lieves a little extra effort up front is cheaper in the long run: "If you get grass established the first time, you don't have to go back."

Hoolehan's theory was substantiated through a comparison of the first and second fairways of the Koolau course after erosion control measures were applied. On the first fairway, where hydromulch provided the only protection, a two-foot-by-200-foot gully was formed by rainfall and irrigation runoff. It required expensive reworking and reshaping of the landscape.

On the second fairway, where erosion control blankets were used, no significant erosion occurred. According to Hoolehan, "If we had not used blankets on the second fairway, the amount of finish work would have been a lot greater. Since the blankets effectively controlled the erosion, we can concentrate our efforts on fine-tuning the hole."

Annual Ryegrass Also Worked

Ryegrass was another useful choice in staving off erosion, says Hoolehan. "On very severe slopes of three to one and greater, we used annual ryegrass to stabilize the soil in the winter months until the bermuda became strong enough to fill in. We also used ryegrass to fill in a lot of other areas until we could come back and revegetate them to the natural conditions that existed before the construction. The rainy season is not a very conducive time to establish bermuda. The grass doesn't go dormant in Hawaii, but the sprigs don't start to spread because of the cooler temperatures and shorter days.

"We're right on the side of a mountain that casts a tremendous amount of shade on the golf course in winter," Hoolehan notes. "That's one of the reasons we went with bentgrass greens. Bermudagrass wouldn't have made a very good greens surface in winter, but we feel that for fairways, tees, and roughs the bermuda will be fine. We expect the course to be playable in the winter despite the rain.

"We've imported silica sand from Australia for the greens construction, because we couldn't get as good a sand here," says Hoolehan. "Most sands in Hawaii are basically coral, and marginal for use in greens construction."

Protecting the Ecology

For ecology's sake, "we had a grading permit that only allowed us to clear 15 contiguous acres. We had to selectively clear the golf course, because it's a sensitive area around her. We tried to eliminate all the runoff we could from the golf course, in order to help control the erosion," Hoolehan recalls.

"Although we had a lot of rain during the construction phase, the contractor built large siltation basins to protect against the runoff of silt from the project. He also utilized silt fences and other material. But as I said, that was not my responsibility," he notes. "My job was to worry about erosion control after construction, not while it was underway."

As soon as they have grown them in, it will be the responsibility of the grasses to keep erosion under control, Hoolehan observes. The golf course superintendent has every confidence they'll be up to the task. If they do as good a job as he and the contractor have done, Koolau Golf and Country Club should be making its formal debut next spring intact and on schedule. It should fit beautifully into its spectacular surroundings, with no harm to the delicate ecology.

"Before this course was built, the area was a tropical rain forest," says Hoolehan with a smile. "Now we have a country club, and the rain forest is still here!"

EXPERIMENTAL PARK PLANTED AT MEADOWLANDS

The Hackensack Meadowlands Development Commission in Hackensack, NJ has opened an experimental park at the site of the closed Kingsland landfill. The six-acre park in Lyndhurst is the first of its kind in the country to support a spreading root vegetation system atop a Hypalon-based geomembrane cap.

The landfill was capped with Terra-Tuff, a geocomposite membrane manufactured by JPS Elastomerics Corp. of Northampton, MA. It eliminates cover soil slippage on steep slopes and allows rainwater to drain off the cap.

Terra-Tuff is a nonwoven geotextile, made from recycled polyethylene terephthalate soda bottles, bonded to a scrim reinforced Hypalon-based geomembrane. More than 440,000 recycled one liter soda bottles were used to manufacture the Kingsland landfill cap. The experimental park opened last summer and was planted in several stages to reflect the natural transformation of a meadow into a woodland. Trees, bushes, grasses, and ground cover are planted in up to five feet of topsoil covering the geomembrane cap. Vegetation mostly indigenous to the Meadowlands area, including grey birch trees, red chokeberry bushes, milkweed, goldenrod, and Indian grass, are intended to attract a wide variety of wildlife to the park.

JENSEN AT TURF-SEED

Vanessa Jensen has joined Turf-Seed, Inc. as Mid-Atlantic marketing manager and technical service representative. She will assist distributors and dealers in this region with their technical questions and will help introduce the new Turf-Seed products.

