January 1988

LAWN INSTITUTE

Harvests

Volume 34 Number 4

THE HARVEST MIX

We are late again. January Harvests will be mailed in early March. Word processor and printer and copier, all essential in getting Harvests camera ready for tabloid printing, broke down in January. Sufficient repairs have been made to get this issue out to you but with some loss in printing quality.

The thirty two Threshing the Journal research reports each have important new information presented in eight sections: Growth Regulator Research, Research Technology, Tissue Culture, Golf Putting Green, Heat/Mowing/Drought Stress, Warm Season Grasses, Soil Microbiological Research, and Water Use and Management. This organization made for an interesting review of research papers. We hope that you find it of value.

THRESHING THE JOURNALS

(Published research results)

Growth Regulator Research

RESPONSE OF A RED FESCUE-KENTUCKY BLUEGRASS TURF TO THREE CONSECUTIVE ANNUAL APPLICATIONS OF AMIDOCHLOR, MEFLUIDIDE AND ETHEPHON

Prasanta C Bhowmik
Weed Science
Volume 35 Number 1
Pages 95-98
1987

Suppressed seedhead emergence and limited above ground growth of turfgrasses have resulted from applications of various growth-regulating compounds. These materials have been useful mostly in low-maintenance turfgrass areas.

Inhibition of root and rhizome development in addition to shoot growth have also resulted from use of growth retardants. Limited information on the effects of long-term use of growth retardants on root recuperative potential is available.

The objectives of this study at The University of Massachusetts were to:

- evaluate the effects of amidochlor, mefluidide and ethephon applied annually for three consecutive years on a red fescue-Kentucky bluegrass turf;
- evaluate the root recuperative potential of turf subjected to long-term usage of amidochlor.

The following results were noteworthy:

- Amidochlor and mefluidide treatments injured turfgrass [11 to 64 percent] four weeks after application. Turfgrass recovered after eight weeks.
- Amidochlor at the medium and high rate and mefluidide suppressed [75 to 100 percent] seedhead development. Ethephon was ineffective.
- Turfgrass recovered normally each spring after amidochlor treatments with no delay in spring green-up.
- Root length, root weight and root:shoot weight ratio of the plugs from the greenhouse study were unaffected by three consecutive annual applications of amidochlor, mefluidide and ethephon.
- One annual spring application of amidochlor, mefluidide and ethephon for three consecutive years caused no adverse effects that would limit their use on red fescue-Kentucky bluegrass turf.

GROWTH RETARDATION OF BERMUDAGRASS WITH METSULFURON METHYL AND SULFOMETURON METHYL

J N Rogers III, E M Miller & J W King
Agronomy Journal
Volume 79 Number 2
Pages 225-229
1987

Bermudagrass used as a turfgrass througnout the southern United States has a long growing season. To maintain maximum aesthetic value bermudagrass lawns should be cut at least once a week. Up to 20 mowings can be required per growing season. One way to minimize mowing requirements is to use plant growth regulators.

The objectives of this research at The University of Arkansas were:

- to find optimum times and rates of application for metsulfuron methyl [MSM] and sulfometuron methyl [SMM] plus MSM to reduce mowing without adversely affecting the aesthetic value of the bermudagrass turf;

- to determine whether nitrogen fertilizer can offset any adverse effects of the chemicals;

- to determine what effects irrigation would have on the treated bermudagrass turf.

The following results are of interest.

- MSM alone produced much less growth retardation than a combination of MSM and SMM.

- The combination of rates 1/2 plus 1/2 and 1 plus 1 ounce per acre [35 plus 35 and 70 plus 70 grams per hectare] and higher produced good growth suppression for 6 to 8 weeks followed by a flush of growth, but excessive discoloration injury especially when repeated at 5-week intervals.

- The combination applied at 1/8 plus 1/8 on May 24, 1/4 plus 1/4 on June 28 and 1/2 plus 1/2 ounce per acre on August 2 [8.8 plus 8.8 on May 24, 17.5 plus 17.5 on June 28 and 35 plus 35 grams per hectare on August 2] provided excellent growth retardation [70 percent mowing reduction] all season with only very slight injury.

- The influence of irrigation and nitrogen fertilization was found to be minimal on effectiveness of PGRs.

- MSM plus SMM on bermudagrass can be effective in reducing growth of the turf if applied at proper rates and times. Early applications on bermudagrass have a more dramatic effect on clipping weight, quality and height than later applications. As bermudagrass matures, the injury becomes less severe and higher rates can be utilized.

ZOYSIAGRASS COMPETITION IN TWO COOL-SEASON TURFGRASSES TREATED WITH PLANT GROWTH REGULATORS

J D Fry and P H Dernoeden
HortScience
Volume 21 Number 3
Pages 464-466
1986

Poor summer performance of cool-season turfgrasses in the transition zone has created a need to use warm-season grasses whenever possible. Meyer zoysiagrass is a warm season grass possessing excellent winter hardiness and summer performance. One factor limiting zoysiagrass use is its slow establishment rate. When planting plugs into bare soil, 2 or 3 years may be required for complete zoysiagrass coverage. Bare ground and subsequent weed encroachment can reduce the aesthetic quality and increase the establishment period of zoysiagrass. Plugging zoysiagrass into an existing, cool season turf helps to maintain turfgrass quality, but time required for establishment is prolonged by competition from the cool-season species. The use of plant growth regulators has been suggested as a means of reducing competition from cool-season grasses during zoysiagrass establishment. This research at The Unversity of Maryland was conducted to determine if the rate of Meyer zoysiagrass establishment and spread could be enhanced when plugs were introduced into plant growth regulator treated Kentucky bluegrass and perennial ryegrass turfs. Three year old stands of Yorktown II perennial ryegrass and a blend of Merion, Sydsport and Vantage Kentucky bluegrass grown on a silt loam soil were used. Flurprimidol, mefluidide, amidochlor and ethephon were evaluated as plant growth regulators.

Results were recorded as follows:

- During the first growing season, plant growth regulator treatment made little difference in zoysiagrass spread.

- Zoysiagrass coverage in perennial ryegrass treated with mefluidide [57 percent] or amidochlor [63 percent] was greater than in ryegrass treated with ethephon [47 percent] or the untreated control [48 percent] by the end of the second year.

- Enhanced zoysiagrass spread in perennial ryegrass treated with mefluidide and amidochlor was attributed to stand thinning resulting from plant growth regulator phytotoxicity and environmental stress in the first year.

- Zoysiagrass coverage in Kentucky bluegrass was greatest in mefluidide treated plots, but the increase over the control was only 6 percent.

- Flurprimidol slowed the establishment of zoysiagrass in both cool season turfs.

- These studies have shown that the rate of zoysiagrass coverage in mature perennial ryegrass, but not Kentucky bluegrass, can be encouraged by the end of the second growing season with mefluidide and amidochlor. Use of these plant growth regulators, however, resulted in unacceptable turf quality which may negate their use in intensively managed turf. This reduction in quality; however, generally would be preferred to plugging into bare ground in many situations.

EFFECTS OF AMIDOCHLOR ON SHOOT GROWTH AND SEEDHEAD SUPPRESSION IN COOL-SEASON TURFGRASSES

P C Bhowmik
HortScience
Volume 22 Number 1
Pages 63-65
1987

Success with plant-growth-regulating compounds in retarding turfgrass growth has been limited. Many compounds have been reported to inhibit seedhead emergence and to reduce growth of turfgrasses. These compounds have proven to be useful in low maintenance turfgrass areas, but most growth retardants have limited or no use in high maintenance turfgrass areas. Factors that have limited use of plant growth regulators in turf are phytotoxicity and lack of uniform responses among species.

This research at The University of Massachusetts was conducted on a mixed stand of Kentucky bluegrass and red fescue. The objectives were to:

- evaluate the effectiveness of amidochlor in relation to seedhead suppression and shoot growth reduction;

- determine the extent of turf injury.

The following results are reported:

- Amidochlor applied at 2 and 3 pounds active ingredient per acre [2.24 and 3.36 kilograms active ingredient per hectare] provided excellent [90 percent or better] seedhead suppression of Baron Kentucky bluegrass and 80 to 90 percent seedhead suppression for Pennlawn red fescue turf.

- Although amidochlor provided excellent shoot growth retardation up to 42 days after treatment, the greatest shoot growth reduction was noted 28 days after treatment.

- Turfgrass injury was within acceptable limits over the entire study except during the 28 day period when unacceptable injury [32 to 64 percent] was noted.

- After 28 days the quality of turf improved.

- Maximum shoot growth reduction [85 to 93 percent] as measured by fresh clipping weight occurred during the initial 28 day period and thereafter declined, followed by a stimulation of turfgrass growth 56 days after treatment.

