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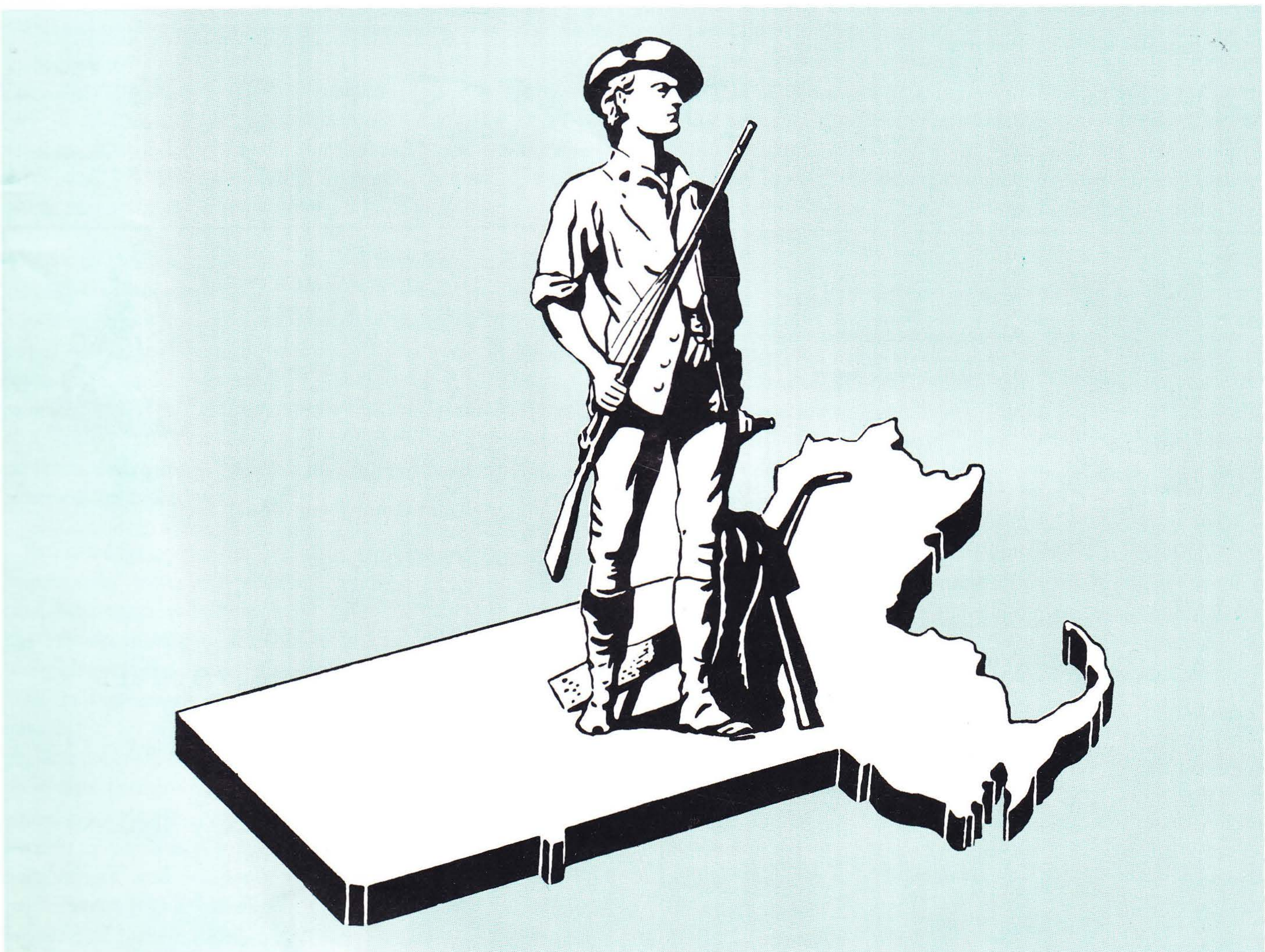
TURF BULLETIN

MASSACHUSETTS TURF AND LAWN GRASS COUNCIL INCORPORATED



BETTER TURF THROUGH RESEARCH AND EDUCATION

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TURF BULLETIN

Vol. 3 No. 1 **February, 1966**

More detailed information on the subjects discussed here can often be found in bulletins and circulars or may be had through correspondence.

Turf Professions And Education

by

RICHARD C. BLAKE, *President, Massachusetts Turf and Lawn Grass Council and Superintendent, Mt. Pleasant CC, Boylston, Massachusetts*

RICHARD C. BLAKE

The fine turf industry has been estimated, in Massachusetts, to be valued at anywhere from 50 to 75 million dollars annually, by conservative economists. A total value in dollars and cents for each and every turf area, old or new, presents quite a difficult problem. In any event, fine turf in Massachusetts represents a sizeable portion of our Commonwealth's net worth. Additionally, there is the sheer pride and joy associated with owning a beautiful, healthy lawn; this cannot be rung-up on a cash register.

With this enormous investment involved, and the high annual costs of upkeep in mind, we would need capable hands protecting our investments. People of high professional stature as exemplified by our local golf course superintendents, and many of our professional landscapists, are excellent examples. How do they maintain their professional acumen? How do they meet competition? How do they perform their jobs so well? The answer lies in education — practical and academic.

Education provides the vast storehouse of knowledge required by today's professional turfmen, but more important education will help him solve tomorrow's problems; the experts inform us that there will be more scientific and technological changes in the next five years than in the past 500. It appears then, that our thirst for knowledge will be inundated by a flood of material in a very short span of years, unless we continue to keep pace with the times. Take short fine turf course; go to conferences; go to your professional organizations conventions; read avidly; consult with experts often; swap information within your local groups; help others, and in turn you will learn from others. The turf industry is a unique one, it requires a knowledgable amount of information drawn from many experiences such as those in: plant pathology, chemistry, hydrology, civil engineering, design, administration, accounting, horticulture, agronomy, sociology, to name a few that come to mind. Certainly, we cannot retain a high degree of expertise in all areas, but we can acquaint ourselves with the problems inherent in each one.

Just as important, perhaps, is the fact that our practical educational processes never cease — we can learn from our turf fledglings; they in turn from the professionals; the professional turfmen in turn can share their experiences with the educators. This process should be a never-ending cycle in which all levels benefit, the educator and the educated. To insure that our country will never be wanting for well-qualified turfmen we must never cease our educative processes. Once we stop, our minds become stagnated; our actions antiquated.

Massachusetts is blessed in having three of the finest turf education programs in the country — the two-year and four-year programs at the University of Massachusetts, plus the Winter School for Turf Managers. Historically, Massachusetts is the leader in fine turf education with its eight-week Winter School at the University, now in its thirty-fifth year, and its two-year program a pioneer in schools of its kind.

No matter what state you call home, support your turf schools in any manner possible, for in helping them we help ourselves as well. At this moment our Nation is embarking on a gigantic "green belts" and conservation program and all turfmen can help. Will you be ready?

Editor's Note: Richard C. Blake, Pres. MTLGC; Superintendent, Mt. Pleasant CC, Boylston, Mass.; Class A member of GCSAA; former President Rhode Island GCSA. Served as editor of New England GCSA Newsletter for five years; presently 2d V.P. of N. E. GCSA. Turf education at Stockbridge School, Univ. of Mass.; Rutgers University, and participated in many conferences and short turf courses. Marine Corps veteran; member of Boylston Conservation Commission; Planning Board and Police Association. Contributes much of his time to educating others and is often called upon to give instruction at the University of Massachusetts; speak at conferences, and writer of many fine turf articles.

those that grow in the Fieldes and Medowes, and then of the rest in their order.

1. *Gramen pratense paniculatum molle.* The soft Medow tufted Grasse.

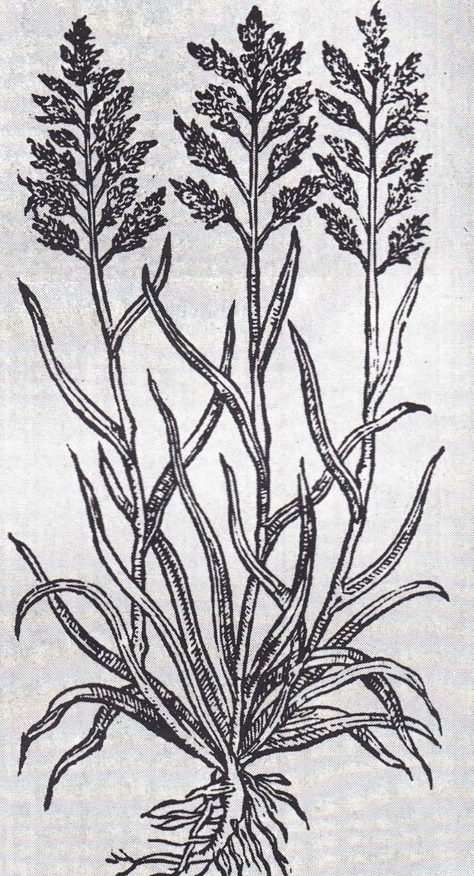
This soft Medow Grasse, hath sundry long and somewhat broad soft or woolly Grasse-like leaves, rising from a small tuft of short white fibres, and from among the leaves rise up a stalke, two or three, about a cubit high, with some few leaves upon it, and at the toppe breaketh forth a soft woolly spiked head, much divided, whose bloomings are reddish.

2. *Gramen paniculatum Germanicum odoratum.* Sweete Dutch Grasse with a tufted head.

The roote of this Grasse doth creepe in the ground, being white, and full of joynts, shooting out fibres at every

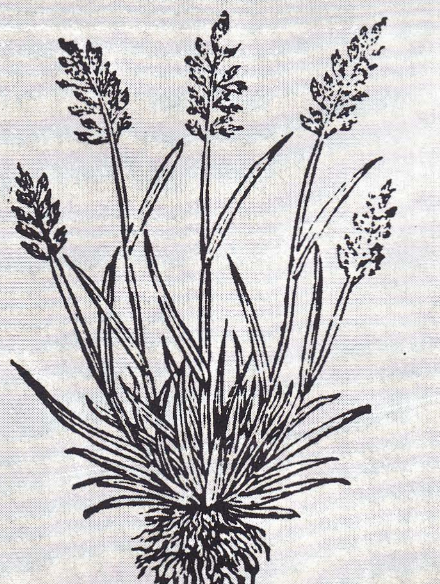
4. *Gramen pratense vulgatius majus.*
The greater ordinary Medow Grasse.

4. *Gramen pratense minus.*
The lesser tufted Medow Grasse.



4. *Gramen pratense minimum album.*
The least white Medow Grasse.

