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Choosing the one perfect seed variety for a sports field or golf course is a lot like picking the best thoroughbred at a racetrack from the mass of statistics in the racing form. Some horses race better on dirt than turf, while others have an advantage on a muddy track. The form has columns of data on the past performance of every horse and jockey that may mean something to the racing fan but they often confuse the occasional bettor.

The seed industry's equivalent to racing forms are the National Test Reports sponsored by the United States Department of Agriculture and the Maryland Turfgrass Council. Significant data about the performance of seed cultivars at numerous test sites around the country are published every few years to provide an objective comparison. A separate report is compiled for Kentucky bluegrasses, perennial ryegrasses, tall fescues, fine-leaf fescues and bermudagrasses.

If anything, there is more data to digest in the test reports than there is in racing forms. It's almost too much for a sports turf manager to fully comprehend and incorrect conclusions can be drawn from the data. Characteristics which may be desirable for lawns may not be best for heavily-used, low-mowed sports turf. That is why a number of test sites are now building wear machines to simulate the stress placed on sports turf.

But the test results are teaching the industry as a whole some very important characteristics of turfgrass varieties. They clearly establish the improvements made in turfgrasses during the past ten years. They reveal that no single cultivar outperforms its competition in all parts of the country thus opening the door for all cultivars to prove their strength on a regional basis. Most importantly, the tests give the sports turf manager the evidence he needs to support his case for renovation of older turf areas. Is a facility manager going to question scientific tests carried out under the supervision of the USDA?

While turfgrass breeders have been working diligently the past 40 years to improve the color, disease resistance, texture and insect resistance, "Breeders never completely solve everything," explains Dr. Reed Funk, turf breeder at Rutgers University in New Brunswick, NJ. Funk is an internationally-recognized leader in turfgrass breeding.

Turfgrass breeding and selection efforts were initiated largely by the United States Golf Association (USGA) working in conjunction with the USDA. Early work revolved around finding turfgrasses that stood out as particularly healthy amongst other grasses in parks, golf courses and even cemeteries. Varieties from Europe and Asia were planted in test plots to be compared against native varieties.

Early work centered primarily on bentgrasses. The USGA was intent upon finding a replacement for South German bent for greens. It was actually a mixture of creeping, velvet, colonial and redtop bents. These

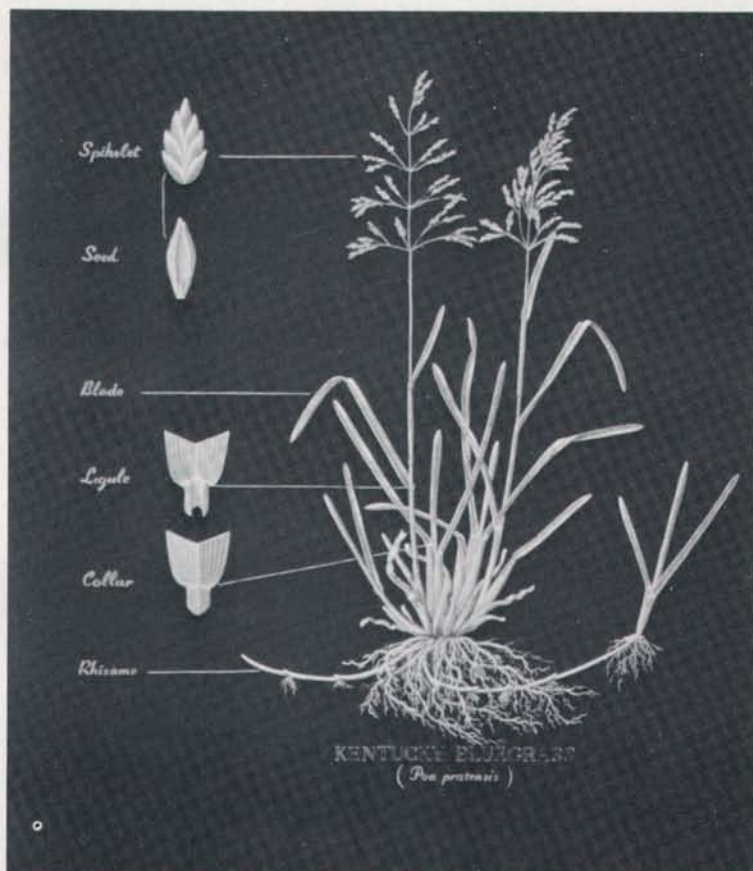
Selecting the Best For Cool-Season Sports Turf

components would separate after establishment to turn greens into a patchwork of the four bents. The USGA picked out and propagated the best performing patches of creeping bent to create the C-series of bentgrasses. They include Toronto, Arlington, Congressional, Cohansey and nearly 200 more.