- In these tests, amidochlor demonstrated potential for use as a growth retardant for cool season grasses.

THRESHING THE JOURNALS CONTINUED

EFFECTS OF FOUR GROWTH REGULATORS ON PHOTOSYNTHATE PARTITIONING IN MAJESTIC KENTUCKY BLUEGRASS

K V Hanson and B E Branham
Crop Science
Volume 27 Number 6
Pages 1257-1260
1987

Recent advances in the field of plant growth regulation indicate the potential for use of these chemicals in the turfgrass industry. Understanding the physiological changes induced by plant growth regulators is essential for proper use of the compounds as a turfgrass management tool. Growth stimulation or suppression of various plant organs through plant growth regulator application could improve turf characteristics such as water use, drought tolerance, winter hardiness and sod establishment.

This research at Michigan State University tests the hypothesis that application of growth retardants on Majestic Kentucky bluegrass alters the normal photosynthate partitioning patterns among competing vegetative sinks such as immature leaves, axillary shoots, crowns and roots. Limit, Cutless, mefluidide and paclobutrazol were evaluated.

The following results should be noted:

- Limit tended to cause an increase in photosynthate accumulation in the crown with 63 percent of the labeled carbon found in the crown at 4 weeks after application compared to 17 percent for the control plants.
- Mefluidide caused a similar result with 39 percent of the labeled carbon in the crown at week 4.
- Paclobutrazol caused a decline in photosynthate partitioning to the roots at week 4 with 20 percent versus 49 percent for the control.
- Cutless exhibited a similar response with 10 percent accumulation in the roots versus 27 percent for the control at week 4.
- Mefluidide increased translocation to the roots when compared to the control plant at weeks 2 and 4 [39 percent versus 21 percent and 51 percent versus 27 percent respectively].
- Results indicate that while all four growth regulators suppress top growth, each alters partitioning patterns differently among above and below ground organs. This is important in understanding turf response to plant growth regulator application in the field.

'If a man will begin with certainties,

he shall end in doubts; but if he will be

content to begin with doubts,

he shall end in certainties'

Francis Bacon

Research Technology

ISOLATED PLOT TECHNIQUE FOR STUDYING SEEDLING GROWTH OF TURFGRASSES

A D Brede
Agronomy Journal
Volume 79 Number 1
Pages 5-7
1987

The study of field survival and seedling growth of turfgrasses under field conditions is complicated by many factors. Unexpected weather events can disrupt the most carefully planned experiments. The results of these disruptions can be in the form of increased experimental error or a completely destroyed experiment.

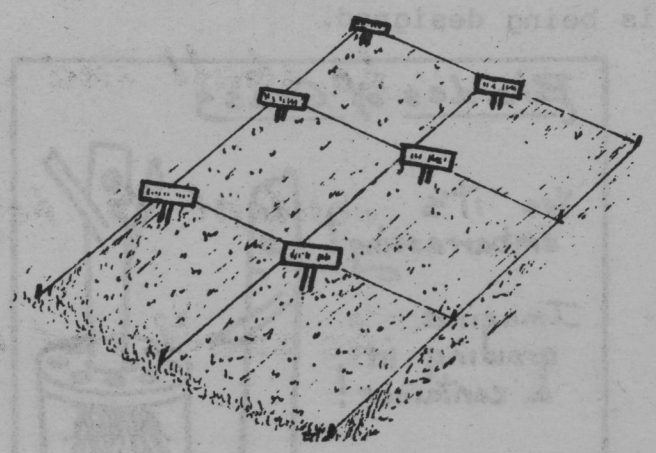
Seedling studies are also complicated by sampling error. The traditional method of studying turf seedlings has been to establish a solid stand of grass and then subsample the plots periodically with a soil probe. Plants in the resulting plugs are then counted and measured as needed by the researcher. The process of sampling a large population would add a sampling error that would be absent if individual plants could be periodically re-examined without the need for sampling.

Information on field survival and seedling growth is needed in turfgrass science. Laboratory germination tests are often a poor predictor of seed performance under field conditions. Depending on the species, there may be as great as 50 percent discrepancy between laboratory and field results.

The purpose of this research conducted at Oklahoma State University was to develop and evaluate a method for studying turf seedlings in the field that could be utilized without the disruptive effects of nature.

The following results are of interest.

- A technique was developed for affixing turf seeds to a seedbed in the field for the purpose of monitoring field survival and growth of seedlings over time.
- Isolated plots of turfgrass seed, 1 inch in diameter [25 millimeters] and spaced 3 inches apart [75 millimeters] on a seedbed, were held in place with a liquid latex-based mulch and a non-woven fabric mulch.
- Seed displacement from rain-washing was held below 0.1 percent with this technique.
- The latex/fabric mulches have the same effect on seedling growth as do conventional mulches of straw or wood fiber.
- Field survival [percent germination] was accurately assessed using this technique without the added variance associated with subsampling of solid stands. Field survival of perennial ryegrass seedlings was measured with 9 percent variability compared with 35 to 51 percent variability with traditional sampling-probe methods.
- Values of field survival obtained using isolated plots corresponded closely with values found in solid stands but with lesser variability.
- Plant growth parameters [leaves, shoots, roots] in isolated plots and solid stands diverged over time; interspecific competition occurred sooner in solid stands than in isolated plots.
- Care must be taken when extrapolating seedling growth results found using this technique to solid stand conditions since the seedlings are essentially space planted.



A MODULAR ASSIMILATION CHAMBER FOR CARBON EXCHANGE RATE MEASUREMENTS OF TURF

S W Akers and R L Green
HortScience
Volume 22 Number 1
Pages 151-153
1987

Research at Oklahoma State University has had the objective of developing and standardizing a modular assimilation chamber for estimating carbon dioxide exchange rates of small turf swards. The modular assimilation chamber has been designed for rapid determination of relative differences of carbon dioxide exchange rates between treatments in a large number of replications. This chamber can be used either in the laboratory or greenhouse as part of an open or closed system.

Results of this research include:

- Growth of Enoble Kentucky bluegrass and Houndog turf type tall fescue in Cone-tainers with attached base plates under greenhouse conditions.
- A chamber top was sealed to the base plate to complete the modular assimilation chamber.
- This was then used under laboratory conditions to measure carbon dioxide exchange rate by an open differential carbon dioxide method or by closed chamber-syringe sampling methods.
- The two-module concept provides a relatively simple tool for making rapid measurements.
- However, the consistently low carbon dioxide exchange rate values obtained from closed-system measurements indicate that an increase in the current chamber volume is needed to increase the reservoir of carbon dioxide. Since inadequate mixing also could be part of the problem, a second generation chamber is being designed.

AN AUTOMATED APPARATUS FOR MEASURING ROOT LENGTH

C E Barnett, R A White, A M Petrovic & G L Good
HortScience
Volume 22 Number 1
Pages 140-144
1987

Research at Cornell University has had the objective of developing and evaluating methods for measuring root length. One system for estimating root length involves superimposing lines over a surface on which root segments have been placed, to enable the detection of root-line intersections. The number of root and line intersections increases linearly with root length and can thus be used for estimating root length. However, regardless of the method used, these types of estimations are tedious to make, time-consuming and cause a considerable amount of eye strain.

Results of interest from this research include:

- Root lengths of an adventitious root system from creeping bentgrass and of a woody plant fiberous root system from Hetz juniper were estimated using an automated method employing a video camera and an area/length meter to count scanning line and root intersections. A grid method of root length estimation was used for comparison.
- Test results were much closer to the actual root length, in the ranges evaluated, than the estimates from the grid method.
- Although the estimation of root length by the automated method did not always exhibit a 1:1 relationship with the actual measurement, the accuracy demonstrated was considered acceptable for measurement of creeping bentgrass and Hetz juniper root systems in the ranges of length evaluated.
- By adjusting the camera focus and f-stop, the light level, and the threshold and window size of the area/length meter, the best possible resolution of the object was achieved and an accurate count on the scanning line-object intersections made.

KENTUCKY BLUEGRASS AUTOMATIC HYBRIDIZATION APPARATUS

T P Riordan, R C Shearman, J E Watkins &
J P Behling
Crop Science
Volume 28 Number 1
Pages 183-185
1988

Kentucky bluegrass is a facultative apomict where there is a range in type of reproduction from almost complete apomixis to complete sexuality. Because many of the first turf-type cultivars were highly apomictic, improvements through conventional intraspecific hybridization were not successful. This may have been due to the lack of knowledge that anthesis occurs mostly during the nighttime period between 10:00 PM and 5:00 AM; that pollen needs to be applied very early, prior to the development of the proembryo; and that there are environmental factors which enhance sexual reproduction of apomictic plants.

Now, programs using intraspecific hybridization where hybrids are produced in reasonable numbers can be most successful in developing cultivars adapted to the cool humid regions of the world. Conventional hybridization techniques have been used to transfer pollen from the selected male parent to the selected female plant.