4. *Gramen pratense minimum rubrum.*
The least red Medow Grasse.



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THE MIGRATION OF A PLANT

Kentucky Bluegrass Followed Settlers of New World

by ROBERT W. SCHERY

Kentucky bluegrass, *Poa pratensis*, has made its mark as one of the most widespread and "successful" of the higher plants. Although man has in many instances upset ecological balances, Kentucky bluegrass has managed to adapt to changing conditions, rather than to die out or linger on precariously in isolated ecological niches. Indeed, throughout history, Kentucky bluegrass has increasingly enhanced its world position, for it followed man as he felled trees and turned soil.

It is a true grass, a member of the Gramineae, one of the plant kingdom's most useful families. We all depend upon grasses—for grains that make bread, for forage that nurtures our livestock, for the cover that holds our soil, for sugar, for certain essential oils and medicinals, and even for beer. Traditionally, Kentucky bluegrass has fallen into a subfamily and tribe named for the fescues, Festuceae. Certainly the fescues are similar to the bluegrasses, *Poa,* in many ways, and are well placed side by side in classification, just as they are companions in the better lawn seed mixtures. Both behave similarly in a lawn and respond to the same general regimen of handling, perhaps a further indication of relationship. Bromes and other forage grasses are also of this tribe.

According to modernists, the Festuceae, embracing the fescues, ryegrasses, orchard-grasses, etc., as well as bluegrass, are of the "large chromosome" type, usually with a base number of seven. (Base number means the lowest denominator that is possible to cover the hereditary complement.)

In comparison with other grasses, Kentucky bluegrass was traditionally regarded as having many primitive characteristics; its tribe was thought to be among the least specialized, which may help explain its remarkable adaptability. But the whole business of primitiveness is being questioned these days, for a major attribute of Kentucky bluegrass is that its seed mostly forms without being fertilized by the male cell. Except for a small percentage of instances in which there is true sexual crossing, the seed of Kentucky bluegrass is identical with the mother plant on which it is borne. This type of asexual reproduction, known as apomixis, is analogous to cuttings or live starts in other grasses and horticultural plants. Apomixis has been regarded as a relatively advanced character, and often is associated with polyploidy, the doubling of the chromosomes (in the case of Kentucky bluegrass, repeated and seemingly irregular duplication). Apomixis is characteristic of many of the world's most widespread and successful plants, including various lawn nuisances such as the dandelion.

For the bluegrass seed industry, apomixis is a boon; it is necessary to find only one plant of unusually desirable features, and propagate from it by seed. This has been the chief means of discovering new bluegrass varieties, rather than the more involved crossing of isolated parent plants. By the same token, the system imposes limitations, and it becomes difficult to cross bluegrasses of two different types in order to combine desirable features of both parents in the offspring.

Not much is really known about the hereditary make-up of Kentucky bluegrass other than that it is mixed and has an extremely wide range of chromosome numbers—ranging from less than fifty to more than two hundred in some polyploids. With such a diverse genetic complex to choose from, there is almost no need for the plant breeder to attempt sexual crossing. Those instances in which sexual crossing has been successful have not resulted in producing a bluegrass superior to those chosen from nature.

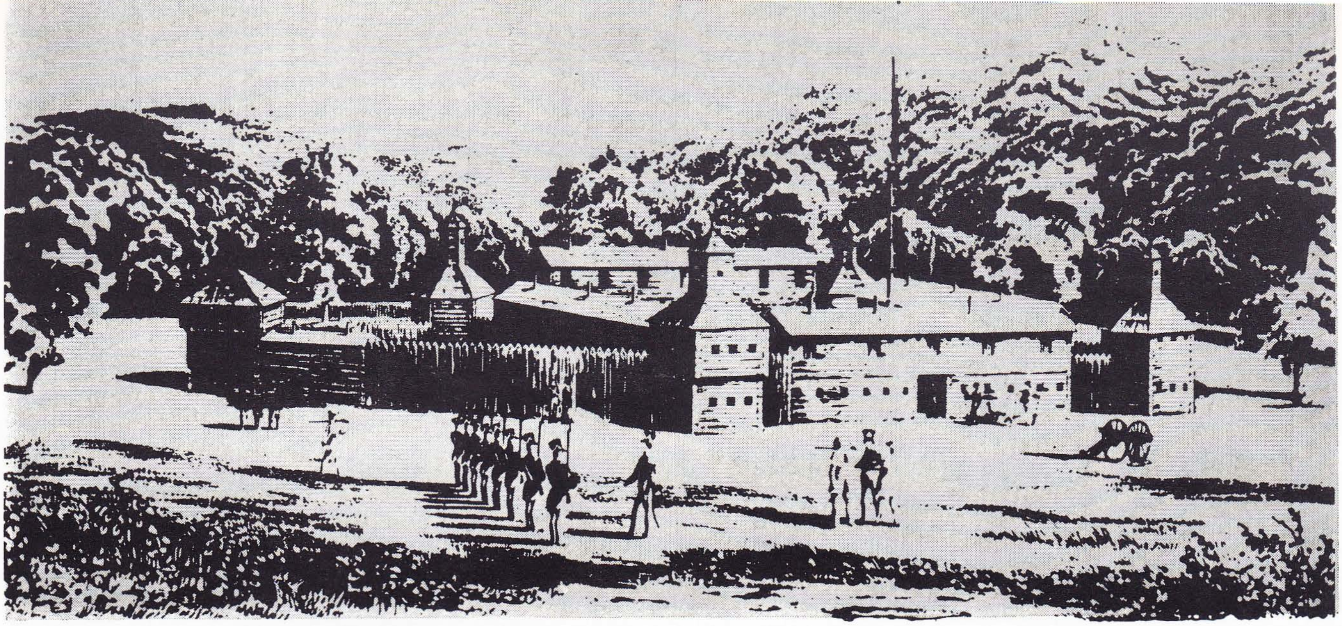
One of the original antecedents of Kentucky bluegrass may have been diploid *Poa pratensis,* native to southeastern Europe, with a chromosome number of possibly only fourteen. In its subsequent peregrinations there has occurred a grand genetic mix-up, perhaps with other bluegrasses, and certainly involving a great deal of duplication and variation in chromosome sets. The resulting complex—the present-day *Poa pratensis*—may represent a synthesis of several species.

Bluegrass has conquered the hills and the uplands in moist temperate climates over most of the globe. Heat, rather than cold, seems to be its nemesis, for it is found within the Arctic Circle and was planted and survived in the Antarctic during recent geophysical year investigations. But it persists in tropical environments only at high elevations. In the United States it is not permanent south of Tennessee in the east or below northern Arizona in the west, although some ecotypes hang on in the shade as far south as the Gulf of Mexico. It may, however, be a prize component of annual winter seeding mixtures for golf greens and lawns throughout the south.

This, then, is a "cool-weather" grass, as distinguished from "warm-weather" grasses such as Bermuda, *Zoysia*, Bahia, and other southern types. While the latter flourish in the heat of summer, bluegrass physiology is adjusted to a lower optimum temperature. In fact, its internal mechanisms seem to suffer when temperatures remain persistently above about 85° F. Catabolic losses, through stepped up respiration, mount rapidly at higher temperatures, while food making (photosynthesis) does not increase proportionately, and may even slow down. The net result is an "operating loss" for bluegrass during hot weather. Of course, if this deficit persists for any great length of time, stored energy is exhausted, and the plant dies.

In those regions or seasons where temperatures range between 55° and 80° F., Kentucky bluegrass is at its glorious best. The food build-up from photosynthesis exceeds its dissipation, and there is abundant thickening, quick revival, and beautiful color. Growth slows when temperatures ap-

Woodcuts from 1640 Parkinson herbal refer to bluegrass as "Medow Grasse."



OHIO'S Ft. Washington is thought to be early site of bluegrass in America.

proach freezing, but the health of the grass is in no way impaired. Kentucky bluegrass can stand crisp freezes without harm and with scant blemishing; in middle latitudes it is not until after Christmas that its sods begin to show the effects of winter.

The grass is primarily spread by underground runners called rhizomes, which weave a firm sod. If the stem-buds at the crown of the plant grow upward instead of sideways, they form new shoots (culms) called tillers, which thicken the stand of grass. This is characteristic of growth during autumn, when, incidentally, the leaves are short and bend low in response to the declining day length. Rhizomes may be produced almost any time the growing weather is favorable, particularly with plants that are not crowded (sod-bound) and are rooted in loose soil. Rhizome spread contrasts with aboveground pre-emption by crabgrass, one of the chief competitors of bluegrass in the lawn. Crabgrass is an annual, sprouting from seed as the weather warms, then spreading rampantly by trailing runners called stolons.

With "wild" bluegrass, enough rain to keep the grass green during the good growing weather of autumn augurs well for a fine seed crop the following June. Many fat shoots will initiate a primordial inflorescence, or seed head, about Christmastime, as temperatures drop to near freezing. Short day length is also necessary; plants kept in a lighted greenhouse will not set seed. In spring, each culm that is to become a seed head carries characteristic, stubby "flag" leaves with a bluish sheen; the seed stalk becomes tough, and for a couple of weeks during late spring it is difficult to mow neatly. Each culm that bears a seed head will die, to be replaced by side

SAMPLE from lawn shows underground rhizomes, by which the grass spreads.

tillers. Even the healthiest of bluegrass will experience a temporary downturn in early summer, and the regaining of its resplendency depends largely upon how quickly and fully the new tillers take over. Obviously, tiller resurrection will be more adequate in favorable climates with coolish nights.

There will be some differences in growth pattern depending upon the variety or selection, but research has indicated the marvelous plasticity of natural Kentucky bluegrass. Plants brought together from north and south, east and west, dissimilar in their appearance where they grew, all gradually mold to an essentially identical norm when grown side by side. The reason for this adaptability is not altogether known; probably it is because of the tremendous genetic reservoir that gives bluegrass a broad base compatible with most environments. As we saw earlier, there may be duplication to two hundred chromosomes from a base number of only seven.