Jensen has been involved with the turfgrass industry for 19 years, earning several awards and honors, and is immediate past president of Maryland Turfgrass Council.

CGSA/ACSG CELEBRATES 25TH ANNIVERSARY

This year marks the 25th anniversary of the 1,200-member Canadian Golf Superintendents Association/Association Canadienne des Surintendants. The organization was founded in Quebec in 1966, and held its first conference and meeting the following year.

On September 25, the association will hold its 25th Anniversary Fall Field Day at Carling Lake in Quebec. The key event of the anniversary year will be the 43rd Canadian Turfgrass Conference and Trade Show slated for December 8-11 in Toronto. Special ceremonies will take place during the opening of the conference and the closing banquet.

Foxboro Stadium Goes Natural

By Matthew Trulio

Hitting rock was the only thing Randall & Blake, Inc., *hadn't* anticipated in the construction of the new, natural turf sand-based field at Foxboro Stadium in Foxboro, MA, so naturally they hit tons of it.

"When we started trenching to put in the drainage lines, we encountered 'rock ledge,' a condition which is very common in many parts of New England," recalls Dan Almond, registered landscape architect and design/build division manager for the landscape architecture and construction firm based in Littleton, CO. "The soil borings we performed very early on didn't show us how much rock was down there. About 90 percent of what was down there was rock."

Fortunately, they discovered the problem late in the week and had the weekend to solve it. By Monday, they were back in business.

"We had originally planned on using a Vermeer 450 trencher, but we switched to a 650, which is about twice the size, and it worked like a champ," says Almond. "We did go through hundreds of teeth, though."Hitting rock caused a little bit of anxiety because our schedule was so tight," he continues. "But we were able to regroup over the weekend, bring in the new equipment, and make up what little time we lost. These are the things that happen in a project like this. You just have to make adjustments and go on."

Adjusting to improve a difficult situation is a subject the New England Patriots, the NFL team which calls Foxboro Stadium home, know something about. After suffering through one of the toughest seasons in the history of the franchise, a season filled with loss and controversy, the Patriots decided it was time to make some adjustments.

They hired Sam Jankovich as chief executive officer and owner's representative. They picked high in the NFL draft, which is perhaps the only consolation for a team with a losing season. And they turned their attention to the field itself and its well-worn artificial surface.

"Mr. Jankonvich was the athletic director at the University of Miami, so he was used to natural turf," says Almond. "He was strong on the idea of going to it at Foxboro Stadium."

And go to it the Patriots and Foxboro Stadium owners did.

"This is a great commitment on behalf of [Patriots owner] Victor Kiam and the New England Patriots organization to install a proven natural turf field," Jankovich said earlier this year. "This decision is in the best interest of not only the Patriots' football players, but also other players around the National Football League. In addition, such a surface is conducive to a better brand of football."

RBI finalized negotiations for installing the new field in January. The field had to be playable by June 1, when a soccer match between the national teams of the U.S. and Ireland would be held. Work began in mid-February. Missing the deadline was simply not an option.

Out With The Old

Before RBI could begin work on installing its GraviTURF Natural Turf Athletic Field System at Foxboro Stadium, the old surface had to be removed. That meant taking up 93,000 square feet of artificial turf and padding, 2,000 cubic yards of asphalt, and 4,000 cubic yards of soil. Although another outside contractor was hired for the removal chores, RBI was onsite when they took place.

"Because the field at Foxboro was arti-

continued on page 14

Foxboro's new turf ready for international soccer match.

Foxboro Stadium
continued from page 13

ficial, it had a crown," Almond recalls. "In the middle of the field, the asphalt was about 15 inches thick! Even on the sides, it was three or four inches thick. The nice thing was that they removed the surface and the pad and gave it to charity. Then they ground up the asphalt and used it in parking lot improvements at the stadium. Nothing was wasted."

In With The New

The GraviTURF system installed at Foxboro Stadium is a gravity-drained, sand-based athletic field set-up. The system was invented by RBI, which is in the process of having it patented.

