height and frequency, rolling with a heavy smooth roller, and irrigation water management.

Mowing Height. Ball speed was strongly affected by mowing height. For every 0.6 cm. (0.25 in.) decrease in mowing height, the roll distance (speed) increased by one m. (3.3 ft.). In the range between 2.5 cm. (1 in.) and 5 cm. (2 in.) lowering the mowing height 0.6 cm. increased ball hop by 1.75 cm. (0.6 in.). Below 0.6 cm., the mowing height had no significant effect on ball hop. Mowing frequency had an effect on ball roll and ball hop only when new growth exceeded approximately 0.3 cm. (0.125 in.).

Rolling. Turf was rolled twice with a 454 kg. (1000 lb.) smooth roller increased roll distance by 1.4 m (4.6 ft.) where turfgrass was mowed at 2.9 cm. (1.125 in.) and ball hop increased 5 cm. (2 in.). Where turf mowed at 2.2 cm. (0.875 in.) was rolled twice ball roll increased by 3 m. (9.9 ft.) with no significant effect on ball hop.

Water Management. Only moisture conditions with penetrometer readings indicating either a very soft or very hard surface affected ball roll and ball hop. Relating the ball roll and ball hop to specific soil moisture content was very short term with practical limitations,

FIGURE 3. Soccer gauge ramp.

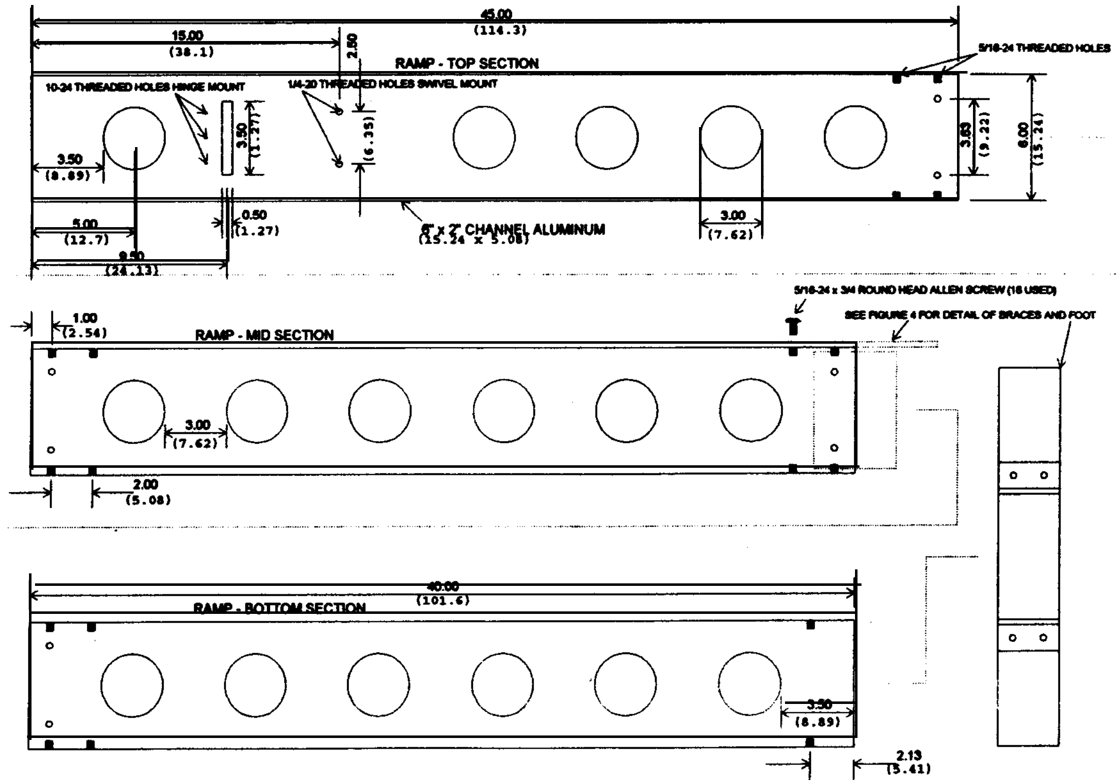


FIGURE 4. Detail of ramp top and foot.