Research at The University of Nebraska has been concerned with the development and standardization of apparatus built from easily obtained materials and designed to allow:

- suspension of one plant above another;
- environmental modification of the lower plant;
- control of pollen dispersal;
- a moderately large number of different crosses to be attempted;
- easy set-up and dependability.

Results of these investigations indicate that when compared with hand pollination, this automatic hybridization apparatus gave a lower percentage of hybrids, but was more efficient in total number of hybrid plants produced.

AN INDIRECT METHOD FOR ESTIMATING TURFGRASS LEAF AREA INDEX

D M Kopec, J M Norman, R C Shearman &
M P Peterson
Crop Science
Volume 27 Number 6
Pages 1298-1301
1987

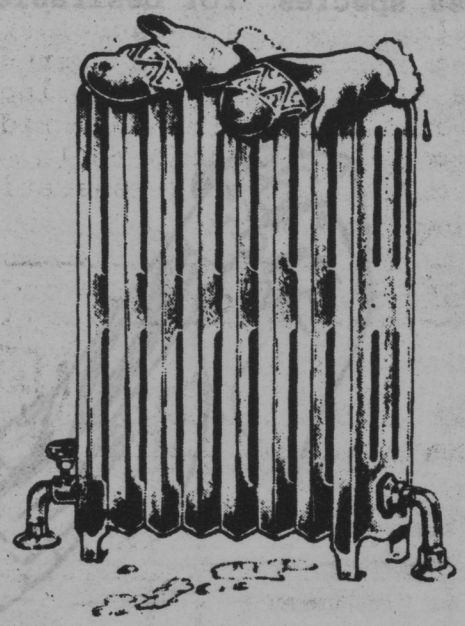
Turfgrasses vary in canopy structure, leaf area and growth habit due to genetics, environmental conditions and cultural practices. Leaf area index can be used in the assessment of canopy density, plant growth characteristics and physiological responses.

Turfgrass leaf area index determination is tedious, time consuming, requires considerable labor and is usually destructive in terms of the plant material examined.

Research at The University of Nebraska has been concerned with the development and evaluation of a system to measure leaf area index that is nondestructive.

The following results have been reported.

- Leaf area index has been estimated indirectly based on canopy attenuation of light that is transmitted from a source placed at the base of the turf canopy.
- This method is essentially the reverse of a procedure used for measuring sunfleck distribution.
- Leaf area index determinations have been made without destroying experimental units.
- This nondestructive method allows turfgrass canopy growth estimation over time using the same experimental units.



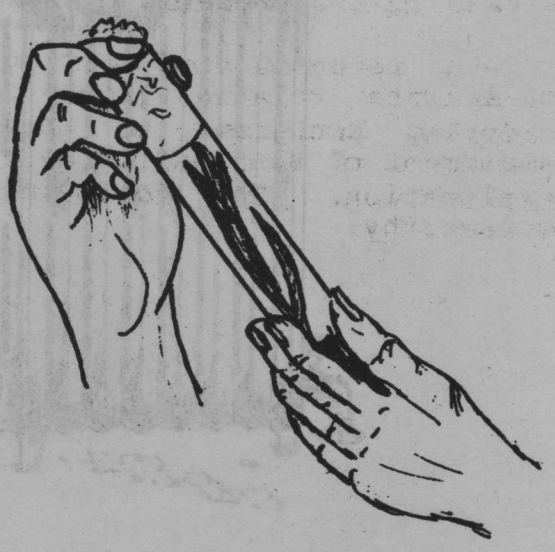
Tissue Culture

REGENERATION OF BERMUDAGRASS CULTIVARS AND EVIDENCE OF SOMATIC EMBRYOGENESIS

B J Ahn, F H Huang & J W King
Crop Science
Volume 27 Number 3
Pages 594-597
1987

Somatic embryogenesis provides a means for the regeneration of turfgrass species. Cultures are obtained from either young embryos, whole caryopses or immature inflorescences. Often the common 2,4-dichlorophyenoxy acetic acid is used as an auxin source. The mode of plant regeneration can be determined by scanning electron microscopy and histology. The development and standardization of these methods are necessary in order to bring about improved bermudagrass selections.

From research to date, plantlets have been regenerated through somatic embryogenesis in three improved cultivars of bermudagrass. Evidence of somatic embryogenesis has been confirmed by histological observation. Compact cell clumps in suspension culture differentiated into globular embryoids that matured and germinated uniformly into numerous plantlets. These methods will be useful in genetically improving turf-type bermudagrass species for desirable agronomic traits.



IMPROVEMENT IN CALLUS GROWTH AND PLANTLET FORMATION IN CREEPING BENTGRASS

F C Blanche, J V Krans & G E Coats
Crop Science
Volume 26 Number 6
Pages 1245-1248
1986

Penncross creeping bentgrass is known to undergo plantlet formation from somatic callus. Research at Mississippi State University has a long term goal of improving the salt and heat tolerance of Penncross. Once accomplished, this would result in a new cultivar better suited to the summer stress environment of the southern states. New research techniques must be developed and standardized in order to make these long term accomplishments. Good progress is being made through this research.

Golf Putting Green

BENTGRASS AND BERMUDAGRASS PUTTING GREEN TURF TOLERANCE TO POSTEMERGENCE HERBICIDES

J M Higgins, L B McCarty, T Whitwell & L C Miller
Hort Science
Volume 22 Number 2
Pages 248-250
1987

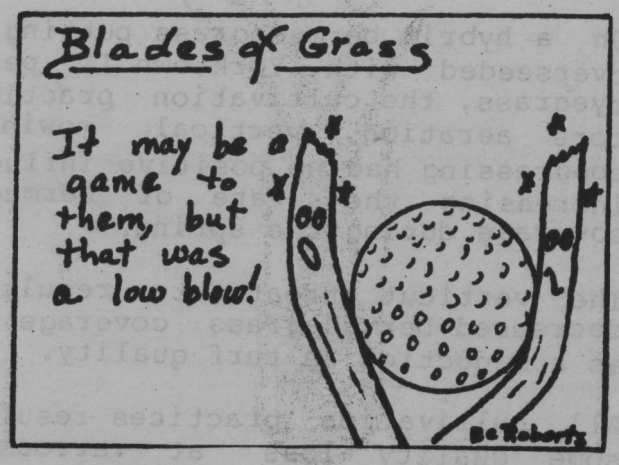
Research with preemergence and postemergence herbicides has demonstrated inconsistent performance, poor turfgrass tolerance or both on Penncross creeping bentgrass and on Tifgreen bermudagrass.

The objectives of this Clemson University research were to determine the tolerance of Penncross creeping bentgrass and Tifgreen II bermudagrass to single applications of the following six postemergence herbicides:

- sethoxydim
- fluazifop
- haloxyfop
- xylafop
- fenoxaprop
- poppenate.

These herbicides were applied in June to bentgrass and in June and August to bermudagrass. Bentgrass and bermudagrass had unacceptable color and density through 28 days after treatment with all herbicides.

Both species showed tolerance at 28 days after treatment to fenoxaprop at the low and medium rate but turf density was reduced compared to the untreated check. Bermudagrass quality at 42 and 49 days after treatment was not different from the untreated check with low and medium rates of fenoxaprop. All other herbicides reduced bentgrass and bermudagrass quality to unacceptable levels.



GROWTH OF CREEPING BENTGRASS ON A NEW MEDIUM FOR TURFGRASS GROWTH: CLINOPTILOLITE ZEOLITE - AMENDED SAND

G A Ferguson, I L Pepper & W R Kneebone
Agronomy Journal
Volume 78 Number 6
Pages 1095-1098
1986

Modern golf greens are constructed on man-made media built primarily of sand. The highly permeable sands resist compaction and have adequate aeration, infiltration and percolation but have poor nutrient and water retention. Typically, organic residues are added to sand greens to help hold nutrients and water. Nitrogen is the element most often applied to bentgrass. Nitrogen applied as the ammonium ion [+] is retained on the surface cation exchange sites of organic amendments where it is quickly converted microbially to nitrate [-]. Nitrate is subsequently subject to leaching and denitrification, thus decreasing fertilizer-nitrogen use efficiency. Organic amendments also decompose in the soil, thus reducing their benefits with time.

Clinoptilolite zeolite is a natural silicate mineral with a high degree of internal tunneling and internal cation exchange capacity. Clinoptilolite is available as sand-sized particles, has good drainage and water holding characteristics and yet has a cation exchange capacity of 200 centimole per kilogram [milliequivalents per 100 grams]. Thus Zeolite has desirable physical properties associated with sand and favorable chemical characteristics associated with clay. Zeolite also has a high affinity for the ammonium ion [+] and the ability to hold these ions internally where they are physically protected from nitrifying bacteria. Hence, nitrification rates are slowed in the presence of Zeolite.

