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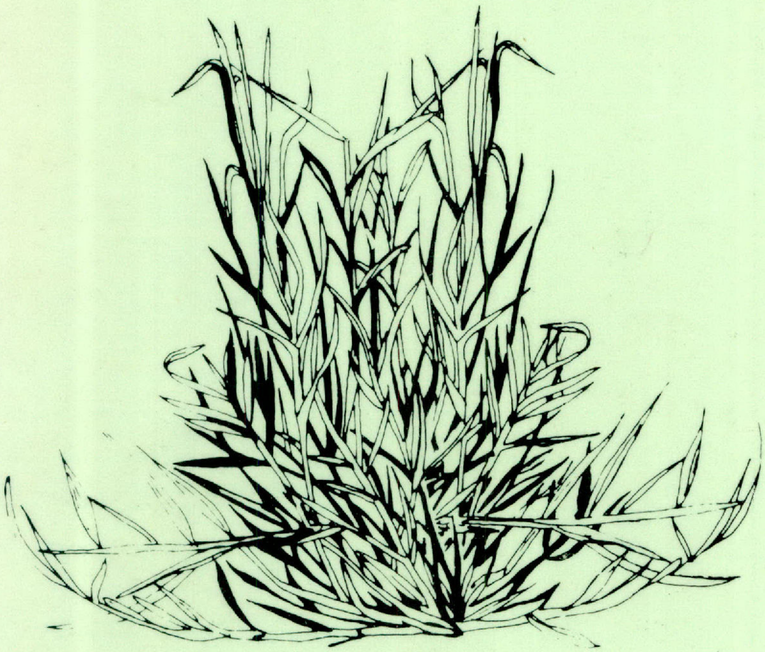

Texas Turfgrass Research — 1982

The Texas Agricultural Experiment Station
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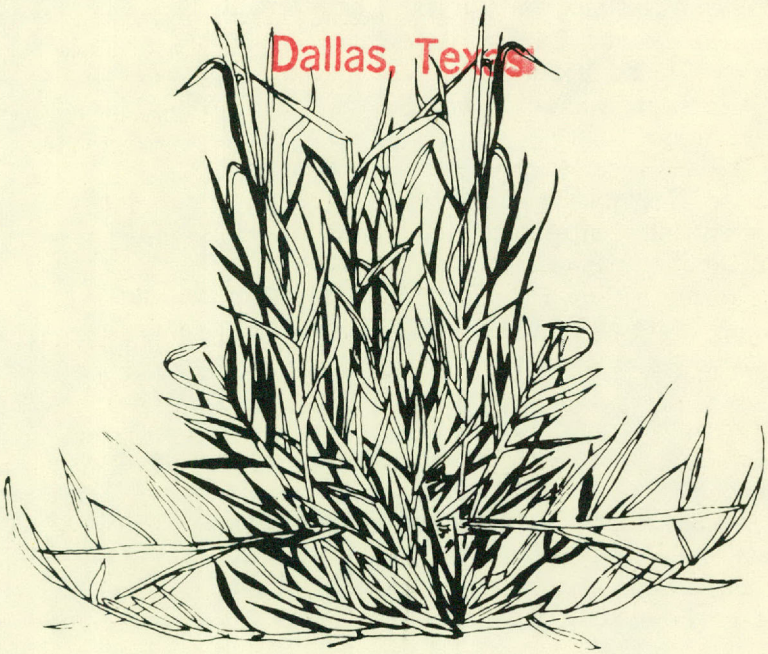

Texas Turfgrass Research — 1982

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Turfgrass Usage In Texas

Size and Contributions

Turfgrasses for functional, recreational, and aesthetic uses cover approximately 3.2 million acres in Texas. The annual expenditure for establishment and maintenance of these turfs is estimated at approximately $840 million. In another perspective, turfgrasses are maintaned for over 2 million homeowners. In addition, turfs are used on grounds surrounding businesses, industries, schools, churches, institutional facilities, and public buildings as well as for parks, sports grounds, golf courses, cemeteries, military installations, and roadsides. The significance of turfs cannot be measured simply in terms of size or monetary value. Even more important may be the contribution toward (1) functional benefits such as soil stabilization against water erosion, control of dust blowing problems, heat dissipation, noise abatement, glare reduction, atmospheric pollution control, and prevention of visual pollution; (2) low cost recreational and sport surfaces for physical activities contributing to human health and also for sports where spectator entertainment is involved; and (3) ornamental beauty and aesthetic benefits that contribute to mental health and a more favorable environment for social interaction among peoples, especially in densely populated urban areas. Thus, there are many facets to the contributions of turfs in providing a favorable quality of life.

Projected Changes and Research Needs

Energy and non-renewable resources will be increasing concerns as supplies become more limited and costs increase. Thus, it is imperative that turfgrass cultivars and cultural practices be developed that have a more simple, lower cost maintenance requirement and yet retain their very valuable functional role in providing a favorable quality of life for productive, harmonious human activities. Of most concern will be changes toward lower water and energy requirements. An associated concern is the potential for continued concentrations of people in urban areas combined with less frequent mobility to outlying recreational and resort areas due to increased energy costs. This will result in an even greater intensity of use on parks, sports grounds, and related green belt areas in the immediate vicinity of urban centers. This increased use will place even greater stresses on the turfgrasses utilized on these sites. Thus, reseach is needed to develop improved cultivars and cultural practices which will enable these turfgrasses to survive intense use and satisfy the functional, recreational, and aesthetic needs of people living in this concentrated urban setting.

The turfgrass problems and research needs of the residents of Texas are great and very diverse. The pool of fundamental knowledge is very small compared to the traditional agricultural commodity areas. It is critical that improvements be made in terms of turfgrass species and cultivars so that they can be maintained at a lower intensity of culture, particularly in terms of water and energy resources. These reseach contributions must be achieved at this time before demands for these resources become so limiting that restrictions are imposed which will drastically impair the use of turfgrasses; thus, in turn, creating a decline in the quality of life.

Background on the Turfgrass Experimental Area at College Station

The economic stresses of the early 1980's has had a strong impact on the operation of the Turfgrass Field Research Laboratory at College Station. The combination of high inflation and a sharp decline in grant support necessitated a reorganization of the field plots. All the long term research plots have been moved to the northern half of the original facility. The only exceptions are the rhizotron and the green for winter overseeding studies. Every effort is being made to maximize efficiency of the field research operation. Alleyways and non-geometric configurations of plot areas are being eliminated to minimize maintenance costs. Furthermore, new experimental techniques are being developed to ensure maximum efficiency in operating expenditures.

The turfgrass research facility development activities for the past year included: renovation of approximately 50 percent of the irrigation system; replacement of the wooden portion of the turfgrass rhizotron structure; development of a deep sand root zone area; initial construction of a rainout shelter for use in future water use rate and drought stress studies; and completion of the sand root zone modification for the major cultivar characterization block.

WEATHER SUMMARY

Summary of monthly temperature and precipitation patterns for the College Station Area*.

	Temperature (Mean Monthly ^{o}F)			Precipitation (inches)		
Month	1981-82	Average 1933-62	Departure from Ave.	1981-82	Average 1933-62	Departure from Ave.
June 1981	79.4	81.9	-2.5	9.48	3.72	+5.76
July	81.5	84.5	-3.0	5.35	2.88	+2.47
August	83.2	84.8	-1.6	2.51	2.56	+0.05
September	76.4	79.4	-3.0	5.96	3.30	+2.66
October	68.6	70.7	-2.1	8.32	2.84	+5.48
November	62.1	59.1	+3.0	4.70	2.31	+2.39
December	52.7	53.6	-0.9	.64	3.50	-2.86
January 1982	49.8	51.1	-1.3	1.44	2.86	-1.42
February	51.1	54.6	-3.5	2.26	2.93	-0.67
March	61.1	61.6	-0.5	2.4	2.67	-0.27
April	67.1	68.2	-1.1	4.67	3.73	+0.94
May	73.3	68.2	+5.1	5.98	3.73	+2.25
June	80.1	75.6	+4.5	2.0	4.44	-2.44

*Measured at Texas A&M Turf Farm Station, College Station, Texas

Acknowledgment of Research Support

A substantial portion of the research results reported herein could not have been accomplished without the grant support and the equipment, chemical, and plant material contribution from foundations, associations and companies within the turfgrass industry. Thus, it is only appropriate that these very important contributions be recognized. The specific granting agency is acknowledged at the end of the appropraite progress report being supported. In addition, general grants for support of the field laboratory operation were provided by the *Texas Sod Producers Association* and the *Texas Turfgrass Association.*

Numerous turfgrass equipment manufacturing firms and suppliers have provided equipment, chemicals, seed, and allied materials that are so vital to the continuing operation of the turfgrass research facilities. Through their cooperation, the available operationg monies can be utilized primarily for employment of personnel needed to maintain the experimental plots. Their assistance is gratefully acknowledged. Vital major donations of equipment have been given by *Goldthwaites of Texas, Jacobsen Manufacturing Company, The Toro Company, Watson Distributing Company,* and *Yazoo Manufacturing Company.* A complete summary of the companies that have given donations of equipment, chemicals, and materials are summarized on the facing page.

Donations Acknowledged

Recognition is given to those who have generously provided equip- ment and materi- als during the past two years to aid in devel- opment of the Texas A&M University turf- grass research and teaching programs.

Equipment

Billy Goat Co.
Brookhollow Golf Club
Bunton Co.
Champions Golf Club
Chemical & Turf Speciality Co.
Goldthwaites of Texas
Jacobsen Manufacturing Co.
O. M. Scott & Sons
Outdoor Power Equipment Div.,
FMC Corporation
Ryan Division, OMC Lincoln
Smithco, Inc.
The Spencer Co.
The Toro Co.
Watson Distributing Co.
Yazoo Manufacturing Co.

Pesticides

Allied Chemical Corporation
Aquatrols Corp. of America
Estech, Inc.
Great Salt Lake M&M Corporation
Hendrix & Dail, Inc.
Hercules Incorporated
LESCO Products
Milwaukee Sewerage Commission
Occidental Chemical Company

Fertilizer and Chemicals

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Turfgrass Research at TAES-Dallas

M. C. Engelke and A. J. Turgeon

Texas was second only to Florida as the fastest growing state in the nation, with a population increase of 27 percent during the past decade. Over 80 percent of Texas residents now live in densely populated urban areas with the majority centered in the metropolitan areas of Houston, Dallas-Fort Worth, and San Antonio. A strong Texas economy and desirable living conditions are expected to favor continued population growth over the next several decades.

