

plant. This *Lolium* endophyte lives symbiotically within the host plant and causes no outward symptoms when present.

The mechanism of resistance is not clear, the best theory is that the fungus produces a chemical within the plant that is toxic to chewing insects. The endophyte is transmitted by seed or by vegetative propagation such as tillering. It does not spread from plant to plant in the field.

Under "average" storage conditions the fungus will remain viable in seed from 8 to 16 months after harvest. Under cool storage (40 degrees F.) the endophyte will remain viable for many years.

One of the most recent developments has been the release of several cultivars resistant to damage by insects.

Plants grown from seed possessing living *Lolium* endophyte will have the endophyte growing within the plant and concentrated mainly in the lower stem and crown. Ryegrass plants with the endophyte have demonstrated resistance to damage caused by chewing insects such as the sod webworm (*Crambus* spp.), billbug (*Sphenophorus parvulus*) and Argentine stem weevil (*Listronotus bonariensis*).

Endophyte enhanced performance

In addition to improved insect resistance, ryegrass plants possessing the *Lolium* endophyte often exhibit improved turf performance—particularly during periods of summer stress due to heat and drought.

For reasons that are not clear, endophyte infected turf appears to have improved persistence and vigor during periods of summer stress. It may also have increased vigor, a more attractive appearance, improved density and recover more rapidly from injury.

During most of the year good varieties not containing endophyte will be every bit as good as those that do. It is only during periods of chewing insect infestation or summer stress that an endophyte containing cultivar may

Perennial Ryegrass Varieties

All Star is a leafy, attractive, medium early, turf-type variety. It is marketed by J. and L. Adikes of Jamaica, NY. Most of the parental germplasm of All*Star originated from selections made from old turfs located in Baltimore and College Park, MD. All*Star has the ability to produce a fine, dense turf with a reduced rate of vertical leaf growth and an attractive bright, dark green color. The variety has shown good heat and drought tolerance and good cold hardiness. All*Star has demonstrated good resistance to *Rhizoctonia* brown patch disease and some species of sod webworm.

Barry is a leafy, attractive, late maturing turf-type variety, developed in Europe by Barenbrug Holland BV, and marketed in the U.S. by Turf Merchants Inc., Albany, OR. Its parental germplasm came from Manhattan and from selections made in Europe. Barry is capable of producing a fine textured, dense, medium-low growing turf with a dark green color. It has good resistance to brown blight and *Rhizoctonia* brown patch. Barry has good heat and cold tolerance and the ability to maintain good color into the cool temperatures of late fall. Mowing characteristics are above average.

Belle is a medium early maturing variety currently being produced by E. F. Burlingham and Sons of Forest Grove, OR. Belle is a leafy, persistent, turf-type variety capable of producing an attractive, dense, moderately low-growing, fine-textured turf of a moderately dark green color. Belle has shown moderately good resistance to some races of crown rust, *Rhizoctonia* brown patch and winter brown blight diseases. It has shown medium to good heat and cold tolerance, good wear and good mowing qualities.

Birdie is a medium early variety developed by Turf Seed, Inc. of Hubbard, OR. It has a moderately dark green color, medium-fine texture, medium-high density, and is a moderately low-growing, turf-type variety. Birdie has moderately good resistance to *Rhizoctonia* brown patch and some races of dollar spot. It is susceptible to the winter brown blight disease. Birdie has shown medium-good heat tolerance and medium cold hardiness. It has relatively good mowing qualities except during late spring when the turf becomes quite stemmy.

Birdie II is an early maturing variety developed by Pure-Seed Testing and marketed by Turf Seed Inc., Hubbard, OR. This variety was derived from Birdie perennial ryegrass and new sources of stem rust resistance. It produces a leafy, persistent turf with a medium dark blue-green color and good density. Birdie II has excellent seedling vigor, and improved resistance to winter brown blight, brown patch, stem rust, and heat tolerance, and a dwarfier growth habit than its parent Birdie. This variety has moderately good resistance to insects such as bill bugs and sod webworm based on its high endophyte level (81 percent). It has performed very well for the overseeding of dormant bermudagrass in the southern U.S.