The problem with the C-series bents is all of them had to be planted vegetatively, either by sod or sprigging. A seeded variety of creeping bentgrass was needed and finally discovered along the Pacific Coast of Oregon in the late '20s. Named Seaside, the seed was used extensively to repair or renovate vegetative greens.

It was not until 1956 that another seeded creeping bentgrass appeared on the market. Dr. Burton Musser at Pennsylvania State University developed a superior bentgrass for turf by cross-pollinating four different parent plants. The seed produced by this complex procedure, when planted, germinated into creeping bentgrass with better putting quality, color and ability to compete against annual bluegrass. It also didn't segregate (separate) after establishment.

Dr. Joe Duich, who studied under Musser, has carried on the bentgrass tradition at Penn State with the development of Pennagle (1978) and PennLinks (1986). In recent years, two European creeping bent-

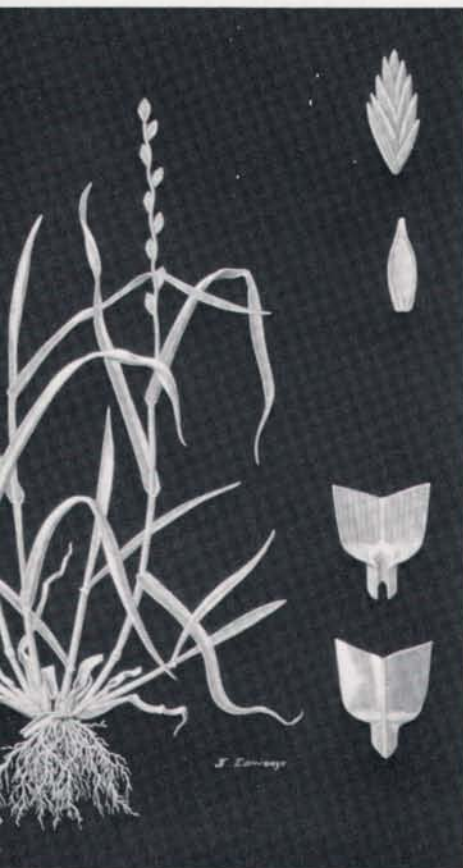


Kentucky bluegrass. Photo courtesy: O.M. Scott & Sons.

Seed Turf

grasses have also been marketed in the U.S., Prominent from Holland and Emerald from Sweden. The continuing strength of the golf course market and the growing popularity of bentgrass fairways in the North and bentgrass greens in the South have created periodic shortages of creeping bentgrass. This has encouraged a number of other companies to speed up development of their own creeping bentgrasses. Two of the new releases are Putter and Cobra.

Golf course superintendents for more than 60 years have sown colonial bentgrasses in fairways as a less expensive alternative to creeping bentgrasses. Highland is by far the largest selling colonial bentgrass in this



Perennial ryegrass.

country. Astoria is another older variety still on the market. Bardot, Exeter and Holfior are improved colonials. Research is underway at Penn State and other locations to develop a colonial bent that creeps.

Velvet bentgrass, chiefly one called Kingstown, is used to a limited degree in New England for low maintenance areas with heavy shade and acid soil. Redtop, which was once popular as a nurse crop for other grasses, has declined in use with the growing popularity of turf-type perennial ryegrasses.

Development of improved Kentucky bluegrasses began in the early '50s. Kentucky bluegrasses have the tremendous advantage for sports turf of spreading by means of rhizomes, stems that extend outward from the base of the plant below the surface. These rhizomes actually knit together providing exceptional strength to sod or a turfgrass stand. New plants also develop on the rhizomes to fill in damaged spots without the need for overseeding. The resulting density and color of Kentucky bluegrass is something breeders are constantly trying to duplicate in other turf species. If Kentucky bluegrass germinated faster it would almost be the perfect grass for sports turf.

