

# Kentucky Bluegrasses and Their Culture

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Selection of turf seed can make a huge difference in the appearance and maintenance requirement of a turf area. Differences between varieties are significant to the professional. Keep this article and the next two parts of the seed series, as a reference for future seed purchases.



**K**entucky bluegrass, *Poa pratensis* L., is the most important lawn grass in the northern half of the United States. It is hardy, aggressive, persistent, attractive and widely adapted.

New lower-growing Kentucky bluegrass varieties have been developed which produce a more attractive, durable, persistent turf under a wide range of environmental conditions. These are making this species more useful to the turfgrass industry.

## Origin and adaptation

Kentucky bluegrass is native to the Old World and occurs naturally throughout the temperate regions of Europe and Asia. Early colonists brought the grass to North America in seed mixtures, hay and bedding. It was disseminated rapidly by men, birds and other animals.

Much of the bluegrass found on millions of acres of fertile pastures, roadsides, and other open areas developed without seeding by man. Its ability to colonize is one reason for its widespread occurrence.

Like other cool-season grasses, Kentucky bluegrass grows best during the cool months of spring and fall. Studies at Beltsville, MD, and Kingston, RI, have shown some root growth will occur throughout much of the winter in

unfrozen soil if fertility and soil pH are adequate.

With prolonged summer drought, Kentucky bluegrass may become dormant and turn brown. However, it usually recovers and resumes growth quickly with the return of cooler temperatures and favorable soil moisture. Instances of poor recovery from summer drought are usually associated with insects, thatch, excessive density, insufficient rhizomes, disease, and management practices which include excessive applications of nitrogen fertilizer and/or close mowing.

The development of Kentucky bluegrass varieties with greater tolerance to the long hot summers of the transition zone from Southern New Jersey, Washington, D. C., Cincinnati, Louisville, St. Louis and westward is a real challenge to the turfgrass breeder.

Kentucky bluegrass is best adapted to well-limed, fertile loam soils and cool exposures. In humid regions the soil pH should be corrected to 6.0 to 6.8 for optimum performance although some more acid tolerant cultivars, such as Fylking and Victa, may persist on soils with a pH slightly below 5.0. Under arid soil conditions in dry land areas Kentucky bluegrass thrives on soils having a pH as high as 8.0 if irrigation is provided.

Growth of Kentucky bluegrass is best on well-drained soils. However, it is considerably more tolerant of poor soil drainage than the fine fescues. Helminthosporium leaf spot and crown rot can be especially damaging to susceptible varieties on poorly drained soils.

Kentucky bluegrass is not as well adapted to the extremely sandy coastal plain soils as the fescues, or zoysiagrass unless such soils are properly modified with appropriate additions of organic matter, lime, fertilizer and use of some water. It is also moderately intolerant of excess salt accumulations.

A well-limed, vigorous Kentucky bluegrass sod is noted for increasing organic matter content and improving physical structure of soil. Nevertheless, excessive traffic and poor management may weaken the turf and favor the invasion of species more tolerant of compacted soil conditions such as *Poa annua* and knotweed. Friable soils of good physical condition enhance the ease of establishment of Kentucky bluegrass.

## Fertility response

Kentucky bluegrass responds well to generous fall fertilization. Minimal spring and summer fertilization is usually best when



**Off-type grass plants in the field are killed by roving crews (left), so the seed crop purity is maintained.**



**Seedheads emerge on Kentucky bluegrass (left), and later just prior to cutting and swathing in the field.**

summer stress is severe.

Turf should be fertilized primarily to improve color and density or to heal injury. This can be done most effectively from September through late fall. Short days and cool fall temperatures stimulate tiller production and root growth. They also reduce the rate of leaf blade elongation and cause the plant to grow in a more decumbent (spreading) manner.

In contrast, during the long days in May and June rapid leaf elongation of Kentucky bluegrass occurs and plants are upright.

Fertilizer applications in the fall do not increase mowing as much as the same fertilizer rates applied during the spring growing season. Also, sparse turfs typically increase their density more

following fall fertilization. Late fall fertilization of Kentucky bluegrass promotes better winter color and also assures early spring green-up.

Excessive nitrogen, that stimulates Kentucky bluegrass in late spring and summer, prevents it from developing the physiologically-hardened condition that helps it survive heat and drought stress. Lush spring growth from high fertility also intensifies damage from the *Helminthosporium* leaf spot and crown rot disease.

In short, fall fertilization of turf causes less turf injury during stress, requires less mowing, gives adequate color and gives better turf density than spring fertilization.

### **Adaptation to shade**

Kentucky bluegrass normally performs best in full sun and light shade. In warmer areas it may tolerate afternoon shading with good air movement. In fact, the cooling effect of light shade may reduce injury from chinch bugs, *Fusarium* blight, heat and drought. In warmer regions, Kentucky bluegrass normally does not occur in full sun.

Shaded areas with restricted air movement in wet climates result in slow drying of the turf and a hot humid microenvironment which weakens the grass and provides conditions favorable for disease development.

Moderate to heavy shading of Kentucky bluegrass reduces carbohydrate food reserves, restricts

## Kentucky Bluegrass Varieties

Adelphi (Adikes, Jacklin) is a moderately low-growing, turf-type bluegrass with a very attractive, dark green color which is maintained throughout the entire growing season. It has shown good resistance to leaf spot, Fusarium blight, most races of stripe smut and rust and has moderate resistance to dollar spot. Adelphi is a hybrid between a fairway selection from the Bellevue Country Club and Belturf.

America (Pickseed) originated as a single, highly apomictic plant. It was selected from the open pollinated progeny of a highly sexual hybrid. This hybrid was obtained from a progeny of the cross 'Bellevue' x 'Belturf'. America is a leafy, low-growing, turf-type bluegrass capable of producing an attractive, compact, fine-textured turf of high density and dark color. America has shown good resistance to leaf spot and leaf rust. It has shown less damage from stripe rust than many Kentucky bluegrass varieties.