The system begins with perforated pipe drainage lines, which vary from four to 12 inches in diameter depending on the drainage requirements of a particular project. "The pipe is all bedded in pea gravel–under it, around it, and on top of it–and we typically use a well-rounded material," says Almond. "On top of that, depending on the type of installation the client wants, we install our soil warming system."

The Patriots wanted the soil warming system. It consists primarily of electric heat cables which run the length of the field, from end zone to end zone.

"Most of the time, we have to upgrade the power a bit because the heating system requires something on the order of 500,000 watts," says Almond. "But it is a phased system–the whole thing doesn't run at once, because that way it's a lot more economical for the owner to run.

"Obviously, a soil warming system is rarely used more than 2-1/2 months a year, but it really helps extend a field's playability, as well as the ability to keep it green," he adds.

After the warming system, if specified, is in place, a peat and sand mix is put down. At Foxboro, the sand and peat were mixed in a Dakota Blender. The job of making sure the sand and peat were compatible went to Chuck Dixon, an agronomist and founder of Turf Diagnostics And Design, an Olathe, KS, firm which evaluates materials for suitability of use in putting greens and other sand-based systems.

"The sand fits United States Greens Association particle size criteria," he explains. "The gravel is about five to seven times larger than the sand."

"We mostly use Dakota Reed Sedge Peat," adds Almond. "A lot of people seem to be going to it now."

Lastly, there is the grass. RBI generally seeds if time allows. "That way, we can seed into our root zone mixture exactly the type of grass mix we want to use," says Almond. "By seeding, we also avoid any soil interface problems."

Faced with Foxboro's tight time frame, however, RBI was forced to sod.

Getting The Old Team Together

Although RBI, founded in 1975, had constructed about 30 golf courses throughout the West, as well as a number of athletic fields, the first professional field installation of a GraviTURF system was at the Denver Broncos' training facility in 1989. Mark Altman, of Altman & Altman Turf and Soil Fertility Specialists, an independent consulting firm based in Marshall, MN, was brought in by RBI and the Broncos to perform soil analyses on the project.

Electric heat cables and irrigation installed in pea gravel base.

"That was about as close to a sterile media as I've run across," says Altman. "They [RBI] had planned on doing a standard soil analysis, but I suggested taking a number of soil samples because they were going with a sand-based field. With a sand-based field, you can create a designer mix of nutrients. That gives you some real options that you don't normally have."

Altman designed a soil fertility program, which included major and minor nutrients, for the seeded turf. "When the turf came up, it had all the nutrients it needed," he enthuses. "You can make a profound difference in turf establishment through proper soil fertility management."

"I think the system is a perfect marriage between drainage and water retention," says Ross Kurcab, field manager of the Broncos' training facility. "We have enough drainage where we never have any standing water. At the same time we retain enough water so we're not just flushing it through."

Once RBI secured the Foxboro project, the firm contacted Altman again.

"They called me and said we've got another project to do, but with a completely different set of circumstances than at Denver," says Altman. "This time, we were sodding instead of seeding. We started out with six weeks from sodding to playing time, but by the time everything came together, that was down to four weeks."

Building Bionic Turf

When RBI began its search for sod to be used at Foxboro, it was looking not only for a specific type of grass, but also for one that had been grown in a sandy loam that approximated the sand-peat-gravel mix they'd be using. Their search, with Altman's assistance, took them throughout the New England area, and as far west as Indiana. Finally, after exhaustive testing of sods and soils from various turf farms, they settled on a Kentucky bluegrass of 27 percent Merit, 30 percent Ram, 20 percent Glade, and 23 percent Eclipse from Gold Star Farms in Canterbury, NH.

"There were a lot of soil samples swapped back and forth," says Mack MacPhail, a customer service manager at Gold Star. "They wanted a sod that had been grown in a sandy loam to begin with, and our soil was very close to what they had been looking for."

The idea in testing the soil was not to "match" loam to loam, since the sod would be washed free of all farm loam after harvest, but to find a sod that was *already* at home in a medium similar to that used at Foxboro.

"The number one problem I see in sand-based fields is the sod-soil issue," says Dixon of Turf Diagnostics And Design. "A really fine-textured sod can seal off the sand base, and you never get rooting or other benefits. That's one of the benefits to sod washing–you eliminate the interface problem."