These features, plus leaves finer than common Kentucky bluegrass, made Merion, a variety found on a Pennsylvania golf course, a tremendous commercial success. The biggest problem with common Kentucky is its susceptibility to summer diseases. But Merion provided hope there as well since it exhibited excellent resistance to leaf spot. Breeders also discovered that the seed of Kentucky bluegrass varieties produced genetically identical plants, a characteristic called apomixis. The seed is viable without being pollinized. As long as the seed was pure, no offtypes would develop in the stand over time.

Merion and other first generation improved Kentucky bluegrasses, such as Windsor and Newport, had a weakness — they were susceptible to stripe smut. Breeders got to work searching for bluegrasses with both leaf spot and stripe smut resistance. Over the next 20 years they achieved this with improved varieties such as Adelphi, Baron, Glade, Parade, Plush, Ram I and Touchdown.

Some resistance to rusts, dollar spot, *Fusarium* blight and powdery mildew has since been selected and bred into many improved Kentucky bluegrass cultivars. Dr. William Meyer, breeder for Turf Seed Inc. and Pure Seed Testing, pioneered much of the disease resistance work in Oregon, especially for rusts. It's important that you ask specifically about resistance to key diseases before you buy any variety of Kentucky bluegrass.

But the real key to disease control, says Funk, is blending a number of disease-resistant Kentucky bluegrasses together. This genetic diversity provides a backup in case one of the varieties is less resistant than the others to disease.

According to the results of the latest

National Kentucky Bluegrass Test, the 30 commercially available cultivars rated highest overall at 22 locations in the U.S. and Canada, are: Blacksburg, Midnight, Princeton 104, Bristol, Eclipse, A-34, Challenger, America, Trenton, Estate, Chateau, Freedom, Coventry, Julia, Rugby, Sydsport, Classic, Glade, Haga, Cynthia, Aspen, Tendos, Dawn, Victa, Ikone, Abbey, Liberty, Cheri, Nassau and Parade. This ranking was determined by averaging quality ratings from all test stations. A number of varieties entering the market this fall were tested under code numbers and are not listed here because they were not commercially available when the report was published.

Regional strengths and weaknesses can effect their rank for your particular region. For example, a bluegrass that does well in Rhode Island may not do nearly as well in Virginia or Washington. Your local extension specialist and turf seed supplier should obtain a copy of the National Kentucky Bluegrass test, USDA-ARS, Beltsville Agricultural Research Center, Beltsville, MD 20705, for regional rankings. USDA stresses that results for some cultivars may be poorer than expected if the single seed samples used for the tests were bad.

But the concept of regional cultivars is growing each year. Lofts Seed is custom blending seed for many of its distributors and large customers to match regional conditions, says John De Matteo, turf agronomist. Jacklin and Turf Seed have signed agreements to grow specific cultivars of Kentucky bluegrass exclusively for certain regional distributors. The other trend, established largely by Scotts, Northrup King and International Seed, is to market blends of Kentucky bluegrasses instead of individual cultivars. The cultivars in the blends can be changed without changing the name of the blend. This enables the seed companies to incorporate better cultivars into blends as they become available and to change them to solve regional needs or production problems.

Breeders have been working with Kentucky bluegrasses recently to find cultivars which exert more of their energy toward lateral growth than upright growth. Dr. Eliot Roberts, executive director of the Lawn Institute, believes that these "dwarf" varieties may have a place in sports turf in the future. As for now, they are used primarily to reduce mowing frequency in commercial turf maintenance.

Pickseed West, among other seed companies, is reversing a trend toward finer and finer bladed Kentucky bluegrasses to select and market broader leaved varieties that blend in well with tall fescues. Pickseed's cultivar is called Bronco. "Fine-bladed grasses are more suited for home lawns than for sports turf," says Jerry Pepin, Pickseed's breeder.

Kentucky bluegrasses have the reputation of being high maintenance turfgrasses. If this maintenance level wasn't practical,

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Selecting the Best Seed

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schools and parks turned to tall fescue. The problem with this is tall fescues are bunch grasses and do not spread to fill in damaged areas. If heavily-used tall fescue sports turf is not reseeded regularly to maintain density, it turns clumpy, and in some cases, dangerous. Tall fescues, however, have a definite advantage over other cool-season turfgrasses when it comes to shade tolerance, water conservation, drought tolerance and fertility requirements.