Arboretum (Mangelsdorf) was selected at the Missouri Botanical Garden from old pastures and lawns in Missouri and neighboring states. It is an erect-growing variety highly susceptible to the Helminthosporium leaf spot and crown rot disease. It is useful for low maintenance turf.

Banff (Pickseed) was selected from a closely-mowed turf in Canada. This moderately low-growing, turf-type variety has medium texture and a bright, medium dark green color. Banff has excellent early spring color. It has good resistance to leaf spot and most rusts and above average resistance to dollar spot and stripe smut.

Baron (Lofts) was developed in Holland. It has rather broad leaves, a moderately low-growing, turf-type growth habit and a medium dark green color. Baron has shown moderately good resistance to leaf spot and has been widely accepted as a good bluegrass variety in many areas throughout the world. The variety has shown only moderate resistance to leaf rust, stem rust, dollar spot and powdery mildew under New Jersey conditions. Baron is moderately slow to become green in the spring. It has a large seed and rather good seedling vigor. Baron produces high seed yields.

Birka (Burlingham) was developed in Sweden. This variety has a medium fine texture, a moderately low turf-type growth habit and a moderately dark green color. Birka has shown good resistance to leaf spot, stripe smut and powdery mildew in New Jersey tests. It is moderately slow to green-up in the spring. The variety is susceptible to stem rust.

Bonnieblue (Burlingham) is a hybrid between the selection from the Bellevue Country Club and Penstar. This moderately low-growing, turf-type variety has good resistance to leaf spot, stripe smut and leaf and rusts. It has a bright, rather dark green color and becomes green early in the spring.

Bristol is a hybrid between a fairway selection from the Bellevue Country Club near Syracuse, NY, and Anheuser Dwarf. This variety has a rich, dark green color, wide leaves and rather decumbent growth habit with a moderately slow rate of vertical growth. Bristol has good resistance to leaf spot and red thread, and moderately good resistance to stripe smut, dollar spot and most races of powdery mildew.

Challenger is a moderately low-growing, leafy, turf-type variety with medium-fine leaves, medium high density, and a very attractive, bright, dark green color. It has excellent early spring color and the ability to stay green into late fall. Challenger has shown good resistance to Helminthosporium leaf spot and melting-out, leaf rust, stem rust, stripe smut, and dollar spot. Challenger is a hybrid between NJE P-123, a selection from Lafayette Park in Washington, D. C., and PSU K106, a selection found in northern Kentucky.

Cheri (Jacklin) was developed in Sweden. This variety has medium-broad leaves, a moderately low, turf-type growth habit and a medium dark green color. Cheri has shown moderately good resistance to Helminthosporium leaf spot and crown rot disease. It has shown only moderate resistance to leaf rust, stem rust, dollar spot and powdery mildew under New Jersey conditions. Cheri is moderately slow to greenup in the spring. Cheri has large seed and rather good seedling vigor.

Columbia (Turf-Seed) was selected from an old, non-irrigated, moderately low-maintenance turf near Frederick, MD. This moderately low-growing, turf-type variety has medium texture, good density, and a bright, medium dark green color. Columbia has an exceptionally attractive early spring color, the ability to stay green into late fall, and the capability of maintaining good winter color in protected locations. Columbia has shown good or moderately good resistance to leaf spot, leaf rust, stem rust, dollar spot, stripe smut and Fusarium blight. Turf produced may have a high proportion of stemmy reproductive tillers in late spring and early summer.

Common Kentucky bluegrass, South Dakota Certified, is a source of Kentucky bluegrass harvested from natu-

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development of roots, rhizomes and tillers, and causes long thin succulent leaves. Such turf is predisposed to diseases, intolerant of wear and less able to recover from injury. Kentucky bluegrass sod laid in intense shade roots slowly and usually fails in 1 to 3 years with the intense shade and wetness of climates such as New Jersey (or the Northeast).

Where shade occurs, Kentucky bluegrass seed content of a mixture should be reduced, but not omitted. This will give a blending of Kentucky bluegrass between the sun and light shade areas.

There is some variation in the shade tolerance of Kentucky bluegrass varieties. Merion, which has been one of the better varieties for general use, is highly susceptible to powdery mildew, a disease which is very damaging to susceptible varieties growing in shade, but of little consequence in full sunlight.

Selection for mildew resistance as been of primary importance in breeding shade tolerant bluegrass varieties. Warren's A-34, Eclipse, Bristol, Benverde, Touchdown, Nugget, Ram 1, Birka and Glade are bluegrass varieties with moderate-to-good mildew resistance. A number of promising experiments also appear to have excellent mildew resistance. However, it must be pointed out that different pathogenic races of powdery mildew develop naturally which would cause some of these selections to become infected.

Shade tolerant Kentucky bluegrasses should also have good resistance to leaf spot and other diseases. Also, they must have the ability to photosynthesize enough food to give tillering, generous rooting, rhizome development and carbohydrate storage.

The ability of some of the fine fescues to tolerate tree root competition and the acid infertile soil conditions frequently associated with shaded locations contributes to their success as a shade tolerant component of a turfgrass mixture.

### Disease resistance

The present varieties of Kentucky bluegrass show substantial differences in resistance to common turf diseases. Use of disease resis-

ralized or native stands. However, some studies indicated natural stands of bluegrass in South Dakota do not contain as much genetic diversity as found in the famous bluegrass region of Kentucky. Kenblue and Park have visually outperformed South Dakota Certified Kentucky bluegrass in New Jersey tests. Studies by Dr. Glen Wood in Vermont showed that bluegrass from the Kentucky areas produced turf more resistant to weed invasion than bluegrass obtained from South Dakota.

*Delta* was selected in Canada. It is similar in growth habit and appearance to common Kentucky bluegrass and is also highly susceptible to the Helminthosporium leaf spot and crown rot disease. In earlier years *Delta* generally performed as well as common Kentucky bluegrass in turf tests at Rutgers. However, during the past few seasons the performance of *Delta* has been poor.