The quality of urban life is highly dependent on planning and development of residential communities, commercial and industrial establishments, transportation systems, and recreational facilities. The so called "energy crisis" beginning in the early 1970's resulted in overall reductions in pleasure travel, and consequent increase in leisure time spent in local communities. In spite of unfavorable economic conditions in recent years, sales of landscape plants and related materials and equipment have flourished, suggesting that the urban dweller is using more of his leisure time improving his home environment.

Plant materials of all types are highly valued for their functional and aesthetic roles in enhancing the quality of urban life. During the late part of the 70's the expenditures for horticultural products in Texas, including plant materials, were conservatively estimated at $3.5 billion annually. Over 15 percent of this total was spent for maintenance of an estimated 3.1 million acres (1.25 million hectares) of turf. Texas turf has a total valuation estimated in excess of $2.5 billion.

The development of turfgrass cultivars and associated cultural practices were largely influenced by the availability of inexpensive energy sources and abundant supplies of water. Today, with rapidly increasing urban populations in Texas due to considerable migration from other parts of the United States, the growing demand for water and other environmental resources, coupled with declining supplies of water and energy in some areas, has focused sharp attention on how these resources are used. Clearly, one candidate for future "resource conservation" by local municipalities is landscape-plant communities, especially residential landscapes. Luxury consumption of water and other precious resources must be checked to ensure adequate supplies for the future. This can be done through an aggressive program of research directed toward developing resource-efficient landscape plants and cultural strategies.

The establishment of a turfgrass breeding position with supporting facilities within the Texas Agricultural Experiment Station was initially investigated in the early 1970's. Numerous attempts to gain legislative approval for such a position finaly resulted in the initiation of a breeding and genetics project at TAES-Dallas in 1980. The Dallas research staff already included other professionals working in turfgrass pathology, entomology, and edaphology.

Thus, a team composed of scientists at Dallas, and at other TAES units, was in place by mid 1980 to pursue the goal of developing resource-efficient turfgrasses and cultural strategies. The first order of business was to initiate the construction of experimental facilities to adequately support the unit's expanded turfgrass research program.

Turfgrass Field Plots

The field plots are situated on an Austin silty clay soil (Entic Haplustolls) with a 1 to 3 percent slope. The area is divided into irrigaed and unirrigaed sites to maximize efficient use of land resources and to provide the range of environmental conditions necessary in a turfgrass field reseach program.

The primary area is a 13-acre site which is subdivided into 12 blocks measuring 60 by 240 ft, or 1/3 acre each (Figure 1). This includes blocks 11 through 16 and 21 through 26. One block (#13) was constructed with 36 subplots measuring 20 by 20 ft. Each plot is serviced by four quarter-circle Toro Series 300 stream rotor heads, and is individually controlled for irrigation treatments. These "microplots" were designed for pursuing cultural studies in which irrigation is the main-plot treatment. The other eleven blocks were established with perimeter irrigation using quarter- and half-circle Toro Model 640-park heads on 60-ft centers. At 50 to 60 pounds per square inch (psi) presure, this system will deliver up to 0.66 inches of precipitation per hour. The current use of these blocks is shown in Figure 1.

A 1-acre shade nursery was completed in the spring of 1982. Major portions of the irrigation system were donated by the L. R. Nelson Irrigation Co. A dual system was installed, including a bubbler system (L. R. Nelson, 6010 Bubbler) to support the trees and a system with gear-driven steam heads (L. R. Nelson GS-1) to support the surrounding turf

Two species of trees were established in the nursery in the spring of 1982. The western half was planted to live oaks *(Quercus virginiana)* donated by Green Valley Nursery, Inc., Floresville, Texas, and the eastern half was planted to Red Oaks *(Quercus texana)*. The turf area is being established to 'Raleigh' St. Augustinegrass. Initially, the site will be used primarily for investigations with the trees; however, once the trees have matured sufficiently to provide uniform shade, the site will be used to develop shade-tolerant, disease resistant turfgrasses.

A sand-based creeping bentgrass experimental green was constructed in the summer of 1982 by labor and funds donated by local golf-course personnel (Figure 1, Block 10A). This experimental facility will be used to investigate cultivation and topdressing practices for optimizing the environmental stress tolerance of creeping bentgrass.

The remaining areas of the turfgrass field plots (Blocks 10CD and 20AD) and adjacent areas of an estimated 10 acres are irrigated as needed by a portable system. These areas are extensively employed in the initial assessment of native and introduced turfgrass genotypes.

Additional Facilities

A 4800-sq ft building to support both turfgrass and forage field research is presently under construction. This building includes storage areas for equipment and supplies, a maintenance shop, two fully equipped laboratories, and offices. Covered external storage is also included for soil amendments and topdressing media.

An expansion of greenhouse facilities was accomplished by adding 10 individual greenhouses measuring 25 by 40 ft, and providing 450 sq ft of bench space, per house. These greenhouses are complemented by a 3800 sq ft headhouse which includes soil storage and handling facilities, plotting benches, and six walk-in controlled-environment rooms.

All facilities currently under construction are scheduled to be completed by December, 1982. The new facilities greatly enhance the capabilities of the unit's research program generally, and the turfgrass research program in particular.

TURFGRASS FIELD PLOTS

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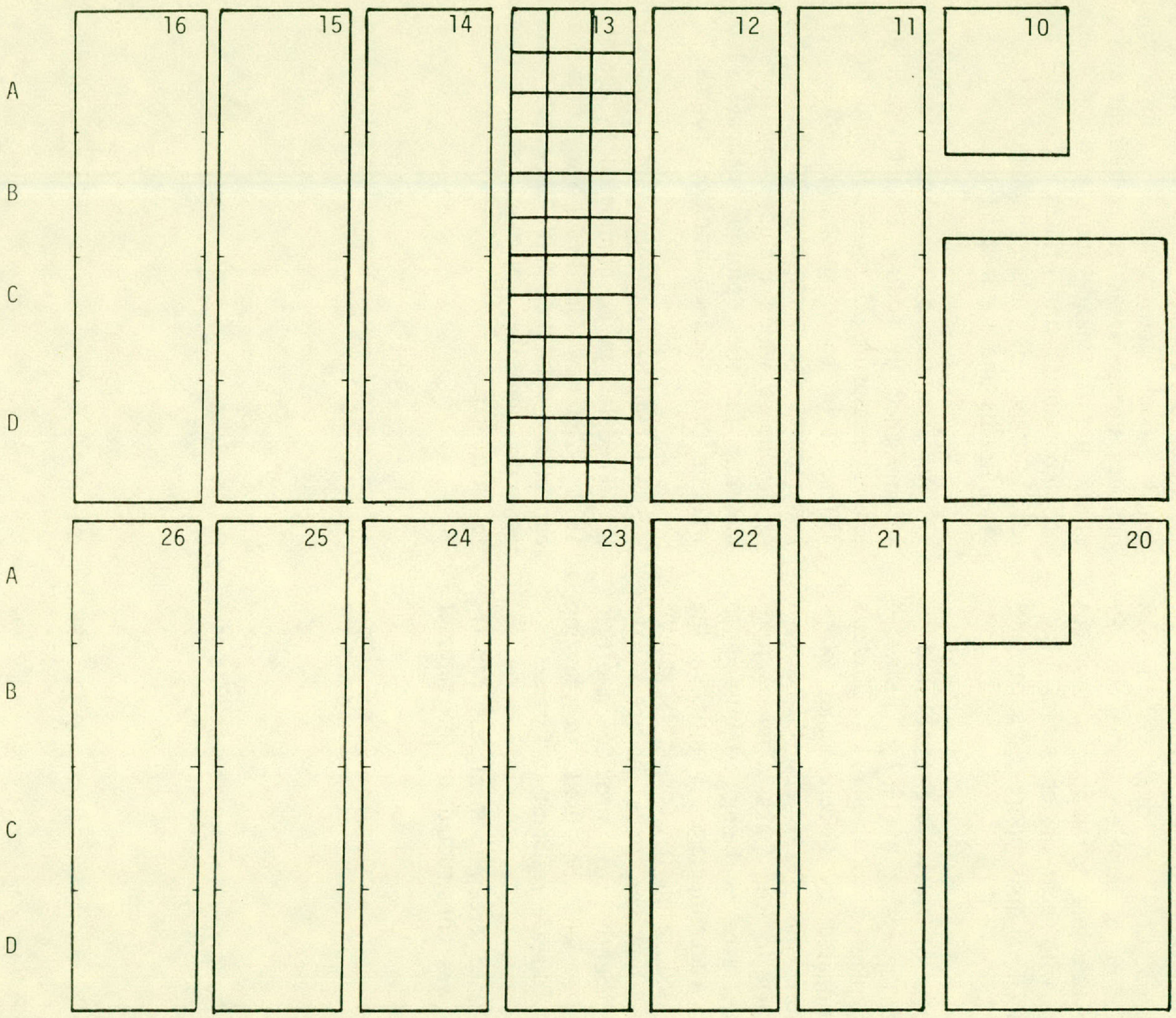

Turfgrass-Forage
Field Laboratory

10A 'Penncross' Bentgrass, USGA Green
10CD Zoysiagrass germ plasm nursery

11AC 'Tifgreen' Bermudagrass Green
11D OPEN

12AC 'Tifway' Bermudagrass Lawn
12D '82 Turf-type Tall Fescue Evaluation Trial

13AD 'Texas Common' St. Augustinegrass macroplots

14AD 'Arizona Common' Bermudagrass lawn

15AD 'Arizona Common' Bermudagrass lawn

16AD Bermudagrass Cultivar Evaluation Trial

20A 'Texoka' Buffalograss lawn
20BD Buffalograss germ plasm nursery

21AD St. Augustinegrass germ plasm nursery

22A 'Meyer' Zoysiagrass lawn
22B 'Emerald' Zoysiagrass lawn
22CD Zoysiagrass cultivar evaluation trial

23AB 'Raleigh' St. Augustinegrass lawn
23CD Zoysiagrass germ plasm nursery

24AC St. Augustinegrass cultivar evaluation trial
24D '80 Turf-type Tall Fescue Evaluation trial

25AD Zoysiagrass germ plasm nursery

26A Centipedegrass cultivar evaluation trial
26BD Zoysiagrass germ plasm nursery

Figure 1. Turfgrass Field Research Facilities at TAES-Dallas.

