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