*Eclipse* (Jacklin) is a highly apomictic hybrid selected from the progeny of the cross 64-765-4 x Anhesuser Dwarf. The female parent, 64-765-4, was selected from the progeny of the cross SP-1 x Belturf. *Eclipse* is a low-growing, leafy, turf-type variety capable of producing an attractive, dark green turf of good density, good vigor and medium texture. *Eclipse* has demonstrated good or

moderately good resistance to leaf spot, leaf rust, stem rust, powdery mildew, stripe smut, red thread, and dollar spot. It has performed well in shade trials.

*Enmundi* (International Seeds) is a leafy, attractive, moderately low growing variety developed in Holland. The variety has shown good resistance to leaf spot, stripe smut and Fusarium blight in New Jersey tests. Low seed yields are limiting the use of *Enmundi*.

*Fylking* (Jacklin) was developed in Sweden. This turf-type variety has good resistance to the Helminthosporium leaf spot and melting out disease. *Fylking* is more resistant to stripe smut, stem rust, leaf rust and powdery mildew than *Merion*. It is occasionally damaged by dollar spot and Fusarium blight. *Fylking* produces an attractive, dense, moderately low-growing turf of a rather fine texture. It maintains this leafy appearance during seed head setting time in May and June when many other bluegrasses become quite stemmy. An attractive, rich dark, green color is developed in early spring which is maintained into late fall and under moderately adverse. *Fylking* is moderately tolerant of close mowing. However, cutting the grass at a height of 1-1/4 inches will favor vigorous growth and help prevent weed invasion. The

variety has rather fine leaves which tend to lean at higher cutting heights, thus a neater appearance is attained with moderately close mowing.

*Geronimo* (Jacklin) was developed by Mommersteeg International of Vlijmen, Holland. It is a moderately dark green, turf-type variety, with medium wide leaves, and medium density. It has moderately good disease resistance to the Helminthosporium leaf spot and crown rot disease.

*Glade* (Jacklin) is a moderately fine-textured, dark green selection obtained from an old lawn in Albany, New York. It has shown excellent resistance to stripe smut, many races of powdery mildew, and leaf and stem rust. It has moderate resistance to leaf spot. *Glade* is an aggressive, turf-type bluegrass with a relatively slow rate of vertical growth. This variety has shown good seedling vigor. It has performed well in blends and mixtures with other Kentucky bluegrass, ryegrass and fine fescue varieties. It has shown some tolerance of moderate shade. *Glade* is moderately slow in spring green up.

*Georgetown* (Lofts) was selected from an old turf in western Oregon. It is a moderately low-growing, turf-type variety with medium texture and a

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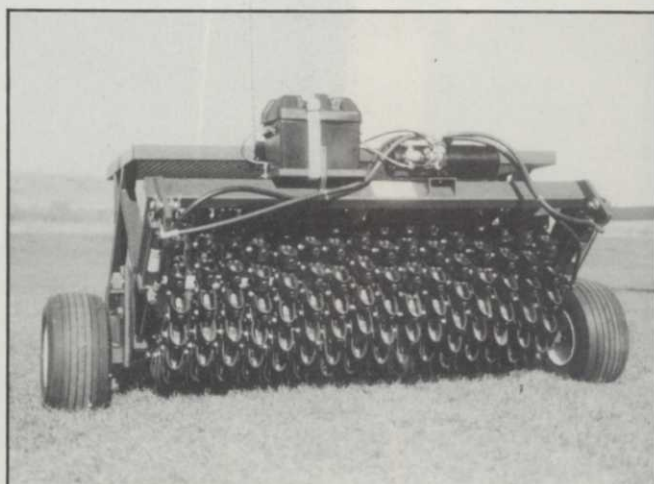


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tant varieties along with good management practices is the safest and most economical means of controlling many important turfgrass disease problems.

Resistance to disease is a prime consideration in selecting any bluegrass variety.

**Melting out disease** The most damaging disease of Kentucky bluegrass in New Jersey is a leaf spot and crown rot caused by the fungus, *Helminthosporium vagans*, commonly called "melting out". This disease appears on leaf blades and sheaths as circular to elongate, purplish to brown spots with straw-colored centers. Some lesions extend the entire width of the leaf, especially on the finer-bladed varieties, causing the portion the leaf blade above the affected area to wither and die.

During severe attacks, especially in late spring and early summer, the fungus causes severe leaf die-back and extensive crown rotting which leads to a melting-out condition. The weak plants and thin turf cover allow invasion by

crabgrass and other unwanted weeds before the bluegrass recovers.

Under New Jersey conditions, *Helminthosporium vagans* produces abundant spores during the cool, cloudy, wet season from October through April. Moderate disease buildup may occur in the fall, persist through the winter, and subsequently intensify into severe damage in May and early June. Disease activity and spore production decrease from May through September. If the turf has not been damaged too severely it will recover significantly at this time, provided growing conditions are favorable.

The severity of the *Helminthosporium* leaf spot and crown rot is greatly influenced by various management practices. Disease injury is more severe with close mowing than high mowing. The shorter cut removes more photosynthetic surface thus limiting carbohydrate development. This weakens the turf, making it more susceptible to damage and

less capable of recovery.

Plants receiving low to moderate levels of nitrogen fertilizer often show greater numbers of leaf spot lesions when examined in March or April. However, during late May and early June when the melting-out or crown rot phase of the disease is most severe, turf receiving high rates of nitrogen fertilizer suffers the greatest damage.

Low light intensity due to either shade or cloudy weather also lowers carbohydrate reserves and increases disease damage.

The best methods of controlling this disease are: the use of resistant varieties such as Merion, Eclipse, Bristol and Touchdown, higher cutting heights, and avoiding excessive nitrogen fertilization during the spring season. Varieties such as Park, Delta, Arboretum, S-21 and Kenblue perform little, if any, better than Common Kentucky bluegrass under New Jersey conditions due to their high susceptibility to *Helminthosporium vagans*.