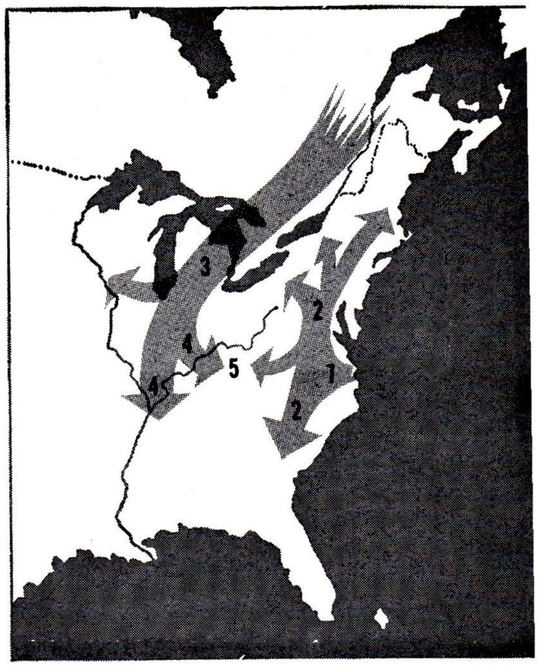
As evidenced by the scatter diagrams on page 44, Kentucky bluegrass populations differ as the plant extends its range. In this country it seems to have behaved according to Vavilov's hypothesis that greatest variation occurs at the center of origin and dispersal. It looks as if the lower Midwest, Kentucky in particular, where bluegrass was known early and widely planted, served as the seat of dispersal. Even today, Kentucky seems to carry the largest bluegrass gene pool of any area. From this center, particularly successful hereditary combinations appear to have migrated rapidly outward, especially pushing northwest. Collections of specimens from North Dakota and Minnesota exhibit a narrower range of variation and express a more characteristic phenotype (physical appearance) than in Kentucky, where no single expression seems to have dominated the population.

This, then, is Kentucky bluegrass as we have it today—one of the most nutritious pasture grasses, an excellent soil builder, and the most widely used quality lawn grass. How came this change from diploid vagrant to polyploid world colonist, from unnoticed adventive to pampered lawn grass?

It is probably a good assumption that Kentucky bluegrass originated in Europe or the Near East, where semidomestication and the chance for intercrossings leading to polyploidy have been so notable with many cultivated plants. The early Greeks had a word for it, although it merely signified "fodder herb" or "forage grass." This "pua" of Euripides and Eubulus has been verified as a floral constituent of the Peloponnesus, where the climatic cycle has a summer moisture deficit similar to that of our Midwest. It is also identified by Professor G. Hausman, Director of the Experiment Station of Field and Pasture Crops at Milan, as a "grass found in every part of Italy, especially the mountain districts." What is probably *Poa pratensis* flourished in southeastern Europe in pre-Christian times.

No doubt the Romans grazed their chargers on bluegrass as their legions marched on Heidelberg and Paris. Garibaldi's palace at Innsbruck was described as having a lovely lawn, probably of bluegrass. The herbalists of the Middle Ages made recognizable woodcuts of bluegrass, which they called "meadow grass" or "June grass" in the polynomial descriptions prevailing before Linnaeus. They verify cognizance of bluegrass by the Greeks, mentioning its medicinal properties as prescribed in ancient Greek tomes. By the time botanical identification had become a science, bluegrass was known throughout the continent. It was Linnaeus, in his *Species plantarum*, who gave it the *Poa pratensis* designation—*Poa* after the old Greek; *pratensis* meaning "of the meadow." Today, in all its variations, it is universally known as *Poa pratensis*, although through the years scores of common names have been accorded it.

At the time of the discovery of the New World, *Poa pratensis* was widely spread throughout northern Europe, even though given scant attention in an age when pastures were taken for granted and cultivated lawns scarcely yet "invented," although formal estate gardens were the vogue. Was bluegrass also in Asia, the North Atlantic islands, in North America itself? We can only guess. Circumstantial evidence, as we shall see, suggests that it was not. Glacier-capped islands of the North Atlantic make poor stepping stones, and there are no herbarium specimens to indicate that bluegrass came from the inhospitable wastes of Siberia across the Bering Sea to Alaska, and thence into the western United States. That it was not in North America when the first colonists landed at Jamestown is indicated, too,

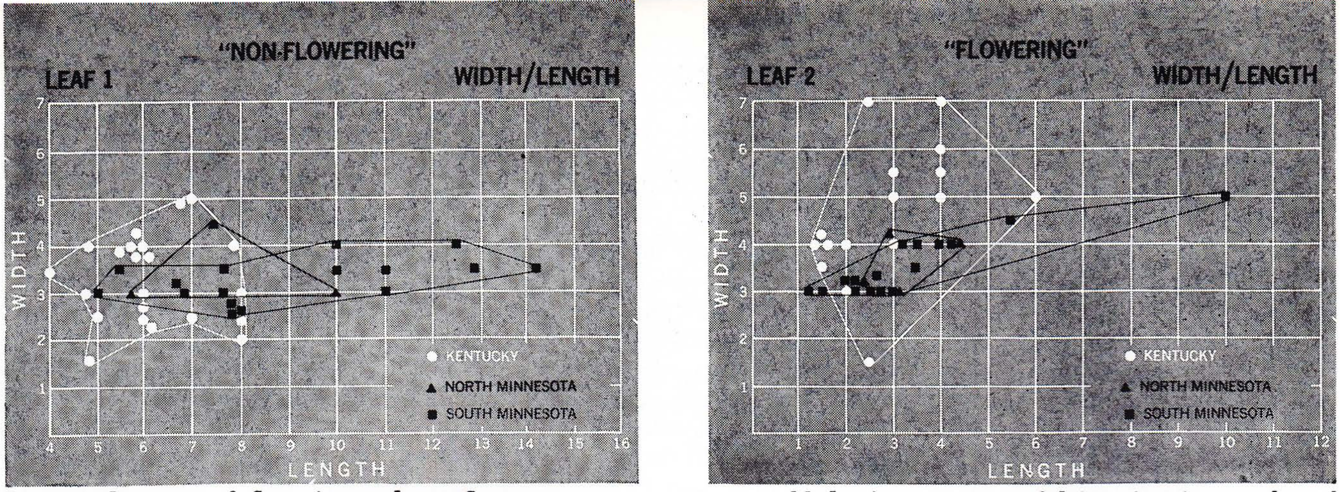


Map traces possible migration routes from Jamestown (1) to colonies (2); and southward into Mississippi Valley (3) to Illinois (4) and Kentucky (5).

by the fact that it was never given an Indian prefix in the colonial records, a custom with newly discovered plants such as Indian corn (maize). Most likely it was merely a chance passenger on the early ships bringing colonists and cattle to the new land—taken for granted, if it was noticed at all. There are no exact records, but then who would report to Raleigh about grass while exploring a new continent beset with "treasure" and mystery?

Yet the early records of the Jamestown colony, and of subsequent settlements in eastern North America, leave no doubt that bluegrass could have gained a foothold. There are many mentions of tilled lands and gardens, prime habitat for bluegrass. Thomas Harriot's *A Brief and True Report of the New Found Land of Virginia*, 1588, includes a notation that "we found topsoil deeper, we saw there more and larger fields and finer grass, as good as any in England . . . more English cattle should be transported; likewise our varieties of fruits, roots and herbs . . . some of them have already been sown and have grown well. . . ."

Other reports of "English grass," as bluegrass mixed with white clover was termed in those days, attest to



SCATTER diagrams of flowering and non-flowering plants of Kentucky and Minnesota indicate that grass with long, narrow blades is most successful in migrating northward from center of dispersal. Measurements are in 1/32 inch.

familiarity that implies Old World origin. Captain John Smith, in 1629, reported "James Towne is yet their chief seate most of the wood destroyed, little corne there planted, but all converted into pasture and gardens; wherein doth grow all manner of herbs and roots we have in England in abundance and as good grasse as can be. . . ." William Penn told of sowing English grass, and Thomas Jefferson mentions it repeatedly. By Revolutionary times there were many names for *Poa pratensis*—at least twenty-seven have been counted—including "blue grass," so called by Thomas Jefferson in his *Notes on Virginia*, 1782. Other names were green grass, Junegrass, meadow-grass, speargrass, Rhode Island grass, and greensward grass.

Trained botanists did not set foot in America until the mid-eighteenth century. Peter Kalm observed bluegrass in 1749, indubitably *Poa pratensis*, abundant along the St. Lawrence. Gronovius listed it—no mistaking the identity—in his *Flora virginica* of 1762. And there are reports of "seas of grass," of uncertain botanical definition, greeting Boone when he first left the Yadkin Valley of North Carolina for his explorations into Virginia's western territory, known as Caintuck. Indeed, Caintuck, eventually Kentucky, is said to have meant "among the meadows" in Indian language.

It is not known how bluegrass first reached Kentucky. One report, difficult to verify, mentions an Irishman, John Findley, who paddled down the Ohio River from Pennsylvania, and then up the Kentucky River to trade with the Shawnee in 1752. Findley is said to have built a cabin and stockade, and to have scattered "English hay" that had been packed around his cargo. Was this the first introduction of the grass that was to be named for the eventual state of Kentucky? A John Finley—perhaps the same person—is also reported to have engaged Daniel Boone to act as his guide across the old "warrior's path" from the Blue Ridge into Kentucky, in 1769. Might this, or other Boone expeditions, have carried bluegrass seed into the state, either by chance or by intent?

While these speculations may be worth considering, the most likely explanation is that *Poa pratensis*, noted so widely in French Canada by botanist Peter Kalm in 1749, may have been carried down into the Illinois country by French missionaries in the early seventeenth century, and from there spread along the waterways, bypassing the mountains, to what is now Kentucky. The missionaries may have intentionally brought in bluegrass seed as they were wont to do with seeds of other plants. Marquette and La Salle had opened missions in Illinois as early as 1672 and 1682, and there were settlements at Kaskaskia, Illinois, by 1700, and at Vincennes on the Wabash River by 1702, a half century ahead of John Findley's Indian trade in the same general area. Both settlements were flourishing when visited by Charlevoix in 1721. It is likely that bluegrass was poised just north of Kentucky, or introduced there, before Boone visited the land he opened.

Interesting support of the belief that bluegrass may have naturalized in the Midwest is given by letters written in 1818 by an Illinois resident named Birkbek: "Where the little caravans have encamped as they crossed the prairies, and have given their cattle hay made of these perennial grasses, there remains everafter a spot of green turf for the instruction and encouragement of future improvers—a fact which, I think, is conclusive against the prevailing notion that the natural grasses, as they are called, are the best adapted to soil and climate." It is well accepted that the North American prairies were entirely of grasses that turn brown in winter; Birkbek's observation suggests that Old World introductions were present where travelers encamped.