The sod RBI selected at Gold Star was strong and healthy, according to Altman and Almond. But, given the deadline for the Foxboro project and the impending soccer match, they knew it had to be even stronger.

"After we decided that Gold Star was the one, we sent their samples to Mark, who ran his tests to determine fertilizer rates," says Almond. "He did something that I think is unique. He came up with a pre-fertilizer program, including biostimulants, that was used at the farm to create a 'bionic' sod. And it paid off big time!"As for the "exacts" of the program he created for sod on the

farm, Altman isn't giving away any secrets. ("I need *some* competitive edge," he laughs.) However, he does provide a general description of the on-farm program.

"The idea was to bring the turf up to sports turf durability and playability before it came to the stadium," Altman reveals. "From the soil analyses at the sod farm, we were able to come up with a program of fertilization, Roots biostimulant, and foliar feeding."

"We understood that whatever process they were recommending, we were going to work with them," says MacPhail of Gold Star. "The material [specified by Altman] was shipped here, and we put it down at the recommended rates.

"We had to ship the sod by May 1, and that's just barely spring here. The sod was just starting to come out of dormancy, and we were happy to take any suggestions on 'waking it up.'"

After the sod was harvested, all 93,000 square feet of it were washed as planned. Gold Star used a special sod washing machine, patented in Tasmania and assembled in Toronto, Canada, to accomplish the task. The washing procedure, which used 400 gallons of water a minute at 45 psi, was done at the farm.

The idea was to bring the turf up to sports turf durability and playability before it came to the stadium.

"I think RBI was, among other things, looking for someone who had the most 'enthusiastic' way of washing the sod," MacPhail says. "Bringing a machine here assembled in Canada and patented in Tasmania is about as enthusiastic as you can get."

From Farm To Field

Before a foot of the washed sod was laid at Foxboro, a custom-designed, pre-plant fertilizer was incorporated into the sand and peat mix. "We incorporated major and minor nutrients into the mix, which was low in potassium and had a high percolation rate," says Altman. "We used a sulfur-coated sulfate of potassium, so we could prevent the potassium from leaching away. We also included trace elements–manganese, copper, and zinc. Sands vary greatly from pit to pit, and you need to take that into consideration when you design programs for sand-based fields."

The soil fertility specialist having, Sustain, from W.A. Cleary Chemical, put down to inoculate the soil prior to sod installation, but because of a shipping problem they had to apply it after the sod was laid. Altman also wrote a fertilizer program for the field after sodding.

The results of the combined efforts of everyone involved have been impressive.

"In two weeks, we had roots down 2-1/2 to three inches," Altman says with relief. "And with what we did on the farm, we were able to reduce transplant shock to zero."

"One of the keys to this whole system is drainage," Almond points out. "We guarantee our percolation rates at five inches per hour, but at Foxboro we'll probably get a percolation rate in the range of six to eight inches per hour. According to tests we've done recently at the Broncos' practice facility, the percolation rate there now is 6.2 inches per hour.

continued on page 16

Foxboro Stadium

continued from page 15

"Quality control is the key," he adds. "Every system is installed the same way, every time. We absolutely do not compromise on materials or installation."

Game Time

To protect and maintain their considerable investment–more than $1 million were spent in the entire Foxboro Stadium renovation–the Patriots and venue managers hired Pierre Landry as field superintendent. The 29-year-old from Rochester, NY, has a degree in plant and soil science from the University of Massachusetts and was previously an assistant superintendent at Monroe Golf Club in Pittsford, NY, and Andover Country Club in Andover, PA. He was recommended for the Foxboro job by RBI.

Dan Almond (r) and Ross Kurcab at Bronco's practice facility.

"I've worked with USGA sand-based greens, so I have a good idea about their irrigation and fertilization needs," he says. "The stress on this field is going to be different than it is on a golf green–it's more physical than environmental. I understand turf really well and I just have to adapt to sports fields."

Landry's golf course experience came in handy during the first two weeks after the sod was laid at Foxboro. Using the field's five-row, gravity-fed (from a nearby water tower) irrigation system consisting of Hunter I-40s, a Weathermatic controller and brass valves, and Hydrovisor moisture sensors, he syringed the field daily. It takes approximately 1-1/2 hours for the system, which is designed with head-to-head coverage, to complete its entire cycle.