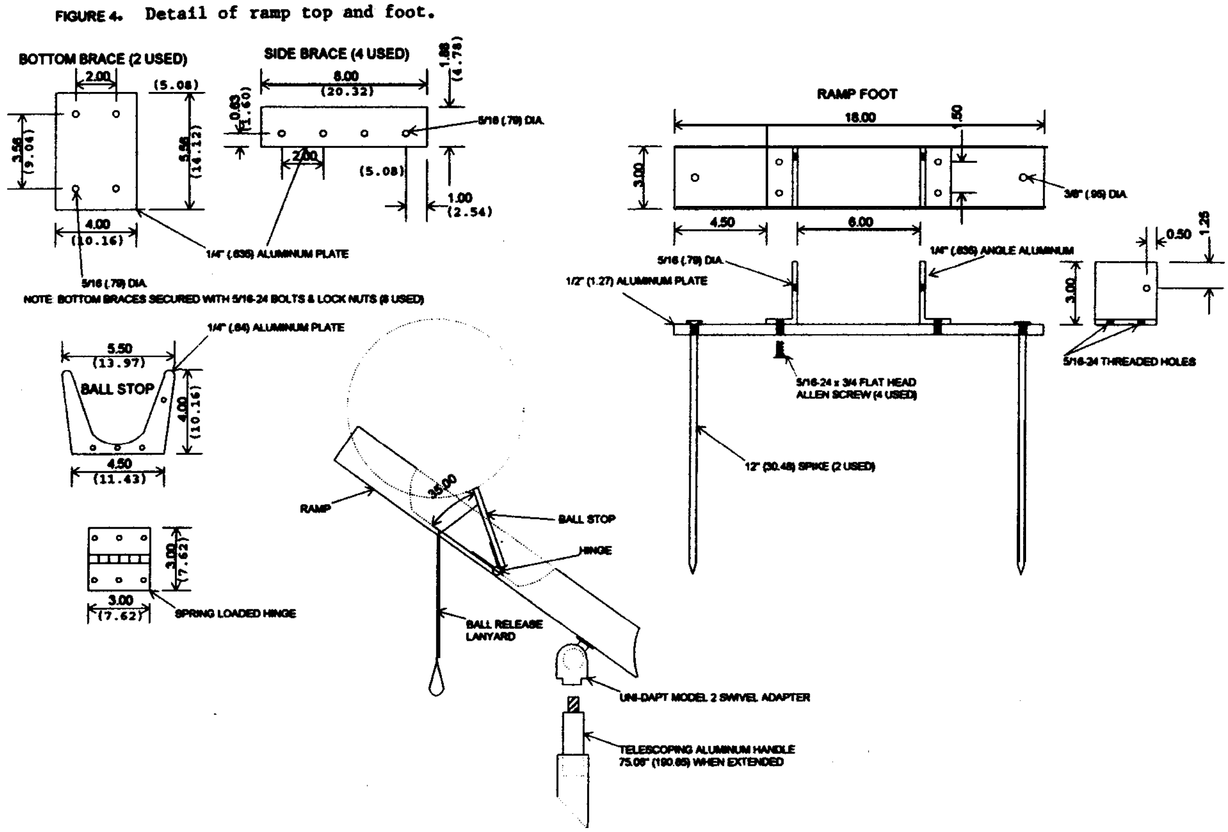


FIGURE 5. Ball hop indicator.