The tall fescues have come a long way from Kentucky 31 and Alta. These were forage grasses to begin with. Only in the past ten years have tall fescues been bred specifically for turf. Breeders sought and found cultivars with finer blades, darker green color and improved disease resistance. As they became closer in appearance to Kentucky bluegrasses, sports turf managers in the hot, humid transition zone had a suitable substitute for the more disease-prone bluegrasses.

The strengths of tall fescues are a moderate fertility requirement and improved drought tolerance due to their deeper root systems. As Dr. Fred Lederborer, a breeder for Turf Merchants, explains, "Tall fescues can go deeper in the soil for water, but that doesn't mean they need less water to grow." This trait, however, gives the sports turf

The names of individual cultivars have become secondary to the names of tall fescue blends in some areas.

manager more time between irrigation cycles.

In tests at the University of California at Riverside, Dr. Vic Gibeault demonstrated that turf-type tall fescues come in second to bermudagrass for efficiency where quality turf is necessary and water is tight. Tall fescues grow well with only moderate fertilization and less frequent irrigation. That is what they will do under limited use, but when use levels grow, higher maintenance standards need to be applied. More nitrogen and water may be necessary to stimulate recovery.

Since the tall fescues do not spread by stolons or rhizomes, plants that fail during the playing season, must be replaced by

reseeding. That is nothing to be ashamed about says The Lawn Institute's Roberts. "Slicer/seeder have made reseeding a real sound practice for all turf managers. They have increased the germination of seed in established turf and enabled turf managers to incorporate improved varieties into older stands." Pregermination has also reduced the amount of time it takes to get seed established.

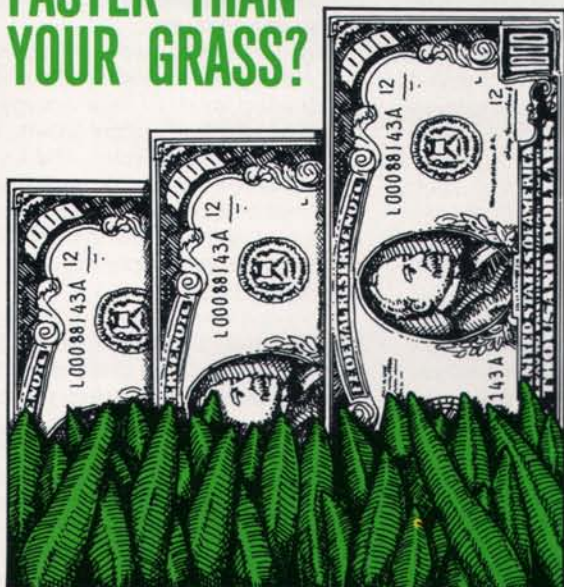
The newer tall fescues have improved resistance to a few diseases, including brown patch, leaf spot and rusts. They are finer bladed and darker green than the old tall fescues. They perform better in shade than even shade-tolerant Kentucky bluegrasses.

Thirty tall fescues were tested at 19 different locations in 1987 under USDA guidelines. When the quality ratings of all sites were averaged, the top 15 cultivars were Arid, Jaguar, Apache, Bonanza, Rebel, Mustang, Adventure, Olympic, Trident, Houndog, Falcon, Maverick, Pacer, Tempo, and Finelawn I.

The names of individual cultivars have been secondary to the names of tall fescue blends in some areas. This trend had its beginnings in the sod industry where growers gave tall fescue sod a name to promote it more effectively. The growers knew the advantage of planting blends and did so for their sod. When customers wanted

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TURF TYPE TALL FESCUE

Selecting the Best Seed

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seed to match the sod, it was easier to call the seed by a single name than to state the individual cultivars in the blend. Seed producers responded in kind with blend names such as Marathon and Triathlon.

The cool-season turfgrass that still has the industry guessing at its full potential is



Tall fescue.

perennial ryegrass. At one time it appeared that the future of this fast-germinating grass was limited to a nurse grass for mixtures of Kentucky bluegrass and fine fescue. The older cultivars were light green, stemmy and mowed poorly. But, they weren't considered permanent turf anyway.

However, Dr. Howard Kaerwer, former breeder for Northrup King, and breeders at Penn State and Rutgers saw a greater place for perennial ryegrass in the overseeding market. They started selecting varieties that were far superior to annual ryegrass in appearance, mowability and traffic tolerance. Northrup King's first entry was NK 100. Penn State developed Pennfine and Funk at Rutgers introduced Manhattan. With steady promotion in the Sun Belt, the concept of perennials over annuals finally struck home in the late '70s.