There are those who claim that the bluegrass that made Kentucky famous actually came from southern Indiana, brought back by the returning volunteers who fought with Harrison at the Battle of Tippecanoe in 1811. It was reported that the soldiers discovered the superior qualities of bluegrass and, when they returned home, sowed the seed on limestone soil. A present-day farmer, C. Henry Baum, Jr., of West

Lebanon, Indiana, maintains that General Harrison camped in his grove at both start and finish of the Tippecanoe expedition. He believes that the bluegrass seed in question was gathered from his farm. Similar claims are made for a spot five miles north of Crawfordsville, where a Federal penitentiary now stands near Terre Haute (the seed reportedly sent to Henry Clay in Kentucky by his brother-in-law, General Harrison). Another Indiana resident, Mayme Jacobs, corroborates: "My great-grandfather, John Hamilton, was a captain with General William Henry Harrison in his raid on Tecumseh, and my mother heard great-grandfather Hamilton tell of being one of those who carried the bluegrass seed to Kentucky."

Although admitting that bluegrass came to the United States with the Jamestown and Williamsburg settlers, still others have claimed that it was not in Kentucky until after 1812. Rather, they say, the cavalry with Anthony Wayne spread bluegrass at the encampments on the Pickaway Plains in Ohio, where it prospered, and from which seed was gathered and taken to the Lexington area of Kentucky. About 1822, a man named Renick is said to have gathered the seed and delivered it to the farm of his brother, who settled near Lexington. This is possible, but most likely it is not the first introduction into Kentucky, where bluegrass had probably flourished on the rich phosphatic soils for a long time. In any event, there, near Lexington, the English grass, meadow-grass, speargrass, or what you will, became Kentucky bluegrass.

Poa pratensis was not known by the name Kentucky bluegrass until after 1833. Neither Elliot's *Botany of South Carolina and Georgia*, 1812; Muhlenberg's *Catalog of the Plants of North America*, 1813; nor Short's *Catalog of the Plants and Ferns of Kentucky*, 1833, mention it by that name, although the species is invariably listed.

But by 1840 there are references such as this by Bidwell and Falconer: "the limestone region of Kentucky was famous in the West as the center of prosperous and contented agriculture. Its bluegrass pastures were widely known. . . ." Well's *Yearbook of Agriculture*, 1855-6, mentions: "*Poa pratensis:* smooth-stalked meadow grass. In Kentucky it is called Kentucky bluegrass . . . succeeds far better in Kentucky . . . than it does in any part of Europe, where it is native." And Charles Flint, *Grasses and Forage Plants*, 1858, notes: "In Kentucky it is universally known as bluegrass, and elsewhere frequently called Kentucky bluegrass. . . ."

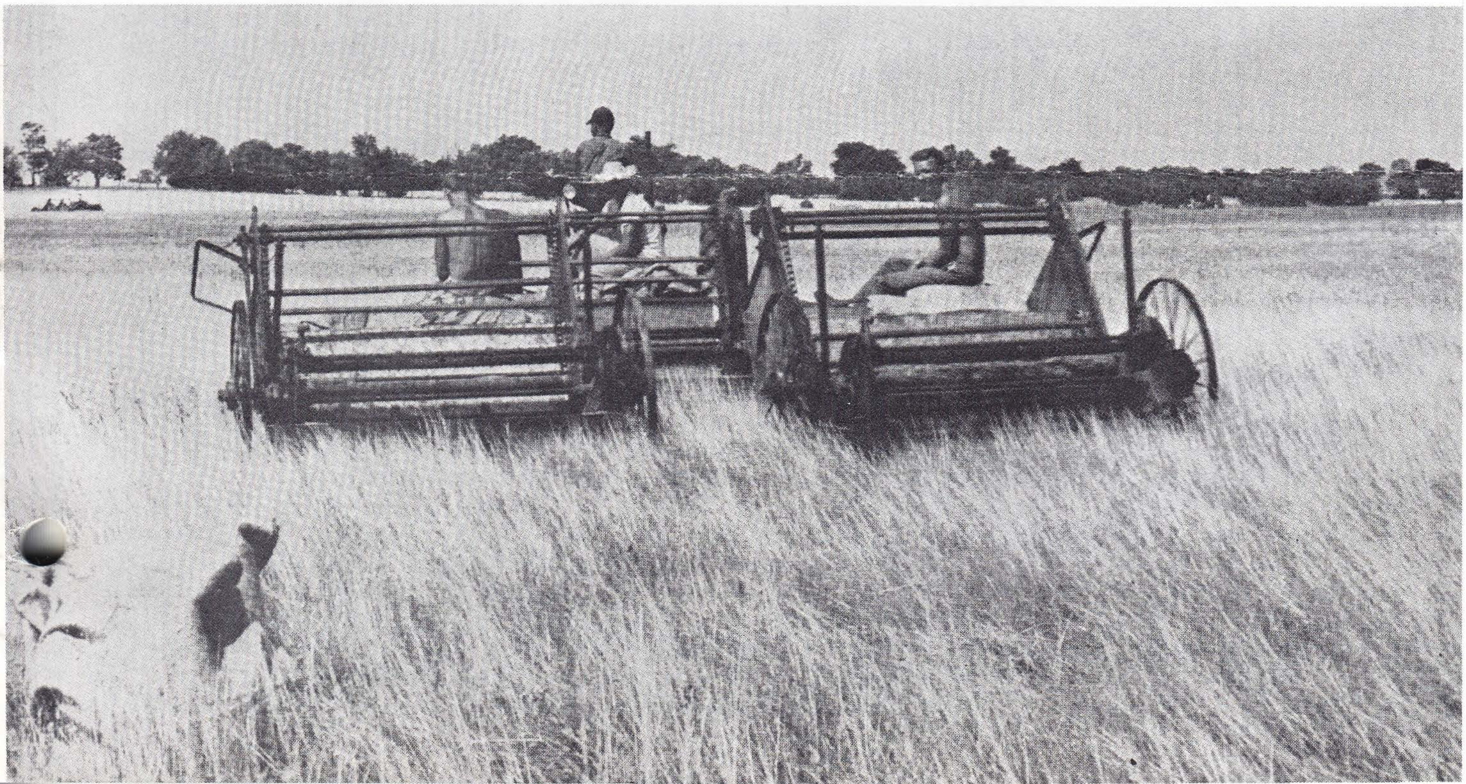
Thus did Kentucky bluegrass gradually come to be known for the state. It remains resplendent today over the fields and pastures of north-central Kentucky, one of the finest and most beautiful agricultural areas in the world, renowned especially as the breeding ground for some of the fastest thoroughbred horses. To a large extent, the growing of bluegrass for seed is now carried on farther west. But the tradition lingers in Kentucky, where a way of life has been based upon grassland farming.

Not only in Kentucky, but throughout the United States, bluegrass has played an important role in suburbs and agricultural areas. Dr. E. N. Fergus of the University of Kentucky points out: "With little assistance it achieved wide distinction for pasture and turf. One has only to imagine—if he can—home lawns, parks, playgrounds, air fields, golf courses, roadsides, cemetaries, campuses and other institutional grounds without their carpets of bluegrass to appreciate in some degree the significance of this grass in our living."

Perhaps the most eloquent eulogist was John James Ingalls, senator from Kansas, 1873-1891, who delivered a speech, "In Praise of Bluegrass," to Congress. Ingalls concluded: "Grass feeds the ox; the ox nourishes man; man dies and goes to grass again; so the tide of life, with everlasting repetition, in continuous circles, moves endlessly on and upward, and in more senses than one, all flesh is grass. But all flesh is not bluegrass. If it were, the devil's occupation would be gone."

Reprinted from Natural History Magazine

STRIPPING machines comb seed heads from stalks. Seeds will then be cured.



Lawn Seed Division Members Updated On Turfgrass Evaluation And Management

The morning and only session of the winter meeting of the Lawn Seed Division of the A.S.T.A. on Nov. 23 was "gaveled" to order by its Chairman Arnie Bonnicksen. The minutes of the June meeting in Minneapolis were read by Secretary Gager T. Vaughan, as was the Treasurer's report. Addressing himself to the topic Lawn Seed Can Help Beautify America, Mr. Bonnicksen presented some thoughts of germane interest.

Harold Doellinger then presented a duplicate of the Report of Joint Legislative Committees of the American Association of Seed Control Officials; Assn. of Official Seed Analysts; International Crop Improvement Assn. and American Seed Trade Assn., which he made before the Legislative Committee of ASTA in Kansas City early in November.

The resolution presented by Gager T. Vaughan at the meeting of the Atlantic Seedmen's Assn. the day before, relating to criteria for classification of fine textured grasses in lawn seed mixtures, complete text of which appears as part of the report on that meeting, was approved by the Lawn Seed Division's membership as well.

An honored guest, ASTA's President William R. Herron, filled the seedsmen in on the Association's activities, among these being the Tokyo Seed Fair and Seminar held earlier this year and the constructive opportunities it may portend for the industry; the Limitation of Liability Clause; and the Federal Seed Act changes to be introduced in Congress next year. He also told how the Association is combating to the utmost the proposed harmful Maryland regulation adding Poa Annua to the restricted noxious weed list and the new law to be submitted to the Virginia legislature in 1966 on registration of lawn seed packages. He concluded his remarks by cordially inviting all to attend the June, 1966 convention of the ASTA to be held at the Benj. Franklin Hotel in Philadelphia, which, incidentally, he pointed out, is the first to be held in the City of Brotherly Love since 1887.

Spotlighting the session was a thoroughgoing and detailed "Evaluation of New Turfgrasses" by Dr. C. Reed Funk, Rutgers — The State University. A capsule sketch of his findings follows:

"The turfgrass industry has a vital part in making America more beautiful, in conserving its soil and water resources, and in making it a better place to live in and enjoy. . . . Improved turfgrass varieties which reduce mowing, spraying, and other maintenance costs and/or add to the beauty and functional value of turf are very valuable. . . . The development and use of improved turfgrass varieties will increase the interests of the American homeowner in his lawn. This has been illustrated by Merion Kentucky bluegrass in its area of adaptation. . . . Improved varieties have a highly stimulating effect on the entire turfgrass industry.

"In the evaluation of new turfgrass varieties it is important to recognize the factor of regional adaptation. Due to differences in climate, soil and disease complex, a specific variety may show exceptional performance in one area and be only mediocre elsewhere."

Dr. Funk particularized various varieties of Kentucky bluegrass, red fescue, perennial ryegrass, turf-type ryegrass and bentgrass relating to their development, disease potential, resistance, etc.