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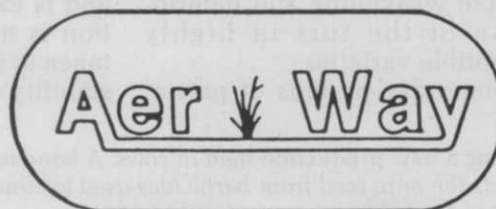
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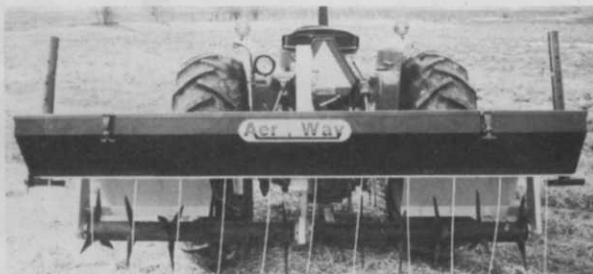
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**Stripe smut** Stripe smut caused by *Ustilago striiformis* is a widespread disease of Kentucky bluegrass that has caused serious damage to many turf areas. It appears to be most serious in the Middle Atlantic states but can cause damage throughout the United States. Apparently, it is not a serious problem in Europe. Stripe smut has been observed for many years and can be found in many mature bluegrass stands.

The increased seriousness of stripe smut has probably resulted from the use of susceptible varieties such as Merion, Newport, and Windsor.

Spores present in the soil or carried on the seed germinate and systemically infect tillers and young seedlings. Long, narrow, gray to black stripes develop on the leaves. The gray stripes are unruptured sori. The black streaks result when the smut sori rupture and liberate mature spores. Following rupture of the sori, infected leaves curl from the tip downward and become shredded. Such tillers then die and disappear during periods of winter and summer stress. The result is a progressive weakening and deterioration of the turf in highly susceptible varieties.

Temporary periods of partial

recovery may occur. Most new stands of the susceptible varieties, if infected, do not deteriorate seriously until they are three to four years old which suggests the disease organism infects the plants slowly. Some turfs escape damage for longer periods.

Turf infected with stripe smut becomes much more susceptible to leaf spot and other diseases. It is also less likely to recover after periods of environmental stress. Resistant varieties offer the most practical means of control.

Some of the systemic fungicides are useful for control of stripe smut in turf.

**Fusarium blight** The *Fusarium* blight disease is causing serious damage to the more lush bluegrass turf in warmer regions. *Fusarium* blight is generally most severe during periods of high atmospheric humidity with daytime air temperatures of 80° to 95° F and night temperatures above 70° F. Temporary drought stress, high nitrogen levels and heavy thatch appear to contribute to the severity of this disease.

Control with fungicides such as benomyl requires proper timing and is expensive. More information is needed on varietal resistance to this disease(s) and on the stability of such resistance.

Observations at New Brunswick during the summers of 1972 through 1976 showed that varieties differed substantially in susceptibility to *Fusarium* blight. Under conditions of high nitrogen fertility and 3/4-inch mowing, the common types of Kentucky bluegrass including Park, Kenblue, Arboretum and South Dakota Certified showed extensive damage from *Fusarium* blight disease. Merion showed moderate damage. Fylking, Nugget, Geronimo, Delft, Modena and Enita had more damage than Merion. Windsor, Columbia, Enmundi, Parade, Adelphi, Rugby, Sydspport, Majestic, Vantage and Glade showed fair to good resistance in these tests.

Developing the required *Fusarium* blight resistance in Kentucky bluegrass will require intensive research.

**Rusts (*Puccinia* and *Uromyces* spp.)** A number of genera, species and races of rust infect Kentucky bluegrass. A variety resistant to one species or race of rust may be highly susceptible to another.

Stem rust (*Puccinia graminis*) causes considerable discoloration of susceptible varieties in many parts of the United States.

The disease is normally serious with poor vegetative growth under conditions such as low fertility and moisture stress. An improvement in growing conditions usually brings effective control as new leaf blades are removed by mowing before infection develops.

Merion and Touchdown are susceptible to stem rust, whereas Plush, Eclipse, Majestic, Adelphi, Bristol and Bonnieblue show moderate resistance to present races.

Leaf rust (*Puccinia poae-nemoralis*) is common on Kentucky bluegrass but is normally of concern on only the most susceptible varieties such as Vantage.

**Dollar spot** Dollar spot is a fungus disease caused by *Sclerotinia homoeocarpa*. While it is severe on many other turfgrasses, this disease is increasing in importance because of the widespread use of irrigation and susceptible varieties.

On Kentucky bluegrass it forms

**Planting a new production field** in rows. A band of activated charcoal protects the pure seed from herbicides used to eliminate weeds and old grass plants in the field.



bright, medium dark green color. Georgetown has excellent early spring color. It is similar in appearance and performance to Parade, Haga, Banff, Rugby, Trenton, and Columbia in turf trials at Rutgers. Georgetown has good resistance to leafspot and most rusts and above average resistance to dollar spot and stripe smut.

*Haga* (Burlingham, Jacklin) was developed at the Weibullsholm Plant Breeding Institute in Landskrona, Sweden. Its experimental designation was WW AG 463. Haga is a moderately dark green, turf-type Kentucky bluegrass with medium high density, medium texture, and moderate aggressiveness. It has excellent cool temperature color retention and an exceptionally attractive early spring color. Late spring and early summer turf quality can be adversely affected by a stemmy appearance resulting from an abundance of reproductive tillers. Haga has good resistance to leaf spot, most leaf and stem rusts, and above average resistance to dollar spot and stripe smut.

*Kenblue* represents an attempt to reconstitute the type of common Kentucky bluegrass formerly harvested from naturally occurring stands of the famous bluegrass region of Kentucky. *Kenblue* represents a blend of seed harvested from selected seed fields of 8 to 15 years standing, situated on 12 farms located in seven central Kentucky counties. After blending, part of the seed was used to establish a breeders seed block at the University farm in Kentucky. The remainder was distributed to producers of certified seed. The first certified seed was harvested in 1967. In recent years, seed growers in Washington and Oregon have selected varieties with high seed production potential. As a result, some seed currently being sold as common Kentucky bluegrass is actually seed of one or more of these high seed producing varieties. Such seed lacks the genetic diversity of seed harvested from naturalized stands. In some situations, especially in short term tests, these varieties may perform better than common bluegrass. However, knowing the true variety has many advantages. Purchase of seed of Certified *Kenblue* Kentucky bluegrass will assure a consumer that he is getting bluegrass of known origin and wide genetic diversity.