This research conducted at the University of Arizona related growth and quality of creeping bentgrass to ranges of Zeolite amendment of sand and three rates of nitrogen application. The following results are noteworthy:

- Penncross creeping bentgrass germination and establishment were increased by amendment of sand with 5 or 10 percent Zeolite.
- The 10 percent Zeolite treatment initially did not increase turf quality because of the initial high sodium content of the Zeolite. With time, this ceases to be a problem.
- In time, high nitrogen fertilization reduced turf quality because of high nitrogen-induced iron chlorosis.
- Clipping yields from seven harvests and nitrogen-use efficiency increased significantly with Zeolite.
- Zeolite also increased both root growth as indicated by soil organic carbon and shoot-clipping phosphorus content. Excess nitrogen decreased root growth.
- Phosphorus uptake decreased with nitrogen during the hot summer months but increased when temperatures became cooler.

These results indicate at Zeolite has potential as an ingredient of new media for growth of turfgrass. These media show good physical and chemical properties and appear to be ideally suited for golf-green construction.

INFLUENCE OF AERATION, TOPDRESSING,AND VERTICAL MOWING ON OVERSEEDED BERMUDAGRASS PUTTING GREEN TURF

A R Mazur and D F Wagner
HortScience
Volume 22 Number 6
Pages 1276-1278
1987

Bermudagrass putting greens in the southeastern United States are overseeded to provide green color and uniform surfaces to prevent attrition damage from equipment and foot traffic, and to minimize the disruptive invasion of weeds during winter dormancy. Greens normally are overseeded with cool-season grasses in the fall several weeks prior to frost. The spring transition period from cool-season to warm-season grasses is particularly troublesome. Competition from cool-season grasses is known to delay emergence of bermudagrass in the spring. A substantial loss in turf quality results when there is a rapid decline in cool-season grasses and delayed emergence of bermudagrass. Several cultural practices have been reported to hasten or delay spring transition. Vertical mowing in two directions weekly and core aeration were thought to improve conditions for bermudagrass emergence. Now, high-intensity vertical mowing has been associated with slowed bermudagrass emergence. The development of drought and disease-tolerant cool-season turfgrasses for overseeding has magnified the problems associated with spring transition.

The objective of this research at Clemson University has been to determine the effect of core aeration, vertical mowing or topdressing on the rate of bermudagrass emergence and quality of putting green turf during the spring transition. The following results are important.

- On a hybrid bermudagrass putting green overseeded with Yorktown II perennial ryegrass, the cultivation practices of core aeration, vertical mowing and topdressing had no positive influence on increasing the rate of bermudagrass coverage during the spring.
- The verticut treatment resulted in decreased bermudagrass coverage as well as a reduction in turf quality.
- All cultivation practices resulted in some quality loss at various times during the spring transition period compared to the control.

TOLERANCE OF BENTGRASS TO DATES AND FREQUENCY OF PREEMERGENCE HERBICIDE TREATMENTS

B J Johnson
Agronomy Journal
Volume 79 Number 6
Pages 992-996
1987

The upper south is generally considered the lower region of the transition zone between cool and warm-season grasses. Creeping bentgrass is widely grown in this region. In recent years, bentgrass use for golf greens has expanded into the Southeast. Turf managers have been willing to deal with the high temperature, high humidity and intensive disease stresses characteristic of this region. In order to maintain high quality bentgrass greens, use of herbicides for weed control are often necessary.

The purpose of this research at The University of Georgia was to determine the tolerance of Penncross creeping bentgrass greens to herbicides applied on different dates and at different frequencies. Artificial rootzone greens at two separate locations were used to evaluate response to applications of:

- oxadiazon
- bensulide plus oxadiazon
- benefin plus oxadiazon.

Results of these tests were as follows:

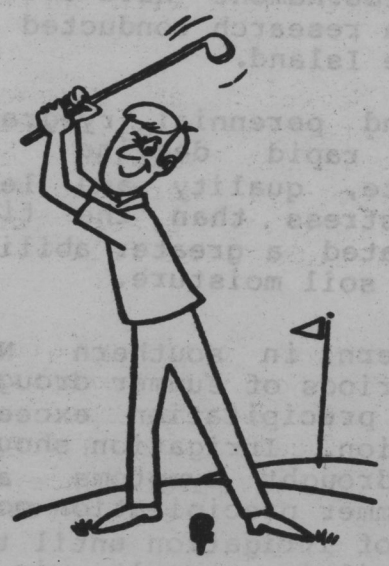
- All three herbicides caused slight to moderate bentgrass shoot discoloration, but the grass fully recovered with no stand loss during the year of treatment.

- Herbicides applied in early March did not discolor bentgrass as much as they did when applied in early April.

- There was no advantage in bentgrass tolerance with split applications at reduced rates when compared to a full single rate. In several instances, discoloration was higher from split applications [March and May or April and June] at reduced rates for oxadiazon and benefin plus oxadiazon than when the chemicals were applied as a single full rate in March or April.

- Oxadiazon alone or in combination with either bensulide or benefin can be used on Penncross creeping bentgrass if some foliage discoloration can be tolerated. Some injury may occur regardless of location and time of year.

HISTORY AND WARM WEATHER MAKE GOLF POPULAR



Many think of Scotland as the golf capital of civilization and it is true that the history of the game of golf stems from this country. Scotland has 30,405 square miles with a population of 5,117,146. There are 390 golf courses in Scotland.

Florida is 58,560 square miles [not quite two times the size of Scotland] with a population of 10,680,000 [about two times that of Scotland]. This state boasts of 796 golf courses, second only in the United States to California which has 829 courses]. Proportionally Florida supplies as many golf courses per capita and per square mile as Scotland.

Tourism swells the numbers who play on the links in both Scotland and Florida. The historic identification of golf with Scotland makes this a golf attraction. Florida's weather is a big factor in the popularity of the game there.

Piedmont Airlines F88

Heat / Mowing / Drought Stress

INFLUENCE OF PRESTRESS ENVIRONMENT ON ANNUAL BLUEGRASS HEAT TOLERANCE

D L Martin and D J Wehner
Crop Science
Volume 27 Number 3
Pages 579-585
1987

Annual bluegrass characteristically has reduced quality during periods of high temperature. In order to improve summer quality of annual bluegrass, heat tolerance of selections has been evaluated along with cultural practices that may promote stress tolerance. Variability in stress tolerance of annual bluegrass does not appear to be very predictable. Of the other factors known to influence heat tolerance, the turfgrass manager has control over cultural practices, such as irrigation, fertilization and mowing.

The objective of this research at The University of Illinois was to monitor the heat tolerance of field grown annual bluegrass over the growing season and to examine the effect of two different soil moisture regimes on heat tolerance, color, quality and rooting depth. Annual bluegrass grown in a silty clay loam was sampled on 23 dates over 2 growing seasons and exposed in the laboratory to high temperatures. The dry weight of stressed plants expressed as a percentage of the controls was used as a measure of heat tolerance. The results indicated only a trend for annual bluegrass maintained under moist soil conditions to be less heat tolerant than under dry conditions. No differences in heat tolerance were found due to rooting depth. Because of reduced turfgrass quality with dry soil conditions, there seemsto be little potential for increasing heat tolerance of annual bluegrass through irrigation management.

COOL-SEASON TURFGRASS RESPONSES TO DROUGHT STRESS

L J Aronson, A J Gold & R J Hull
Crop Science
Volume 27 Number 6
Pages 1261-1266
1987

As the supply of water available for turf irrigation becomes limited, the importance of water-efficient and drought-tolerant turfgrasses increases. In order to establish the critical soil water potential at which cool season turfgrasses begin to experience drought stress, the growth and quality responses of Baron Kentucky bluegrass, Yorktown II perennial ryegrass, Jamestown Chewings fescue and Tournament hard fescue have been determined in research conducted at The University of Rhode Island.

Kentucky bluegrass and perennial ryegrass exhibited a more rapid decline in evapotranspiration rate, quality and leaf growth under moisture stress than the fine fescues which demonstrated a greater ability to thrive with limited soil moisture.

The rainfall pattern in southern New England can produce periods of summer drought even though annual precipitation exceeds annual evapotranspiration. Irrigation should be withheld until drought symptoms are imminent to utilize summer precipitation most efficiently. A delay of irrigation until the onset of temporary wilting results in a significant decrease in water consumption by turf. Clear indicators of impending drought stress must be identified to minimize unnecessary application of irrigation water. In addition, grass species need to be selected which can maintain acceptable visual quality during lengthy rain-free periods.