Today, seed companies can't produce enough perennial ryegrass seed to meet the demand of golf course superintendents and sports turf managers. "We may need to find other places to grow seed," states Tom Stanley, marketing manager of Turf Seed Inc. New Zealand is one place being considered. The seed crop there is harvested around New Year's Day while the harvest in the Pacific Northwest takes place in July and August.

The popularity of perennial ryegrasses has resulted in the release of many new and improved cultivars. More than 60 were tested in 1987 in the National Perennial Ryegrass Test. Diseases of concern to breeders have been brown patch, dollar spot, rusts and red thread. Since they are used largely for

overseeding, *Pythium* is a major concern of breeders.

Based on average quality ratings from 22 test sites, these 25 commercially available perennial ryegrasses were highly rated: SR 4000, Fiesta II, Tara, Omega II, Aquarius, Dasher II, Pennant, Manhattan II, Competitor, SR 4100, Repell, Palmer, Blazer II, Citation II, Commander, Lindsay, Allaire, Prelude, Gator, Rodeo, Patriot, Derby, Belle, Goalie and Yorktown II.

As with tall fescues, blends are becoming a major factor in perennial ryegrass sales. Shortages of some cultivars during the past few years have made blend marketing more flexible than cultivar marketing. Golf courses and sports complexes who overseed with perennial ryegrass want a cultivar that germinates successfully and quickly, tolerates heavy winter play and then fades away rapidly in the spring to make room for the bermudagrass. A ryegrass that is heat tolerant can hang on too long for the needs of the turf manager and become a problem in the spring.

Steve Cockerham, manager of the sports turf research plots at UC Riverside, is impressed with the wear tolerance of some perennial ryegrasses. Cockerham uses a wear simulator to stress turfgrass cultivars. He is now cooperating with test facilities in Oregon, Missouri and Pennsylvania to gather scientific data on wear tolerance. "Wear data is just now being developed that will enable breeders to select cultivars specifically for sports and other high-traffic turf. We are also evaluating different root zones, the effect of compaction on cultivars, fertility requirements, thatch levels and water needs." The work of Cockerham and others will undoubtedly lead to improved turfgrasses specifically for sports turf.

While some speculate on the value of perennial ryegrass as a permanent turf, Roberts prefers to see it as a good marriage for Kentucky bluegrass. "Ryegrasses have strengths that make up for Kentucky bluegrass' weaknesses, and visa versa." Roberts feels sports turf managers should not abandon Kentucky bluegrass as the base grass for cool-season sports turf. "You need the rhizomes only bluegrass has. You also need the fast germination of ryegrass." Roberts suggests that sports fields can be reseeded anytime, not just in the fall, and the seed should contain Kentucky bluegrass and fine fescues as well as perennial ryegrass seed. "Seed on top of the snow in spring if you have to," he states. "Heavily-used sites may benefit greatly from weekly reseeding. Seed is relatively inexpensive compared to the value of keeping sports turf safe and in play."

Roberts thinks fine fescues can help sports turf managers improve turf performance in low-maintenance and shady areas around sports facilities. They germinate fairly rapidly and have waxy thin blades that help them utilize water and nutrients better than other turfgrasses. However, they are not aggressive and can succumb to red thread. Certain cultivars have improved resistance

to powdery mildew. Fine fescues require less water, fertilizer and mowing. They are ideal for low maintenance areas such as roughs, banks and heavily shaded areas.

Fine-leaf fescues really consist of creeping red fescue and the non-creeping chewings, hard and sheep fescues. They can be used to establish turf quickly and inexpensively. More aggressive turfgrasses can then take



Fine Fescue.

over from the fine fescues as water, fertility and light levels increase. Fine fescues are more popular in Europe than in the U.S.

The USDA tests included 47 cultivars tested at seven locations. The leaders were ST-3000, Aurora, Scaldis, Biljart, Spartan, Bighorn, Victory, Waldina, Longfellow, Reliant, Flyer, Banner, Shadow, Center, Waldorf, Epsom, Mary, Jamestown, Enjoy, Ensyva and Pennlawn. Their role in mixtures has downplayed the notoriety of any particular cultivars. Still, considerable improvements have been made by turf breeders. Seed buyers should make a point to check the label on mixtures to see what cultivars they contain.