PR-4032

Spring Root Decline—A Six Year Summary

J.B. Beard and K.S. Kim

Since the initial discovery of the spring root decline phenomenon in bermudagrass and St. Augustinegrass, the TAMU turfgrass rhizotron has been used each spring to investigate this event. The rhizotron facility consists of an underground chamber with two opposite rows, each containing 24 glass-faced root observation boxes. This technique allows the seasonal observation of root growth on a continuous, nondestructive basis and thus facilitated discovery of the spring root decline phenomenon.

To summarize, in late fall the aboveground shoots enter winter dormancy and become totally brown (Figure 1). In contrast, the root system remains white and healthy throughout the winter. Then in the spring, shoot growth is initiated when soil temperatures rise to 64 degrees F. Within approximately 4 days, the root system turns brown and deteriorates rapidly over a 24 to 48 hour period. Subsequently, all new root initiation occurs from the nodes on crowns and lateral stems of these perennial grasses. Thus, there is a period of 2 to 3 weeks in the spring when the warm season perennial grasses have an extremely limited root system in terms of the capability to take up moisture and nutrients. The occurrence of spring root decline may be a significant factor contributing to winter kill, especially desiccation; spring pesticide toxicity; and spring establishment failures. Furthermore, spring root decline may be an important factor dictating the timing and intensity of such spring cultural practices as mowing, fertilization, irrigation, vertical cutting, and herbicide application.

Six Year Summary

A summary of the past 6 years of observations as to whether spring root decline occurred plus the associated winter and spring environmental conditions is shown in Table 1. Spring root decline occurred for 3 consecutive years and was associated with very low winter temperatures plus a fairly rapid rate of spring greenup. During the next 2 years – 1980 and 1981 – spring root decline was not observed. In this case, the winters were very mild and the rates of spring greenup and subsequent growth were very slow. Spring root decline was observed to occur again in 1982, although not at as rapid a rate. This occurrence was associated with extremely cold winter temperatures followed by relatively early spring greenup, but subsequent very slow spring growth. A pattern is starting to emerge in terms of the specific winter-spring environmental conditions associated with the occurrence of spring root decline. The extremes and duration of winter soil temperatures plus the rate of temperature change during the late winter and spring period need further detailed investigation in terms of how the induction of spring root decline occurs. These types of investigations are now under way, primarily by means of environmental stress simulation chambers.

Species Responses

Ten warm season perennial grass sods were transplanted onto a sand root zone in the TAMU turfgrass rhizotron in mid-July of 1981. Three replications were made. The general mowing and nutritional regimes utilized were representative of the optimum for each individual species under lawn turf conditions. Irrigation was applied as needed to prevent visual wilt. No specific disease or insect problems were observed. All 10 species were fully rooted and stabilized prior to the onset of fall dormancy. The 10 species utilized included Common, Tifgreen, and Tifway bermudagrasses *(Cynodon* spp.); Floratam, and Texas Common St. Augustinegrass *(Stenotophrum secundatum);* Meyer zoysiagrass *(Zoysia japonica);* common centipedegrass *(Eremochloa ophiuroides);* Pensacola bahiagrass *(Paspalum notatum);* Adalayd *(Paspalum vaginatum);* and Texoka buffalograss *(Buchloe dactyloides).*

Observations during the winter of 1981-82 revealed that the root responses for all 10 warm season perennial grasses were the same as previously observed for bermudagrass and St. Augustinegrass. Specifically, the roots continued to grow at a slow rate for approximately 2 to 4 weeks after low temperature color discoloration of the shoots had occurred. Subsequently, the root systems of all 10 species remained white and apparently healthy throughout the remainder of the winter dormancy period. In early March when soil temperatures rose above 63 degrees F at a 4-inch depth, and the initiation of spring greenup had occurred, spring root decline was observed to occur on seven species. Included were Common, Tifgreen, and Tifway bermudagrasses; Meyer zoysiagrass; common centipedegrass; Adalayd Paspalum vaginatum; and Texoka buffalograss. Unfortunately, the severe low temperatures during the winter of 1982 resulted in direct low temperature kill of Floratam and Texas Common St. Augustinegrasses and Pensacola bahiagrass. However, the spring root decline response had been observed in three previous years on St. Augustinegrass. Thus, these observations suggest that spring root decline is common to most of the warm season perennial grasses used for turfgrass purposes. This assumes that the proper winter low temperature stresses and subsequent rate of spring greenup which are prerequisites for the induction of spring root decline have occurred.

These studies of the spring root decline phenomenon of warm season perennial grasses are continuing at College Station, Texas. The grant support of the O.J. Noer Research Foundation in pursuing this investigation is gratefully acknowledged.

TABLE 1. SUMMARY OF SIX YEAR'S OBSERVATIONS OF SPRING ROOT DECLINE AT COLLEGE STATION, TEXAS

Spring	Spring Root Decline Occurrence	Winter Temperatures	Spring Greenup	Spring Shoot Growth
1977	Yes	Cold	Early	Rapid
1978	Yes	Cold	Normal	Rapid
1979	Yes	Cold	Normal	Normal
1980	No	Mild	Late	Very slow
1981	No	Mild	Late	Slow
1982	Yes	Very Cold	Early	Slow

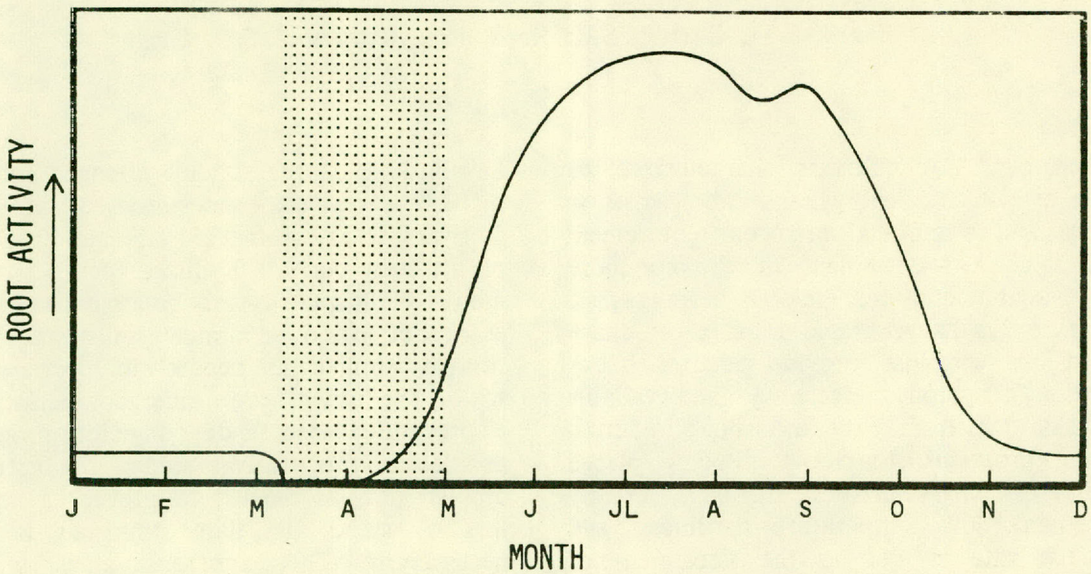

Figure 1. Representative root growth pattern associated with spring root decline of warm season, perennial turfgrasses.

PR-4033

1981 Bermudagrass Cultivar Characterizations

J.B. Beard, S.M. Batten, S.R. Reed, K.S. Kim, and S.D. Griggs

The need for cultivars characterized by low water use, less energy and labor costs in mowing, and a minimal nitrogen requirement has dictated a reassessment of the commercially available and near-release bermudagrass cultivars. Results generated from these characterizations will also provide detailed background information concerning the available germplasm which may be of value in future breeding programs. Emphasis is being placed on turfgrass characteristics, nitrogen fertility requirement, low temperature hardiness, and water use rate as well as the assessment of any disease or insect resistance differentials that may appear. The 1981 seasonal evaluations presented in this Progress Report include turfgrass quality, shoot density, leaf extension rate, leaf width, internode length and diameter, fall low temperature color retention, and spring greenup rate.

A minimum of 6 continuous years is required to obtain a reliable field evaluation of turfgrass cultivars. This is the third year of a 6-year study. Thus, final conclusions concerning the adaptation and performance of these bermudagrass cultivars cannot be made until the termination of this study.

Research Procedure

Nineteen bermudagrass (*Cynodon* spp.) cultivars were planted in August of 1978 in a modified loamy sand root zone at the TAMU Turfgrass Field Laboratory. Plot size is 5 x 15 feet in a randomized block design of three replications. Sixteen of the cultivars were planted by sprigging, while Tifdwarf was sodded, and both Arizona Common and NK-78098 were seeded. The plots are mowed twice weekly at 0.75 inch with clippings returned. During 1980 the entire area was fertilized at a rate 0.5 pound nitrogen per 1,000 square feet per growing month. During 1981, three subplot nitrogen fer- tility differentials were superimposed across the cultivars at rates of 0.25, 0.5, and 0.75 pound of nitrogen per 1,000 square feet per growing month. Phosphorus and potassium are applied as needed based on annual soil tests. Irrigation is applied as needed to prevent visual wilt. The use of pre- emergent herbicides or a preventive insecticide/fungicide program is avoided in this cultivar study. A pesticide is applied only as needed to prevent a complete loss of stand. To date, this has not been necessary. This approach gives a better opportunity to obtain data concerning the relative susceptibilities of cultivars to disease causing pathogens and to insects.

Results

Turfgrass Quality. The comparative seasonal performances of 19 bermudagrass cultivars are shown in Table 1. The visual estimate of turfgrass quality is based on two primary components: (a) a uniformity of color, density, and texture and (b) a high shoot density. Tifdwarf, Ormond, Santa Ana, Sunturf, and Tifgreen were the strongest performers during the 1981 growing season. Ormond, Santa Ana, Sunturf, and Tifgreen also ranked the highest in 1980, which was the first full growing season. In contrast, Everglades ranked high during the first growing season but has declined seriously in turgrass quality, while both Tifdwarf and Midway have shown continuous improvement.

The six lowest ranking cultivars included Common, U-3, FB-119, Texturf-1F, NK-78098, and Texturf-10. The lower density of these cultivars, as shown in Table 2, contributed substantially to the lower ranking in the overall seasonal turfgrass quality assessment. As a group these cultivars have a much lower nitrogen fertility requirement and are used on low maintenance turfgrass areas where they are well adapted and perform acceptably. Texturf 10 ranked highest in turfgrass quality of these low density, low nitrogen requiring bermudagrass cultivars and was substantially superior to Common seeded bermudagrass.

