

TABLE 2
The Relationship of Components to Topmix Permeability

	Sample 1 (1958)	Sample 2 (1988)
% Sand-Soil-Peat	70-20-10	85-0-15
Bulk Density	1.49 g/cc	1.41 g/cc
Total Pore Space	39%	44%
Capillary	18%	19%
Non-Capillary	21%	25%
Permeability	1.4 in./hr.	14 in./hr.

TABLE 3
Differences in Physical Characteristics Between Mixtures Using Different Peat Sources with the Same Sand*

Characteristics	Sphagnum	Reed-Sedge
Bulk Density	1.39 g/cc	1.40 g/cc
Total Porosity	42%	41%
Capillary	23%	28%
Non-Capillary	19%	13%
Water Retention	17%	20%
Permeability	17 in./hr.	5 in./hr.
Compression Factor (shrinkage)	9%	18%

*Data courtesy Agri-Systems of Texas

to provide the laboratory with as much up-front information as possible. The decision by the laboratory to recommend a particular mixture over another may hinge upon such factors as anticipated play, unusual local conditions, quirky weather, irrigation water sources, and other concerns. The physical analysis of a mixture to be used in green construction should not be just a sterile compilation of numbers. Rather, it should be part of a dialogue with the laboratory director that results in a clear understanding of all of the factors that influence the outcome of such a major undertaking. And don't forget, there is no such thing as a dumb question when it comes to building greens the right way.

References

- ¹Madison, John H., J. L. Paul and W. B. Davis. 1974. Consider — A New Management Program for Greens. USGA GREEN SECTION RECORD. 12(3): 16-18.
- ²Spomer, L. Art. 1977. Principles of Soil Preparation for Drained Golf Greens. USGA GREEN SECTION RECORD. 15(4): 9-12.

Editor's Note: A copy of the recently published (1989) version of the USGA's SPECIFICATIONS FOR A METHOD OF PUTTING GREEN CONSTRUCTION can be purchased through the United States Golf Association, P.O. Box 708, Far Hills, NJ 07931-0708.

New Zealand . . . The Grass Capital

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DURING a six-month period in 1989 I had the opportunity to study turfgrass science and tissue culture technology in New Zealand. I was granted a sabbatical leave from my present position at Mississippi State University, and I worked at the Division of Scientific and Industrial Research (DSIR), Grasslands, in Palmerston North, New Zealand. The trip was supported in part by the USGA, and included laboratory research as well as on-site visits to golf courses, sports fields, and general-use turf areas. In my study and research I collaborated with Peter Evans, an agronomist, and Derek White, a molecular geneticist.

Research work dealt with the development of protocol for the *in vitro* manipulation of colonial bentgrass (brown top)

Agrostis tenuis. The on-site visits to turf areas were arranged by David Howard, an agronomist with the New Zealand Turf Culture Institute, who also accompanied me on many of these visits.

New Zealand consists of two islands located in the South Pacific Ocean approximately 1,200 miles southeast of Australia. Its land mass is comparable to that of Montana, and it has a climate similar to coastal Washington and Oregon. If you went to Cairo, Illinois, and dug a deep enough hole, it would eventually come out in the center of New Zealand. Because it is in the southern hemisphere, its seasons are the opposite of ours.

With a population of about three million people, New Zealand has a low population density, which makes the

country pleasing and unspoiled. Visitors are overpowered by another statistic that adds to New Zealand's flavor and appeal — it is home to over 65 million sheep. As this figure implies, the country's economy is based heavily on agriculture. In addition to its sheep and low population density, New Zealand possesses some of the most beautiful landscapes and scenic countryside in the world.

Of special interest to me was New Zealand's ability to grow grass. This alone was one of the most impressive parts of my six-month study. For example, at the turfgrass research plots in Palmerston North, perennial ryegrass (a cool-season species) and bermudagrass (a warm-season species) were maintained side by side as perennial

stands. The bermudagrass did not winter kill, and the perennial ryegrass did not succumb to high temperatures. Not only does this illustrate the desirability of New Zealand's climate, but it also provided me with some insight into the factors that allow these grasses to survive environmental extremes. In the case of bermudagrass, nighttime air temperatures dropped below freezing, but soil temperatures (the critical factor in low-temperature kill) remained above freezing because of high daytime temperatures and heat accumulation by the soil. The summer heat tolerance of perennial ryegrass was accompanied by temperatures of over 90 degrees, but low relative humidity and a constant breeze provided for optimal transpirational cooling.

All of New Zealand's turfgrasses have been naturalized. Originally islands covered by dense forest, New Zealand was changed from trees to grasslands. Today, the principal turfgrass species found on their 400-plus golf courses are colonial (brown top) and highland (dryland) bentgrass, fine-leaf fescues, and perennial ryegrass. Colonial bentgrass is the most dominant; it could be found throughout the golf course, from greens (the preferred putting green surface) to roughs.

Other turfgrasses familiar to us in the United States, including creeping bentgrass, tall fescue, Kentucky bluegrass, St. Augustinegrass, centipedegrass, and bermudagrass, were noticeably missing, but these grasses could be found in localized areas or under special situations.

And of course *Poa annua*, the grass that is found almost everywhere, was there in New Zealand. Of the turfgrasses used, perennial ryegrass required the highest maintenance, compared to the widely used and low-maintenance colonial bentgrass. Fine-leaf fescues were also used as low-maintenance turfs, but they did not predominate to the extent of colonial bentgrass.

Maintenance of turf was unusual and perhaps refreshing compared to our standards. Most courses used the natural terrain, and manicured turf across the entire course was not a prerequisite for their golfers. In some instances, rural golf courses relied on members to mow greens on a rotational basis, and fairways and roughs were clipped by the original mowing machines — the sheep. No weather was too nasty for a game of golf, and riding in a golf cart was unthinkable.

Few golf course superintendents (often called greenkeepers) had formal education past high school level.

Knowledge was passed on through work experience and by participating in educational meetings provided by the New Zealand Turf Culture Institute. The Institute is the primary source of turf culture information. It consists of a group of regional agronomists who conduct activities similar to those of the USGA Green Section. Unlike USGA Green Section support, though, *all* golf and lawn bowling facilities in New Zealand are obligated to pay a standard fee for support of this organization.

Now that I have returned, several impressions of turfgrass management stay with me. First of all, the diversity of our climatic conditions in the United States and the large land mass of the North American continent make our region of the world a challenging place to grow consistently good-quality turfgrass. We may be a leader in several technological fronts, but in many regions of the United States we don't have desirable climate for golf course turf. The ability of colonial bentgrass to flourish under low maintenance and the natural conditions of golf course management in New Zealand have given me a new perspective on this species. In retrospect, it was a unique pleasure and delight to meet the people and see the turf of New Zealand.



The presence of New Zealand's 65 million sheep is never missed, as one can always count on seeing sheep and grass.



A country golf course setting, with the putting green protected from the sheep by a wire fence, and local farmers engaged in mowing the putting surfaces. The four-legged fairway cutting units are always operating in order to keep the fairway surface neat and tidy.



(Above) The New Zealand countryside with its rolling grassland, sheep, and unique appeal and beauty.



(Left) The lawn bowling green in the foreground is used for summer recreation, and a golf course situated in the background is used for winter sport. Both facilities are commonly found together in a country club setting.