*Majestic* (Burlingham) is a moderately low-growing, turf-type bluegrass with a rich dark green color and rather prostrate leaf blades. It has shown good resistance to leaf spot and leaf rust and moderate resistance to dollar spot, stem rust, and stripe smut. *Majestic* has excellent color especially during the cool seasons of spring and fall. It greens up early in the spring.

*Merion* originated from a single plant selection made by Joseph Valentine of

the Merion Golf Club, Ardmore, Pennsylvania in 1936. Until the early 1970's, *Merion* was the only commercially available variety with good resistance to the *Helminthosporium* leaf spot and crown rot disease. This quality made *Merion* the Cadillac of bluegrass varieties for well-maintained turf areas. Under conditions of high fertility and moderately close mowing, common Kentucky bluegrass and other susceptible varieties often show over 80% browning and thinning from melting-out under conditions where *Merion* normally shows little damage.

Compared with common Kentucky bluegrass, *Merion* has wider leaves, lower growth, darker green color when properly fertilized, higher resistance to *Helminthosporium vagans* and greater tolerance for close mowing. When properly managed, *Merion* can produce an attractive, dense, vigorous turf, highly resistant to weed invasion and capable of withstanding moderate wear.

Certain weaknesses of *Merion* are also recognized. Stripe smut, which frequently damages older stands, is the most serious problem. *Merion* is also highly susceptible to powdery mildew and should not be used in heavily shaded areas where it usually fails within several years. Stem rust susceptibility can be a problem, especially under conditions unfavorable to good growth. *Merion* may also be damaged by *Fusarium* blight. The latter disease is associated with turf weakened by high temperatures, excessive nitrogen, thatch accumulation, close mowing and with prolonged drought or improper watering. Many other bluegrass varieties can be damaged extensively under similar conditions. Susceptibility to dollar spot under low fertility conditions is becoming an increasing problem.

*Merion* is normally a vigorous, aggressive grass that will generally crowd out most other bluegrass varieties mixed with it under conditions of adequate fertility, frequent mowing and vigorous growth. Healthy, well-maintained *Merion* turf is seldom invaded by crabgrass or other weeds, but when weakened by stripe smut it is not aggressive.

*Merion* frequently requires and normally tolerates more fertilizer than common Kentucky bluegrass. However, excessive fertility is to be avoided, especially in older stands.

*Merit* (Full Circle) is a moderately low-growing, turf-type variety with a medium coarse texture, and medium density. *Merit* has moderate resistance to the *Helminthosporium* leaf spot and crown rot disease. It has moderate color retention during low temperatures and medium spring green-up. *Merit* has large seed and above average seedling vigor.

*Midnight* (Turf-Seed) originated as a

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small circular spots (two to five inches in diameter) which may merge to form large, irregular areas. The spots become a light straw color and dead grass occupies the center. Fine, white, cobwebby mold growth may be seen in these spots on mornings when a heavy dew is present and the fungus is active. Lesions on individual leaves appear as bleached areas extending the width of the leaf with constricted margins and a chocolate-brown border.

Moderate temperatures (68-86° F) and thick thatch are favorable for dollar spot buildup. Turf deficient in nitrogen tends to show more damage from dollar spot than turf which is adequately fertilized.

Different races of dollar spot respond differently to fungicide control and may attack varieties in a differential manner.

## Insects

White grubs frequently cause extensive and serious damage to Kentucky bluegrass turfs as well as most other turfgrasses. These grubs are the larvae of several species of beetles and chafers including the Japanese beetle, the May and June beetles, the European chafer, and the northern masked chafer. Fully grown larvae are 1 to 2-cm long, white to grayish, with brownish heads and six distinct legs.

Severe infestations feeding on grass roots can cause serious thinning and death of the sod especially under drought stress. Birds, moles, and skunks actively feed on grubs tearing up the sod as they search for them.

Products containing resting spores of the milky disease organism, *Bacillus popilliae*, have been useful in keeping the Japanese beetle under moderate control.

Kentucky bluegrass is often severely damaged or completely killed by larvae of the bluegrass billbug. During May and June, adult billbugs lay eggs in grass stems near the crown. Upon hatching, the larvae are legless, white, fat, up to 1 cm in length and are present during July to mid-August. These larvae feed within the grass stem and later on the

single, highly apomictic aberrant plant selected from the open-pollinated progeny of F64-603, a selection made from an old lawn located near the Natural History Museum in Washington, D. C. Midnight is a persistent, low-growing, turf-type variety with the ability to produce a compact, dense turf with medium fine texture, a slow leaf extension rate, and a very dark green color. It has good heat and cold tolerance, fair shade adaptation, a slow spring greenup rate, and moderate low temperature color retention in late fall. Midnight has shown good resistance to leafspot, stem rust, strip smut, and dollar spot.

**Monopoly** (Pioneer Hi-Bred) was developed by Mommersteeg International of Vlijmen, Holland. Monopoly is a vigorous turf-type Kentucky bluegrass with medium texture, medium density, and a medium green color. It has shown excellent wear tolerance in a recent medium maintenance turf trial. Monopoly has moderately good resistance to leaf spot and dollar spot, and is promoted for its rapid germination.

**Mystic** (Lofts) was selected by Ralph E. Engel and Al Caravella from the 8th fairway of the Echo Lake Country Club, Westfield, NJ, where it had survived repeated sodium arsenite treatments used to destroy annual bluegrass in a fairway renovation program. An apparently identical plant was also found growing as a very large, attractive turf on the 14th fairway of the Seawane C.C. of Hewlett Harbor, NY, by Frank Curra and A.R. Mazur. Mystic is a low-growing, fine-leaved, turf-type Kentucky bluegrass. It displays a bright, medium-green color, and can produce a dense, attractive turf that is highly aggressive and which competes well with annual bluegrass. This makes it well suited for use on golf course fairways and tees. It has shown good resistance to powdery mildew and stripe smut, and moderate resistance to the *Helminthosporium* leaf spot and crown rot disease. Mystic is susceptible to dollar spot.