KENTUCKY BLUEGRASS PHOTOSYNTHATE PARTITIONING FOLLOWING SCHEDULED MOWING

R J Hull
Journal American Society for Horticultural Science
Volume 112 Number 5
Pages 829-834
1987

Photosynthetically fixed radioactive carbon dioxide is partitioned within turfgrass plants in patterns that are influenced by the stage of plant development, time of day, nutritional status and mowing regime. During midday, photoassimilate translocation from blades to leaf sheaths and stem bases declines over that during early morning or late afternoon. Even more important than diurnal variations may be changes in photosynthate distribution within turfgrass plants in response to mowing.

Frequent or close mowing reduces both shoot and root growth. Frequent mowing increases tiiler number but reduces the number of roots per tiller. These morphological responses suggest that mowing may induce dramatic adjustments in the partitioning of photosynthetic energy within turfgrass plants. If this is so, measurements of carbon distribution could easily reflect a response to mowing rather than to an experimentally imposed variable.

This research at The University of Rhode Island has measured photosynthate partitioning during the growing season at three intervals following a routine mowing of Baron and Merion Kentucky bluegrass turf maintained at two fertility levels. Experiments were conducted in late spring, midsummer and early fall for two years in field plots on a silt loam soil. Turf was cut at 1 1/2 inch [3.8 centimeters].

Photosynthate translocation from leaf blades to leaf sheaths and crowns was reduced by as much as 25 percent within 2 hours after mowing, but generally returned to a constant and greater rate within 24 hours. Midsummer mowing temporarily inhibited photosynthate transport more than mowing in spring or fall. Photosynthate distribution within turfgrass plants was influenced more by time of year and nutritional status than by mowing. Kentucky bluegrass maintained as closely mowed turf sustains only a slight and temporary disturbance in energy partitioning in response to mowing.

These findings may prompt a questioning of the conventional view of mowing as a management stress. To be sure, the partial leaf loss caused by mowing reduces the energy available to support tiller and root growth. Frequent mowing and close cutting heights result in turfgrass plants with shallow root systems and a reduction in number of roots per tiller. This change can result in increased weed invasion and disease incidence. However, once turfgrasses have reached an equilibrium between the photosynthetic surface maintained by mowing and the biomass present in non-photosynthetic organs, such as roots, rhizomes and crowns, a regularly scheduled mowing may impose little additional stress.

Warm Season Grasses

SEASONAL ESTABLISHMENT OF BERMUDAGRASS USING PLASTIC AND STRAW MULCHES

R S Sowers and M S Welterlen
Agronomy Journal
Volume 80 Number 1
Pages 144-147
1988

Bermudagrass is inherently wear resistant and heat and drought tolerant. Thus it is used extensively for recreational facilities such a athletic fields and golf course fairways in the southern United States. Quick establishment is often necessary to meet the intensive use requirements of such facilities.

Clear plastic mulches reduce evaporation of soil moisture and elevate soil temperature. Use of these covers during summer establishment of bermudagrass may stimulate growth of developing sprigs. Further, use of bermudagrass in the transition zone is limited by the minimal amount of time available for establishment. Since clear plastic covers create a greenhouse effect, it should be possible to use them to extend bermudagrass growth during the fall when it would otherwise become dormant.

The purpose of this research at The University of Maryland was to:

- determine if clear plastic covers can be used to enhance establishment of bermudagrass during the recommended establishment period in comparison to bermudagrass sprigs mulched with straw or left uncovered.

- determine if clear plastic covers can be effectively used to enhance bermudagrass establishment in the fall.

Midiron, Tufcote and Vamont bermudagrass sprigs were used in planting during May, June and July, months generally recommended for planting in the transition zone. Late-season spriggings were made in August, September and October. Tests were conducted on a sandy loam soil.

Results were noted as follows.

- Summer bermudagrass establishment was reduced under straw and polyethylene covers.

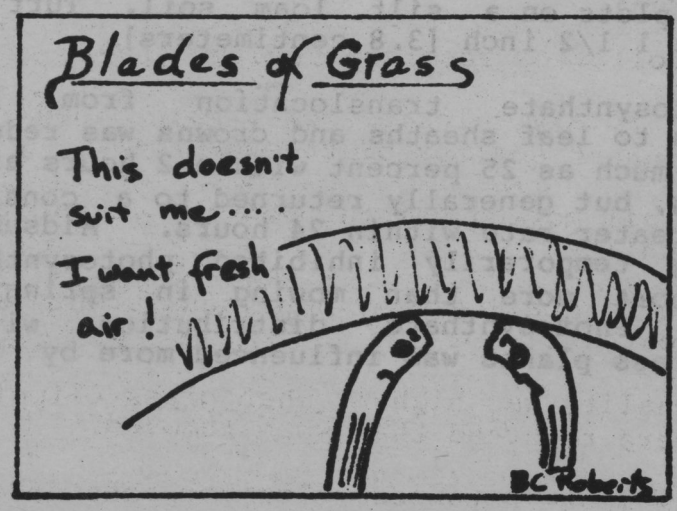
- Injury under plastic occurred to plantings made in May and June, which were exposed to mean soil temperatures above 106 degrees Farenheit [41 degrees Centigrade] during the 8-week cover period.

- In contrast, plastic mulch stimulated early fall bermudagrass growth and delayed dormancy.

- August and September plantings remaining under plastic throughout the winter exhibited high winter survival in comparison to unmulched or straw mulched turf, and were nearly 100 percent established by July 1 of the following year.

- Spriggings under plastic planted after September 20 exhibited poor establishment by July 1 the following year.

- Plastic covers can be used to extend the establishment season of bermudagrass into the fall; however, plastic covers are detrimental to summer bermudagrass establishment.



BERMUDAGRASS TURF RESPONSE TO MOWING PRACTICES AND FERTILIZER

B J Johnson, R N Carrow & R E Burns
Agronomy Journal
Volume 79 Number 4
Pages 677-680
1987

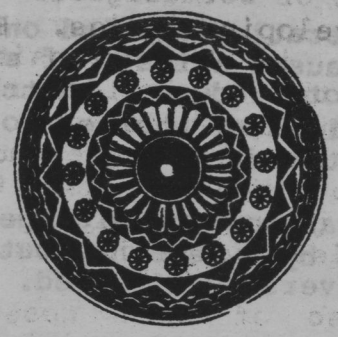
To maintain a good quality turf, it is necessary to apply adequate fertilizer throughout the growing season. Other factors such as mowing, thatch and disease also influence turf quality. While numerous studies exist on the influence of mowing height, mowing frequency and clipping removal, limited data exist on the effect of mower type on turf quality.

The principal mower types used for cutting turfgrass are reel, rotary and flail. The reel mower is primarily used for cutting high-quality grass at 1 inch [25 millimeters] or less. The rotary mower is more versatile than the reel mower as it can be used to cut weeds and tall grasses on either smooth or rough areas. The rotary mower is especially good to use in areas where a low to medium-quality turf may be acceptable. The flail mower is primarily for utility turfs where mowing is performed infrequently and quality of the turf is less important. The type of mower selected will influence turf quality.

Because information on bermudagrasses treated with different fertility levels and mowing treatments is limited, research at The University of Georgia was initiated to determine the responses of bermudagrass to nitrogen and potassium fertilizer and mowing treatments. Nitrogen applications at 2 to 6 pounds per 1000 square feet [100 to 300 kilograms per hectare] and potassium applications at 1 to 3 pounds per 1000 square feet [50 to 300 kilograms per hectare] were made to Tifway bermudagrass grown on a sandy loam soil.

The following results were obtained.

- A rotary mulching mower maintained the highest quality of bermudagrass.
- Flail mowing maintained the lowest turf quality.
- Turf quality was not consistent each year.
- Quality was higher when grass clippings were returned than when removed.
- In most instances, bermudagrass did not respond to nitrogen rates above 4 pounds per 1000 square feet [200 kilograms per hectare].
- Turf quality and shoot density were as good when potassium was applied at 1 pound per 1000 square feet [50 kilograms per hectare] as at higher rates.
- Neither fertilizer treatments nor returning grass clippings influenced thatch accumulation. However, turf cut with a rotary mulching mower had a greater thatch accumulation than did turf cut with a flail mower.
- These results show that mower type and clipping disposal have significant impact on turfgrass quality and shoot density but only minimal influence on thatch. No clear benefit of rotary over reel mower was found for these home lawn conditions, but both were superior to the flail mower. When using a rotary mower, mulching and returning clippings will improve the turf over removing clippings. In fact, returning clippings was beneficial for both reel and rotary situations.



