PHYSIOLOGY RESEARCH: CHEMICAL GROWTH REGULATORS, WATER USE RATES, THATCH CAUSES, AND LOW TEMPERATURE KILL

Dr. James B. Beard, Professor
William J. Eaton, Turfgrass Technician
Ronald L. Yoder, Laboratory Technician
Department of Crop and Soil Sciences
Michigan State University

This paper reviews the results of selected turfgrass physiology and ecology research projects conducted at Michigan State University during the past year. The investigations were partially supported by donations of maintenance equipment, chemicals, fertilizers, and irrigation equipment from numerous turfgrass equipment and chemical companies throughout the state. Their continuing cooperation in furthering these research projects has been very valuable. Funds for the operational expenses have been provided in part through grants from the Michigan Turfgrass Foundation. Finally, the thatch research has been supported by a grant from the O. J. Noer Research Foundation.

CHEMICAL GROWTH REGULATOR EVALUATIONS

Four of the newer chemical growth regulator treatments plus an untreated check were utilized in this study conducted at Traverse City, Michigan, on a loamy sand site. A mature, infrequently mowed stand of Kentucky bluegrass, red fescue, and annual bluegrass with a scattering of quackgrass was used. The plot area was irrigated as needed to prevent wilt.

The growth inhibitor treatments were applied in three different combinations across three replications. The individual plot size was 6 x 10 feet. One-third of the experimental area received a single application on May 18th. This was just after the first mowing of the turf in the spring. The remainder of the plot area also received the same May 18th application. A second application was applied six weeks later on June 28th. The treatments were also applied over the remaining one-third. Finally, a third application was applied to the last one-third of the plot area on August 9th. Thus, the plot area was split into three sections, one receiving a single spring application, one receiving a spring and early summer application, and a third receiving three applications over the spring and summer period. The experimental plot area was not mowed at any time during the growing season.

Table 1. Comparative shoot growth inhibition achieved from four chemical growth regulator treatments on a Kentucky bluegrass-red fescue-annual bluegrass turf.

Treatment	Application Rate (lb. /A)	Degree of shoot growth inhibition* (1-best; 9-least) June 15	June 29
Maintain CF-125 + Maleic hydrazide (MH-30)	1 + 3	1.8	1.3
Sustar (3M)	4	3.0	1.7**
C-19490 (Geigy)	7.5	5.2	3.8
Maintain CF-125	2	6.7	6.3
Untreated	-	9.0	9.0

*Average of 3 reps.
**Chlorosis and some thinning of stand evident

The growth inhibition results are summarized in Table 1. Maintain CF-125 at 2 pounds per acre has been the best performing growth regulator in earlier experiments. In this particular series with newer materials it was the poorest of the four treatments. The best treatment in terms of overall performance was a combination of Maintain CF-125 at one pound plus maleic hydrazide at 3 lbs/acre, Sustar also gave good growth inhibition although not ranking quite as high as the Maintain CF-125 + maleic hydrazide combination. The Sustar treated plots did show some chlorosis and thinning of stand following the second and third repeat applications on the plot area. Finally, the Geigy C-19490 experimental material proved highly phytotoxic resulting in extensive thinning of the turfgrass stand and at the same time failing to provide adequate shoot growth inhibition of the surviving plants. A certain degree of leaf injury or foliar burn was evident from all four chemical growth regulators following the third application made on August 9.

This chemical growth inhibitor study has been the most effective and successful of the long series that has been conducted by Michigan State University at various locations throughout the state. The key in this case was that the initial application was made at just the right time in the spring. This timing is the most critical and difficult aspect to execute in the use of chemical growth regulators. A similar series of experiments will be repeated during the 1973 growing season at both Traverse City and East Lansing to ascertain if comparable results can be obtained for a second year.