Another feature was a survey of Developments in Sod Production by Dr. Henry W. Indyk, Specialist in Turf Management, Rutgers. An outline of his thoughts is appended:

"The use of sod is not a recent innovation. It has been in use many years, particularly from the standpoint of soil stabilization. Today, interest in the use of sod is primarily expressed in its aesthetic value and rather completely overshadows its utilitarian value. . . . Developments characterizing the present day industry are of recent date. One of the most striking developments is the rapid development of sod production as a highly specialized and sophisticated industry. . . . Large acreages are being devoted exclusively to the production of a high quality sod of improved varieties of selected turfgrasses with the use of up-to-date turfgrass culture techniques. Fields serving in the dual capacity as a source of forage for dairy or beef animals and a source of sod are rapidly disappearing. . . . The marked improvement in quality of sod perhaps more than any other single factor has stimulated a surging interest in the use of sod for establishing a lawn. . . . A sod certification program has been initiated in New Jersey as an aid toward continued progress in improving sod quality. . . . The primary objective of the New Jersey program is to make available to the public high quality sod of superior types of turfgrasses so grown and distributed to insure genetic identity and purity, and reasonable freedom from injurious insects, diseases, nematodes, and weeds. . . .

"Advances in mechanization have been few but significant. This phase of sod production has many needs and opportunities for further advancement. The industry as a whole has made rapid progress as of recent date. I personally anticipate continued growth of the industry to satisfy the increasing demand. I foresee a continued increase in demand for sod as long as the industry continues to progress in more efficient production and has a high quality product to offer. Quality will be in the pathway to quantity."

Dr. Henry W. Indyk then explored the theme "Principles in Lawn Renovation," a talk which wound up the Lawn Seed Division meeting. Here in part is what he had to say:

"Lawn renovation for the purpose of this discussion will be regarded as a technique or procedure necessary to re-establish a satisfactory stand of desirable lawn grasses in a previously established lawn which has partially or entirely deteriorated.

"Knowledge of the factors involved in a specific situation will aid in determining the necessary steps of the renovation program as well as an effective management program. If proper precautions are not taken to correct the source of failure, the results of a renovation program will be a complete disappointment or short-lived. . . ."

After discussing specific conditions characteristic of lawns in need of renovation and the necessary corrective procedure, Dr. Indyk went on:

"In preparing the area for seeding in any one of the procedures I have outlined, it is essential that conditions be provided so that the lawn grass comes in direct contact with the soil. Results obtained from short-cut procedures such as seeding on the surface of a thatch layer usually are disappointing in spite of high quality seed. Under such conditions, the environment in which the seed is placed is not conducive to germination."

The talks by Dr. Funk and Dr. Indyk were partially slide-illustrated with a question period following.

Reprinted from *Seed World*

Massachusetts 1966 Turfgrass Conference

This is your first call for the 1966 University of Massachusetts Annual Fine Turf Conference. Reservations should be made in advance, when possible. Conference dates are March 3 and 4 at the Student Union, University of Massachusetts, Amherst. For information regarding registration, room reservation and meals write:

Dr. Joseph Troll, Chairman
Annual Fine Turf Conference
Rm. 202, Stockbridge Hall
University of Massachusetts
Amherst, Massachusetts

This year's guest speakers are among the leaders in their field; their talks and the following question and answer periods should prove invaluable. The conference is being presented and sponsored under the cooperative efforts of The Massachusetts Turf and Lawn Grass Council; The New England Golf Course Superintendents Association and the Massachusetts Cooperative Extension Service. Dr. Troll has good reason to be proud of this year's program. He feels that he was fortunate in obtaining the services of so many top turf specialists at one time — a no mean feat in this day and age of conferences and conventions.

The conference is open to all those interested in fine turf culture; golf course superintendents, custom landscapists, homeowners, educators, public grounds personnel, architects, sodmen, recreation managers, and on ad infinitum. We hope this year will be the largest turnout ever. Register early!

Program

ANNUAL FINE TURF CONFERENCE

University of Massachusetts
Student Union
Amherst, Massachusetts

MARCH 3, 1966

COMBINED SESSION

Chairman: Leon St. Pierre, President
New England Golf Course Superintendent Assoc.

9:30 - 10:00 Registration and Informal Coffee Hour

10:15 - 10:30 Welcome
— F. P. Jeffrey, Associate Dean
College of Agriculture
University of Massachusetts

10:30 - 11:15 Soil Warming — Its Potential Use for Golf and Athletic Areas
— Dr. William H. Daniel
Purdue University

11:15 - 12:00 Review of 1965 Turf Problems
— Holman Griffin, Agronomist
USGA — Green Section

12:00 - 1:00 Catered Luncheon

1:00 - 1:45 Review of *Poa annua* Control
— Dr. William H. Daniel
Purdue University

Fertilizer Symposium

Chairman: Charles K. Mruk, Agronomist
Hercules Powder Company

1:45 - 2:15 Role of Nitrogen in Turf Grass Management
— Dr. R. E. Blaser
Virginia Polytechnic Institute

2:15 - 2:45 Role of Phosphorus in Turf Grass Management
— Dr. Marvin H. Ferguson, Mid-Continental Director
USGA — Green Section

2:45 - 3:15 Role of Potash in Turf Grass Management
— Dr. Robert E. Wagner, Director
American Potash Institute

3:15 - 3:45 Role of Trace Elements in Turf Grass Management
— Alexander M. Radko, Eastern Director
USGA — Green Section

3:45 - 4:15 Question and Answer Period

4:15 Massachusetts Turf and Lawn Grass Council
— Business Meeting

ALTERNATE SESSION

Chairman: Richard Blake, President
Massachusetts Turf and Lawn Grass Council

1:00 - 1:45 Water Supply
— Allan Grieve, Jr., Civil Engineer
Metropolitan District Commission

1:45 - 2:30 Weather
— Robert Copeland
WBZ-TV Channel 4

2:30 - 3:15 Establishment & Maintenance of Campus Turf
— William Lambert, Landscape Architect
University of Massachusetts

3:15 - 3:45 Management of Athletic Field Turf
— James T. Williams, County Agent
Middlesex County Extension Service

6:30 P.M. Banquet

Toastmaster: Joseph Troll
University of Massachusetts

Speaker: Rev. Russell E. Camp, Chaplain
Connecticut State Prison

Dinner Music — The Novelaires

MARCH 4, 1966

COMBINED SESSION

Disease Symposium

9:30 - 10:00 Plant Infection by Fungi
— Dr. F. L. Howard
University of Rhode Island

10:00 - 10:30 Brown Patch and Pythium
— Dr. Malcolm Shurtleff
University of Illinois

10:30 - 11:00 Fusarium Blight
— Dr. George A. Bean
U. S. Department of Interior

11:00 - 11:30 Dollar Spot and Snow Mold
— Dr. Noel Jackson
University of Rhode Island

11:30 Question and Answer

Trunk Temperatures

W. Baier
Agro-Meteorological Section
Plant Research Institute, Ottawa, Ontario

Under conditions of intense solar radiation and wide temperature fluctuations, injuries commonly known as winter or summer scald can cause considerable damage to tree trunks. The relation between environmental factors and temperatures in the trunk of ornamental trees and the possible effects of these conditions on sun-scald damage were studied by the writer in the Highveld region of South Africa. Because of the high elevation of the area (more than 4,000 feet) incoming and outgoing radiation is here particularly intense, and wide daily and seasonal temperature fluctuations prevail throughout the year. Yet the findings obtained in such an extreme climate may also be applicable to those parts of Canada where winter or summer sun scald on tree trunks occurs.

In the Highveld region of South Africa (in the southern hemisphere), the mean daily temperature range is 15° to 20°C, the mean daily length of bright sunshine is 8 to 10 hours throughout the year. In winter, the daily minimum temperature of the air drops to several degrees below freezing point, whereas the daily minimum temperature may rise to 20°C. Under these climatic conditions winter sun scald of fruit and ornamental trees often occurs. The trees may die prematurely or injury may affect their yields adversely for a number of years. Splitting of the bark, or scalding, is generally ascribed to extreme temperatures occurring in the bark of the trees.

As no records of trunk temperatures and sun-scald damage under these conditions were available, the temperatures in the bark and heartwood of several ornamental trees of the species *Acer buergerianum* resistance thermometers (Withof type) were placed ½ inch deep under the bark on opposite positions of the trunks and 2 inches deep in the heartwood. The thermometers were connected by temperature-compensated cables to an H & B 12-channel electronic compensation recorder (Polycomp).

During the first stage of the investigation, the temperatures in the bark and heartwood of trunks in the course of the year were compared with those of the air and sunshine. Thereafter, the temperature in (a) whitewashed and (b) grass-covered trunks were compared with those of an untreated tree.

From the comprehensive experimental data collected from 1960 to 1962, typical periods throughout the year were selected and analyzed.

The following results were obtained:

The temperatures in the bark and wood of trunks were mainly influenced by the air temperature and the direct sunshine on the trunk. It was found that during the winter, when the ecliptic is low and there are no leaves on the tree to shade the trunk, the maximum temperature in the tree trunk considerably exceeded the maximum air temperature. For example, on the northern exposure of the tree trunk the mean maximum temperature ½ inch deep in the bark was 20°C higher than the corresponding maximum air temperature and the temperature 2 inches deep in the heartwood was 15°C higher. On clear days the daily temperature fluctuations in the bark, in the wood, and of the air were as much as 38°, 34° and 19°C, respectively. A typical example for the temperature distribution on a clear winter day is shown in Figures 1, B and 1, C.

Visible damage of the bark was measured weekly and photographed. During spring and summer in 1960, the length of splitting increased from 37.5 cm to 40.4 cm and the width from 8.0 cm to 9.7 cm. Eventually, the whole bark on the northern side of the trunk broke off. In all cases scalding was observed only in those parts of the trunk where the largest temperature fluctuations occurred during winter; that is, in the bark on the northern position of the tree trunk.

Thus, it was concluded that the so-called sun-scald damage on tree trunks was caused by intense sun radiation on the unprotected bark during winter and the consequent extremely wide fluctuations in daily temperatures. In addition, repeated freezing and thawing of the bark so aggravated the disturbance of the original unit between heartwood and bark. This damage became visible only in spring when the cambium began to grow.

In order to reduce the wide daily temperature fluctuations in the trunk and possibly the sun-scald damage, two simple practical techniques were employed. A whitewash of the trunk decreased the maximum bark temperature by 4°C as compared with an untreated control tree. A loose grass cover placed around the tree trunk was more effective and decreased the maximum temperature by 14°C and 10°, respectively (Table 1). In other words, under local conditions whitewashing reduced the daily temperature range during summer and winter in the cambium to 80 per cent and a grass cover to 43-47 per cent of the temperature range in the cambium of a control tree.

Table 1. Mean bark temperatures of treated tree trunks and deviations from control temperatures of untreated trees in summer and winter.

	Treatments					
Period	Whitewashed			Cross-cover		
	Max. °C	Min. °C	Range* °C	Max. °C	Min. °C	Range* °C
Winter						
Mean	28.3	–1.4	29.7	18.3	2.6	15.7
Dev.	–4.0	–0.2	3.8–	–14.0	+3.8	17.8–
Summer						
Mean	28.8	14.3	14.5	25.1	17.3	7.8
Dev.	–4.1	–0.6	3.5–	–7.8	+2.4	10.2–

* The minus sign after the number indicates that the range of the specific treatment is smaller than the range of the control.