Blazer is a medium late maturing variety currently being produced by Pickseed West Inc., of Tangent, OR. Blazer is a leafy, persistent, moderately low-growing turf-type perennial ryegrass capable of producing an attractive, dense, fine-textured turf of a bright, moderately dark green color. Blazer has shown good resistance to *Rhizoctonia* brown patch and winter brown blight and moderate resistance to some races of crown rust. It has demonstrated good heat and cold tolerance and has good mowing qualities.

Caravelle is a medium maturing variety developed in the Netherlands by Mommersteegs International and distributed in the United States by O. M. Scott and Sons of Marysville, OH. Caravelle is a leafy, low-growing, turf-type variety with a very dark green color, medium fine texture and medium density. It has medium-poor cold hardiness and poor heat tolerance. Caravelle is susceptible to the *Rhizoctonia* brown patch disease. This variety is used primarily for winter overseeding in the South. It tends to mow poorly in hot, dry weather.

Citation is an early maturing variety with an attractive, bright, dark green color. It was developed, and is being produced and marketed by Turf Seed Inc. of Hubbard, OR. Citation produces a low-growing turf with medium fine texture and medium density. The variety has medium cold hardiness, good heat and wear tolerance and good resistance to *Rhizoctonia* brown patch and *Fusarium* blight. Citation has moderate resistance to red thread and many races of dollar spot. It is susceptible to the winter brown blight disease. Citation has good mowing qualities except during its reproductive phase in late spring.

Citation II is a medium-early maturing variety capable of producing a fine textured turf of medium high density. Citation II has the rich dark blue-green color and heat tolerance of its parent Citation. This variety, marketed by Turf Seed Inc. was developed cooperatively by Pure Seed Testing Inc. and the New Jersey Agriculture Experiment Station. It has shown very good resistance to brown patch, stem rust, winter brown blight, dollar spot and crown rust. Citation II has also shown improvements in its tolerance to red thread and *Fusarium nivale*. This variety has excellent seedling vigor, heat and cold tolerance, close mowing tolerance, improved mowing quality and a low growing, dwarfier leaf orientation. The endophyte of this variety is very high at 94 percent, which should convey resistance to above ground feeding insects. It has performed very well in southern overseeding trials.

Cowboy is a new, very early maturing variety being marketed by Loft's Seed Co., Bound Brook, NJ. It was developed as a new stem rust resistant variety cooperatively by the New Jersey Agriculture Experiment Station and Pure Seed Testing Inc. This variety has a moderately dark green color, a medium fine texture and medium density. It has a low growing habit compared to other early maturing varieties. It has

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shown good resistance to winter brown blight, brown patch, crown rust, and dollar spot. It has good heat and cold tolerance and will be very good for the overseeding of dormant bermudagrass in the southern U.S. It has a moderately high endophyte content (57 percent) which should convey a moderately good level of insect resistance.

Dasher is a medium early variety developed by Pickseed West Inc. of Tangent, OR. It is a fine-textured turf-type variety capable of producing a leafy, dense, attractive moderately low-growing, persistent turf with a bright, medium dark green color. Dasher has shown good resistance to winter brown blight. It has medium good cold hardness and good heat tolerance. Dasher has relatively good mowing qualities except during the reproductive period in late spring.

Delray is an early maturing variety that was developed and is being produced by Northrup King. It has a medium dark green moderately low-growing, turf-type variety. Delray has moderate resistance to Rhizoctonia brown patch and some races of dollar spot. It appears to be highly susceptible to the winter brown blight disease. Delray was developed for improved winter hardness and improved performance at reduced fertility levels. It appears to have moderately good heat tolerance. It has moderately good mowing qualities except during its stemmy, reproductive period in late spring.