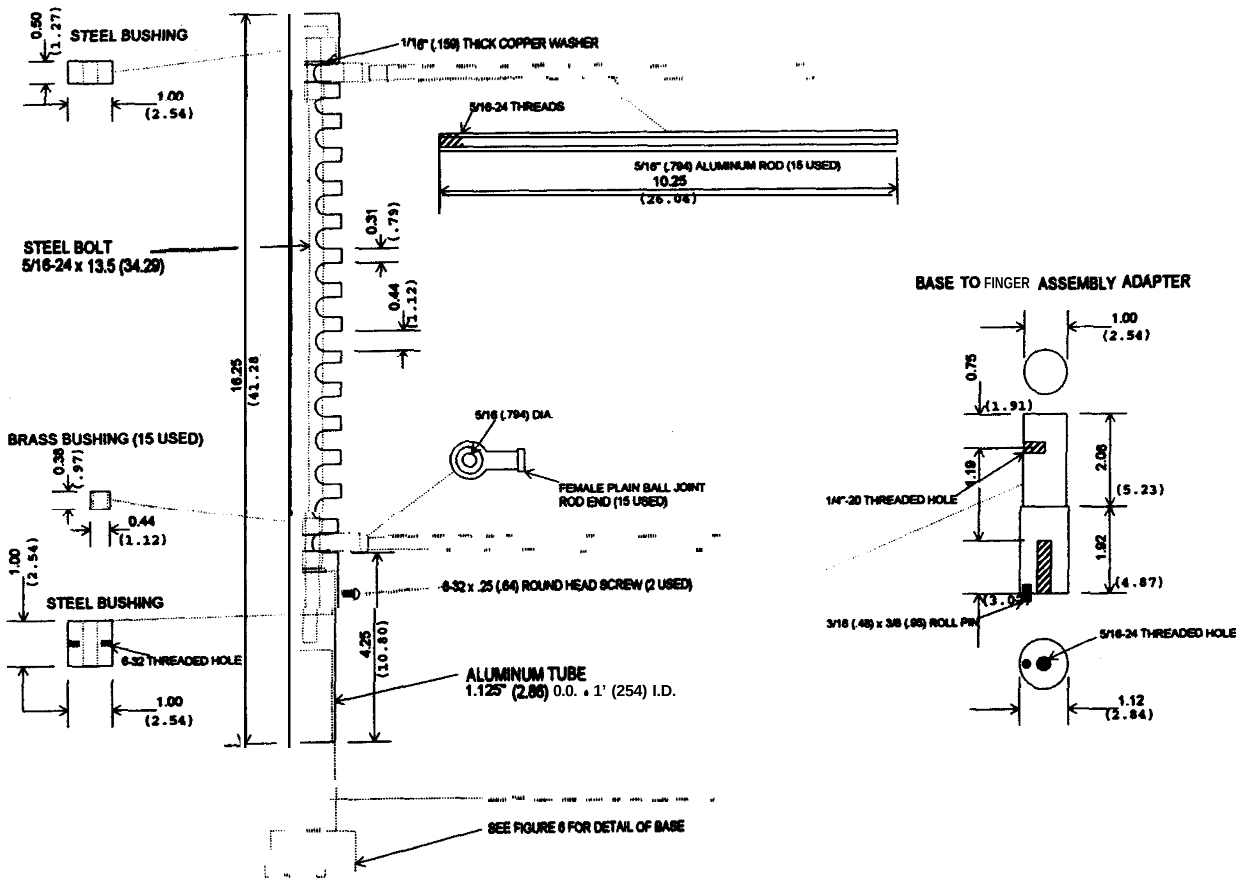
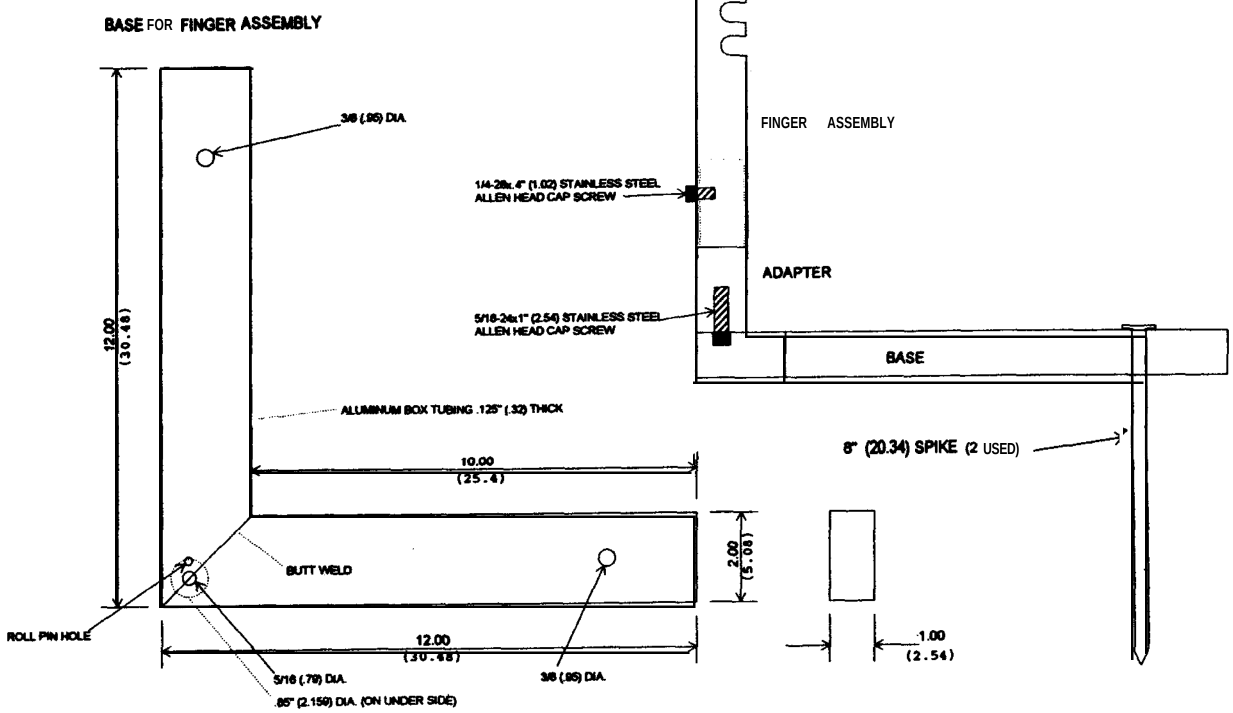