Among the high density, vegetatively propagated bermudagrasses, Tifdwarf, Tifgreen, and PeeDee are utilized primarily for high density turfs such as greens. These characteristics also increase the likelihood of a thatch problem.

Three cultivars of note in terms of use on sport fields, fairways, and other medium to high maintenance lawn turfs are Midway, Santa Ana, and Tifway. Midway was developed in Kansas and has demonstrated superior low temper- ature hardiness as well as good overall turf performance during the initial 4 years in this Texas study. Santa Ana was developed in Southern California for smog tolerance and superior winter color retention. It continues to rank consistantly high in these Texas evaluations. Tifway has been the most widely used of the sports field type bermudagrass cultivars and is performing quite acceptably. Ormond is a very attractive, dark green bermudagrass cultivar which continues to rank high in these Texas studies. Its use in the past has been restricted primarily to Florida. Even there it is declining in popularity, because of susceptibility to bermudagrass mites. No significant disease or insect susceptibility differentials have become apparent during the initial 4 years of this study.

Density. A dense turf is able to compete against weed invasion more successfully, while the associated increase in verdure contributes to improved wear tolerance. The comparative shoot densities of 19 bermudagrass cultivars 4 years after establishment are summarized in Table 2. The green-type bermudagrasses, such as Tifdwarf, Tifgreen, and PeeDee, ranked among the highest in shoot density even at a 0.75 inch cutting height. This high density frequently contributes to increased thatching and puffiness, especially at higher cutting heights. Thus, the high density types are best maintained at a moderate controlled nitrogen level and at as close a mowing height as possible, with periodic vertical cutting as needed to minimize thatch accumulation.

Ranking medium to high in shoot density were Tifway, Midway, Sunturf, Santa Ana, and Ormond. At the other end of the spectrum, Common bermudagrass ranked substantially inferior to the other 18 cultivars in shoot density. Ranking quite low in density were Everglades, Texturf-1F, and FB-119. Both FB-119 and Texturf-10 have superior tolerance to minimal nitrogen fertility conditions. It is interesting that of these two, Texturf-10 is able to support a significantly higher shoot density under medium low nitrogen fertility conditions. Also, the experimental seeded bermudagrass, NK-78098, has a substantially improved shoot density compared to Common seeded bermudagrass. This density differential was not as apparent during the initial two growing seasons.

Vertical Leaf Extension. The more rapid the leaf extension rate, the greater the mowing frequency and resultant higher labor and energy costs. In contrast, too slow a vertical leaf extension rate may be associated with a slow rate of lateral growth which could restrict the recuperative rate. The comparative vertical leaf extension rates of 19 bermudagrasses are shown in Table 3. More than a two- fold difference in rates was noted among the cultivars. Tifdwarf exhibited the slowest growth rate, while Common seeded bermudagrass ranked highest. Sunturf, Santa Ana, and Tifway form quality turfs of relatively high densities, yet exhibited moderately slow vertical leaf growth rates. Mid- way, which ranked high in turgrass quality and shoot den- sity, exhibited a more rapid vertical leaf growth rate which will necessitate a higher mowing frequency. Both Texturf-10 and FB-119 had relatively rapid vertical leaf growth rates combined with a minimal nitrogen requirement.

Leaf Width. The bermudagrasses possess a relatively fine leaf texture compared to other turfgrass species. Leaf widths of the 19 bermudagrass cultivars are compared in Table 3. In general, the finer textured types tend to be used in higher quality turfs, whereas the course textured cultivars are associated with minimal maintenance turf conditions, especially a low nitrogen requirement.

Cultivars possessing a narrow leaf width are not necessarily associated with a slow vertical leaf growth rate, as demostrated by comparing the data for U-3.

Internode Characteristics. Bermudagrass possesses lateral stems, both rhizomes and stolons, that are important factors in rate of lateral spread during establishment, sod formation, and recuperative rate, which is especially important on sport fields. The comparative internode lengths and diameters of the 19 bermudagrass cultivars are shown in Table 4. The short internode lengths U-3 and Midway are of particular interest. The finer textured, high shoot density cultivars generally have the shortest internode length and smaller internode diameter. However, there are exceptions to this as demonstrated by comparing the data for U-3.

Color Responses. Most bermudagrasses lose their green color due to chill injury when soil temperatures decline to between 58 to 54 degrees F. In locations such as southern Texas, Florida, and California, good late fall low temperature color retention is an important charactertistic which may negate the need for winter overseeding if the winters are relatively mild. However, warm season turfgrasses exhibiting late fall color retention may have increased susceptibility to low temperature injury (i.e. below 32 degrees F). This would be a concern in the more northerly portion of the warm climatic region. The capability of 19 bermudagrass cultivars to retain thier color during fall low temperatures is shown in Table 5. There are distinct differences in ability to retain color at low soil temperatures, as exhibited by the superiority of Santa Ana. The two seeded cultivars also exhibited fairly good fall low temperature color retention. Good fall low temperature retention is particularly important for sports turfs, such as football, which receive play late into the fall. Consideration should be given to Santa Ana where this characteristic is important, although both Midway and Tifway rank reasonably well.

Cultivars such as U-3, Tifdwarf, and FB-119, which possess poor fall low temperature color retention, are prone to an increased annual grassy weed problem during winter dormancy. This problem is accentuated by low mowing heights. Thus, earlier low temperature discoloration trans- lates to more favorable temperatures for weed seed germ- ination and less competition during seedling emergence of annual grasses such as annual bluegrass.

Early spring greenup is of particular interest where early spring play occurs, such as on a baseball field. It should be stressed that a rapid rate of spring greenup is a characteristic which has no relationship to the winter low temperature hardiness of that cultivar. Cultivars possessing a very rapid spring greenup rate should not be associated with superior winter low temperature hardiness. The comparative rates of spring greenup of 19 bermudagrass cultivars are also in Table 5.

Santa Ana exhibited good fall low temperature color retention, but was one of the slowest in terms of spring greenup. The seeded types, NK-78098 and Common, plus Midiron generally possessed more rapid spring greenup as well as good fall low temperature color retention. The inferior ranking of Tifway in terms of spring greenup rate is a negative factor in its use for spring sports such as baseball, especially when compared to the relatively rapid spring greenup of Midiron, Texturf-10, and Ormond.

The overall 4-year rankings for low temperature color retention capability revealed that both Santa Ana and Midiron ranked consistantly high, whereas U-3, Tifdwarf, Tifgreen, Texturf-10, and PeeDee ranked poorest. Three years of evaluations reveal that Common, Midiron, PeeDee, NK-78098, and Texturf-10 have the earliest spring greenup, while the slowest greenup rates are represented by Santa Ana, U-3, Tifway, and Sunturf.

TABLE 1. COMPARATIVE TURFGRASS QUALITY [1] OF 19 BERMUDAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	May	June	July	Aug.	Sept.	Oct.	Seasonal Avg.
Ormond	6.8	6.7	7.0	6.3	6.8	6.2	6.6 a [2]
Midway	6.2	6.7	6.5	6.2	6.5	6.2	6.4 ab
Tifdwarf	6.0	6.2	6.5	6.3	6.3	5.8	6.2 ab
Sunturf	6.0	6.3	6.2	5.8	5.8	6.2	6.1 abc
Santa Ana	5.7	6.2	6.3	6.2	5.7	6.2	6.0 abc
Tifgreen	5.7	5.8	5.5	5.8	6.2	6.2	5.9 abc
Tifway	5.5	5.3	5.2	5.7	5.3	5.3	5.4 abcd
PeeDee	4.8	5.2	5.5	5.7	5.7	5.2	5.3 abcd
Midiron	5.7	5.3	5.0	5.2	5.3	5.2	5.3 abcd
Bayshore	5.3	5.8	5.5	5.2	4.7	5.0	5.3 abcd
Tiflawn	5.2	4.8	4.8	5.0	5.7	5.2	5.1 bcde
Tiffine	5.0	5.2	5.0	4.7	5.0	5.7	5.1 bcde
Texturf-10	5.0	4.8	4.3	4.7	5.0	6.0	5.0 cde
NK-78098 (seeded)	4.8	5.2	5.3	4.7	4.7	5.0	4.9 cde
Everglades	5.2	4.8	5.2	4.7	4.3	4.7	4.8 def
FB-119	4.3	4.7	4.8	4.3	4.3	4.7	4.5 def
Texturf-1F	4.7	4.3	4.8	4.7	4.3	4.2	4.5 def
U-3	4.0	5.0	4.8	4.3	4.2	4.0	4.4 ef
Common (seeded)	4.0	4.0	4.2	3.5	2.8	2.3	3.5 f

[1] Visual estimate of turfgrass quality with 9 - best and 1 - poorest.

[2] Values joined by the same letter are not significantly different at the 5% level for the Duncan's multiple range test.

TABLE 2. COMPARATIVE SHOOT DENSITIES OF 19 BERMUDAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Density (shoots per square decimeter) [2] Oct. 16, 1981
Tifdwarf	59.9 a [1]
Tifgreen	57.0 a
Tifway	52.7 b
PeeDee	44.7 c
Midway	42.9 cd
Sunturf	42.6 cde
Santa Ana	39.6 def
Ormond	38.4 efg
Midiron	37.6 fgh
Tiflawn	36.9 fgh
Texturf-10	36.8 fgh
Tiffine	36.6 fgh
Bayshore	36.4 fgh
NK-78098 (seeded)	36.1 fgh
U-3	35.4 fgh
Everglades	34.2 gh
Texturf-1F	33.9 gh
FB-119	33.7 h
Common (seeded)	23.2 i

[1] Values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

[2] Average of nine individual plug counts.