THATCH AND QUALITY OF TIFWAY BERMUDAGRASS TURF IN RELATION TO FERTILITY AND CULTIVATION

R N Carrow, B J Johnson & R E Burns
Agronomy Journal
Volume 79 Number 3
Pages 524-530
1987

In order to promote rapid growth for recovery from traffic and to provide a dark green, dense turfgrass stand on recreational sites, high fertility levels are often necessary. These conditions may encourage the formation of thatch, an intermingled layer of dead and live plant tissue that accumulates between the green vegetation and soil surface of a turfgrass sod. Mat has been defined as a layer below the thatch that has mineral soil intermixed into the thatch by topdressing or core aeration. Secondary cultural practices, such as core aeration, vertical mowing [dethatching] and topdressing with sand or soil have been routinely used as ways to reduce thatch accumulation and ultimately improve turfgrass quality.

Some 77 percent of lawn care companies offer core aeration to their customers. Core aeration and dethatching are the two most common add-on services that lawn care companies use to diversify their businesses. This research at The University of Georgia was designed to evaluate the use of secondary cultural practices on Tifway bermudagrass maintained under home lawn conditions. Nitrogen and potassium fertilization regimes were included.

Results of this research are as follows.

- Neither nitrogen or potassium influenced thatch accumulation, but a minimum of 4 pounds of nitrogen per 1000 square feet [196 kilograms per hectare] was necessary for adequate shoot density and color. One pound of potassium per 1000 square feet [49 kilograms per hectare] resulted in as good or better shoot density and color than did higher potassium rates.

- Three to four times more dollar spot occurred at the lowest nitrogen rate while potassium had much less influence on disease incidence.

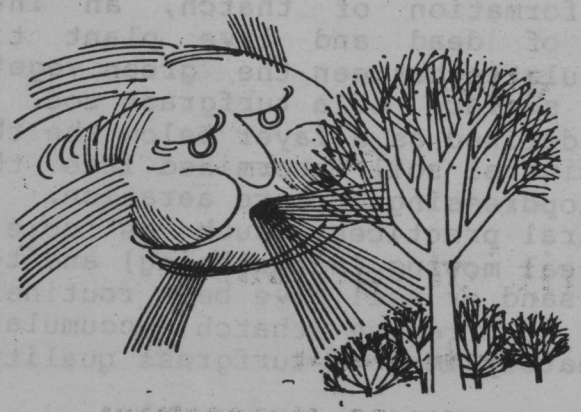
- Core aeration applied once or twice a year caused a loss of stand density and did not reduce thatch accumulation regardless of whether cores were removed or returned.

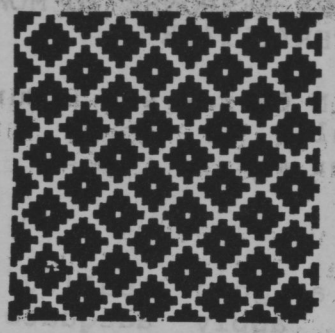
- Vertical mowing twice per year decreased thatch by 8 percent, but shoot density was adversely affected.

- At the end of 4 years, topdressing with sand reduced thatch by 44 and 62 percent for one and two applications, respectively, while maintaining adequate shoot density and color.

- Increasing nitrogen or potassium did not offset the adverse effects of core aeration or vertical mowing.

- Thus, under home lawn conditions, core aeration and vertical mowing should only be used if a specific problem exists and not as routine practices to prevent thatch accumulation.





BERMUDAGRASS GERMPLASM ADAPTATION TO NATURAL PEST INFESTATION AND SUBOPTIMAL NITROGEN FERTILIZATION

Philip Busey
Journal American Society of Horticulture Science
Volume 111 Number 4
Pages 630-634
1986

Bermudagrass was introduced to the United States from Africa by 1751. Its value as a turfgrass was recognized in the United States by 1917, and it was planted on golf courses and lawns in Florida at least by the 1920s. Subsequently, bermudagrass cultivars, including the vegetatively propagated hybrids Tifway and Tifgreen were intentionally developed through breeding. Considerable germplasm has been evaluated in the southern United States during the period 1955 through 1962.

Because of its fine-leaved texture, high density and traffic tolerance, bermudagrass is appropriate for sports turfs and lawns. With the limited use of bermudagrass in Florida home lawns and other low-maintenance areas, this University of Florida research involves a search among bermudagrass introductions to discover germplasm that would establish and persist as a turf under natural pest infestation and suboptimal nitrogen fertilization.

Among 95 clones, 4 experimentals survived repeated cycles with relatively high turfgrass coverage and quality when no nematicides, fungicides or insecticides were applied and severely damaging mole cricket populations were left uncontrolled. Among cultivars, only Tifgreen II and Ormond bermudagrass performed well.

African introductions and artificially-induced mutants of hybrid cultivars were the best sources of adapted germplasm. Although the mechanism of this adaptation is unknown, field tests were an effective prescreening method for clonal selection.

COMPANION GRASS AND MULCH INFLUENCES ON BAHIAGRASS, CENTIPEDEGRASS AND ST AUGUSTINEGRASS ESTABLISHMENT

A E Dudeck and C H Peacock
Journal American Society of Horticulture Science
Volume 111 Number 6
Pages 844-848
1986

Vegetative planting of warm-season turfgrasses with plugs or sprigs leaves bare and unprotected soil for several months until a complete turfgrass cover is achieved. Plugs of centipedegrass and St Augustinegrass are usually spaced on 10 inch centers [25 centimeters]. Plugs are usually 2 inch [5 centimeter] in size. Thus 96 percent of the soil surface is unprotected and is subject to erosion and weed invasion. Where single sprigs are planted, the unprotected soil averages slightly less than 100 percent. Water losses from irrigation or natural precipitation are high and elevated soil temperatures may affect plant establishment.

Use of mulch has been shown to moderate soil temperature, conserve soil water and provide excellent protection against wind and water erosion. Also, companion grass species are commonly seeded with legumes, while temporary grasses such as ryegrass are seeded with cool-season turfgrasses. Both provide quick ground cover until the slower-establishing permanent species dominate the sward. Competition between species during establishment can be a serious problem if compatible seed mixtures are not chosen.

This research at The University of Florida had the following objectives:

- to identify compatible, temporary grasses that provide rapid ground cover during the slow establishment period for several warm-season turfgrasses;
- to study effects of mulch on establishment of selected warm-season turfgrasses.

Vegetative plantings included centipedegrass and St Augustinegrass and seeded plantings included bahiagrass and centipedegrass. Grass hay was used as a mulch.

The following results are of interest.

- Browntop millet was the most rapid companion grass to establish in all plantings, but it was also most competitive to warm-season turfgrasses.
- Although FL-501 oats had a slower establishment rate than browntop millet, it was less competitive than the latter as warm-season turfgrass cover 63 days after planting was equal to control planted without a companion grass.
- Mulch had a beneficial effect on establishment rate of seeded bahiagrass that negated the need for a companion grass.
- Mulch had no detrimental effect on the slow establishment of vegetatively propagated St Augustinegrass and centipedegrass or on seeded centipedegrass.

"1988 is not just a new year,

but the beginning of a new age:

the reincarnation of the spirit of grass"

Heide Aungst

Landscape Management

Soil Microbiological Research

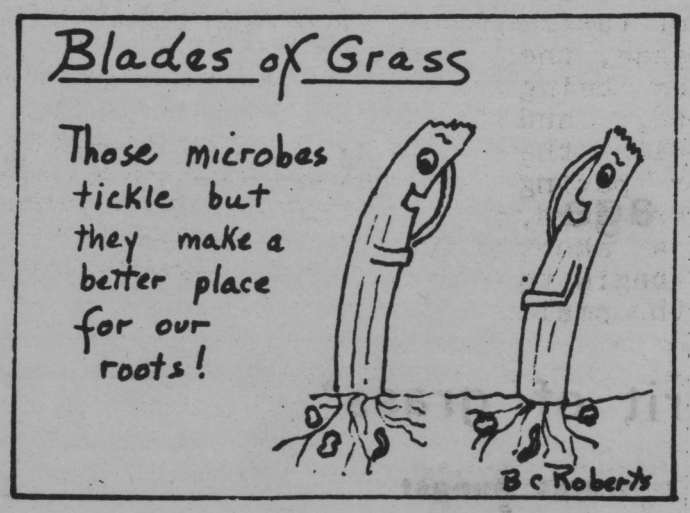
DISCRIMINANT ANALYSIS FOR KENTUCKY BLUEGRASS BILLBUG RESISTANCE RATINGS

A H Bruneau, A M Parkhurst & R C Shearman
Journal American Society for Horticultural Science
Volume 112 Number 6
Pages 978-980
1987

Kentucky bluegrass can be severely damaged by the bluegrass billbug. Bluegrass cultivar response to billbugs indicates that there is likely a genetic base for billbug resistance. Anatomical, morphological and physiological characteristics of 12 Kentucky bluegrass cultivars were compared with 4 categories of billbug resistance. Variables have been measured from field, controlled environment and greenhouse grown plants.