FIGURE 6. Ball hop indicator frame.



Algae Problems on Turf
A Review

J. Michael Henry[1]

During a study and research leave, I spent four months looking at the current literature on reclaimed water used for irrigation of turfgrasses. One of the common complaints from turf managers, especially golf course superintendents, is that the reclaimed water is the source of increased algae problems on greens and in lakes and ponds. This article is a summary of the current information regarding algae problems on turfgrass. The fact is that no work specifically addressing the role of reclaimed water and increased algae problems has been done. However, there is some new information that should be of interest to those experiencing algae problems on turfgrass.

Algae are single or multi-celled primitive plants that contain chlorophyll and are, therefore, able to produce their own food in sunlight. In wet turf areas they form a dense green-black surface scum, which impairs air and water movement into the soil. Also posing a safety hazard to workers and players who might slip on the slick surface coating are serious issues on their own. They also can prevent the normal shoot growth (stolon) that allows many grasses to fill in bare areas. Algae growth on the surface of golf greens and other soil surfaces where turf is growing is generally attributed to the following factors:

- Medium-low to high light intensity.
- Thin, open turf canopy that allows light to penetrate to the soil surface.
- Moist soil surface due to frequent rains and/or sprinkler irrigation. (Compacted soil also holds moisture at the surface.)
- Nitrogen available to the algae through the water or the soil.

Superintendents often have these questions:
Is the algae on my greens coming from the algae in my irrigation lakes? Which comes first, the algae or the bare spot on my green?

Recent work (Maddox and Krans, 1991) may suggest that the common perception of turfgrass managers that algae in irrigation water was the source of algae problems on the surface of greens and other turf areas is unfounded.

They collected samples from five golf courses in Mississippi from both irrigation lakes and golf green surfaces and analyzed the samples for the algae species and density of populations. They found approximately 90 species between the sources and locations over the year-long study. When the species found on the soil surfaces were compared with those from the irrigation lakes, they discovered that there was no correlation. Thus, they concluded that the algae on greens are not coming from the algae growing in the irrigation waters. It is widely known that aquatic algae and cyanobacteria (blue-green algae) do not grow on soil and soil-based algae cannot grow in water.

If the once logical assumption that algae on greens *is coming from the green lakes on golf courses has* been found to be potentially untrue, where does it come from? Their study did indicate a correlation between high populations of algae on greens with low grass density and poor turfgrass quality. It appears that algae on greens comes after the grass has thinned due to poor growth conditions (compaction, wear, disease, etc.).

Cultural Control Practicum

Typical turf management recommendations for algae control include:

- Reducing the time soil surfaces are moist.
- Eliminate light hitting the soil surface by encouraging a dense turf cover and raising the mowing height.
- Manage the fertilizer (especially nitrogen and phosphorus) to avoid their continuous supply at the surface.
- Combine the above management strategies with the judicious application of registered algaecides recommended for turfgrass application (see page 19).

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Soils Factors

The most important factor in reducing the time the soil surface is kept moist is the soil type itself. A pure sand green has excellent drainage and allows the surface to drain relatively quickly. A native soil green or a sand green that has a clogged surface will hold water on the surface for long periods allowing the algae to gain a foothold and thrive once established. In the West the fact that we have management control over the irrigation makes this a critical tool in the control of algae in greens. Less frequent irrigation coupled with timing during the day will help reduce the time the surface is moist. Irrigating greens just prior to sunrise rather than letting them sit moist all night would be an example of irrigation management to discourage algae.