TABLE 3. THE COMPARATIVE LEAF EXTENSION RATES AND WIDTHS OF 19 BERMUDAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Vertical Leaf Extension Rate (mm) Oct. 16, 1981	Cultivar	Leaf Width (mm) Oct. 16, 1981
Tifdwarf	8.9 a [1]	Sunturf	1.35 a [1]
PeeDee	9.8 ab	PeeDee	1.45 a
Sunturf	10.5 abc	U-3	1.53 abc
Tifgreen	10.9 abc	Tifway	1.54 abc
Santa Ana	10.9 abc	Tifgreen	1.67 bcd
Tifway	11.3 abc	Midway	1.72 cde
Everglades	11.3 abc	Tiffine	1.78 def
Tiffine	12.2 abc	Everglades	1.83 defg
Ormond	13.3 bcd	Tifdwarf	1.86 defg
Bayshore	13.3 bcd	Bayshore	1.92 efgh
Tiflawn	13.8 cde	Texturf-1F	1.98 fghi
Texturf-1F	14.5 cdef	Santa Ana	1.98 fghi
NK-78098 (seeded)	14.5 cdef	Ormond	1.99 fghi
Midway	16.7 defg	Midiron	2.02 fghi
Midiron	17.0 defg	Texturf-10	2.06 fghi
	defg		ghi
Texturf-10	17.3 efgh	FB-119	2.10 hij
FB-119	18.1 fgh	Tiflawn	2.12 hij
U-3	18.3 gh	NK-78098 (seeded)	2.19 ij
Common (seeded)	21.1 h	Common (seeded)	2.30 j

[1] Average of nine measurements; values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

TABLE 4. THE INTERNODE CHARACTERISTICS OF 19 BERMUDAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Internode Length (mm) October 16, 1981	Cultivar	Internode Diameter (mm) October 16, 1981
Tifdwarf	14.1 a [1]	Sunturf	0.78 a [1]
Midway	17.0 ab	PeeDee	0.80 ab
PeeDee	18.0 abc	Tifgreen	0.87 abc
		Tifdwarf	0.90 abcd
U-3	19.7 abcd		
Sunturf	19.8 abcd	Tiffine	0.91 abcd
Santa Ana	20.1 abcd	Texturf-1F	0.91 abcd
Midiron	20.3 abcd	Everglades	0.94 bcde
Tifgreen	21.7 bcde	Midiron	0.95 bcde
		Tifway	0.97 bcde
Tifway	23.7 cdef		
Bayshore	24.9 defg	Midway	1.00 cdef
Common (seeded)	26.7 efg	Bayshore	1.00 cdef
FB-119	26.8 efg	Tiflawn	1.01 cdef
Tiffine	26.9 efg	Common (seeded)	1.02 cdef
		Santa Ana	1.03 cdef
NK-78098 (seeded)	27.4 efg		
Tiflawn	27.5 efg	NK-78098 (seeded)	1.04 cdef
Ormond	27.9 efg	Texturf-10	1.07 def
Texturf-1F	29.2 fg	FB-119	1.08 ef
Everglades	30.6 g	Ormond	1.14 f
Texturf-10	30.7 g	U-3	1.30 g

[1] Average of nine measurements; values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

TABLE 5. THE COLOR/TEMPERATURE RESPONSES OF 19 BERMUDAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Fall Low Temperature Color Retention[2] Nov. , 1981	Cultivar	Spring Greenup Rate (percent green) March 23, 1981
Santa Ana	7.3 a[1]	Tifdwarf	30.0 a[1]
NK-78098 (seeded)	6.3 a	PeeDee	25.0 ab
Common (seeded)	6.0 ab	Common (seeded)	22.5 ab
Midiron	6.0 ab	Midiron	20.0 ab
Everglades	5.6 abc	Texturf-10	20.0 ab
Midway	5.5 abc	Tifgreen	20.0 ab
Tifway	5.3 abc	NK-78098 (seeded)	19.3 ab
Ormond	5.0 abcd	Ormond	18.3 ab
Sunturf	4.6 abcde	Everglades	16.6 abc
Tiffine	4.6 abcde	FB-119	16.6 abc
Tiflawn	4.6 abcde	Midway	14.0 bc
Bayshore	3.3 bcde	Tiffine	12.6 bc
Texturf-1F	3.3 bcde	Tiflawn	12.3 bc
Texturf-10	2.8 cde	Bayshore	11.6 bc
PeeDee	2.3 de	Sunturf	8.0 bc
Tifgreen	2.3 de	U-3	7.0 bc
FB-119	2.0 e	Tifway	6.6 bc
Tifdwarf	2.0 e	Texturf-1F	6.0 bc
U-3	2.0 e	Santa Ana	3.0 c

[1] Values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

[2] Visual estimate with 9= most green and 1= no color.

PR-4034

St. Augustinegrass Cultivar Update

J.B. Beard, R.L. Toler, R.L. Crocker, and M.P. Grisham

Information concerning the characterization of the individual St. Augustinegrass *(Stenotaphrum secundatum)* cultivars has been quite limited. Furthermore, two new cultivars have been released, specifically Raleigh (NCSA-21) by the North Carolina Agricultural Experiment Station in 1980 and Seville (S-516) by the O.M. Scott & Sons Company in 1981. Thus, a series of cooperative investigations were initiated at College Station, Texas, in 1976 to quantify the specific characteristics for five commercially available St. Augustinegrass cultivars: Floratam, Floratine, Raleigh, Seville, and Texas Common. All five are propagated only through vegetative means, such as sodding, plugging, or sprigging. There is no seed commercially available. Vegetative planting material for each of the first four cultivars was obtained from the respective originating breeder; while the 'Texas Common' material was obtained from the Milberger Sod Farm at Bay City, Texas. There is no uniform source of Texas Common, thus it's characteristics may vary depending upon the particular source.

This summary of results is based on replicated field data and on detailed laboratory assessments conducted during the past 4 years. The turfgrass field plots were established in August of 1978 on a well drained, modified, loamy-sand root zone. The plot size is 6 x 9 feet, arranged in a randomized block design with three replications. The experimental area is mowed twice weekly at 1.5 inches and receives 0.5 pound of nitrogen per 1,000 square feet per growing month. Phosphorous and potassium are applied as needed based on annual soil tests. The area is irrigated as needed to prevent visible wilt. In addition to the field results, detailed laboratory procedures were developed and utilized to assess St. Augustine decline virus resistance, chinch bug resistance, cold hardiness, shade adaptation, and downy mildew resistance. Detailed published data for the five St. Augustinegrass cultivars can be found in the Texas Agricultural Experiment Station Consolidated Progress Reports on Turfgrass Research for 1977-78 (PR 3484-3493) 1978-79 (PR 3667-3678), and 1979-80 (PR 3831-3851).

A minimum of 2 additional years will be needed to complete this series of experiments. Additional information will be generated in the upcoming years including specific data concerning gray leaf spot and brown patch resistance, shade adaptation, water use rate, drought tolerance, nitrogen requirement, and white grub resistance.

Summary of Results

The comparative characteristics of the five commercially available St. Augustinegrass cultivars are summarized in Table 1. The comparative rankings for environmental adaptation in the summary table are in the following order: excellent-good- medium-fair-poor.

All five cultivars form acceptable turfgrass covers under pest free, non-stress environmental conditions. Texas Common and Seville are characterized as lower growing turf types, Floratam forms a coarse textured turf, and both Floratine and Raleigh have intermediate rankings. Raleigh exhibits a particularly rapid establishment rate.

A slow rate of vertical leaf extension is associated with a lower mowing frequency. Seville has a slow leaf extension rate and thus ranks very good in terms of a less frequent mowing requirement. In contrast, Floratam has a very rapid leaf extension rate, Floratine and Texas Common are only slightly less rapid, and Raleigh is intermediate.

The lack of cold hardiness has limited the use of the St. Augustinegrasses in the northern part of the state. Most low-temperature hardy (temperature stresses below 32 degrees F) of the five cultivars are Texas Common and Raleigh, while Floratam is very poor in this regard. Even the two most low-temperature hardy cultivars, Raleigh and Texas Common, may be damaged at 4 to 5 year intervals when grown north of a line running from College Station to Austin, Texas. No low temperature injury problems are anticipated from any of the St. Augustinegrass cultivars, including Floratam, when grown south of Houston, Texas.

More than 25 percent of the turfs grown in Texas are under some degree of shade stress. Recent data show Floratam to possess poor shade adaptation in contrast to the good shade adaptation of Texas Common and Floratine. Although the available experimental data are not yet conclusive, both Raleigh and Seville are showing promising shade adaptation. That is, they have demonstrated the ability to form lateral stems and tillers under low light intensities. Equally important in shade adaptation is the increased potential for disease development, expecially brown patch (*Rhizoctonia* spp.) and gray leaf spot (*Piricularia grisea*). These aspects of shade adaptation are yet to be fully evaluated for the five cultivars.

Raleigh has demonstrated a very good spring greenup rate with Floratam ranking at the other end of the spectrum. A slower spring greenup rate increases the potential for weed seed germination and weed invasion during early spring. It should be emphasized that the rate of spring greenup is distinctly different from low temperature hardiness. None of the five cultivars have demonstrated a superior response in terms of fall low temperature color retention.

The incidence of St. Augustine decline virus continues to increase in severity in Texas. Resistance to the SAD virus is the most important characteristic to be considered when selecting a St. Augustinegrass cultivar for Texas. Floratam, Raleigh, and Seville all have good resistance to SAD virus. To be successfully used in Texas, any St. Augustinegrass cultivar released in the future should have SAD resistance.

While three of the cultivars possess SAD resistance, only one, Floratam, has been shown to have reasonable resistance to chinch bug. Southern chinch bug (*Blissus insularis* Barber) is a greater problem in the southern half of the state, especially during droughty years.

Downy mildew (*Sclerophthora macrospora*) is a problem primarily under rainy, wet soil conditions and where surface movement of water occurs. It is found more commonly in those portions of the state, such as along the Gulf Coast, that are subjected to higher rainfall. None of the five cultivars possess resistance to downy mildew, with Seville being more susceptible than the other four.

Gray leafspot (*Piricularia grisea*) is a late spring-early summer disease problem. Although none of the five cultivars has shown superior resistance to gray leaf spot, Floratam and Raleigh are less prone to this disease than the other three cultivars.

Brown patch (*Rhizoctonia* spp.) is a very severe problem in Texas on St. Augustinegrass turfs during early fall. None of the five cultivars are resistant to brown patch. Floratam and Seville are slightly less susceptible to certain strains of *Rhizoctonia* than are the other three cultivars.

This summary will be updated and ammended as additional information is generated from the Texas Agricultural Experiment Station Turfgrass Research Program. These studies are partially supported by grants from the Texas Sod Producers Association.