From these results it was recommended that in order to control so-called sun-scald damage, the temperature fluctuations in the trunk should be reduced particularly in winter. This can be achieved by a whitewash of the trunk or more effectively by protecting the trunk against direct solar radiation with, for instance, a loose grass cover. The latter method is now being applied experimentally to peach trees.

Ragweed And Its Control

More than eighteen million Americans suffer from hay fever, or approximately one out of every 18 people. In fact, hay fever is considered the most common allergic disease in the nation.

Spring or summer hay fever is caused by an allergy to the pollen from trees, grasses and weeds. In general, hay fever is most prevalent from mid-August to frost. During this period, the ragweed plant is most prolific in its pollen production. Each square mile of ragweed growth will produce as much as 16 tons of pollen in a single season.

There are two species of ragweed which grow in Rhode Island. These are common ragweed (Ambrosia artemisiifolia) and giant ragweed (Ambrosia trifida), though giant ragweed is not too common in this region. Common ragweed attains a height of one to five feet. The multi-branched stem is hairy. The leaves are only slightly hairy, strongly indented or parted, and mostly opposite on the stem and branches.

Giant ragweed often grows from five to more than 15 feet tall. The many-branched stems are erect, coarse and hairy. The lower leaves are usually three-lobed, while the upper ones may be three-lobed or simple. All the leaves are hairy.

In late summer, pollen is produced in the green, inconspicuous flower parts at the tips of the branches. Since the pollen is very light, it may be carried easily by the wind for miles.

The common and giant ragweeds reproduce only from seed. Both are annuals and are readily destroyed by heavy frost. Unfortunately, one plant can produce thousands of seeds that will re-infest the area year after year. The seeds are liberated around mid-August and may be carried several miles by wind, birds and water, or by mechanical means such as the automobile.

Because these ragweeds are annuals any method of control that prevents seed from maturing will be effective. Mechanical methods such as cutting, mowing, pulling or hoeing are good on small areas. However, such controls must be practiced early in the season before the plant has a chance to liberate most of its pollen.

For large infestations or when a community project is undertaken, use of the weed-killing chemical 2,4-D is by far more practical. This material is inexpensive, effective and safe to use *providing the directions on the label are followed.* Spraying with 2,4-D is best done as early in the plant's growth as possible.

Since 2,4-D may be "INJURIOUS" to vegetables, flowers, and ornamental shrubs, one should use this chemical with utmost care when spraying around these plants. Avoid spraying on a windy day and follow the label directions.

—TED W. STAMEN
Urban Horticulture Agent
University of R. I.

Turf Management

ELWYN E. DEAL

Maryland Extension Turf Specialist

Spring Seeding of Lawns

Spring is the second best time to seed cool-season grasses, but it is a poor second. Every effort should be made to give new seedlings a chance to become established before spring and summer problems begin. Difficulties most often encountered include weed competition, diseases, drought, and hot weather. Most cool-season grasses stop growing at temperatures above 75 to 80 degrees, while crabgrass and other weeds continue to flourish.

The soil should be limed and fertilized, especially with phosphorus, to encourage maximum seedling growth. Light, frequent irrigations with a fine spray during germination and establishment and judicious use of water through the summer is essential. A single dry period, even for a few hours, during germination may result in the loss of a large number of seedlings. Diseases such as Damping-off may become a problem in warm humid periods but these can be easily controlled with fungicides.

A new crabgrass pre-emergence herbicide has been developed which reportedly controls crabgrass seedlings but is so selective that it does not affect desirable cool-season turf grasses even if used at the time of seeding. The chemical, to be sold under the trade name TUPERSAN, will be especially helpful with spring seedings if it proves to be effective. Silvex and 2,4-D can be used to control broadleaf weeds if used at slightly lower than the usually recomended rates and on young grasses after the seedlings have passed the four-leaf stage.

Spring Fertilization

A light application of an organic fertilizer in early March will get the cool-season grasses off to a good start in spring without danger of over-stimulation. Mixtures of soluble and slowly available nitrogen give a quick green-up as well as a long-lasting effect. Most slowly-available forms of nitrogen such as ureaform and natural organics depend on microorganisms for their breakdown, thus releasing their nitrogen over a longer period of time. The soluble forms give an immediate response.

Over-fertilization results in succulent grass that is more susceptible to injury and diseases, especially leafspot *(Helminthosporium spp.)*. Over-stimulation is more likely to occur with high rates of soluble nitrogen than with similar rates of slowly available forms. However, if high rates are applied even the slower forms may cause over-stimulation during warm humid periods when microorganisms are most active and nitrogen is released at a very rapid rate. Over-fertilization during hot weather forces the plant to use food reserves that were stored during the fall and winter and makes the grass more susceptible to injury during adverse conditions.

Spring fertilization for most bluegrass-fescue turf areas should include about one pound of nitrogen per 1000 square feet applied in early March or one-half pound in March and one-half pound in late May if a soluble form is used. Slightly higher rates may be used if the nitrogen is in a slowly-available form. This amount of nitrogen may be applied in a complete fertilizer if phosphorus and potash are needed. Merion Kentucky bluegrass requires almost twice as much fertilizer as other bluegrasses. A second lighter application is needed in early summer for Merion if only one pound was applied in March.

Timing Of Seeding

by

EVANGEL J. BREDAKIS and JOHN M. ZAK
Department of Plant and Soil Sciences
University of Massachusetts
Amherst, Massachusetts

The high speed tempo of our society today has compelled us more than ever to cover our country with fast vehicular transportation routes linking city with city and state with state. These roads, some already established and others in the planning stages, have been or will be chewed out of America's natural landscape. Once these gigantic bites have been made or planned, we must find a way to re-establish grass belts which will, in part at least, heal these man-made wounds.

The highway developers not only seek the most direct route in their planning but they also try to eliminate steep grades and curves. Very often this leads to filling, grading or contouring the roadsides.

It is with these shoulders, slopes, and grades that our experiments are concerned. How can new growth be encouraged in these areas? What is the most economical, the most beneficial and the easiest to maintain in the years to come?

Although there are thousands of plant species available to stabilize our roadsides, it appears that few species of grasses, legumes,, shrubs and trees are adaptable to our roadside areas. It has been shown through experimentation that different species of plants vary in their response to climatic and soil conditions. For best results, therefore, research work must be done in a given area in order to find the most suitable species for the particular use.

Because it is not certain that the results of the work done in other states can be applied successfully to Massachusetts, we at the University of Massachusetts, in cooperation with the Massachusetts Department of Public Works and the United States Bureau of Public Roads, initiated a series of experiments which we hoped would help solve some of our pressing problems.

There are many phases to our experiments. One of the phases pertained to the "Timing of Seeding Throughout the Growing Season", which is the only phase of concern topically. This experiment was carried out on our University experimental farm. The soil was Cheshire loamy sand, 75% sand, 19% silt, and 6% clay. The pH was 6.0.

Prior to seeding, the area was cultivated and a 10-10-10 fertilizer applied at the rate of one-half ton per acre. No additional fertilizer treatments were made. The plots were seeded by hand at intervals of approximately two weeks, starting May 1 and continuing until September 16, 1963. The same seed mixture was used throughout the experiment: 65% creeping red fescue, 20% Kentucky bluegrass, 10% ryegrass, and 5% red top. Two rates of seed mixture, 75 lbs. and 150 lbs. per acre, were used at each planting. After seeding, the plots were divided horizontally for mulching so that only half of each plot was mulched. Hay was used as the mulch material and was applied by hand at the rate of one ton per acre.

There was very little value from the use of the hay mulch in seed germination and seedling establishment for the spring and fall seedings. However, the mulch was of value when used during the summer seeding. The summer seedings, even though mulched, were infested with weeds and the weed infestation became heavier as the seeding dates advanced during the summer. Weed infestation on plots of spring and fall date seedings was very light, and not enough to be competitive with the permanent grasses. The 75-pound rate of seeding per acre gave just as good a stand of grass as the 150-pound rate in both mulched and unmulched areas for spring and fall seeding. However, the summer seeding plots which had been mulched showed a slight difference between the two rates of seed mixtures with the heavier rate giving better results. On unmulched areas seeded in the summer, the two rates of seed mixture gave similar results both of which were poor stands of grass.

We might have had different results if the total precipitation of the 1963 season had been closer to the average. As shown in Table 1, precipitation for the growing season was much lower than the average for previous years.

TABLE 1

Precipitation in inches from the
University Meteorological Station (1963)

	Apr.	May	June	July	Aug.	Sept.	Oct.
Actual Total	4.19	1.97	3.98	1.92	2.54	3.57	0.32
Normal Average*	5.52	3.60	3.75	4.10	4.08	4.24	3.29

* The average based upon observations made from the period 1889 to 1939.

For example, the average precipitation for May was 3.60 inches, while for May 1963 it was 1.97. The July and October average totals were 4.10 and 3.29 respectively, but for the same months of 1963 they were 1.92 and 0.32 inches. These data indicate that the 1963 growing season was especially dry.

The experimental plots were mowed in October 1963 and again in June, 1964. Before the June mowing, the percentage of cover in the experimental plots was observed. These results are shown in Table 2. The percentage of each species in the established turf is also reported in the same table. Samples of three one-square-foot areas were taken per treatment in May and August, 1964. Mean dry weight yields of these samples are shown in Graph 1. Dry matter yields and grass cover were used to evaluate the establishment of the grasses.

Table 2 shows that in the second year the percentages of bare spaces on the grass plots for spring, summer and fall seedings were about 5-10%, 20-25% and 0-5% repsectively. In regard to bare spaces, there was no significant difference between the 75 and 150 pounds per acre rate of seeding. There was more bare space on the unmulched plots than on the mulched ones. In evaluating the grass plots for cover and appearance at the end of the second year, the plots which had been seeded in the fall were rated best. The spring seedings were rated good, and the summer seedings were the poorest.

The 1964 evaluation of species in the seed mixture that was used for this experiment is also reported in Table 2. From all the species that were used, the creeping red fescue produced the best results. This grass was successful throughout all the dates of seeding during the three seasons to the extent that it made u at least 80% of all the existing vegetation, even though it had been applied at the rate of 9.12% of the total number of seeds per plot. Kentucky bluegrass showed only fair results during the fall dates of seeding, while the results of spring and summer were a complete failure. The failure of Kentucky bluegrass may be attributed to the fact that it requires a longer period for germination than the other grasses that were together in the seed mixture. This late germination, together with the fact that the weather was unfavorable, was undoubtedly the reason for the poor result. There was little survival of ryegrass and red top during the second year from the spring and summer seedings, while the fall seedings showed a slightly larger amount of survival of the two species.