Clogged sand surfaces and compacted native soil surfaces are major factors in keeping the surface moist for long periods. Aerification methods that remove soil, leaving openings for water and air movement down into the soil profile are the best means of overcoming these conditions. Preventing the clogging of a sand green surface seems to be worth considering, because it negates much of the benefits of a carefully selected uniform sand base for high trafficked sports turf situations. Causes of this condition include: the addition of unwashed sod over the sand base; application of some organic fertilizers; wind-blown dust from areas adjacent to the turf area; greens top-dressings that contain slit and clay or organic matter (Burpee and Anderson, 1987; Goss, 1987). Improper top-dressing that traps thick layers of thatch or different textured top-dressing materials that result in layers in the soil profile over time can reduce water and air movement into the root zone. Even the organic and inorganic carriers found in some turf fertilizers have been suggested as culprits by superintendents.

Thatch

Dense thatch can serve as a deterrent to water movement into the soil and root zone. While it keeps the soil surface moist for longer periods of time, the thatch itself can be the substrate for algae growth. Once a layer of algal scum forms over the thatch it further reduces the movement of water and air into the soil and turfgrass root zone.

Light

Sunlight is a needed component for algae growth, although one theory relating to the formation of black-layer on sand greens suggests algae as a major player even below the soil surface (Hodges, 1987, 1989). Turfgrass cover that is dense enough to eliminate sunlight on the soil surface will help reduce the competitive factor for algae growth. On a highly trafficked sport turf, the normal wear associated with players causes a thinning of the turf cover or its total elimination in severe cases. Another factor that is often overlooked is the array of grass maintenance practices that also stress the turfgrass. One contributing factor to turf thinning around the margins of golf greens is the over-use of groomers especially on the “clean-up” pass around the circumference of the green. This often results in double verticutting in this area and can greatly thin the grass cover where normal wear and play is minimal except on focused traffic entry or exit points around the green. Eliminating this practice on the perimeter “clean-up” pass and in areas of the green that are already thin, can help encourage more turf cover to reduce light and bare areas that favor algae colonization and growth.

Fertilizer Management

It is a known fact that nitrogen and phosphorus are especially beneficial to aquatic or terrestrial algae. Any management practice that keeps these elements in constant supply at the surface will greatly encourage algae growth on greens. Reclaimed water used for turf irrigation generally has elevated levels of nitrogen and phosphorus, but the levels vary greatly by source and time-of-year. If a manager is using reclaimed water, any practice that lengthens the period between irrigation applications reduces not only the moisture on the surface, but also the nutrients that greatly encourage algal growth.

In some cases the management of the storage lakes and ponds on a golf course can help reduce the nutrients in the irrigation water. A storage lake that is out of play can be planted with a variety of aquatic plants that take up the nitrogen and phosphorus thus reducing the levels that are applied to the greens where they are used by the algae.

Situations where the storage ponds have a very high turnover will not benefit from this natural nutrient reduction system.

Slow-release fertilizers formulated for greens use are another possible long-term source of nutrients at the surface where algae can be encouraged. In situations where algae is a problem, the use of soluble fertilizers that move down into the soil away from algae on the surface will reduce this factor in algal growth.

Chemical Controls

Much work evaluating chemicals and pesticides to reduce algal growth on turf areas has been done around the world (Anonymous, 1983, 1986, 1988; Baldwin, 1988; Vyas, 1984). Few have shown much promise. It is clear that at best these materials can help only as long as the cultural practices that favor algae are eliminated and replaced with ones that discourage algae and encourage a strong dense turfgrass cover.

Fertilizers that Discourage Algae

Using soluble fertilizers that discourage algae is one recommendation that makes sense. Some benefit has been found with applications of ferrous sulfate or ferrous ammonium sulfate at the rate of 2 to 3 ounces dissolved in four gallons of water, applied over 1,000 square feet of turf. The higher rate should be reserved for locations with cool humid climates. Again this is not a means of eliminating the algae, but a tool that is useful in a comprehensive algae control program.

Non-Fertilizer Chemicals for Algae Control

In California, only two pesticides are registered for algae control on turfgrass. Copper sulfate is registered for turf use. It can cause damage to turfgrass and should be used only in severe cases where temporary damage to turf can be tolerated. The fungicide mancozeb (Fore@) is also registered for turf algae control in the State. Follow label rates for algae control. These recommendations are contained in the University of California Cooperative Extension publication #21345, *Moss and Algae Control in* Lawns (Harivandi, 1986).

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Effects of Pre-Plant Incorporation of Polymers on Turfgrasses

John Karlik[1]

Introduction

Periodic California droughts and local water shortages have generated interest in alternative approaches to water conservation in landscapes, including turfgrass. Polymers have been suggested as a soil amendment which can benefit establishment and growth of turfgrass (Nus, 1992).