Derby is an early maturing variety de-

veloped by International Seeds Inc., of Halsey, OR. It has been a very popular variety for the last 10 years. It is a moderately fine-textured, turf-type variety capable of producing an attractive turf of medium density and a moderately dark green color. Derby has medium cold hardness, good heat tolerance and good wear tolerance. The variety is susceptible to the winter brown blight disease but shows moderately good resistance to Rhizoctonia brown patch and some races of dollar spot. Leaf appearance is moderately good after mowing except during late spring.

Diplomat is a medium late maturing variety developed by Lofts Seed of Bound Brook, NJ. It is an attractive, moderately dark green, turf-type cultivar that produces a leafy, persistent turf of greater density, finer texture, and a slower rate of vertical growth than most other perennial ryegrasses. It has moderately good resistance to Rhizoctonia brown patch and the winter brown blight disease. Diplomat has good heat and cold tolerance and relatively good mowing qualities.

Elka is a late maturing variety developed in the Netherlands by Cebeco-Hendelsraad. International Seeds is currently producing seed of this variety. Elka is a turf-type variety with a medium light green color. It has soft, fine leaves and the ability to produce a turf with greater density and a slower shoot growth rate than most varieties currently on the market. It has fair heat

tolerance and moderately good cold hardness and shade adaptation. Elka has demonstrated good resistance to present races of crown rust but the variety appears moderately susceptible to Rhizoctonia brown patch, winter brown blight and dollar spot. Mid-spring performance ratings of Elka can be excellent but summer performance can be below average.

Fiesta is a medium early maturing variety currently being produced by Pickseed West Inc., of Tangent, OR. Since its release in 1977, Fiesta has been a popular and widely used variety. It has a moderately dark green color, medium fine texture, and medium high density. It has a reduced shoot growth rate and a turf-type growth habit. Fiesta has good cold hardness and good heat tolerance. The variety has good resistance to Rhizoctonia brown patch and moderate resistance to winter brown blight.

Game is an early maturing variety developed in the Netherlands. Game has a bright, medium green color, low density and produces a turf with an erect growth habit and a rapid shoot growth rate. Game has shown poor heat and cold tolerance and high susceptibility to Rhizoctonia brown patch. It has a very poor leaf appearance after mowing.

Gator was developed by International Seeds Inc., Halsey, OR, from germplasm obtained from the New Jersey Agricultural Experiment Station. It is a leafy, turf-type ryegrass

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medium maturity. Gator is a newer Variety and is capable of producing an attractive, persistent, low-growing, fine textured turf of medium high density and has a bright medium dark green color. It has shown good resistance to Rhizoctonia brown patch and winter brown blight. It has very good resistance to many races of crown rust. Gator has demonstrated good winter hardiness and improved summer performance. It has better mowing qualities than most other varieties now available and can tolerate low cutting heights well. Gator is very low in percent endophyte content.

Linn is an early maturing variety with a

bright, medium green color, low density, an erect growth habit and a very rapid vertical growth rate. It has poor heat and cold hardiness and poor wear tolerance. Linn is susceptible to the Rhizoctonia brown patch and winter brown blight diseases. It has very poor mowing qualities.

Loretta is a late maturing variety developed in Germany. It is distributed in the United States by O. M. Scott and Sons of Marysville, OH. Loretta is a leafy, moderately low-growing variety with soft leaves and a turf-type growth habit. It has a bright medium light green color, medium fine texture and medium high density. Loretta has medium heat and

cold hardiness. The variety has good resistance to present races of crown rust, moderate resistance to Rhizoctonia brown patch and winter blight and is quite susceptible to dollar spot. Loretta exhibits a good leaf appearance after mowing.

Manhattan is a late maturing variety developed by the New Jersey Agricultural Experiment Station. Manhattan is a leafy, moderately low-growing, turf-type variety with a bright, moderately dark green color, a medium fine texture and medium density. Manhattan has moderately good tolerance of heat and shade, improved cold hardiness and excellent wear tolerance when growing conditions are favorable. Manhattan has good resistance to the winter brown blight disease and moderate resistance to Rhizoctonia brown patch. It is moderately susceptible to crown rust, red thread and dollar spot. This variety shows relatively good mowing quality during heat stress.