One of the ways race horse breeders select future winners is to concentrate on the offspring of past winners. Breeders and speculators spend millions of dollars to claim the rights to the foals of great racehorses speculating on their future. The same is true for turf seed. We are now entering the third generation of improved turf cultivars. Many never make it to the market. Instead they are knocked out of turf trials during the selection process. They have to be better than their parents, not just as good.

Furthermore, as blends and mixtures of improved varieties are marketed, the sports turf manager has available to him the strengths of many strong performers. To keep betting on older seed varieties is like kissing your money goodbye at the betting windows. There is a science to turfgrass selection. The stakes in sports turf management are too high not to buy the best cultivars available to you.

ATTENDANCE DOUBLES IN NEW BUFFALO STADIUM

The value of a "major league stadium" for minor league baseball is being proven in Buffalo, NY. The attendance so far this season at Buffalo Bison games has averaged two-and-one-half times more in the new Pilot Field than the previous year in War Memorial Stadium. At the current rate, the Pittsburgh Pirates Class AAA team will be only the second team in minor league history to top the one million attendance mark.

Pilot Field, built with \$30 million in state, local and private funds, opened at the beginning of the Bisons 1988 season. During the first 36 games, an average of 15,000 out of the 19,500 seats in the new stadium have been filled with fans. The average in War Memorial Stadium was about 6,000.

It is no secret that Buffalo Bison owner Robert Rich wants to build attendance to prove that the city will support a major league expansion franchise. Pilot Field was designed by HOK Sports Facilities Group in Kansas City, MO, to be expanded to 40,000 seats. Its appearance follows the tradition of Ebbets Field, Comiskey Park and Wrigley Stadium, explained project architect Ben Barnert. One big difference is those historic parks were constructed without 38 luxury suites and a 3,500-seat club level.

The field is 72,000 square feet of Kentucky bluegrass/perennial ryegrass sod

installed hurriedly last fall to give it time to knit before the first snow fell. The sod contains Victa, Bristol and Merit Kentucky bluegrasses and Pennfine perennial ryegrass. Star Landscaping of Buffalo installed the sod. John Danforth Company of Buffalo installed the Toro automatic irrigation system. Cowper Management, Inc., was the principal contractor for the stadium.

Roger Bossard, head groundskeeper for the Chicago White Sox, consulted with stadium officials to assure that the field met major league standards. More than 6,500 feet of drain pipe was installed in a vein-like pattern to remove excess water.

OREGON COLLEGE INSTALLS GRID IN BENCH AREA

Linfield College in McMinnville, OR, fields one of the best football teams in Division II of the National Association of Intercollegiate Athletics (NAIA). Coach Ad Rutschman has compiled a 150:34 won/loss record over 19 years, including three championships. The value of football to the college has been enormous. College administrators felt it was time to do more to make 60-year-old Maxwell Field a gridiron fit for champions.

The natural turf field at the stadium takes a beating during the rainy football season.

Regular reseeding with perennial ryegrass keeps it covered for the five or six regular season games and post-season play, but the small bench areas between the track and the field didn't hold up.

Several alumni are seed growers in the Willamette Valley so artificial turf was out. The coach and the alumni wanted grass in the bench areas, not carpet or covers. So when the field was renovated this spring, Coach Rutschman agreed to test a plastic interlocking grid system from Chempath. The grid was installed on both sides of the field, covered lightly with soil, seeded and topdressed. By June, the bench areas were indistinguishable from the rest of the field. The real test comes in September when the Wildcats open their season at Maxwell Field.

ROYALS ADD DORMITORY TO TRAINING SITE

The Kansas City Royals have begun construction of a dormitory at its spring training facility located on the grounds of Baseball and Boardwalk, a baseball theme park near Orlando, FL. The 37,000 square foot facility will house 200 players along with staff.

The Royals trained at the theme park for the first time this past spring. The center has six fields including a 6,500-seat stadium.