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Furthermore, polymers may affect field hardness in an established turfgrass sward. Accordingly, a series of experiments was conducted on two turfgrasses to determine the effects of six rates of polymer on establishment of two turfgrass species, performance under reduced irrigation, and field hardness.

Materials and Methods

The study was located at the UC Cooperative Extension facility in Bakersfield, CA. The soil was a loam with 38,44 and 18 percent sand, silt and clay, respectively, which had previously been disced. The experimental area was prepared by rototilling in two directions. An irrigation system using gear-driven single-stream heads was installed in each of two 54 X 60 ft areas; the distribution uniformity was 0.89.

Experiments were conducted on separate swards of common bermudagrass and tall fescue. Prior to planting, a cross-linked polyacrylamide polymer was incorporated at six rates (in lb/1000 sq ft): 0, 5, 15, 30, 60 and 90. Polymer was weighed and spread on the surface of each 8 x 15 ft plot, and incorporated to a depth of three inches with a small rototiller. The polymer treatments were replicated four times and arranged in a randomized complete block design for each grass.

Establishment Study. A tall fescue blend consisting of 39% 'Titan,' 30% 'Stagecoach' and 30% 'Conestoga' was seeded, at the rate of 8 lb/1000 sq ft , on March 30, 1993 and lightly raked. Immediately, the plots received 0.21 inches of water. The next day, the irrigation controller was set to 15 minutes/day, which provided 0.078 inches, applied in the early morning. On April 2 1, the controller was reset to 30 mm/day, providing 0.16 inches at each daily irrigation. On April 29, the controller was reset to 45 mm/day, providing 0.23 inches at each daily irrigation: Coverage of turf was estimated visually over a four week period of time, with five ratings taken at one week intervals beginning April 16. ET,, for the establishment and data collection period was 9.47 inches compared to 7.98 inches of irrigation applied.

Unhulled common bermudagrass was seeded June 11 and the controller set to deliver .36 inches of water per day, divided into 7 equal increments. Bermudagrass germinated and rapidly filled all plots.

Reduced Irrigation Study. Beginning July 16, irrigation was reduced on both tall fescue and bermudagrass study areas. Plots of both turfgrasses had filled; turf coverage was uniform. The historic ET, for this period of time in Bakersfield is 0.25 inches/day or 1.75 inches/week. In 1993, ET, differed little, < l%, from the historic average for the period July 16-August 3 1. The irrigation controller for the tall fescue was reset to apply 60% of historic weekly ET,, with one-third of the water applied on Tuesday, Thursday and Saturday of each week. The controller of the bermudagrass area was reset to apply 40% of the historic weekly ET,, half applied Monday and half Thursday. Calculations were based on UC Leaflet 21499 (Gibeault et al.) and included accounting for irrigation system uniformity. Tall fescue and bermudagrass plots were evaluated for color on July 27 and August 3.

Daily maximum temperatures greater than 100" resulted in obvious stress to tall fescue, which required tall fescue irrigation to be increased August 5 to 80% of ET,,, applied daily. In contrast, bermudagrass showed no signs of stress, and irrigation was reduced to a single application per week of 20% of the historic weekly ET_0.

Field Hardness Study. Tall fescue had recovered upon resumption of 80% of ET_0. Bare spots were reseeded in August and plots were uniform. Bermudagrass, although receiving little irrigation, persisted in uniform growth. A traffic treatment was imposed with a Brinkman traffic simulator (BTS), (Cockerham and Brinkman, 1989). Treatments were applied to half of each plot in a split-block design. Two passes were made on September 10, and two more September 13, followed by rating. Ratings were made using a penetrometer, which measures depth of penetration of a probe, and a Clegg accelerometer, which measures rate of change of velocity of a dropped mass when it impacts turf. Three measurements with each device were made on each sub-plot. Two passes of the

BTS were made on September 17, 20, and 22, followed by measurements of plots with the penetrometer and accelerometer.

Irrigation Cutoff Study. Irrigation ceased on bermudagrass and tall fescue on September 27. Plots were rated at approximately weekly intervals until mid-November.

Results

Bermudagrass did not show any effect from polymers in any of the experiments; polymers did not affect appearance or field hardness. The only effects of treatments on bermudagrass were attributable to the imposition of traffic, observed September 27 and October 11, following irrigation cutoff. There were no significant polymer x traffic interactions.