Manhattan II is a leafy, attractive, persistent, turf-type variety of medium maturity. It was developed cooperatively by Pure Seed Testing Inc., the Manhattan Ryegrass Growers Association, and the New Jersey Agricultural Experiment Station. It is capable of producing a dense, fine textured, medium low growing turf with a bright, dark green color. Compared to Manhattan, Manhattan II shows improvements in resistance to stem rust, brown blight, Rhizoctonia brown patch and red thread. It also shows improvements in heat tolerance, summer performance and mowing qualities.

NK200 was developed by the Northrup King Company. It is a late maturing variety with a bright, medium dark green color, medium texture and a turf-type growth habit. NK200 has improved cold hardiness but below average heat tolerance. It is susceptible to crown rust and Rhizoctonia brown patch. NK200 has good mowing qualities except during heat stress.

Omega is a medium maturing variety developed by Turf Seed Inc. of Hubbard, OR. It has a bright, type habit, a medium high density and a reduced rate of vertical shoot elongation. It has good heat, cold and wear tolerance. Omega has good resistance to the Rhizoctonia brown patch and the winter brown blight diseases. The variety shows relative good leaf appearance after mowing.

Omega II is a medium early variety being marketed by Turf Seed Inc. It was developed by Pure Seed Testing Inc. with the cooperation of the New Jersey Agricultural Experiment Station. This variety has excellent rust resistance. It has a dark green color and produces a dense, leafy, attractive turf. It has a dwarf leaf orientation than most other varieties. Omega II has shown excellent brown blight resistance and improvements in heat tolerance, mowing qualities, brown patch, red thread, dollar spot and crown rust resistance compared to its parent, Omega. It possesses comparable seedling vigor and cold tolerance to Omega. This variety contains an endophyte level of 55 percent, to convey a moderately good level of resistance to above ground feeding insects. It has shown good performance in southern overseeding trials.

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Each year hundreds of Southern courses literally apply millions of pounds of "overseeding" grasses to their Bermudagrass greens and tees.

The process of applying the seed takes place normally in October and November and is quite detailed. Exact procedures vary from course to course. At Inverrary, our overseeding program begins long before temperatures cool in the fall.

A successful overseeding is the

However, the green with more seed may putt slower.

After seed application, the single most important program is proper irrigation. Light, frequent irrigation is the key to a high percentage of seed germination and retention.

Golfers are inconvenienced by the frequent daytime watering and it places more pressure on the irrigation crew. But, the temporary inconvenience is justified by the condition of the over-

The day of seeding two crewmembers **remove the dew** from the greens by dragging hoses across them. This speeds up the time it takes for the greens to dry. The greens must be dry so the seed is not tracked off the greens on the shoes of the seeding crew.

Next, the **greens are spiked** in four directions to allow the seed to make better contact with the soil.

Seeding takes the most thought. I like to think we get better each year. Hopefully, the days

Winterseeding

The Greening of Inverrary

by Brad G. Kocher, Golf Course Superintendent, Inverrary Country Club, Club Corp. of America, Lauderhill, FL.

product of a lot of prior planning and effective turf management. We try to strive for (1) a healthy turf, prior to seeding; (2) a good seedbed; (3) consistent seed application; (4) adequate irrigation; and (5) proper post-germination mowing, watering and fertilizing practices.

Healthy turf is paramount to any quality putting surface. Our pre-seeding goals are to have healthy turf, while not overly lush. Lush turf causes Bermudagrass to grow more rapidly and compete with the newly establishing overseeded grass.

The turf should also be weed-free, fungus-free and void of insects. At no time do we wish to have an outbreak of disease or insects in conjunction with newly established grasses.

A good seedbed is also quite important. This involves minimizing thatch and application of top-dressing material after seeding to assure seed/soil contact.