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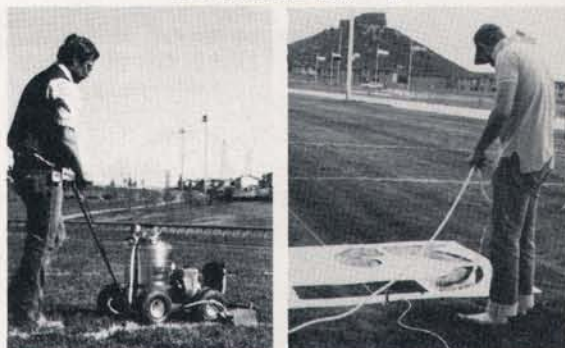
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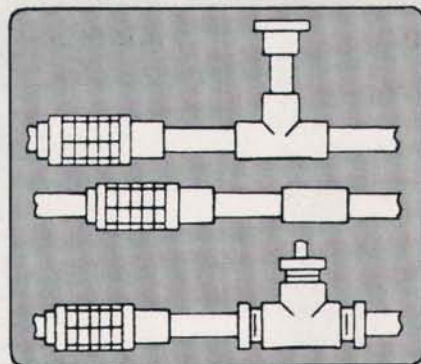
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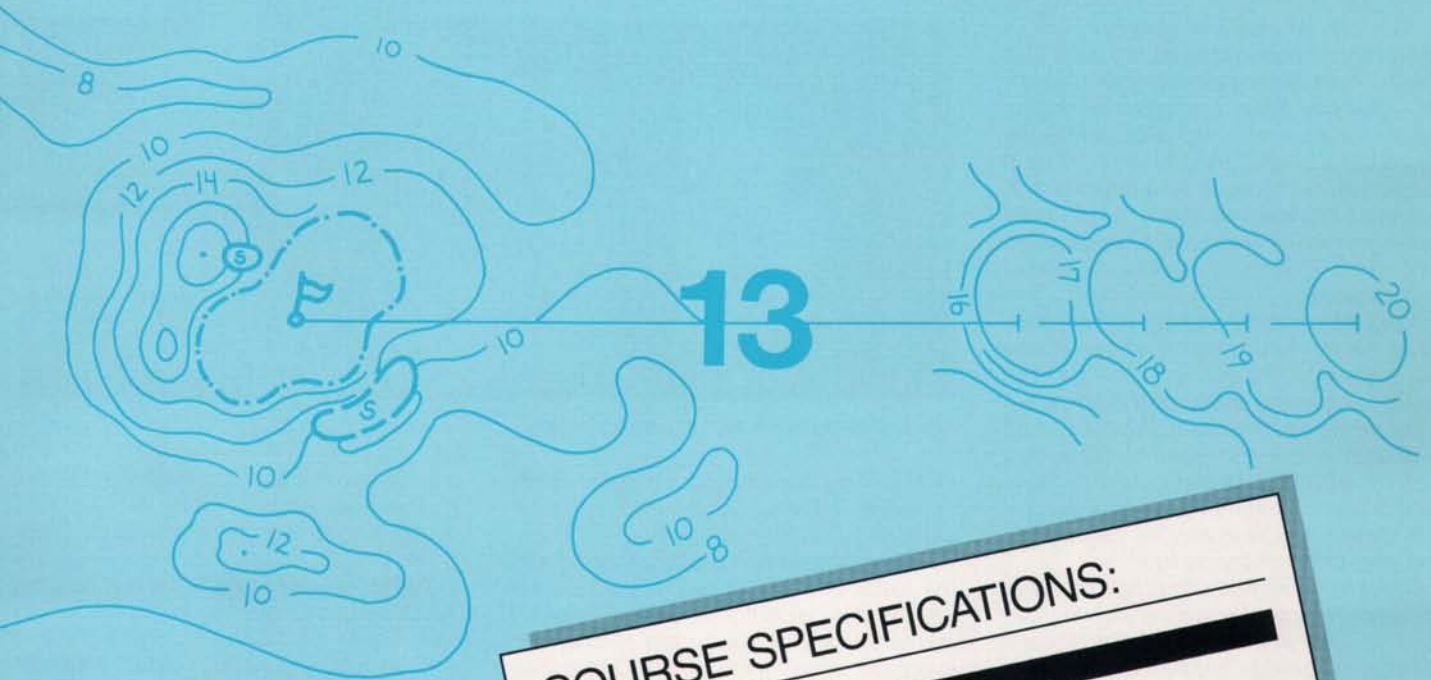
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TIPS FROM THE PROS

GREAT POTENTIAL EXISTS FOR PREGERMINATION OF SEED

By Nicholas R. Spardy

Pregermination of seed is essential to turfgrass management today. Sports turf managers are expected to produce a cosmetically appealing and durable turf in a short period of time. While it is currently being used on a limited basis by a few turfgrass managers, the potential for pregermination, especially where accelerated establishment is necessary, is now being realized.