WATER USE RATE EVALUATIONS AMONG KENTUCKY BLUEGRASS CULTIVARS

Water use rate is defined as the total amount of water required for turfgrass growth plus the quantity lost by transpiration and evaporation from soil and plant surfaces. The water use rate reflects the quantity of water that is lost from the turfgrass plant over a period of time. If this specific amount is not replaced through normal precipitation it must then be provided by means of irrigation. Otherwise the turf will suffer wilt and possibly death by moisture stress. The increased concern for efficient water usage and the regulations limiting lawn irrigation in urban areas have resulted in the need to assess the water use rate of turfgrass species and cultivars. The objective of this particular series of experiments was to determine the comparative water use rates of a series of Kentucky bluegrass cultivars. Are there inherent genetic differences in the use of water among these cultivars? This is significant in terms of minimizing irrigation requirements and maximizing the water available through precipitation.

The experiments were conducted in a climatically controlled wind tunnel apparatus having a wind velocity of 4 mph, a constant temperature of 90°F, and a relative humidity of 30%. Four inch sod plugs were collected from the field plots, placed in a growth chamber under controlled conditions for a three week period, and then placed in the wind tunnel for a period of 12 hours. The weights of the plugs were measured before and immediately after removal from the wind tunnel. The plugs were then dried, weighed, and the difference determined as a measurement of water loss.

Table 2. Comparative water use rates of 17 Kentucky bluegrass cultivars.

Very low	Low	Intermediate	High	Very high
Prato	Pennstar	Merion	A-34	Sodco
Cougar	Park	Galaxy	Newport	Sydsport
Delta	Nugget	Monopoly	Fylking	
Kenblue	Windsor	Baron		

The comparative water use rates of 17 Kentucky bluegrass cultivars are compared in Table 2. Significant differences were found in the water use rate among these bluegrass cultivars. Ranking very low in water use rate were Prato, Cougar, Delta, and Kenblue. In the low category were several of the improved Kentucky bluegrass cultivars including Pennstar and Nugget. In contrast, Sodco and Sydsport ranked very high in their water use rate while A-34, Newport and Fylking ranked in the high category. The results of these experiments indicate that there are differences in water use rates among the Kentucky bluegrass cultivars and that one might wish to consider this factor when selecting the particular cultivars to be included in the Kentucky bluegrass blend. Finally, a brief mention might be made that the water use rate of turfgrasses may also be manipulated through certain cultural practices. In general, the water use rate is lowered as (a) the cutting height is lowered, (b) as the nitrogen fertility level is decreased, (c) as the irrigation rate and frequency is decreased, and (d) when the turf has been subjected to a serious disease attack.

FACTORS ASSOCIATED WITH THATCH ACCUMULATION

This series of experiments is being supported by a grant from the O. J. Noer Research Foundation. The primary objective is to investigate the factors contributing to minimum thatching of turfgrasses. This information can then be utilized by turfgrass breeders to select for minimum thatching cultivars early in the breeding program. Two aspects of this research will be reported in this paper.

A Merion cultural-thatch study was initiated in 1962 with the objective of evaluating a whole range of Kentucky bluegrass cultural systems to determine which ones would result in the minimum thatching tendency. The specific cultural treatments included (a) cutting heights of 1 and 2 inches, (b) clippings removed versus return, (c) an annual dethatching versus none, and (d) annual nitrogen fertility levels of 4, 6, 8, 10, 12, and 14 lbs. per 1000 sq. ft. These cultural treatments were combined in all possible combinations in a split, split, split plot arrangement of four replications.

Thatch measurements made in the fall of 1972 revealed no significant difference in thatch accumulation from any of the cultural systems included in the study. However, if one steps outside the immediate plot area there is a significant thatch accumulation evident. The only differential between this and the Merion cultural-thatch study is that no pesticides have been applied to the experimental area whereas the adjacent alley received chlordane applications in 1963 and 1966. This observation leads one to conclude that the activity of earthworms and other small animals in the Merion cultural-thatch study area was sufficient across all cultural systems, including cutting heights of 2 inches, clippings returned, no dethatching, and nitrogen fertility levels as high as 14 lbs. per 1000 sq. ft., that no thatch formation resulted. These observations suggest that turfgrass areas receiving insecticide applications which control earthworms are much more prone to thatch accumulation.