An even application of seed is also imperative to produce a consistent overseeded surface. Our rate is 30 lbs. of ryegrass per 1,000 square feet. We want each green to have the same exact rate, not 28 lbs/1,000 on some greens and 32 lbs/1,000 on others. Golfers may or may not notice the difference.

seeded areas during the next six to seven months. In many areas, overseeded turf predominates for a longer period than Bermudagrass.

Lastly, a good overseeding program requires proper turf management—mowing, watering and fertilizing—throughout the winter months. This is outlined in the following chronolog of overseeding at Inverrary.

Overseeding diary

Our overseeding program begins with **verticutting** the greens ten days to two weeks prior to overseeding. The purpose is to thin the Bermudagrass sufficiently and to give it time to heal before applying ryegrass seed. We have found if we verticut the day of seeding, an excessive amount of seed works its way into the verticut grooves and the seed germinates in rows.

Three days before seeding, we **discontinue mowing** the greens. The reason for this is to give the seed some upright Bermudagrass leaf surface for shelter. The seed is not as exposed and the leaf blades stabilize the seed among the Bermudagrass plants. This is particularly helpful if we have a downpour between seeding and germination. The seed is much less likely to wash away.

of spilling seed out the back of a Cushman as we travel from green to green are over.

Each **green is measured** accurately. We know precisely how much seed we need for each particular green to achieve the 30 lbs/1,000 rate. For example, a 6,000-square-foot green should receive 180 lbs of seed (6 x 30 lbs).

In addition, we overseed the perimeter of the green, the cleanup ring, at 35 lbs/1,000. We seed the cleanup ring at a slightly higher rate because of the higher mortality rate of ryegrass in this area due to triplex greens mowing. The extra seed in the area is only noticeable for the first few weeks.

In the past we tried to establish seed rates based upon the speed of the spreader operator. Due to inconsistencies, we now pre-measure the amount of seed needed for each green based upon individual measurements.

Using a rotary spreader, set wide open, we **spread seed** in four directions at a normal walking pace. Any leftover seed is then applied at a faster walking pace.

The cleanup passes are made with a drop spreader to give a neat, definitive edge to the green.

Neatness is of monumental importance when applying seed. All of our bags of seed are placed on a

piece of carpet on the collar of the green. One man carries the seed to the spreader and two people apply it, one with the rotary and one with the drop spreader. They switch jobs periodically to avoid boredom.

Before the "seeders" leave the green, they clean their shoes using a brush or small broom. In this way they insure that no seed leaves the green on the bottom of their feet. A small piece of carpet is taken from green to green to

provide an area for cleaning.

Next we **apply topdressing** at a rate of approximately one and one-half cubic yards per 5,000 square feet. We use a 90(sand)/10(organic) grade of topdressing. The topdressing helps cover the seed and also provides a medium for good seed-to-soil contact.

Again, neatness is of utmost importance. The topdresser applies his material in a circular motion and never leaves the putting sur-

face until he is finished. This is possible because we back our trucks onto a sheet of plywood at the edge of the putting surface. We can then back the topdresser to the tailgate of the truck and reload it without leaving the green.

When the topdresser leaves he drives onto a sheet of black plastic, cleans the seed off the tires, then proceeds to the next green.

After giving the topdressing material time to dry, we begin **dragging** it in. We use a golf car to pull the mat because it is light and has shallow grooves in the tires making it easy to clean.

We use a steel drag mat with a piece of thick pile carpet attached to one side. We find using the carpet allows us to drag in the topdressing without shifting the position of the grass seed.

Our dragging pattern starts at the outside edge proceeding to a series of shifting oval patterns. In this way, we minimize short turns and avoid going over the same area several times causing a buildup of topdressing in one spot. The natural tendency is to keep going over and over the outside edge.

Once dragging is complete, the car is driven off the green onto a sheet of black plastic and the tires are brushed free of grass seed.

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Topdressing right after seeding and when mowing height is reduced to 1/4-inch is part of a successful overseeding program. Shown right are **greens spiked** in four directions prior to seeding to improve seed/soil contact.

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