Tall fescue germination and coverage were not affected by polymer rate (Table 1). Tall fescue color decreased rapidly under reduced irrigation. However, polymer rate did not affect appearance among plots when irrigation was reduced (Table 2). Although tall fescue declined following irrigation cutoff, polymer rate did not affect appearance among plots.

Table 1. Coverage of tall fescue following seeding[1].

Polymeter Rate (lb/1 000 sq ft)	Apr. 16	Apr. 22	Apr. 29	May 7	May 13
	Rating Date (1993) — Percentage Cover				
0	10	20	25	25	25
5	25	35	33	38	40
15	10	15	20	25	33
30	23	35	40	50	58
60	5	13	23	30	43
90	13	23	28	40	40

[1] Means not significant on any date based on an F test at the 5% level of probability.

Table 2. Color of tall fescue under reduced irrigation[1].

Polymer Rate (I b/I 000 sq ft)	July 27	August 3
	Rating Date (1993) — Color	
0	5.1	3.0
5	5.6	3.3
15	5.0	3.0
30	6.6	3.4
60	5.9	3.1
90	5.6	3.1

[1] Means not significant on any date based on an F test at the 5% level of probability.

Polymer rate did affect field hardness on the tall fescue. There were no significant effects after four BTS passes; however, after 10 BTS passes, field hardness was affected by polymer rate as measured by both the penetrometer and the accelerometer. There was no traffic X polymer interaction significant. When data for subplots of traffic vs. no traffic were analyzed separately, a difference emerged. Field hardness was not affected by polymer rate on subplots receiving no traffic treatments with one exception. On subplots receiving traffic treatments, field hardness was affected by polymer rate after 10 BTS passes, as measured by both the penetrometer (Table 3) and the accelerometer (Table 4).

Table 3. Penetrometer measurements in tall fescue turfgrass, after 10 BTS passes.

Polymeter Rate (lb/1000 sq ft)	Penetrometer Reading
60	6.0 a[1]
90	6.2 a
30	6.6 ab
15	7.0 bc
5	7.4 c
0	7.4 c

[1] Higher numbers indicate less penetration. Means were separated by Fisher's protected LSD test at the 5% level of probability. Means were calculated from four subplots receiving the same polymer rate; three penetrometer readings were taken on each subplot.

Table 4. Accelerometer measurements in tall fescue, after 10 Bts passes..

Polymeter Rate (lb/1 000 sq ft)	Accelerometer Reading
60	44 a[1]
90	46 a
30	50 ab
15	54 bc
0	61 c
5	62 c

[1] Means were separated by Fisher's protected LSD test at the 5% level of probability. Higher numbers indicate greater rate of change of velocity of a dropped mass, and therefore greater field hardness. Means were calculated from four subplots receiving the same polymer rate; three accelerometer readings were taken on each subplot.

Discussion

In the southern San Joaquin Valley, bermudagrass has been observed to be drought tolerant and tenacious under any irrigation regime, due in part to its deep rooting, which makes accessible deeper parts of the soil profile. Although tall fescue is the cool-season turfgrass best adapted to the southern San Joaquin Valley, observations suggest that it is marginally adapted during periods of warm weather.

Attention to irrigation is required to maintain tall fescue during the warmest part of the growing season.

The presence of polymers or the rate did not affect establishment or quality of either bermudagrass or tall fescue under adequate or reduced irrigation regimes. The bermudagrass continued to thrive under reduced irrigation. Tall fescue plots showed a decrease in quality under reduced irrigation, but no differences were attributable to presence of polymer. After irrigation cutoff, a gradual decrease in quality was observed for both grasses, but again no differences among plots were attributable to polymer presence.

The loam soil at the experimental site would be expected to hold l-2 inches of available water per foot of soil (Harris et al.). Because polymers retain water, effects of polymers may be more pronounced on sandy soils. Also, turf is rarely installed without an irrigation system, which could be adjusted to compensate for soil characteristics and conditions of high evapotranspiration.

It could be argued that differences due to polymer rate were obscured by soil variability in these experiments. However, the two acre experimental area appears uniform, and the subset of the area used for the polymer study was disced and tilled repeatedly prior to the experiment to eliminate potential variability.

Differences in field hardness were noticed when walking over plots, especially after irrigation. The ground surface of plots with the highest rate of polymer was obviously soft following irrigation and was easily deformed by walking. Accelerometer and penetrometer data should be considered for quantifying noticeable differences in field hardness, which would affect playability. Polymers can affect field hardness, and it is this effect rather than any related to irrigation scheduling or water conservation which may be more useful in culture of turfgrass.