**Nassau** (Jacklin, Lofts) is a highly apomictic hybrid selected from the progeny of NJE P-59 x Baron. Nassau is a moderately low-growing, turf-type variety with medium wide leaves, and a medium dark green color. It is capable of producing an attractive turf of medium density. It can become very stemmy during late spring. Nassau has shown good resistance to the *Helminthosporium* leaf spot and crown rot disease. It has also shown above average resistance to dollar spot, red thread, pink snow mold, leaf rust, and stem rust. Nassau has attractive early spring color.

**Newport** originated as a single apomictic plant selected from coastal bluffs near Newport, OR. It is a moderately low-growing variety with rather dark green leaves and fairly good establish-

ment and turf-forming characteristics during the first two or three years. Newport has demonstrated good resistance to most current races of stem rust and powdery mildew, but is susceptible to leaf spot and stripe smut. Turf stands of Newport become very stemmy at seedhead setting time in June.

Older plantings of Newport have been heavily invaded by weeds and have frequently shown poor recovery from drought. Newport is often a short-lived type under New Jersey conditions, performing better than common Kentucky bluegrass during the first two or three years of a test; but it does poorly or dies as it ages. Its best use appears to be in blends with other more persistent bluegrass varieties.

**Nugget** (Pickseed) is a very distinctive variety. Nugget was found growing in Hope, Alaska. This variety produces a very dense, compact, rather low-growing turf which can be extremely attractive, especially in mid- to late-spring. Nugget has good to excellent resistance to leaf spot, most races of powdery mildew and leaf rust. Unfortunately, it appears to be susceptible to stem rust, dollar spot, *Fusarium* blight and aphids. This variety has good tolerance of close mowing and moderate shade when free of disease and insect damage. Nugget is very slow to start growing in the spring and has very poor early spring color in temperate climates. Nugget has frequently looked promising in preliminary turf trials throughout the northern part of the United States and Canada. Its performance in more southern areas has been very erratic.

**Parade** was developed in Holland. This moderately low growing, turf-type variety has medium texture and a pleasing moderately dark green color. Parade has good resistance to leaf spot, leaf rust and stem rust. It has above average resistance to dollar spot and stripe smut. Parade has excellent early spring color. Early summer turf quality is often adversely affected by an abundance of reproductive tillers.

**Park** resulted from an extensive selection and testing program initiated in Minnesota in 1937. A large number of plants were collected from old pastures and wasteland areas and tested for breeding behavior and agronomic performance. The 15 best apomictic strains were blended to produce Park, which was released in 1957. The variety has excellent seedling vigor and has shown moderate resistance to stripe smut, leaf rust and stem rust. Some of the component strains have good resistance to powdery mildew. Park is similar in appearance and growth habit to common Kentucky bluegrass and is susceptible to *Helminthosporium* leaf spot. Under New Jersey conditions, Park has often shown some advantages over common Kentucky bluegrass.

**Plush** (FFR Cooperative) originated as a single, highly apomictic plant selected from the lawn of Warinaco Park in Union County, NJ. Plush is an aggressive, persistent, moderately low growing, leafy, turf-type Kentucky bluegrass with medium texture, good vigor, medium high density, and a medium green color. It has shown good resistance to stripe smut and dollar spot and moderately good resistance to leaf spot and stem rust. Plush has shown good heat and drought tolerance.

**Ram I** (Jacklin, Lofts) was discovered growing on a putting green of the Webhannet Golf Club in Kennebunk Beach, Maine. Ram I is a moderately low-growing, leafy, turf-type cultivar with a medium texture and a rich, dark green color. Ram I has shown good tolerance of moderately close mowing and good early spring color. It has moderate resistance to leaf spot and stem rust, good resistance to stripe smut and most races of powdery mildew. It has moderate susceptibility to leaf rust and dollar spot.

**Rugby** (SPIC) is a moderately low-growing, turf-type variety with medium texture, good density, and a bright, medium dark green color. Rugby has a very attractive early spring color, the ability to stay green into late fall, and can maintain good winter color in protected locations. Rugby has shown good, or moderately good resistance to leaf spot, leaf rust, stem rust, dollar spot, stripe smut and *Fusarium* blight. Turf produced by Rugby is generally very stemmy during its reproductive period in late spring and early summer.

**Sydsport** (Burlingham) was developed in Sweden where it is reported to have good tolerance of the wear and abuse received on athletic fields. It has medium wide leaves and can produce a rather tight, dense sod of a medium light green color. Sydsport appears to have moderately good resistance to leaf spot and stripe smut but high susceptibility to dollar spot has been observed in some tests.

**Touchdown** (Pickseed) is a fairway selection from the National Golf Links of America located on Long Island. It has excellent resistance to leaf spot, stripe smut, leaf rust and most races of powdery mildew but is moderately susceptible to stem rust and dollar spot. Touchdown is a very aggressive turf-type variety with medium texture and a moderately dark green color. Like Warren's A-34 and Mystic, Touchdown has an excellent record of being able to compete well against annual bluegrass in closely mowed tests at Rutgers. These very aggressive varieties will normally dominate in blends and usually produce more thatch. Touchdown also shows promise of good performance in moderate shade.

*continued on page 62*



crown, bases of adjacent stems, and on roots and rhizomes.

Sod damaged by larvae is easily pulled from the soil with stems breaking off at the crown. The presence of fine, white, sawdust-like material at the base of each severed tiller is further evidence of billbug feeding. Billbug damage is most severe if turf is under moderate drought stress.

Studies at Nebraska and New Jersey show significant differences in cultivar resistance. Generally, the narrow-leaved, early maturing common types show less injury. However, some improved turf-type cultivars also show promising resistance.

Sod webworms are frequently destructive in lawns. In the warmer months, adult, grayish-white to beige moths frequently fly over lawns and pastures in late evening and drop eggs into the turf. Larvae live in silk-lined tunnels in the thatch during the day and feed on grass blades during the night.