Cultivars with moderate and high resistance to bluegrass billbug larvae had tougher tissue but exhibited lower recuperative potential than tolerant and susceptible cultivars. The capacity to conceal billbug injury was the major factor that differentiated tolerant from resistant cultivars.

Adelphi, Rugby and Sydsport Kentucky bluegrasses were found susceptible to billbug injury; Baron, Fylking, Newport and Victa were moderately resistant; Aquila, Geary, Nugget and Park were rated resistant and Touchdown was found to be tolerant.



OXIDATION OF PHENOLIC ACIDS BY SOIL IRON AND MANGANESE OXIDES

R G Lehmann, H H Cheng & J B Harsh
Soil Science Society of America Journal
Volume 51 Number 2
Pages 352-356
1987

Phenolic acids are important components in a variety of soil processes, including allelopathy, humus formation and micronutrient availability to plants. Phenolic acids are known to inhibit the growth of some plants. Ferulic acid has been studied in this regard. Many other phenolic acids do not cause phytotoxicity under soil conditions. It may be that some soils can inactivate and reduce the allelopathic potential of phenolic acids. Allelochemicals that form from decomposing plant residues may remain active only while in the vicinity of the residues. As these compounds diffuse into the soil matrix, they are probably inactivated.

Research at Washington State University has demonstrated that the reaction of phenolic acids with soil is an oxidation of the acids coupled with a reduction of soil iron and manganese oxides.

While the allelopathic role of phenolic acids may be suppressed by soil, their role in the formation of humus may actually be enhanced in the presence of clays and sesquioxides. The layer silicates [especially 2:2 and 2:1 types] have been found to catalyze the process, and the presence of free iron and aluminum seems to darken the color of the final product.

INFLUENCE OF INOCULUM PLACEMENT DEPTH ON ENDOMYCORRHIZAL FUNGAL INFECTION AND PERENNIAL RYEGRASS SHOOT GROWTH

J B Frank, A M Petrovic and K W Mudge
Journal American Society for Horticultural Science
Volume 112 Number 1
Pages 282-286
1987

Inoculation with VAM fungi [vesicular-arbuscular endomycorrhizae] has potential as an effective management alternative in low-maintenance turf culture. Beneficial effects on growth, phosphorus nutrition and water relations have been noted on a wide range of agronomic crops.

With turfgrasses, the VAM fungi has been found to stimulate growth of centipedegrass and bahiagrass. Studies with tall fescue and perennial ryegrass have not looked as good. Placement of the fungi relative to the seed has been suggested as an explanation for differing plant response. Therefore, the objective of this Cornell University research was to investigate the effect of VAM fungal inoculum placement at different depths in the soil profile on root infection and growth of the cool-season turfgrass Citation perennial ryegrass.

Shoot growth was greatest when VAM inoculum was placed at the soil surface and declined progressively with deeper placement. Greatest mychorrhizal fungal infection of the root system occurred at the site of inoculum placement regardless of depth. The effectiveness of the surface-applied inoculum on enhancing the initial shoot growth of perennial ryegrass suggests that inoculation with the VAM fungus could prove useful when turf is maintained at low levels.

GREEN MAKING IN THE 1600'S

The following is a quote from Way to Get Wealth by Gervase Markham published in 1613.

"To fit a place for this manner of greene plot, it is requisite that it may be cleansed from all manner of stones and weedes, not so much as the rootes left undestroied, and for the better accomplishing hereof, there must boiling water be poured upon such endes of rootes as staying behind in the ground cannot be well pulled up, and afterwards the floor must be beaten and troden down mightily, then after this there must be cast great quantity and store of turfes of earth full of greene grasse, the bare earthe part of them being turned and laid upward, and afterward danced upon with the feete, and the beater or paving beetle lightly passing over them, in such sort that within a short time after, the grasse may begin to peepe up and put foorth small haires."

- Lawns and Ground Covers
Time-Life Encyclopedia of Gardening p 8 1971

Water Use & Management

CANOPY TEMPERATURE BASED IRRIGATION SCHEDULING INDICES FOR KENTUCKY BLUEGRASS TURF

C S Throssell, R N Carrow & G A Milliken
Crop Science
Volume 27 Number 1
Pages 126-131
1987

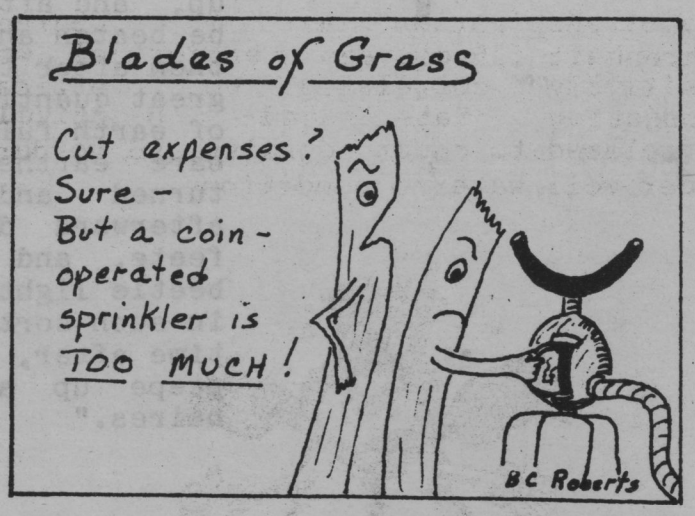
An ideal irrigation scheduling technique should use the plant as the indicator of water stress since the plant responds to both the aerial and soil environments. Turf managers generally schedule irrigations based on their experience and observations of the turf site or irrigate on a set time interval. Both of these techniques have promoted overwatering. Both tensiometers and evaporation pans are being used to help schedule irrigations for turf sites, but there are limitations associated with the use of each. New irrigation scheduling techniques need to be developed that will accurately assess the water status of the turf so that overwatering can be eliminated and water conserved.

An infrared thermometer can be used to quickly and easily measure canopy temperature across a large area, at all levels of water stress. The use of canopy temperature to detect water stress is based on the principle that water lost through the transpiration process cools the leaves below the temperature of the surrounding air under well-watered conditions. As soil water becomes limiting, transpiration is reduced and leaf temperature increases. If transpiration is greatly reduced or ceases, leaf temperature will be greater than air temperature because of radiation absorbed by the leaf.

In research conducted at Kansas State University, the plant canopy temperature-ambient air temperature differential was evaluated as an indicator of the water status of turfgrass. Field experiments were conducted to assess the potential of using plant canopy temperature measured with an infrared thermometer to schedule irrigations for Kentucky bluegrass turf. Calculations of stress degree day, crop water stress index and critical point model were developed as indices to schedule irrigations.

Results have been reported as follows:

- During a 25 day period of hot, dry weather, water use was 4, 4.5, 5.5 and 8.5 inches [98, 112, 140 and 210 millimeters] and number of irrigation events were 7, 8, 10 and 15 times respectively for irrigation scheduling by tensiometer, stress degree days, crop water stress index and critical point model.
- Shoot density, verdure and root weight were not different for these treatments - reflecting the greater amount of water applied.
- Further refinement of these indices could allow them to be useful tools for irrigation scheduling.



KENTUCKY BLUEGRASS CULTIVAR EVAPOTRANSPIRATION RATES

R C Shearman
HortScience
Volume 21 Number 3
Pages 455-457
1986

Daily turfgrass evapotranspiration rates have been reported to range between 0.08 and 0.24 inches [2 and 6 millimeters]. This amounts to a weekly range of 0.56 to 1.68 inches with an average of just about 1 inch.

Research at the University of Nebraska was conducted to determine Kentucky bluegrass cultivar evapotranspiration rates. Twenty cultivars were used in this investigation. They were well-watered under controlled environmental conditions.

Results have been reported as follows.

- Enoble Kentucky bluegrass had the lowest rate of 0.15 inches [3.86 mm] per day.
- Merion, Birka and Sydsport Kentucky bluegrasses had the highest rate of 0.25 inches [6.43 mm] per day.
- Cultivars differed in shoot density, verdure, root density, stomatal density and stomatal index. Only verdure was correlated to evapotranspiration for the twenty cultivars.
- When five cultivars were selected to represent categories of high, medium and low evapotranspiration rates, the evapotranspiration for these cultivars increased from 1.1 to 1.7 fold when temperature was increased from 77 to 95 degrees Fahrenheit [25 to 35 degrees Centigrade] depending on cultivar.
- Evapotranspiration at 95 degrees Fahrenheit [35 degrees Centigrade] was positively correlated to vertical elongation rate and negatively correlated to shoot density and verdure under well watered conditions.