The second aspect of the thatch investigations to be reported in this paper involves an anatomical study of the characteristics that are correlated with thatch accumulation. Sod plugs of four creeping bentgrass cultivars, Cohansey, Evansville, Penncross, and Toronto, were taken from a sod plot that had been maintained under putting green conditions at 0.25 inch for 12 years. At the time of sampling, the Cohansey had a thatch depth of 0.2 inch, Penncross - 0.9 inch, Toronto - 1.1 inches, and Evansville - 2.2 inches. The accumulation was more of a mat than a thatch in that the plot area was topdressed twide per year so that soil was intermixed with the organic matter accumulation. The sod plug mat that had been collected was divided into three categories of (a) green shoots, (b) nongreen lateral shoots, and (c) roots. These groupings were then dried, weighed, ashed, and reweighed to determine the dry weights of these three fractions for each of the four creeping bentgrass cultivars.

Table 3. The comparative dry weights of green shoots, nongreen lateral shoots, and surface roots of four creeping bentgrass cultivars.

Anatomical Grouping	Creeping bentgrass cultivars			
	Cohansey	Penncross	Toronto	Evansville
(a) Green shoots	11.4	11.1	10.2	12.7
(b) Nongreen lateral shoots	13.5	13.8	14.2	15.8
(c) a + b	24.9	24.9	24.4	28.5
(d) Roots	54.3	68.4	34.5	91.8
(e) Depth of mat (inches)	0.2	0.9	1.1	2.2

The results of this investigation are summarized in Table 3. The most significant fraction was the quantity of roots associated with Evansville creeping bentgrass which also had the greatest thatch accumulation. Measurements of the lengths of lateral shoots in the sod were also accomplished during this study. These experiments indicated that Cohansey and Evansville creeping bentgrasses possessed the shortest lateral shoots lengths with both Penncross and Toronto possessing lateral shoots that were more than twice as long. Thus, the lateral shoot length probably contributed to the greater thatching tendency of the Penncross and

Toronto compared to Evansville and Cohansey. However, this anatomical component does not explain the much greater thatch accumulation of Evansville compared to Cohansey. Data in Table 3 suggests that the extensive concentration of surface rooting or Evansville may be a major factor associated with thatching of this particular cultivar.

These studies suggest that there is no one anatomical component that is dominant in affecting the thatching tendency of creeping bentgrass cultivars. More than one component may be involved and must be evaluated in a turfgrass breeding program. These studies are continuing with measurements of the lignin content of these individual plant fractions to determine if there is any further relationship with thatching.

LOW TEMPERATURE TOLERANCE OF PERENNIAL RYEGRASS CULTIVARS

Good field differentials were obtained in the comparative low temperature hardiness of five perennial ryegrass cultivars. These cultivars were established at Traverse City, Michigan, on a loamy sand site August 19, 1969. Adequate snow cover existed during the winter period for the first two years so that low temperature kill was minimal. However, serious low temperature damage occurred during the winter of 1971-1972 to the perennial ryegrass cultivars. A very representative evaluation of the comparative low temperature hardiness among the cultivars was obtained. The plot area involved three replications in a randomized block design.

Table 4. Comparative low temperature kill of five perennial ryegrass cultivars at Traverse City

Cultivar	Percent low temperature kill* (5-9-72)
Norlea	20
Manhattan	50
Pelo	55
Linn	90
NK-100	96

*Average of 3 reps.

Earlier studies revealed that Norlea perennial ryegrass is the most low temperature hardy cultivar available for our Michigan conditions. The question arose as to whether some of the more recently released cultivars such as Manhattan perennial ryegrass might rank as well or better than Norlea. Results of this test indicate that Norlea still remains the most low temperature hardy perennial ryegrass cultivar. Manhattan perennial ryegrass was substantially less low temperature hardy but ranked higher than the other ryegrasses included in this test. Earlier observations at East Lansing had indicated that Pennfine ranked quite poor in low temperature hardiness, being much less hardy than Manhattan. These results indicate that when considering the use of Manhattan one must recognize the potential for serious low temperature injury and thinning of stands periodically during those winters when there is a lack of winter cover in the form of snow.