TABLE 1. SUMMARY COMPARISONS AMONG FIVE COMMERCIALLY AVAILABLE ST. AUGUSTINEGRASS CULTIVARS AT COLLEGE STATION, TEXAS

Characteristics	Floratam	Floratine	Raleigh	Seville	Texas Common*
Turf					
Color	Blue-green	Blue-green	Medium green	Medium, dark green	Medium green
Leaf texture	Coarse	Coarse	Medium coarse	Medium	Medium coarse
Growth habit	Semi-erect	Medium low	Intermediate	Low	Low
Establishment rate	Medium	Medium	Good	Medium good	Medium
Vertical leaf extension rate	Rapid	Medium rapid	Medium	Very slow	Medium rapid
Environmental Adaptation					
Cold hardiness	Poor	Medium	Medium good	Fair	Medium good
Shade adaptation**	Poor	Good	Promising***	Promising***	Good
Spring greenup rate	Poor	Medium	Very good	Medium	Good
Fall low temperature color retention	Fair	Medium good	Medium	Medium	Medium
Pest Resistance					
St. Augustine Decline virus	Resistant	Susceptible	Resistant	Resistant	Susceptible
Chinch bug	Resistant	Susceptible	Susceptible	Susceptible	Susceptible
Downy mildew	Moderately susceptible	Moderately susceptible	Moderately susceptible	Susceptible	Moderately suceptible
Gray leafspot	Moderately susceptible	Susceptible	Moderately susceptible	Susceptible	Susceptible
Brown patch	Moderately susceptible	Susceptible	Susceptible	Moderately susceptible	Susceptible

* Characteristics can vary with source.
** Ability to grow at low light intensities.
*** Preliminary data are promising, but more detailed studies are needed.

PR-4035

1981 St. Augustinegrass Cultivar Characterizations

J.B. Beard, S.M. Batten, S.D. Griggs, K.S. Kim,
M.P. Grisham, and S.R. Reed

The number of commercially available St. Augustinegrass *(Stenotaphrum secundatum)* cultivars has increased by 50 percent as a result of the introduction of Raleigh (NCSA-21) and Seville (S-516). These two new cultivars plus five culti- vars that have been commercially available are being assessed for adaptation and performance under Texas condi- tions. The 1981 seasonal evaluations presented in this Progress Report include turfgrass quality, shoot density, leaf extension rate, leaf width, internode length, and inter- node diameter.

A minimum of 6 continuous years is required to obtain a reliable field evaluation of turfgrass cultivars. This pro- gress report represents the third year of a 6-year study. Thus, final conclusions concerning the adaptation and perform- ance of these St. Augustinegrass cultivars cannot be made until termination of this study.

Research Procedure

Five St. Augustinegrass cultivars - Floratam, Raleigh, Seville, Scott's 1081, and Texas Common - were vegetatively established in August of 1978 on a well drained, modified loamy sand root zone at the TAMU Turfgrass Field Laboratory. Subsequently, two additional cultivars - Bitter Blue and Floratine - were planted vegetatively in July of 1979. The Texas Common utilized in these studies was obtained from Milberger Sod Farm of Bay City, Texas. The plot size is 6 x 9 feet arranged in a randomized block design with three replications. The experimental area is mowed twice weekly at a 1.5 inch cutting height with clippings returned. The experimental area received 0.5 pound of nitrogen per 1,000 square feet per growing month through 1979. Three sub-plot nitrogen differentials of 0.25, 0.5, and 0.75 pound of nitrogen per 1,000 feet per growing month were super- imposed across the cultivars in June of 1980 . Phosphorous and potassium are applied as needed based on annual soil tests. Irrigation is applied as needed to prevent visual wilt. The use of preemergent herbicides or a preventive insecticide/ fungicide program is avoided in this cultivar study. A pest- icide is applied only as needed to prevent a complete loss of stand. To date this has not been necessary other than one appli- cation during the year of diazinon for insect control.

Results

Turfgrass Quality. The comparative seasonal turfgrass qual- ity of the seven St. Augustinegrass cultivars are shown in Table 1. Seville, Floratam, and Texas Common ranked highest in overall seasonal turfgrass quality. Intermediate in turf- grass quality were Raleigh and Bitter Blue, with Floratine ranking lowest. Floratine had a substantial invasion of bermuda- grass in comparison to the other six cultivars. Raleigh, which had ranked quite high in turfgrass quality in previous years, also was a strong performer in the early months of April and May of 1981. Subsequently, Raleigh declined in turf- grass quality due to a disease complex involving gray leaf spot and brown patch. In contrast, Seville and Floratam ex- hibited no serious deterioration due to this summer disease complex, while Texas Common ranked intermediate. This is the first time that this summer disease complex has occurred on Raleigh. It remains to be seen if this will be a reoccurring problem during subsequent growing seasons.

Density

A dense turf is able to compete against weed invasion more successfully. Among the St. Augustinegrass cultivars, Scott's 1081, Raleigh, Bitter Blue, Seville, and Texas Common, all ranked similar in shoot density when the counts were made in October of 1981 (Table 2). Both Floratine and Floratam ranked much lower in overall shoot density, but only Floratine exhibited problems with weed invasion, primarily bermudagrass.

Vertical Leaf Extension

The more rapid the leaf extension rate, the greater the mowing frequency, which results in higher labor and energy costs. The comparative vertical leaf extension rates of the seven St. Augustinegrass cultivars are shown in Table 2. Seville exhibited a much lower vertical leaf extension rate, with Floratam ranking the most rapid. There is a two-fold differential in vertical leaf extension rates among the seven cultivars, which is very significant in terms of the relative mowing frequency required.

Leaf Width

Many of the St. Augustinegrasses used in the past have been characterized by a very coarse leaf texture in comparison to most turfgrass cultivars utilized in North America. The comparative leaf widths of seven St. Augustinegrass cultivars are shown in Table 2. Seville had the narrowest leaf width with the Florida types, such as Bitter Blue, Floratam, and Floratine exhibiting a coarse leaf texture.

Internode Characteristics

St. Augustinegrass possesses lateral stems called stolons that grow horizontally above ground, in contrast to bermudagrass which also has below ground stems called rhizomes. The comparative internode lengths and diameters of the stolons of seven St. Augustinegrass cultivars are shown in Table 2. Scott's 1081 possessed the shortest internode length, with Raleigh having the longer internodes. The remainder of the cultivar's ranked intermediate in terms of internode length. Texas Common and Scott's 1081 had the smallest internode diameter, with Bitter Blue and Floratam possessing much thicker stolons. The same general trends in terms of internode characteristics have been observed in previous years. It should be noted that the internode length tends to be longer during the initial establishment year. Subsequently, there is a general trend to a shorter internode length regardless of the cultivar involved.

This investigation is partially supported by grants from the Texas Sod Producers Association.

TABLE 1. COMPARATIVE SEASONAL TURFGRASS QUALITY[1] OF SEVEN ST. AUGUSTINGRASS CULTIVARS AT COLLEGE STATION, TEXAS

Cultivar	May	June	July	August	September	October	Seasonal Average
Seville	6.0 a[2]	7.0 a[2]	7.2 a[2]	6.3 ab[2]	7.6 ab[2]	8.0 a[2]	7.0 a[2]
Floratam	5.6 a	6.8 a	7.2 a	6.8 a	8.0 a	6.6 ab	6.9 a
Texas Common	6.2 a	5.8 ab	5.5 ab	5.1 bc	7.0 abcd	7.2 a	6.2 ab
Scott's 1081	5.0 a	4.6 bc	4.3 b	4.6 cd	6.3 abcde	7.2 a	5.4 bc
Bitter Blue	3.6 a	5.3 b	4.0 b	4.0 cd	5.6 bcde	5.2 bc	4.7 cd
Raleigh	6.0 a	4.6 bc	4.5 b	4.2 cd	4.3 e	4.5 c	4.7 cd
Floratine	4.0 a	3.6 c	4.0 b	3.5 d	4.8 de	4.5 c	4.1 d

[1]Visual estimate of turfgrass quality with 9-best and 1-poorest.

[2]Values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range Test.

TABLE 2. COMPARATIVE TURFGRASS CHARACTERISTICS OF SEVEN ST. AUGUSTINEGRASS CULTIVARS AT COLLEGE STATION, TEXAS

Cultivar	Internode Length[1] (mm)	Internode Diameter[1] (mm)	Leaf Width (mm)	Vertical Leaf Extension Rate[1] (mm)	Shoot Density[2] (per square decimeter)
Bitter Blue	21.5 d[3]	3.8 d3	8.1 d3	20.6 c3	20.5 a3
Floratam	22.1 d	3.8 d	8.1 d	27.6 e	13.8 c
Floratine	21.9 d	3.4 c	8.0 cd	22.2 cd	17.8 b
Raleigh	24.2 e	3.0 ab	7.6 bc	18.7 b	20.6 a
Scott's 1081	16.0 a	2.7 a	7.2 b	18.6 b	20.8 a
Seville	19.5 bc	3.1 b	6.4 a	11.3 a	19.8 ab
Texas Common	18.3 b	2.7 a	7.7 bc	21.0 c	19.8 ab

[1]Average of 15 measurements made October 18, 1981.

[2]Average of 9 measurements made October 18, 1981.

[3]Values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

PR-4036

1981 Tall Fescues Cultivar Assessment for Shaded Sites in the Humid Southwest

J.B. Beard, S.M. Batten, S.D. Griggs, and S.R. Reed

Twenty percent of the turfs grown in Texas are maintained under some degree of shade stress. The adaptation of tall fescue to shaded sites in Texas has been demonstrated through 5 years of investigations at Texas A&M University. When grown under shaded environments with adequate irrigation, tall fescue can withstand the summer heat stress of College Station, Texas, without objectionable thinning. This experiment is part of the southern regional tall fescue evaluation study, which is a multistate coordinated investigation. This report represents the third year of a 6-year study. Final recommendations as to the preferred shade adapted tall fescue cultivars for the humid portions of Texas can not be made until completion of the full 6-year assessment.

Research Procedure

The experimental site was carefully located under a mature stand of post oak trees at the TAMU Turfgrass Field Laboratory. The root zone was partially modified by the addition of a 2-inch sand layer onto the native Lufkin fine sandy loam in order to ensure adequate drainage. Prior to planting the soil was fumigated with methyl bromide for a 24-hour period. Subsequently, 12 commercially available tall fescue cultivars were seeded on April 14, 1979. The plot size is 4 x 6 feet arranged in a randomized block design with three replications. The experimental area is mowed twice weekly at a 2-inch cutting height with clippings returned. The experimental area receives 0.5 lb of nitrogen per 1,000 square feet per growing month from October through April of each year. Phosphorus and potassium are applied as needed based on an annual soil test. Irrigation is applied as needed to prevent visual wilt. The use of preemergence herbicides or a preventive insecticide/fungicide program is avoided in this cultivar study. A pesticide is applied only if needed to prevent a complete loss of stand. To date, this has not been necessary.