SUMMER DROUGHT RESPONSE AND ROOTING DEPTH OF THREE COOL-SEASON TURFGRASSES

K M Sheffer, J H Dunn & D D Minner
HortScience
Volume 22 Number 2
Pages 296-297
1987

During periods of moderate drought stress, irrigation is needed to sustain growth of perennial ryegrass and Kentucky bluegrass. However, tall fescue often retains color and continues growth without irrigation during summers with minimal rainfall. Some characteristics that may differ between tall fescue and Kentucky bluegrass or perennial ryegrass and that may contribute to heat and drought survival include:

- tolerance to physiological drought;
- water use rate;
- soil water absorption efficiency;
- depth and distribution of root systems.

Tall fescue is generally thought to have a deeper root system than Kentucky bluegrass.

Research at The University of Missouri has been conducted to determine root depth distribution and water-absorbing efficiency of Kentucky 31 tall fescue, Fylking Kentucky bluegrass and Manhattan perennial ryegrass in the field when soil moisture is limiting.

The following results are of interest:

- Root mass measurements below 15 inches [36 centimeters] in late August ranked tall fescue most, perennial ryegrass intermediate and Kentucky bluegrass least.
- Root mass measurements above 5 inches [12 centimeters] ranked Kentucky bluegrass most with tall fescue and perennial ryegrass equal and less.
- Soil water content at three depths in August reflected root distribution for the three species.
- Soil water content was lowest under Kentucky bluegrass and highest under tall fescue at 2 inches [6 centimeters].
- At 20 inches [54 centimeters] and 30 inches [78 centimeters] the soil water content was highest under Kentucky bluegrass and lowest under tall fescue.

- Measurement of soil water content provided a good estimate of root water distribution.

- Kentucky bluegrass had 75 percent of its root mass within 5 inches [12 centimeters] of the soil surface.

- Both tall fescue and perennial ryegrass had only 50 percent of their roots within the top 5 inches [12 centimeters].

- Tall fescue root mass was greater at lower depths of soil. These differences may be important for top growth during periods of low rainfall.

EVAPOTRANSPIRATION OF COOL-SEASON TURFGRASSES IN THE HUMID NORTHEAST

L J Aronson, A J Gold, R J Hull & J L Cisar
Agronomy Journal
Volume 79 Number 5
Pages 901-905
1987

Turfgrass maintenance can require considerable irrigation water, even in the humid northeastern United States. Turfgrass culture must be directed toward practices that will lower water requirements as competition for water use increases.

Transpiration accounts for most of the water lost from a dense turfgrass canopy. Transpiration rates vary among well-watered turfgrass species. Knowledge of water use rates of turfgrasses is necessary to identify grasses with lower water requirements and to design and utilize irrigation systems for maximum water use efficiency.

Methods that predict crop water use on the basis of climatic conditions are used frequently for irrigation scheduling because accurate field measurements are difficult to obtain. These methods predict the water use of a standard reference crop which is defined as "the rate of evapotranspiration from an extensive surface of 3.2 to 6 inches [80 to 150 millimeters] tall green grass cover of uniform height, actively growing, completely shading the ground and not short of water". Crop coefficients are used to adjust this value for specific crop and climatic conditions.

Research at The University of Rhode Island was conducted to quantify and compare water use by Baron and Enmundi Kentucky bluegrass, Yorktown II perennial ryegrass, and Jamestown and Tournament fine fescue maintained under well-watered conditions. Crop coefficients for each grass were computed from these data based on two predictive methods - the modified Penman equation and pan evaporation. The variability of each method was evaluated to determine its reliability for predicting evapotranspiration in the variable climate of the northeast United States.

The following results are of interest.

- Consistent annual differences were not observed in the variable summer weather that characterizes southern New England.

- Seasonal crop coefficients based on the Penman equation ranged from 0.88 for Tournament to 1.09 for Enmundi.

- Seasonal crop coefficients based on pan evaporation data were more variable, ranging from 0.86 to 1.31.

- The modified Penman equation consistently predicted evapotranspiration rates for the five grasses that would be reliable and effective in scheduling irrigation of turf in southern New England.

DIFFERENTIAL SENSITIVITY OF TURFGRASS ORGANS TO WATER STRESS

J L Nus and C F Hodges
HortScience
Volume 21 Number 4
Pages 1014-1015
1986

The effect of environmental stress on the growth and physiology of grasses adapted to turf is gradually becoming recognized as a major factor in their culture. The recovery by Kentucky bluegrass from heavy use and production of both tillers [intravaginal branches] and rhizomes [extravaginal branches] has made it the most widely used cool-season species adapted to turf culture. The production of tillers and rhizomes, however, by cool-season perennial grasses is minimal during periods of water stress, and their recuperative and sod-forming characteristics are diminished.

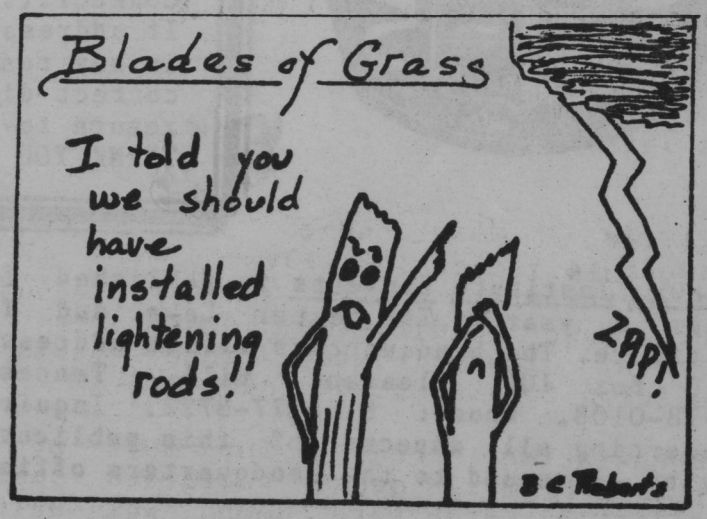
Overall plant growth is sensitive to water stress and has been proposed as a measure of plant tolerance to water stress. Also, the various organs of a plant may differ in their sensitivity to water stress. The concept of relative growth may be useful for comparing differences among plant organs.

Water stress often increases root:shoot ratios and the increase usually is related to a decrease in shoot growth. The vegetative shoot of Kentucky bluegrass includes all organs except roots; i.e., leaves, crowns, tillers and rhizomes.

Research at Iowa State University was initiated with Merion Kentucky bluegrass to determine the effect of water stress on lateral bud [axillary] development into tillers and rhizomes and to determine the relative growth of the various organs of the plant.

Results are reported as follows:

- Lateral bud meristems [axillary] were most sensitive to increases in osmotic pressure.
- The decrease in lateral bud development subsequently resulted in a decrease in tiller and rhizome numbers.
- Relative growth rates of various organs of Kentucky bluegrass further established that shoot dry-matter loss in response to water stress was due primarily to decreased tiller and rhizome growth.
- The effect of increasing osmotic pressure had relatively similar and less severe effects on leaf and root growth.
- Increase in root:shoot ratio of water stressed Kentucky bluegrass is due primarily to a decrease in relative growth of tillers and rhizomes. Differences in relative growth rates of leaves and roots were minimal under increasing osmotic pressure.
- Overall growth may be useful to characterize whole-plant response to water stress, but relative growth of specific organs may provide more precise information on turfgrass response to water stress.



NO, THE ASSOCIATE EDITOR WASN'T TIPSY; A LOANER PRINTER [IN USE WHILE OUR PRINTER IS BEING REPAIRED] WON'T KEEP LINES PARALLEL. SORRY.

THE LAWN INSTITUTE

County Line Road
P. O. Box 108
Pleasant Hill, Tennessee 38578-0108

Bulk Rate
U. S. Postage
PAID
Pleasant Hill TN
Permit No. 3

ADDRESSEE....
HELP US KEEP
YOUR ADDRESS
CORRECT.....
If address is wrong
in any respect, pleas
correct directly, and
return to us.
THANK YOU

PETER COOKINGHAM
TURFGR INFO FILE-LIBRARY
MI ST UN
E LANSING
MI 48824

Lawn Institute Harvests is published four times a year by The Better Lawn and Turf Institute. The headquarters office address is P O Box 108, Pleasant Hill, Tennessee 38578-0108. Phone: 615/277-3722. Inquiries concerning all aspects of this publication may be addressed to the headquarters office.

The Better Lawn and Turf Institute is incorporated as a nonprofit business league formed exclusively for educational and research purposes concerned with agronomic, horticultural and landscape concepts.

Lawn Institute Harvests is dedicated to improved communications among turfgrass seed and allied turf industries and other firms, businesses, organizations and individuals with lawngrass research and educational interest and concerns.

Editor: Eliot C Roberts, PhD

Associate Editor: Beverly C Roberts, MA

Printer: Crossville Chronicle (Tennessee)