TABLE 2

Percentage species in established turf and percentage cover by the seed mixture from the seeding rates and planting dates at Brown Farm experiment — 1963. (Observation: Fall 1964).

Species used 75 lb/A rate	Wt.% per specie	Number seeds per plot	% Seed per plot	% Species in established turf *Spr.	Sum.	F.	% Cover by seed mixture Spr.	Sum.	F.
Creeping red fescue	65	102,345	9.12	95	98	80			
Kentucky blue	20	150,144	13.38	1	1	8			
							94	78	98
Ryegrass	10	7,924	0.71	2	0.5	6			
Red top	5	861,540	76.79	2	0.5	6			
150 lb/A rate									
Creeping red fescue	65	204,691	9.12	94	97	83			
Kentucky blue	20	300,288	13.38	2	1	8			
Ryegrass	10	15,848	0.71	1	1	4			
							95	80	99
Red top	5	1,723,080	76.79	3	1	5			

* Spr.=Spring, Sum.=Summer, F.=Fall

In the May, 1964 harvest the dry matter yields from the mulched and unmulched plots showed no significant difference. This was also true for all the dates of seedings during the 1963 season. However, there was a difference in the yields of the August, 1964 harvest between the mulched and unmulched plots seeded in the spring of 1963, with the unmulched plots producing a heavier yield. This may be attributed to the fact that part of the plant food was used by the microorganisms in decomposing the mulch material; and thus less plant food was available for the grasses in the mulched plots. If the area had been fertilized in 1964, this difference might not have existed because approximately the same number of grass plants were present in the mulched and unmulched areas. The summer seeding plots produced in both harvests smaller yields than those plots seeded either in the spring or fall. This could have resulted from the fact that summer seeding plots had more bare spaces than those plots seeded on other dates, and consequently, had fewer plants per square foot.

An analysis of variance was carried out on the dry matter yields for the various treatments. The analysis was set up as a split-plot design with date, rate, and use of mulch as a three-way factorial design for the whole plot. The sub-plot was the harvest dates versus the above three-way factorial. An F test was used to determine statistical significance for this analysis. A T test was used to find any possible significance within a particular date. The new Duncan's multiple range test was applied to find significant differences within the various treatments as they interacted with the seeding dates.

Table 3 shows the means for all the treatments within a particular date. The F test proved that the difference in seeding dates was significant. Duncan's multiple range test further showed that September 1 was the date, followed by September 15, and then May 15. The closer the seeding date was to mid-summer, the poorer the yield. Also shown in Table 3 are the means for the interaction of rate and use of mulch within the seeding dates.

The treatment mean value for the various dates are shown in Table 4 and are listed by their respective treatments. The F test showed that the overall effect of rate was significantly greater for the 150 pound per acre treatment. Note that there is no significant difference for any one month. The results for the use of mulch were just the opposite — on a month-to-month basis there was a significant difference, but the negative effect of the use of the mulch in the spring counterbalanced its positive effect in the summer. This gave an over-all effect of no significant difference.

TABLE 3

Mean dry weight yields in grams of turfgrasses. Brown Farm experiment. 1964.

Date of Seeding	All Treatments	Mulch Rate 75	Mulch 150	No Mulch 75	No Mulch 150
May 1	19.13 c†	17.0 b	18.5 b	20.5 a	20.5 a
May 15	18.25 c	16.0 bc	17.5 bc	20.0 a	19.5 bc
June 1	17.25 d	16.5 bc	16.5 cd	17.5 b	18.5 bc
June 15	15.71 e	15.0 cd	15.0 de	16.5 b	16.5 d
July 1	12.50 f	14.0 d	13.0 f	11.5 c	11.5 e
July 15	11.75 f	12.0 c	13.5 ef	10.0 c	11.5 e
Aug. 1	12.00 f	13.5 de	13.0 f	10.5 c	11.0 e
Aug. 15	17.60 d	17.5 b	18.5 b	16.5 b	18.0 cd
Sept. 1	21.13 a	20.5 a	22.0 a	21.0 a	21.0 a
Sept. 15	20.13 b	20.0 a	20.5 a	20.0 a	20.0 a
Average	16.55 **	16.2	16.8	16.4	16.8

** F test significant at 5% level.
† Treatment means having no metters in common in same column are significantly different at the 5% level using Duncan's new multiple range test.

TABLE 4

Mean dry weight yields in grams of turfgrasses. Brown Farm experiment. 1964.

Date of Seeding	Rate 75	Rate 150	Treatment Mulch	Treatment No Mulch
May 1	18.75 b †	19.50 b	*17.75 c	*20.50 ab
May 15	18.00 b	18.50 c	*16.15 d	*19.75 b
June 1	17.00 c	17.50 d	16.50 d	18.00 c
June 15	15.75 d	15.75 e	15.00 e	16.50 d
July 1	12.75 e	12.25 f	*13.50 f	*11.50 e
July 15	11.00 f	12.50 f	*12.75 f	*10.75 e
Aug. 1	12.00 e	12.00 f	*13.25 f	*10.75 e
Aug. 15	18.00 b	18.25 cd	18.00 c	17.25 c
Sept. 1	20.75 a	21.50 a	21.25 a	21.00 a
Sept. 15	20.00 a	20.25 b	20.25 b	20.00 b
Average	16.40**	16.80**	16.20	16.60

** F test significant at 5% protection level.
* T test significant at 5% protection level.
† Treatment means having no letters in common in the same column are significantly different at the 5% level using Duncan's new multiple range test.

The following conclusions may be drawn from the results to date:

1. Under normal weather and environmental conditions a fall seeding appears to offer the most merit or an early spring seeding is second best. Although adverse climatic and precipitation stresses were present during our trials, it appears that the highest percentage of germination follows a fall seeding with an early spring sowing second best.

2. The lighter sowing rate of 75 pounds per acre was as successful as the higher 150 pounds per acre rate. Overabundance of seeds per plot does not necessarily assure a larger percentage of healthy plants.

3. A summer seeding program, if followed, would require the use of some type of mulch. The mulch used offsets desiccation of the seeds and seedlings and should be of the type that can retain relatively large amounts of moisture.

4. Of all the grasses tested in these trials, creeping red fescue consistently performed exceptionally well in comparison with the other species tested — especially during the summer sowing program. In addition, this species gave a high percentage of germination as well, in the spring and fall seedings.

Watch Your Language!

A Wisconsin study discovered much misunderstanding by pesticide users of words and expressions used commonly on labels and in making pest control recommendations.

Such common words as "agitate," "contamination," "foliage," "hazardous," "toxic," "lactation," "residues," "residual spray," and "fungicide" were missed altogether or at least not well understood or interpreted by a surprising number of farmers, students and homemakers.

The much used term "herbicide" was missed by 78% of the farmers. Some of the misunderstanding could have had dire results.

Bluegrass Fairway? Yes! If!

W. H. DANIEL
Turfgrass Specialists, Department of Agronomy
Purdue University

As this is written many golf course fairways in the Midwest and elsewhere are being overseeded and renovated. Hot, humid weather, with near flood conditions in some areas, caused much damage from *Pythium, Helminthosporium* and *Fusarium roseum* diseases; then extended dry weather further weakened, killed and dried out fairway turf. From 20 to 90% of fairway cover was lost. And so renovation is a must in '65, but it's often desired in other years also.

Bluegrass in 1966? Yes! If! Now, this was not our earlier suggestion, so why the change? Because new chemicals and tools are available for grooming and protecting bluegrass, which opens the door to revised management intensity.

We now propose—bluegrass fairways cut at less than 1 inch and two or more times a week. Sounds good to golfers —yes! And, it's possible and practical if the following are done:

I. Protect from the *competition* of undesired weeds and grasses.
II. Protect from *drouth* by irrigation as needed.
III. Protect from excessive *damage* by preventive program.

I. PROTECT FROM COMPETITION

Sounds simple enough! The golfer and turf manager both want this, but WHAT AND HOW? Let's explore some preferred ways.

A. *Broadleaf weeds* are easy to control.

1. Once a year is adequate use of 2,4-D for preventing weeds from maturing. Wet spells in mid-summer favor dandelion germination and thus (when soil moisture is adequate) fall spraying is ideal, for it prevents any blossom next spring. Also, cool season bluegrass has maximum chance to fill in. Second choice would be mid-spring use, just as crabgrass is ready to germinate. 2,4-D may be mixed with most other chemicals, if desired.
2. Generally ½ to 1 pound of 2,4-D equivalent per acre as a spray application, or 1 - 2 pounds spread in dry fertilizer are standard rates.
3. Reseeding normally needs to be either 4 weeks before, or 2 weeks after use of 2,4-D to avoid damage to grass seedlings.

B. *Knotwood* and *clover, chickwood* and *yarrow*. Big news here! Since knotweed germinates in thin turf and compacted areas in eary spring and grows vigorously until frost, its selective removal greatly improves the chance for uniform turf.

1. Dicamba kills knotweed easily at all stages of growth. MCPP is quite effective on knotweed, excellent on clover and rather safe on bentgrass. For some years 2,4,5-T, or 2, 4, 5-TP have been used with limited success.

2. Rates of ½ pound of Dicamba, or ½ to 1 Dicamba acts quite slowly, but this is desired as slow kill minimizes discoloring of area.
3. Fall or winter use of Zytron, or a few other preventers may prevent knotweed seedling establishment in early spring. While toxic, they would prevent desired grass seedlings also.

C. *Crabgrass Competition* must be prevented. And, this applies to all summer annuals: foxtails, witchgrass, barnyard grass, wiregrass, sandburs and goosegrass. Why? These grasses grow vigorously in the summer and may become over 90% of turf area. After frost kills them they still occupy space. By mid-spring the next year's infestation starts from seed as warm weather rots the old grass. Anything to break this "competition" cycle —renovation, thinning, or summertime killing with chemicals may be useful, but *prevention* by pre-emergence is strongly recommended.