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Sensitivity of Seashore Paspalum to Postemergence Turf Herbicides

David W. Cudney, Victor A. Gibeault, Clyde L. Elmore, and John S. Reints

Seashore paspalum *(Paspalum vaginatum)* is a relatively new turf species in California. Since its introduction into California in the early 1980's, information concerning its culture and management have been developed. However, little is known about its response to the commonly used foliar turf herbicides.

Few of the herbicides that are used in turf are completely selective. When 2,4-D or MSMA or nearly any of our foliar herbicides are used, the symptoms that they can produce in turf are seldom noticed. These symptoms range from a temporary slowing of growth to temporary changes in color. Most often these symptoms persist for but a few days. The negative effect of the symptoms is far outweighed by the benefits of weed control. Yet occasionally the response of a species to an herbicide is severe enough that the herbicide can not be used with that turf species. An example of such a

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phytotoxic response can be found in the reaction of St. Augustine turf to MSMA application.

In order to assess the effects of the commonly used foliar herbicides in seashore paspalum the following trial was established on a healthy four-year-old turf sward at the University of California, Riverside Experiment Station Turf Facility on August 23, 1995. The herbicides tested included: 2,4-D, MCPP, dicamba, MSMA, fenoxaprop, two of the most common commercial three-way herbicide formulations (containing 2,4-D, MCPP, and dicamba), and a commercial formulation of a four-way herbicide combination (2,4-D, MCPP, dicamba and MSMA). Each plot was 5 by 15 ft and all treatments were applied at rates typical of their use with other turf species with a CO, plot sprayer at a spray volume of 50 gallons per acre. The plots were arranged in a randomized complete block design with four replications of each treatment. Phytotoxicity evaluations were made 2, 5, 10, and 20 days after treatment. Mowing was discontinued during the evaluation period and measurements of turf height were made on the 20th day after treatment.

MSMA and the combinations containing MSMA, as well as fenoxaprop were injurious to the seashore paspalum turf. The extent of the injury from these herbicides increased with time. It is doubtful that MSMA or fenoxaprop could be used on seashore paspalum at normal rates of application. Dicamba, 2,4-D and MCPP alone and in three-way combinations did not cause appreciable injury except for temporary reductions in height from 2,4-D and MCPP. All plots, including the MSMA and fenoxaprop treatments had recovered from treatment effects 50 days after treatment (Table 1).

Table 1. Seashore paspalum post-emergence herbicide sensitivity.

						Phytotoxicity				Turf ht
Herbicide	Fenoxaprop	24-D	MCPP	Dicamba	MSMA	2 DAT	5 DAT	10 DAT	20 DAT	20 DAT
	lb. a.i./A					Rating [1]				in.
Dicamba				0.5		0.3	0.0	0.0	0.0	2.1
MCPP			1.5			0.3	0.0	1.0	1.0	1.6
2,4-D		1.5				0.0	0.0	2.0	2.0	1.4
Fenoxaprop	0.35					0.5	1.8	3.8	4.6	1.2
Combination #l		0.62	0.33	0.06		0.3	0.0	0.0	0.3	1.8
Combination #l		1.24	0.66	0.12		0.0	0.0	1.5	1.3	1.5
Combination #2		0.35	0.63	0.07		0.0	0.0	0.5	0.3	1.9
Combination #2		0.51	0.95	0.11		0.0	0.0	1.3	0.8	1.8
Combination #3		0.50	0.50	0.12	1.9	2.8	3.5	6.3	4.5	1.4
Combination #3		0.83	0.83	0.21	3.0	2.8	4.0	6.3	4.9	1.4
Control MSMA					2.0	3.3	3.5	5.8	5.8	1.4
Control						0.3	0.0	0.0	0.0	2.1
LSD @ 0.05[2]						1.0	0.5	1.1	1.2	0.3

0 - no effect, 5 - plantswith severe leaf burn symptoms, 10 – all plants dead.

[2] Least significant difference at the 5% level of probability.

WARNING ON THE USE OF CHEMICALS

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

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

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

PHYTOTOXICITY: Certain Chemicals may cause plant injury if used at the wrong stage of plant development or when temperatures are too high. Injury may also result from excessive amounts of the wrong formulation or from mixing incompatible materials. Inert ingredients, such as wetters, spreaders, emulsifiers, diluents and solvents, can cause plant injury. Since formulations are often changed by manufacturers, it is possible that plant injury may occur even though no injury was noted in previous seasons.

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

CALIFORNIA TURFGRASS CULTURE

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