"Now that the roots are down 3-1/2 inches, I'm cutting back on water to get them to dive even deeper," says Landry.

Since the previous surface at Foxboro was artificial and, consequently, didn't require turf equipment beyond a vacuum, Landry is in the process of building his turf care arsenal from scratch. In the meantime, he's using demo equipment from various distributors, such as a triplex mower, three times a week, to cut the grass to a 1-1/2-inch height. He adds that he'll soon bring that cutting height down to 1-1/4 inch, and will begin an overseeding program this summer.

"We want to work to obtain a 50-50 bluegrass-ryegrass mix," he reveals.

The Patriots players and coaches, he says, are excited and curious about the new field, and he sees developing a relationship with them as vital to his success at Foxboro, as well as the success of the field itself.

"I think the biggest challenge is going to be satisfying the needs of the coaches and players, in terms of game condition and allowing them on the field," says Landry, who is currently renovating the Patriots' nearby soil-based practice field. "Of course, I want to keep them off it as much as possible [between games] but it's their field and they're going to want to practice on it. But that's mostly walk-through stuff, like setting formations.

"We'll work it out by developing a good relationship where we understand each other's needs."

Like RBI, the Patriots, and the Foxboro Field owners, Landry will make adjustments, and then go on. Sometimes, that's what winning is all about.

GOLF COURSE DEVELOPMENT FORUM

The National Golf Foundation will sponsor a Forum of Public-Private Ventures in Golf Course Development July 12-13 at the Palm Beach Gardens Marriott in Palm Beach Gardens, FL.

The seminar is designed to educate public and private entities about how to form viable partnerships in the development of successful golf facilities. Topics such as funding and management options for municipal golf course development will be covered.

Reservations can be made by telephone or fax. Call (407) 744-6006 or fax (407) 744-9085. Travel arrangements may be made through WorldTek Travel at (800) 243-3180. Identify yourself as an NGF seminar registrant and ask to speak to the Sports Desk.

ASGCA PRESIDENT PURSUES FASTER PERMITTING

Concerned with delays experienced by golf course developers in the permitting process, Tom Clark, president of the American Society of Golf Course Architects, says he will work toward increasing dialogue with regulatory agencies to that the proper information is available for review.

"Environmental regulations have been interpreted differently across the country, and we hope to be able to work will all concerned to have a more uniform application," said the ASGCA president, who was elected during the organization's 45th annual meeting in England. "All of us involved in the process must do our homework so that the paperwork, including necessary research, is right the first time. If the development team works closely with regulatory agencies, we can reduce the approval time."

PGMS CHAPTER FORMING

Professional Grounds Management Society is forming a new branch in central California. The organization offers the opportunity for California grounds managers, park directors, golf and sports field superintendents, and landscape contractors to network with each other. Current events and management techniques are often discussed.

For more information, contact: Michael J. Bova, Arbor Tree Surgery, 802 Paso Robles St., Paso Robles, CA 93446, (805) 239-1239.

EXECUTIVE COURSE OPENS

Willow Springs Golf Course near Baltimore is slated to open this month. The 18-hole, par 62 "executive" course was designed by golf course architect Al Janis and constructed by Golf By Janis, a golf course construction firm based near Ocean City, MD.

The executive course concept combines demanding hole with reduced playing time. Willow Springs has incorporated wooded areas, streams, ponds, and rolling hillsides. Elevation on the course can vary as much as 80 feet.

The greens, which average 6,000 square feet, have been built to USGA specifications. Both nine-hole courses have four par fours and five par threes, so an 18-hole round will total 62. Putting surfaces have contours for a challenging finish to each hole.

Water-Absorbing Polymers Show Promise In Turf

By Jeff Nus, Mike Boaz, and Dan Wofford, Jr.

Turfgrass managers are under increasing pressure today to use irrigation resources wisely. Reductions and restrictions of water use by many municipalities in the U.S. and other countries have made conservation and efficient use of water a necessary goal (Watson, 1985). The United States Golf Association (USGA) and the Golf Course Superintendents Association of America (GCSAA) have placed high priorities on developing drought resistant and/or low water-using turfgrasses and management strategies for the 1990s (Bengeyfield, 1988).