The rate of establishment of pregerminated seed is much faster than if seed was just applied to the soil and covered. The sports turf manager can expect playable turf within weeks of application. Pregerminated seed is also useful to repair divots so that athletes will not injure themselves by stumbling or tripping over divots or depressions. Divot repair also improves the appearance and playability of sports turf.

Successful methods for pregermination should provide quicker germination in inclement weather or when use dictates that a turf stand is needed before it is possible to establish turf by conventional means.

Pregermination is simply a process that incubates the seed off-site. The seed is placed in an environment that is favorable to germination before it is applied to a field, tee or fairway for growth. The seed is then applied after it is either swollen or the radicle (the first root) has emerged, whichever is preferred for the given situation.

There are at least six different methods of pregermination that are currently used by sports turf managers throughout the United States. Tests at Cal Poly Pomona in 1987 compared the success of each method. All but one provided at least 72 percent germination of perennial ryegrass within seven days.

With the Northrup King method seed is soaked in small burlap bags in a tank of water. After 12 hours in water the bags are removed from the tank and hung up to dry for another 12 hours. This cycle is repeated for seven days.

In the Candlestick Park method 50 pounds of seed are mixed with 100 pounds of Lapis sand and 150 pounds of Turface (processed calcined clay). The material is watered thoroughly, drained and pushed into mounds. The mounds are checked daily and kept moist.

Seed is placed directly into tanks or 55 gallon drums filled with water in the Kansas City method. The water is changed every 12 hours. By changing the water, oxygen in the water is replenished and exudates



Seed following seven days of pregermination.

given off by the seed during germination are reduced. These exudates seem to inhibit germination if not removed.

The wetting agent Aqua-Gro is mixed with the water at a rate of two ounces per 55 gallons of water in the Milwaukee Brewers method. Water in the drums is changed every four hours for three days. On the third day or after the seed has become swollen, the seed is removed from the water and mixed with Milorganite fertilizer (6-2-0). The mixture is spread out and left until it becomes semi-dry.

Based on the previous four methods, Cal Poly devised two more methods for testing. The first soaks the seed in water-filled drums like the Kansas City method. The water is changed every 12 hours. A small aquarium pump is used to continuously aerate the water. The second is the same as the first, but Aqua-Gro is added on the third day of soaking.

Initial germination was observed on the third day of the study. Early averages ranged between one to seven percent germination. By the fourth day the percentage of germination jumped to roughly 40 percent for most of the methods. By the fifth day, the Candlestick Park, Kansas City and the Cal Poly methods provided approximately 70 percent germination. The studies indicate that all methods evaluated exhibited germination percentages above 70 percent for perennial ryegrass and above 80 percent for annual ryegrass.

The highest amounts of germination of perennial ryegrass were seen after seven days in the Kansas City and the first Cal Poly methods, 89 and 90 percent respectively. Candlestick Park had 86 percent germination after seven days.

The Cal Poly method which used air bubbled through water, and the Candlestick Park

method consisting of a porous planting mix had the best topgrowth both in height and quality. Kansas City also produced good topgrowth.

The Milwaukee Brewers method became infested with a fungus apparently due to high humidity in the laboratory. Normally this method is done in a cool, outdoor area with lower humidity and greater air movement.

The Northrup King method was modified afterwards by Dr. David Kassnoff, NK's turf breeder, for further testing. A pump and a circulation immersion heater were added to the water tank. Water temperature and aeration were found to be important keys in realizing rapid germination. In experiments using perennial ryegrass it was found that 90 percent germination was reached in eight to nine days when the water temperature was maintained at 68 degrees F. When the water was kept at 77 degrees F., the same germination was achieved in three to four days. The results suggest that 77 degrees F. is a favorable temperature to pregerminate perennial ryegrass.

In similar tests, 90 percent germination of Kentucky bluegrass seed was achieved in seven to nine days when water temperature was maintained at 77 degrees F. This could be a benefit to managers of Kentucky bluegrass sports turf who would like to speed up germination for reseeding.

It is hoped the results of this study will be beneficial to all turf managers. Each method offers different procedures and a different approach to this important aspect of sports turf management. □

Editor's Note: Nicholas R. Spardy conducted the preceding research as a senior under Dr. Kent Kurtz at Cal Poly University, Pomona. Today he is western regional turf specialist for Northrup King.