Cutworms are the larvae of a number of species of night-flying moths. Cutworm larvae feed at night on grass leaves which they chew off close to the soil surface. Birds, particularly starlings, frequently visit turf infested with sod webworm and cutworm larvae and create numerous small circular holes in the sod.

Chinchbugs prefer sunny, hot, dry conditions and often cause serious damage, especially on south and west facing slopes. Plant injury occurs as a result of the insect sucking fluids from the plant. At the same time they inject salivary fluids. This disrupts the water-conducting tissues causing plants to wilt and turn yellow or brown. A fungus, *Beauveria* sp., is normally effective in reducing populations of chinch bugs when moisture conditions are adequate for fungal growth.

The adult frit fly is a very small, shiny, black fly. Larvae (maggots) hatch from eggs layed on leaves and in leaf sheaths. They immediately tunnel into and feed within grass stems. Initially the bluegrass has a yellow appearance as younger leaves emerging from infested tillers are damaged. As feeding progresses

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## National bluegrass test shows regional differences

Performance of Kentucky bluegrass varieties varies by location. To point out regional differences, the National Turfgrass Evaluation Program was developed in 1980. Jack Murray, agronomist, USDA Agricultural Research Service, Beltsville, MD, was selected national coordinator.

Thirty-seven test gardens were set up in 22 states and two provinces of Canada for the trial. Data for 1982 and 1983 has been collected.

The tests judge the varieties by location, and by a number of other factors; including disease resistance, seasonal condition, leaf texture, density, drought tolerance, sod strength, and insect resistance.

Murray cautions that the data is just for the second year of a multi-year evaluation and that seed companies presented seed from just one lot for the tests. Variation by year and between seed lots should be considered. Although varieties were listed in order from best to worst, the difference between some may be considered insignificant.

When data from all locations and for all months was combined and averaged, those with the best quality overall were

Eclipse, Midnight, Bristol, Adelphi, America, Banff, Baron, Enmundi, Majestic, Challenger, Ram-1, Sydsport, Bonnieblue, Cheri, Columbia, Glade, Rugby, and Victa. A number of experimental varieties were included among the top national performers.

The leaders in the home state, Kentucky, were America, Eclipse, Banff, A-20, Nassau, Merion, Mystic, and Monopoly.

Many bluegrasses performed well in Delaware. The best were Midnight, Bristol, Enmundi, Mystic, Kimono, Bonnieblue, Challenger, Majestic, and America. Maryland was led by Merit, Victa, Baron, and Kimono. Virginia's four locations gave the edge to Eclipse, America, Wabash, Columbia, Cheri, Enmundi, Adelphi, Bristol and Midnight.

Georgia's best bluegrasses were Columbia, Birka, Enoble, Monopoly, Sydsport, Adelphi, Majestic, Midnight, and Baron. North Carolina leaders were Baron, Enmundi, Cheri, Glade, and Parade.

Iowa's favorites were Midnight, Majestic, Challenger, Ram-1, Glade, Bonnieblue, Victa, Merit, Nassau, Nuggett, and Bristol. Nebraska, with four test areas, favored Enoble,

Majestic, Wabash, and Geronimo.

Eclipse, Adelphi, Sydsport, Bonnieblue, Touchdown, A-20, and Enmundi performed best in Illinois. Baron, Challenger, Glade, Columbia, Touchdown, Adelphi, Enmundi, Ram-1, Cheri, and Victa showed them in Missouri. Midnight took Kansas by storm with closest rivals Bristol, Eclipse, Challenger, Bonnieblue, Victa, America, and Majestic.

New Jersey results were better than New York's. The leaders in New Jersey were Eclipse, Challenger, Midnight, Bonnieblue, Kimono, Glade and Majestic. New York's two locations favored Eclipse, Monopoly, Midnight, Sydsport, Cheri, and Wabash.

In the Northwest, where most of the seed is grown, Oregon winners were Eclipse, Sydsport, Columbia, Midnight, Majestic, Challenger, and A-20. Washington leaders were Ram-1, Rugby, Banff, Shasta, and Fylking.

For the complete report, write USDA Science and Education Administration, Plant Genetics and Germplasm Institute, Beltsville, MD 20705. □

*Written by Bruce F. Shank, executive editor*

these infected tillers die. Careful examination of the tiller base will reveal one or more active, small white maggots with two characteristic mouth hooks visible with a good hand lens.

The greenbug aphid has recently become a serious pest of Kentucky bluegrass in a number of locations throughout the mid-western United States. The piercing mouthparts of the greenbug are inserted into leaf blades to suck out plant fluids. This probing and the injection of salivary fluids causes leaf tissues to turn yellow to light orange, then even darker orange and finally to brown as the plant may die under very heavy

infestations. Scientists at Beltsville, MD, are developing Kentucky bluegrasses with good resistance to the greenbug aphid.

### Growth habit and turf-forming properties

The growth habit of Kentucky bluegrass is influenced greatly by day length, light intensity and temperature.

During short days, Kentucky bluegrass assumes a more decumbent (spreading) growth habit, has a slower rate of leaf elongation, and tillering is more abundant. During long days, growth is more erect and leaf elongation is more rapid. Reproductive development

also occurs during the long days of late spring.

High light intensity increases photosynthesis and promotes the development of thick, sturdy leaves and a deep green color. Low light intensity produces weak, thin, etiolated (pale) plants with a rapid rate of leaf elongation.

Common Kentucky bluegrass and varieties such as Park, Delta and Kenblue have a rather erect growth habit with a rapid rate of leaf elongation. Such varieties do not tolerate high nitrogen fertility and close mowing, especially during the spring and summer seasons.

During the long days of spring and summer these varieties make noticeably taller growth. This results in the removal of a higher percentage of the leaf area and makes maintenance of good turf in late spring and summer difficult. Carbohydrate food reserves are depleted and such varieties become highly susceptible to damage from the Helminthosporium leaf spot and crown rot disease.

Varieties such as Nugget, America, Eclipse and Glade appear to exhibit the short day length response of decumbent growth and slow leaf elongation through much more of the year than the common type bluegrass varieties. Additional research related to differential varietal growth response to day length should be of great value in breeding bluegrasses with better turf-forming properties and reduced mowing requirement.