Results

The comparative seasonal turfgrass quality of the 12 commercially available tall fescue cultivars included in this shade adaptation study is shown in Table 1. There is a slight decline in turfgrass quality during the summer heat stress period of July and August, which is most evident among the better performing cultivars. Falcon (NJ-78) and Rebel (T-5) were the top ranked of the 12 tall fescue cultivars during 1981. Falcon and Rebel possess better summer growth characteristics than the other tall fescue cultivars. It is assumed that this is associated primarily with heat stress since adequate soil moisture was maintained. Rebel is able to sustain a more distinct dark green color during summer heat stress. Also ranking relatively high in overall seasonal turfgrass quality were Kentucky 31, Kenwell, and Galway tall fescues. Ranking intermediate were Kenmont, Kenhy, Fawn, and Monoco; with Clemfine, Alta, and Goar giving inferior performance. These general rankings of tall fescue cultivar shade adaptation are basically the same as those observed during the first growing season of 1979.

TABLE 1. COMPARATIVE SEASONAL TURFGRASS QUALITY OF 12 TALL FESCUE CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Turfgrass Quality with 1-best & 9-poorest											
	February	March	April	May	June	July	August	September	October	November	December	Seasonal Average
Falcon	7.7	7.4	7.8	7.0	7.2	6.8	7.0	6.3	6.8	7.2	7.5	7.2 a[1]
Rebel	6.8	7.0	7.0	7.3	7.0	6.8	6.7	7.2	7.0	7.5	7.3	7.1 a
Kentucky 31	7.3	7.5	6.7	6.5	6.3	5.8	6.7	6.7	6.5	6.8	5.8	6.6 ab
Kenwell	7.0	7.3	7.0	6.2	6.0	5.8	5.7	5.7	6.0	5.9	6.2	6.3 ab
Galway	7.0	6.5	6.5	6.8	6.3	5.8	6.0	5.3	6.2	5.7	6.2	6.2 ab
Kenmont	6.0	5.8	6.4	5.3	6.1	6.7	6.2	5.7	5.5	5.7	6.2	6.0 bc
Kenhy	6.8	6.0	6.3	5.8	5.8	6.3	6.0	5.8	5.5	5.8	5.8	6.0 bc
Fawn	5.5	6.5	6.5	5.0	5.5	4.3	5.5	5.8	5.5	6.3	5.8	5.7 bc
Monoco	6.0	5.5	5.5	5.3	4.5	5.0	5.3	4.5	6.3	6.5	5.8	5.5 bc
Clemfine	6.0	5.3	6.3	4.7	4.3	4.8	4.3	4.3	4.8	5.5	4.7	5.0 c
Alta	4.9	4.8	4.9	5.3	4.5	4.7	5.5	4.0	5.3	5.0	4.8	4.9 c
Goar	2.8	2.8	3.5	3.8	3.5	2.3	3.2	3.3	3.3	3.8	3.5	3.3 d

[1]Values joined by the same letter are not significantly different at the 5% level for the Duncan's multiple range test.

PR-4037

1981 Zoysiagrass Cultivar and Selection Characterizations

J.B. Beard, S.M. Batten, S.R. Reed, S.D. Griggs, and M.P. Grisham

Zoysiagrass *(Zoysia* spp.) is a warm season perennial turfgrass introduced from China which is characterized by superior wear tolerance and very good heat and drought tolerance. In addition, it has a moderate to low nitrogen requirement and is adapted to shaded conditions. To date the zoysiagrasses have not been widely used in Texas. One of the main problems is a lack of establishment vigor plus a slow recuperative rate when used on recreational and sport fields. There also have been reports of rust problems on zoysiagrass in Texas. Nevertheless, zoysiagrass has so many very favorable attributes for minimal maintenance lawn conditions that it needs continual assessment, especially the newly developed selections from the few active breeding programs in the United States.

This progress report contains the turfgrass quality evaluations for zoysiagrass cultivars from the 1981 growing season. The stands have not stabilized to the point where representative turfgrass characterizations can be obtained. This portion of the cultivar assessment will be conducted during 1982.

A minimum of 6 continuous years is required to obtain a reliable field evaluation of turfgrass cultivars. This is the third year of a 6-year study. Thus, final conclusions concerning the adaptation and performance of these zoysiagrass cultivars can not be made until the termination of this experiment.

Research Procedure

Four commercially available zoysiagrass *(Zoysia spp.)* cultivars and 12 advanced zoysiagrass selections were planted in August of 1979 on a well-drained, modified, loamy sand root zone at the TAMU Turfgrass Field Laboratory. All were planted vegetatively by sprigging. Plot size for the cultivar assessments is 5 x 15 feet arranged in a randomized block design with three replications. In the case of the advanced selections, the plot size is 4 x 4 feet, arranged in a randomized block design with two replications. The plots are mowed twice weekly at a 0.75 inch cutting height with clippings returned. During 1980 the entire study area was fertilized at a rate of 0.5 lb nitrogen per 1,000 square feet per growing month. During 1981, three subplot nitrogen fertility differentials were superimposed across the cultivars at rates of 0.25, 0.5, and 0.75 lb of nitrogen per 1,000 square feet per growing month. Phosphorus and potassium are applied as needed based on annual soil tests. Irrigation is applied as needed to prevent visible wilt. The use of preemergence herbicides or a preventive insecticide/ fungicide program is avoided in this cultivar study. A pesticide is applied only as needed to prevent a complete loss of stand. To date, this has not been necessary. Through this approach there is a better opportunity to obtain data concerning the relative susceptibilities of cultivars to disease-causing pathogens and to insects.

Results

The comparative seasonal performances of the four zoysiagrass cultivars are shown in Table 1. The visual estimate of turfgrass quality is based on two primary components: a) a uniformity of color, density, and texture, and b) a high shoot density. FC13521 *(Z. matrella)* has ranked consistently high in seasonal turfgrass quality. Emerald *(Z. tenufolia x Z. japonica)* and Meyer *(Z. japonica)* have ranked slightly lower in quality, but still very acceptable. Midwest (Z. japonica) ranked lowest in overall turfgrass quality, primarily due to a lower density, a more yellow-green almost chlorotic appearance, and a poor mowing quality when compared with the other three zoysiagrass cultivars.

During the late July-August period, a disease attack caused a leaf defoliation. The result was a brown, stemmy appearance in an irregular shaped pattern. The problem was primarily associated with the Emerald cultivar, athough a slight amount was also observed in FC13521. The disease is yet to be positively identified, but is thought to be related to the Helminthosporium disease complex. It was first observed to a very slight extent in 1980 and then reappeared with more injury during the summer of 1981. Meyer showed no outward evidence of this disease problem. No other disease or insect problems have been evident on these cultivars. Rust, which has been reported to be a severe problem in the past in some portions of Texas, has not been a problem on these tests.

One of the more striking aspects of this zoysiagrass assessment has been the ability to sustain growth and reasonably good color during the very severe heat stress periods of midsummer. All four zoysiagrass cultivars sustained very acceptable turfgrass quality under conditions where summer midday temperatures were above 100 degrees F for more than 30 days. Under this situation, the St. Augustinegrasses showed a very definite deterioration in overall turfgrass quality and growth, and bermudagrasses also declined.

Among the 12 advanced selections, most were received from the Kansas Agricultural Experiment Station and from the USDA Turfgrass Research Program in Beltsville, Maryland. A number of these selections have exhibited an improved establishment rate from vegetative planting in comparison to the commercially available cultivars. They also possess a darker green color and in some cases are reported to possess good rust resistance under Kansas conditions. Seven of the 12 selections have outperformed the commercially available cultivars in terms of seasonal turfgrass quality. These selections will be evaluated in detail for adaptation to Texas conditions. Several may become commercially available within the next several years.

TABLE 1. COMPARATIVE SEASONAL TURFGRASS QUALITY[1] OF FOUR ZOYSTAGRASS CULTIVARS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	June	July	August	September	October	Seasonal Average
FC13521	6.5a	6.7a	6.0a	5.8a	7.8a	6.6a
Emerald	5.7a	5.5a	5.0b	4.8b	7.5a	5.7ab
Meyer	5.5ab	5.3ab	4.7b	5.0b	7.2a	5.3b
Midwest	5.0b	5.0b	5.0b	5.0b	5.5b	5.1b

[1]Visual estimate of turfgrass quality with 9-best and 1-poorest.

[2]Values joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

PR-4038

An Initial Characterization of Two Minimal Maintenance Turfgrass Species for Texas— Buffalograss and Centipedegrass

J.B. Beard, S.M. Batten, S.R. Reed, K.S. Kim, and S.D. Griggs

Buffalograss *(Buchloe dactyloides)* and centipedegrass *(Eremochloa ophiuroides)* are recognized as minimal maintenance turfgrasses. Their use as a turfgrass has been limited in Texas as is the information concerning their turf characteristics and specific adaptation under various Texas conditions. Due to an increasing interest in minimal maintenance turfgrasses, an experiment was established to characterize the commercially available cultivars of buffalograss and centipedegrass.

Buffalograss

Research Procedure

The four commercially available buffalograss cultivars were established in September of 1979 on a well drained, modified, loamy sand root zone at the TAMU Turfgrass Field Laboratory. The seeding rate was 3 pounds per 1,000 square feet. The plot size is 5 x 9 feet arranged in a randomized block design with three replications. The area is mowed twice weekly at a 2.5 inch cutting height with clippings returned. The experimental area receives 0.5 pound of nitrogen per 1,000 square feet in April and in August. Phosphorus and potassium are applied as needed based on annual soil tests. Irrigation is applied to prevent severe visual wilt. No pesticides are applied to the area and no specific insect or disease problems have been noted to date.

Results

The establishment rate of buffalograss under the conditions of this study was surprisingly rapid, approaching that of seeded perennial ryegrass. The available literature suggests that buffalograss is a slow establishing species. This may be the case under unirrigated, semi-arid conditions in the Plains region. However, based on this study, the buffalograss cultivars exhibit a very rapid establishment rate if favorable environmental and soil conditions are provided.