One strategy that possesses great promise for reducing the need for supplemental irrigation on turfgrass sites is the use of water-absorbing polymers to increase the amount of available moisture within the turfgrass rootzone.

One must consider several factors in determining appropriate strategies to reduce irrigation needs for turfgrass. The "water budget concept" (Carrow, 1985) is very useful in this regard. A water budget tracks available moisture much like a checking account reflects one's financial assets. It is based upon moisture inputs, reserve, and outputs.

Moisture inputs include irrigation, precipitation, and moisture provided by capillary rise from shallow or perched water tables. Proper irrigation scheduling involving multiple cycling and proper timing can go a long way to reaching the goal of efficient water use (Meyer and Camenga, 1985).

The output side of the water budget concept equation includes evaporation from the soil surface, transpiration by the turfgrass canopy, runoff due to saturated or compacted soil conditions, and leaching beyond the rootzone. The proper choice of turfgrass cultivar (Beard, 1985) in combination with proper irrigation and other cultural techniques (Shearman, 1985) can limit unnecessary levels of output from the water budget equation.

The amount of reserve moisture held in the turfgrass rootzone depends primarily on the soil texture, effective rooting depth of the turfgrass species, and the presence of any perched water table (e.g., USGA spec putting green) or drainage barrier (e.g., Purr-Wick or PAT systems).

Olathe Polymer Planter treating baseball outfield in Lancaster, CA. Photo courtesy: Dan Wofford, Jr.

Water-absorbing polymers can greatly increase the amount of moisture available in the turfgrass rootzone (Azzam, 1980). This can be especially important in non-irrigated sites, in very coarse-textured, doughty soils, or in sand-based rootzones. Depending upon the manufacturing process, water-absorbing polymers can absorb hundreds of times their weight in water (Bowman et al, 1990) and up to 95 percent or more that water can be released to growing plants (Azzam, 1980).

By increasing the amount of available moisture in the rootzone, the length of the irrigation interval (number of days between irrigations) can be lengthened. Since evaporative losses are greatest during and immediately after irrigation when the turfgrass canopy is wet (Pair et al., 1983), strategies to reduce irrigation frequencies by lengthening the irrigation interval may lead to significant improvements in irrigation efficiency and lower the need for supplemental irrigation.

There might be other potential benefits for turfgrass sites from the use of water-absorbing polymers that aren't quite so obvious. Turfgrass managers are constantly battling the detrimental effects of compaction on turf performance. This is especially true for sports turf managers whose responsibilities include the maintenance of practice fields which become extremely hard and unsafe for the athlete due to the extreme amount of use.

The commonly accepted approach is to use various cultivation techniques to reduce compaction (Carrow, 1990). However, there is mounting evidence that some cultivation methods are ineffective at reducing compaction, or due to limited depth of penetration, the compaction zone is simply moved to a lower depth. In cases where compaction pressures are extreme, improved cultivation strategies are needed to ensure the safety of the athlete and provide greater turf performance.

Water-absorbing polymers are amazingly absorbent and expand a great deal when hydrated. How could this expansion property be of benefit?

Hydrated polymers have been described as having the consistency of "triple-strength gelatin." You can squeeze hydrated granules between your fingers and they spring back after compression. Wouldn't the addition of water-absorbing polymers into turfgrass rootzones provide not only a dramatic increase in available water, but also a much needed "shock absorbing" property to these compaction-prone sites? If so, some degree of compaction resistance would be realized (Terry and Nelson, 1986).

There is a third possible benefit of water-absorbing polymers. This is aerification. Present injection techniques involve placing polymers as dry granules a few inches below the soil surface in established turf. As the dry granule absorbs water and expands, it occupies additional space. As water is drawn from those hydrated granules by roots in close proximity or growing right through the polymer, the hydrated granules shrink. Depending upon the strength of expansion, wouldn't the addition of water-absorbing polymers add an element of aerification from these shrink-swell cycles?

Hydrated polymer 4 1/2 inches below surface.