### Tolerance of close mowing

For golf course fairways, the turf should make an attractive, uniform carpet which is dense enough to give a good lie to the ball. It must also be able to heal divots rapidly, tolerate considerable traffic and resist the invasion of annual bluegrass.

Frequent, close mowing, adequate fertility and water are needed to produce the firm, dense turf required to support the ball above the soil surface. A dense turf has a much higher population of tillers per unit area which causes increased competition between tillers. This, plus severe defoliation by low fairway mowing and ample fertilization weakens the grass. It develops a less extensive root system and is more subject to drought damage and disease attack.

Close cutting and frequent watering encourages rooting above the soil surface and thatch buildup. This favors many disease organisms. Also, damage from disease is more apparent on an otherwise attractive, uniform closely cut turf.

Kentucky bluegrasses have some tolerance of the close mowing and other factors associated with the production of the dense,

firm, aggressive turf desired on fairways. They have the best chance of success with high light intensity, cool temperatures and moderate humidity.

In less favorable climates, improved varieties and better management are needed for successful results. Many of the current Kentucky bluegrass varieties including Nugget, Warren's A-20, Touchdown, Bonnieblue, Eclipse, Birka, Fylking, Majestic, Merion, Adelphi, Glade, Sydsport, Victa, Cheri, RAM 1, and Baron have characteristics which make them more suitable for close-cut fairways than Common Kentucky bluegrass and other erect-growing leaf-spot-susceptible varieties. Unfortunately, each of these varieties has some weakness.

Proper blending of seeds of these improved varieties might help but will not solve all the potential problems associated with fairway turf. Those who use the turf-type ryegrasses as a major fairway grass will find maintaining Kentucky bluegrass in the mixture helpful. New Kentucky bluegrass selections collected from close-cut areas and those generated in hybridization programs give promise of additional improvement.

### Heat tolerance

Kentucky bluegrasses with greater tolerance of summer heat and drought conditions common to the transition zone would be of great benefit.

Most of our attractive, dense, lower-growing, turf-type varieties were selected in the cool summer climate of Northern Europe and from other breeding and evaluation tests located in cool environments. Many of these varieties are often disappointing in southern trials.

An extensive program to collect and evaluate adapted germplasm from summer stress areas of the Mid-Atlantic areas should provide varieties with improved summer performance and dependability. Under conditions of moderately low nitrogen fertility and high cut, varieties that typify common types, such as Kenblue, have survived well in the transition zone.

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Troy was selected from a seed lot introduced from Turkey. It is a tall, erect-growing grass highly susceptible to leaf spot. Troy has been useful as a pasture grass in Montana region but performs very poorly as a turfgrass.

Vantage (International Seeds) was developed by O.M. Scott and Sons of Marysville, OH. Vantage is a persistent Kentucky bluegrass with deep spreading rhizomes, a medium dark green color and a medium texture. It has very good heat and drought tolerance. Vantage has performed well in higher cut, medium maintenance turfs in the Middle Atlantic region of the U.S. where it has shown good resistance to the Fusarium blight disease. However, this same variety has been seriously damaged by Fusarium blight disease in California trials. Vantage has good resistance to stripe smut and dollar spot and moderate resistance to leaf spot. It is susceptible to leaf and stem rusts.

Victa (Scotts) was developed by O. M. Scotts. It has medium broad leaves, a moderately low-growing, turf-type growth habit and a medium dark green color. The variety has shown moder-

ately good resistance to leaf spot. It has shown moderate resistance to leaf rust, stem rust, dollar spot and powdery mildew in New Jersey tests. Victa is moderately slow in spring green-up. It has large seed and rather good seedling vigor.

Wabash was developed at Purdue University. It is a vigorous variety with exceptionally good rhizome development and ability to recover from stress. It produces a turf of medium density, medium wide leaves, and a bright, medium green color. Wabash often shows substantial damage from the Helminthosporium leaf spot and melting-out disease, especially when mowed closely. However, it recovers well and looks very attractive by fall. It showed the best fall recovery of all bluegrasses studied in a test at North Brunswick which had received severe summer stress.

Warren's A-34 (Warren's) is a vigorous, disease resistant variety with somewhat better shade tolerance than most other Kentucky bluegrass varieties. When maintained at a 2-inch growing height, it will tolerate 65% shading.

A-34 does rather well in full sun, producing a dense, medium green turf with moderately good resistance to stripe smut, powdery mildew and leaf spot. It also performed well in wear tolerance trials in Michigan.

**Varietal Blends** Admitted weakness of all currently available bluegrass varieties has caused many turf workers to recommend the use of varietal blends for better lawns, fairways and most other types of turf. It is hoped that the weakness of one variety will be covered up by a complementary strength of other variety. This may or may not be true depending upon a number of complex ecological factors. We need much more research data on ecology, long-term performance and regional adaptation of bluegrass blends.

Research at Rutgers strongly suggests that varieties with good resistance to both stripe smut and Helminthosporium leaf spot should be included in all turfgrass blends recommended for use on intensely maintained turf areas. Also, one or more should have high tolerance of close-cut unless the turf will be mowed high. □



Seed samples are tested in a lab after cleaning. Contents are reported on the seed label.

Under conditions of somewhat closer mowing and higher fertility the lower-growing, wider leafed, open types having extensive deep rhizomes, such as Vantage, have performed better. Merion Kentucky bluegrass has shown above average summer performance when managed properly and when disease is not a problem.

### Color

Visitors at experimental plantings of Kentucky bluegrass selections and hybrids are impressed by the great diversity of shades of green observed.

Mystic has a very attractive bright light green color. Adelphi and Glade have bright, dark colors. Some selections like Bonnieblue, Parade, Columbia and Majestic retain excellent color into the winter and green-up early in the spring. Others like Midnight and Baron go dormant in late fall and green-up later in the spring. Still others like Nugget green-up very slowly in the spring.

Many types show a pronounced purplish cast in late fall, winter and early spring, whereas some, such as Parade, Columbia, Rugby, and Bonnieblue appear to lack this purplish pigment. **WT&T**