1. Technically crabgrass is easy to completely control. Just have *toxic concentrations* of *Surface rootzone* of seedlings *whenever they surface rootzone* of seedlings *whenever they may germinate.* Five points illustrate the complexity, understanding and tedium involved.
   a. *SELECTED PREVENTER*—each chemical varies in selectivity, release and residual.
   b. *SOLUBLE FRACTION* is that added, plus that remaining and currently dissolved.
   c. *TOXIC CONCENTRATION* is soluble fraction not leached downward, nor tied up in aggregates or soil.
   d. *SURFACE ROOTZONE* is more than just a crust—it is anywhere seedling roots may be contacted and thus damaged.
   e. *WHENEVER THEY GERMINATE*—crabgrass may germinate from early spring to mid-fall. Yet, two or three periods of germination may be key times. A period of wet July weather, or extra warm days of early April illustrate the diversity to be expected.
2. Goosegrass starts germination *later* than crabgrass. If crabgrass is controlled by a light and early application of chemical, then goosegrass (a worse competitor) may be a more serious problem. More chemical is required to control goosegrass than crabgrass.

   Generally split applications, such as two-thirds rate for early crabgrass, plus final one-third normal rate timed just as goosegrass is starting may improve goosegrass control. *Caution*: don't attempt to use more than 150% of recommended crabgrass rate in one season.
3. Facts on pre-emergers show that a program of initial and repeat use needs to be well understood. All of these would control crabgrass. Some would control goosegrass and a few seedlings of *Poa annua.*

1. *Kill old* Poa annua.
   a. Toxic rootzone concentrations of arsenic will drastically restrict P. *annua* and weakened plants may die. Meanwhile, competition is prevented.
   b. Sodium arsenite has been widely used at 1 to 2 pounds an acre in two to three applications. It is economical, fast and partially effective. (Then often new seed in soil germinates ahead of planted bluegrass).
   c. Paraquart, cacodylic acid, ammonium nitrate, any burning chemical will brown the turf area where used. Not recommended.
   d. Extensive mechanical vertical cutting and thinning can reduce competition of *P. annua* for short periods. (In spring as seedheads are being formed, etc.)
2. *Prevent new* Poa annua. Seed may germinate (from the multitude of seed near the soil surface(any time drouth, disease, or damage does not kill it. Germination may be expected August 1 to December 1, and March 1 to July 1. Fall rains and cool weather usually start germination of a dense cover.
   a. Rootzone toxicity with arsenic. Bluegrass will tolerate more arsenic than *P. annua.* So get selective control of existing *P. annua* and keep out *P. annua* by maintaining arsenic toxicity through this suggested program:
      (1) In winter dormant overseed blend of bluegrasses.
      (2) By mid-March apply 6 pounds of calcium arsenate for each 1,000 square feet uniformly over the area.
      (3) After a rain apply another 6 pounds of calcium arsenate for each 1,000 square feet for a total of 12 pounds. Be early, well ahead of crabgrass and goosegrass germination to control these. It takes a few days for soil solution of arsenic to become toxic.
      (4) In August overseed with blend of bluegrasses.
      (5) Use vertical thinning—have blade penetrate into soil (Aero-blade, Aero-thatch, Turf groomer, aerifiers, drill, etc.) to have good soil contact for seed in early fall.
      (6) As soon as fall seedlings have sprouted (September 15) apply 4 pounds of calcium arsenate for each 1,000 square feet of stunt *P. annua* during fall period.

(7) To have more arsenic effectiveness with minimum material, *avoid* or drastically reduce phosphorus use. It is a relative balance between phosphorus and arsenic. More soluble arsenic must be present in rootzone than soluble phosphorus. Bluegrass gets neccessary phosphorus at modest levels.

(8) Repeated annual maintenance arsenic dosages of 3 pounds for each 1,000 square feet each fall is necessary to keep toxicity.

(9) After toxicity is secured use little phosphorus and arsenic.

b. Preventing with Betasan, Pre-san. Bentgrass and bluegrass will survive and new seedling of *P. annua* may be prevented by early fall and early spring applications of Betasan. Old *P. annua* won't be affected and applications twice a year should be continuous.

c. Several preventers including Treflan, Dacthal, Bandane ,etc., may reduce seedlings, but these should be plot tested by each superintendent before large scale spring and fall use. Check with other local turf managers as well as turf specialists in your area.

d. A new chemical Tupersan, will prevent crabgrass, but not *P. annua* germination, while bluegrass may readily germinate. Without P. annua many turf areas will be thin and weak, so be advised that it takes time to get a cover of good turf. Advise more than just your greens committee that turf will be sparse and time is required to develop a new turf.

II. PROTECT FROM DROUTH BY IRRIGATION AS NEEDED

What bluegrass is favored by irrigation? I thought bluegrass was tolerant to drouth? Correct! But, close-cut bluegrass turf *must* be protected from drouth, loss of turf, excessive wear, or moisture stress. Remember the concept of this article is *protecting* bluegrass and having it as dense and as uniform as use conditions will permit. Once a leaf is produced it is needed to help produce energy for the next new leaf, vigorous rhizomes and strong feeder roots.

Over-watering, which causes saturated soils with inadequate oxygen, is discouraged. Also, wet leaves favor disease development, so if in doubt delay watering rather than use excess water for bluegrass can wilt. In contrast, bluegrass needs water more frequently and water is the rulee if in doubt.

Irrigation systems, both automatic and manual, have been installed in many golf courses in recent years. Wise use will be installed use, yet keep the bluegrass vigorous. Complete recharging the rootzone when irrigation is applied is preferred, but only as long as the grass is deep rooted.

Current research on anti-desiccants and reduced stoma openings by chemicals offer additional promise. Research and observations on these may further modify future management practices. Fortunately, bluegrass can, much better than bentgrass and *P. annua* wait for water.

III. PROTECT FROM EXCESSIVE DAMAGE

What causes damage? Feet, clubs carts tractors, mowers, grubs, sodwebworms, diseases; in fact, many things.

A. If it's wear try to spread the traffic. If it's carts plan for paths where they congregate. If turf is wilting don't mow. Some courses need renovation to reduce concentrated wear around traps, etc. Sodding of worn areas may be the best way to get that bluegrass turf started.

B. Caution and good management in using chemicals to avoid burn or weakening turf is to be expected. Avoid the loss of green leaves. Develop a philosophy of how little can do the job. Most chemicals are to be used as light as possible.

C. Protect against disease. Growing turf always has some disease, but should be protected from the severe attacks. Although a genetic of varietal resistance to disease is the ultimate, fungicides are needed for protection on bluegrasses now available.

1. Leafspot—*Helminthosporium sativium* and *vagans,* etc. plan 2 to 3 applications as preventive program at 7 - 14 day intervals, starting in mid-spring. Consider Dyrene, PMA, Zineb, Maneb, Acti-dione, M-45. But, check with local supplier and get local recommendations.
2. Melting-out now called *Fusarium roseum* but earlier called *Curvularia,* is followed by *warm soils* and humid weather. It is difficult to control, but a major problem in bluegrass. Disease affects the leaves, crown and rhizomes, causing death in gradually enlarging circles when both soil and air temperatures are high. Circles of active disease may have few green rhizomes emerge in center of rings which grew from yet unaffected parameter. Dead areas gradually recover in fall and by late spring may be completely filled in. Disease tends to occur in same spots the next year. Adequate fungicide controls are uncertain in 1966. Several are being tried for repeat use in preventive program.
3. Fairy ring. Its disfiguring affects the uniformity of the area. Extra aerification, fertilizing and watering should be helpful in reducing surface damage to bluegrass. Soil wetting agents may improve moisture penetration and reduce competition effects.
4. Dollarspot, brownpatch, rust, even snowmold, on bluegrass may be severe for short periods. Playability may be improved and disease cause only limited damage if a fungicide control program is followed.

FROM

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TROLLING

Pollen Grains And Plant History

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Pollen grains are extremely small reproductive structures contained in the anthers, or male elements, of seed plants. They are transferred to the female reproductive body mainly by wind, water and insects.

Dispersal by wind is a haphazard and inefficient method of pollination and it generally demands a vast supply of pollen. In fact, some wind-pollinated plants have as many as 10,000 pollen grains per stamen in flowers with many stamens. Only a minute amount of pollen completes its function in the reproductive cycle of the plant. Pollen that does not happen to land on the female organ of a flower eventually falls and becomes a part of the accumulation of sediments on the earth's surface.

Pollen grains have many different shapes and external features. Because the outer layer, or exine, of most pollen is not easily dissolved, these grains have been preserved without damage in peats and sediments throughout the many geological ages. Present-day pollen grains can be treated chemically so that only the exine remains and this outer shell wall can be compared with fossil pollen. It is easy to imagine the importance of these fossil remains in tracing the history of plants throughout the different geological ages.

Until 1950, little was known about the types and distribution of air-borne pollen in Canada. Interest developed at this time largely because of a very practical need: to find out what pollen types caused hay fever and when and where this pollen was most abundant. Many interesting facts came to light.

The distances to which pollen grains may be blown depend on the nature of the grains, the particular spot where the plants may be growing and the weather at the time the pollen is released into the air. Ragweed plants, chief bane of hay-fever sufferers, have light pollen grains, which are known to travel as far as 400 miles from source. The heaviest concentration of ragweed pollen is in the southern parts of Ontario and Quebec. Since 1951 current information on ragweed pollen has been published from time to time in the booklet entitled "Canadian Havens from Hay Fever".

Comprehensive studies of modern ragweeds, their pollen (both modern and fossil) and the use of geological techniques have led to other interesting findings. We now know more about the history and migration of these plants in Canada. It was found that, about 6,000 years ago, ragweeds existed further northward in Ontario than they do now. It is only within the last 200 years that ragweeds have again become abundant. This increase coincides with recent developments by newcomers to America, who by cutting trees and forming fields for agriculture also provided suitable habitats for ragweed.

The pollen of plantain, consisting of about 16 species in Canada, is now being studied. This may lead to paleobotanical discoveries perhaps similar to those found in ragweeds. Eventually, with a better understanding of all our pollen types and microfossil material, we will be able to write a story on the history of our Canadian flora in postglacial time.

Artists In Weaving

Spiders, of which there are more than 20,000 different species, are remarkable creatures ingeniously equipped by Mother Nature. From its spinnerets on the underside of the abdomen, the spider ejects a fluid which, immediately on contact with the air, solidifies to form an inconceivably fine silk thread. These threads are 1,400 times thinner than a human hair. The spider uses them for numerous purposes — for running, descending, jumping, flying, anchoring. And for weaving many types of webs — sheet webs, tube webs, reticular webs, funnel webs, geometric orb webs. One aquatic spider species weaves its tent under water in the shape of a bell. The silk threads are also used for enswathing insects captured by the spider in its snare. Some spiders make envelopes of tough silk for their brood to stay inside until the spiderlings become capable of taking care of themselves. For the most part, spiders are generally beneficial to man by feeding on insects. But in the home they are an abominable nuisance, just like the rest of the annoying household-inhabiting pests which we wish to be rid of at all costs.