To test these potential benefits from water-absorbing polymers, a series of experiments were designed and implemented at Kansas State University over the past two years. Olathe Manufacturing graciously provided the funding for the project and Western Polyacrylamide, Inc. donated the cross-linked polyacrylamide to be used.

The first experiment was conducted on an active soccer field at the Anneberg Sports Complex in Manhattan, KS. It was designed to compare conventional hollow tine coring versus grooving alone and in combination with the addition of cross-linked polyacrylamide (AB3, Allied Colloids). The polymer was placed approximately three inches below the soil surface at the rate of 170 pounds per acre on one part of the field with an Olathe 831 Polymer Planter. A different portion of the field was grooved by the planter without injecting polymer.

The goal was to evaluate certain parameters, including turf quality and rooting, as well as the moisture content, penetrometer resistance, impact absorption, and bulk density of the rootzone. It was important to establish whether grooving alone, or in combination with injection of the polymer, result in better turf performance and a softer (hence safer) field for the soccer players when compared to conventional hollow tine coring.

Average monthly quality ratings of the soccer field were recorded. Conventional hollow tine coring did not improve the turf quality of the tall fescue soccer field compared to the control plots receiving no cultivation. In fact, during July and August, plots that were hollow tine cored exhibited

continued on page 20

Polymers
continued from page 19

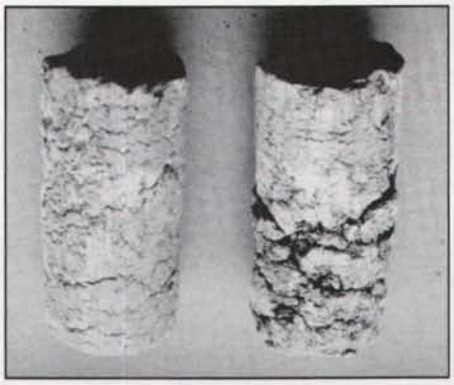
significantly poorer quality than controls.

Grooved plots exhibited superior quality than controls and additional quality enhancement was realized when the polymer was added. This was especially true during the months of August and September, when the irrigation system was shut down for repairs and little rainfall occurred.

Plots with polymer were showing much superior quality compared to the other treatments. This was due, at least in part, to the additional moisture held within the turfgrass rootzone. The average soil moisture was monitored to a depth of 15 cm (roughly six inches) by time domain reflectometry during a dry-down period from July 23 to August 10.

Grooved plots with and without the polymer showed superior moisture content to either hollow-tine cored or control plots. An evaluation of soil cores indicated that the addition of polymer resulted in an average increase in root mass of 30 percent.

Soil penetration resistance was measured at 5, 10, 15, and 20 cm depths with a recording penetrometer. Conventional hollow-tine coring had little effect on penetration resistance at a depth of 15 cm (about six inches). However, grooving significantly reduced penetrometer resistance. Adding cross-linked polyacrylamide reduced penetrometer resistance even further reflecting a less dense rootzone. Differences between the control, hollow-tine coring, grooving alone, and grooving with polymer were consistent as the soil was allowed to dry down.



Soil core on right from polymer treated plot exhibits cracking not found on core from control plot.

Hardness of the rootzone was also measured with a Clegg Impact Absorption meter. This device measures the deceleration of a known mass when it hits the soil surface after being dropped from a constant height. Plots were tested with the meter on June 12, 1990. Higher values indicate harder surfaces.

Again, conventional hollow-tine coring did little to soften the turfgrass rootzone compared to the control plots. Grooving significantly softened the rootzone compared to either the controls or hollow-tine coring. The addition of polymer further softened the rootzone compared to grooving alone.

The data collected suggest that the addition of water-absorbing polymers to sports fields under constant, moderate to severe compaction pressure might represent a feasible method to reduce field hardness and related sports injury. Furthermore, it suggests that we might need to reevaluate the effectiveness of hollow-tine coring as a commonly accepted cultivation method to reduce compaction.

Additional evidence that the water-absorbing polymers were affecting soil strength became apparent when soil cores were removed. Nearly every core taken from polymer-added plots exhibited dramatic cracking and loosening, while control plot cores exhibited little cracking and loos-