No significant difference was found in shoot density, vertical leaf extension rate, and internode length among the four buffalograss cultivars evaluated (Table 1). Texoka did have a slightly wider leaf width and a larger internode diameter. For the most part, all four cultivars are quite similar in appearance and ranked comparable in turfgrass quality in 1979 and 1980. However, in 1981 differentials began to appear in terms of comparative resistance to weed invasion. Texoka was more resistant to weed invasion, while Sharps ranked poorest. The extent of weed invasion increased even more in the spring of 1982 as a result of very wet weather. No insect or disease problems have been noted to date.

Centipedegrass

Research Procedure

Three commercially available centipedegrass cultivars, Common, Oklawn, and Tennessee Hardy, were established in September of 1979 on a well-drained, modified, loamy sand root zone at the TAMU Turfgrass Field Laboratory. The Common centipedegrass was seeded, while Oklawn and Tennessee Hardy were planted by vegetative propagation. The plot size is 5 x 9 feet arranged in a randomized block design with three replications. The area is mowed twice weekly at a 1.5 inch cutting height with clippings returned.

The experimental area receives 0.5 pound of nitrogen per 1,000 square feet in April and in August. Phosphorus and potassium are applied as needed based on annual soil tests. Irrigation is applied as needed to prevent visual wilt. No pesticides are applied to the area and no specific insect or disease problems have been noted to date.

Results

The limited quantity of vegetative material slowed the rate of establishment of the centipedegrass plots. Since they were not fully covered until late 1980, the plots had not stabilized to a point where reliable turfgrass characteristics can be assessed. This is scheduled to be accomplished in the fall of 1982.

The most striking observation to date is the good turf forming characteristics of centipedegrass under alkaline soil conditions of pH 7.8. Traditionally centipedegrass has been regarded as a warm- season turfgrass species that is adapted to acidic soils, especially pH's below 5.5. It will be interesting to follow the performance of these centipedegrasses over the next 4 years under alkaline soil conditions. The initial impressive performance of centipedegrass under alkaline soil conditions raises the question as to why so little centipedegrass has been used for turf purposes in Texas in the past. Only a slight iron chlorosis has been observed on a periodic basis around the perimeter of the plot area. No corrective iron applications have been made to date.

These comments are presented only as a preliminary report. Four more years will be required before sound conclusions can be made.

TABLE 1. BUFFALOGRASS (BUCHLOE SPP.) CULTIVAR EVALUATIONS FOR TURFGRASS CHARACTERISTCS IN 1981 AT COLLEGE STATION, TEXAS

Cultivar	Shoot Density (per sq. dm.)	Leaf Width (mm)	Vertical Leaf Extension Rate (mm)	Internode Length (mm)	Internode Diameter (mm)	Percent Weed Invasion
Texoka	31.3 a[1]	1.4 a[1]	9.7 a[1]	23.1 a[1]	1.4 a[1]	12 a[1]
Comanche	32.2 a	1.2 a b	11.3 a	26.7 a	1.2 a b	23 b
Common	32.6 a	1.1 b	11.9 a	29.1 a	1.3 a b	27 b
Sharps	33.9 a	1.1 b	8.3 a	30.5 a	1.1 b	36 c

[1]Values joined by the same letter are not significantly different at the 5% level for the Duncan's multiple range test.

PR-4039

A Preliminary Assessment of Adalayd Paspalum Vaginatum for Turfgrass Characteristics and Adaptation to Texas Conditions

J.B. Beard, S.M. Batten, S.R. Reed, K.S. Kim, and S.D. Griggs

Paspalum vaginatum is native to the tropical-subtropical climatic regions. It can be found growing along the seacoast and in brackish sands from North Carolina to Florida to Texas. The Adalayd cultivar of Paspalum vaginatum was introduced from Australia into the United States during the 1970's. Initial observations, primarily in California, indicated it has promise for use on soils possessing a high salinity level. For this reason, the new turfgrass was introduced in the species/cultivar assessment study at College Station, Texas.

Research Procedure

Adalayd *Paspalum vaginatum* was vegetatively planted into the bermudagrass cultivar evaluation block at the TAMU Turfgrass Field Laboratory in July of 1980, where the bermudagrass *(Cynodon spp.)* cultivars had already been established for 2 years. The soil has a well-drained, modified, loamy-sand root zone. The plot size is 5 x 15 feet arranged in a randomized block design with three replications. The area was mowed twice weekly at 1.0 inch in 1979 and at 0.75 inch since 1980, with clippings returned. In 1979 and 1980 the entire area was fertilized at a rate of 0.5 pound nitrogen per 1,000 square feet per growing month. During 1981 three subplot nitrogen fertility differentials were superimposed across the cultivars at rates of 0.25, 0.5, and 0.75 pound of nitrogen per 1,000 square feet per growing month. Phosphorus and potassium are applied as needed based on annual soil tests. Irrigation is applied as needed to prevent visual wilt. Neither preemergence herbicides nor preventive insecticide/fungicide programs are used in this cultivar study.

In addition to the College Station planting, Adalayd was planted into a very saline soil (salt index -67) on an irrigated fairway near Galveston in 1980. This area received a medium low intensity of maintenance in terms of fertilization and irrigation, and was located in an intense traffic area. Included with the Adalayd were Tifway and Tifgreen bermudagrasses *Cynodon spp.).*

Results

The establishment rate of Adalayd was similar to that for most of the improved bermudagrass cultivars. It has the capability to spread quite rapidly by elongated lateral stolons and by small rhizomes. Adalayd forms very diminutive seedheads that are less noticeable than for many of the bermudagrass cultivars.

The change in cutting height from 1.0 to 0.75 inch had no significant effect on the turfgrass quality of Adalayd. The overall mowing quality has been good. It apparently responds to nitrogen fertilization, although sufficient data are not yet available to make specific recommendations as to the nitrogen requirement under Texas conditions.

Adalayd has exhibited acceptable turfgrass quality during the initial two growing seasons under College Station climatic conditions (Table 1). The shoot density of Adalayd is significantly lower than for Tifway, Midway, and Santa Ana bermudagrasses. Thus, Adalayd is more prone to invasion by winter annual weeds such as annual bluegrass *(Poa annua).*

The vertical leaf extension rate is comparable to that of Midway and significantly more rapid than for Tifway and Santa Ana. Adalayd has a wider leaf and internode diameter than Tifway, Midway, and Santa Ana. Its internode length is comparable to Midway and Santa Ana, but shorter than Tifway.

The fall low temperature color retention of Adalayd ranked highest in comparison to most bermudagrass cultivars and was comparable to Santa Ana. In contrast, Adalayd ranked as one of the poorest in spring greenup rate, being comparable to Santa Ana and Tifway.

Observations made at the plots on Galveston Island indicate superiority in terms of adaptation to high salt conditions in comparison to Tifway and Tifgreen bermudagrasses. These results suggest that Adalayd is a promising new cultivar for use under saline soil conditions.

This information is presented as a progress report. Final evaluation as to the adaptability and use of Adalayd under Texas conditions cannot be made for at least 4 more years. No significant diseases or insect problems have been noted to date. It is too early to determine if thatch problems may develop.

TABLE 1. A COMPARISON OF THE TURFGRASS CHARACTERISTICS AND PERFORMANCE BETWEEN ADALAYD ***PASPALUM VAGINATUM*** AND THREE BERMUDAGRASSES IN 1981 AT COLLEGE STATION, TEXAS

Turfgrass Characteristic	Adalayd *Paspalum vaginatum*	Bermudagrass Cultivar		
		Midway	Santa Ana	Tifway
Average seasonal turfgrass quality (9=best; 1=poorest)	5.3 b	6.4 a	6.0 a	5.4 a
Shoot density (per sq. dm.)	33.0 c	42.9 b	39.6 b	52.7 a
Vertical leaf extension rate (mm)	18.3 b	16.7 b	10.9 a	11.3 a
Leaf width (mm)	2.21 c	1.72 a	1.98 b	1.54 a
Internode length (mm)	15.0 a	17.0 a	20.1 c	23.7 b
Internode diameter (mm)	2.15 b	1.00 a	1.03 a	0.97 a
Fall low temperature color retention (9=best; 1=poorest)	7.3 a	5.5 a	7.3 a	5.3 a
Spring greenup rate (percent green)	5.6 b	14.0 a	3.0 b	6.6 b

Values within a line joined by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

PR-4040

Water Conservation—A Potentially New Dimension in the Use of Growth Regulators

D. Johns and J.B. Beard

The rate of transpiration from St. Augustinegrass *(Stenotaphrum secundatum)* has been shown to be proportional to the amount of leaf area present. Under conditions favorable for turfgrass growth, the transpiration rate of a mowed turf will increase with time. Transpiration increase can be as much as 30 percent over a 5-day period under normal nutritional conditions. Over the same 5-day period, the leaf area index may increase by 35 to 100 percent, depending on the mowing height selected. Thus, the increases in transpiration are directly attributable to increases in leaf area per unit of land surface. Based on this research, a field study was initiated to evaluate the effectiveness of a growth inhibitor in reducing leaf growth and transpiration on two turfgrass species.

Research Procedure

Duplicate experiments were conducted on both Texas Common St. Augustinegrass *(Stenotaphrum secundatum)* and Tifway bermudagrass *(Cynodon spp.)* growing on a well drained, modified, loamy sand root zone. The plot size was 6 x 6.5 feet arranged in a randomized block design with three replications. In the center of each plot was positioned a miniature weighable lysimeter, 10 inches in diameter. Good quality turf sods were transplanted onto the lysimeters. When in a normal position, the lysimeters were positioned in holes such that the surface matched uniformly with the adjacent turf sward. These lysimeters could be removed and weighed to determine the amount of transpiration during a specific time interval. The treatments utilized in this study included various rates of the experimental growth inhibitor flurprimidol (EL-500) in various combinations with and without mowing. The initial treatment applications were made in early July of both 1980 and 1981.

Assessments of the transpiration rate were made at 15-day intervals through a 100-day period. The actual transpiration measurement was made over a 24-hour period by weighing the lysimeters at 9:00 p.m. on consecutive nights. In addition, measurements of leaf area were made on day 60 using a leaf area meter. The leaf area indices were then calculated from these data. Appropriate analyses of variance were then calculated.

Results

Significant reductions in evapotranspiration were recorded for a period of 14 weeks after application on both the mowed and unmowed plots treated with flurprimidol (El-500). Turfs with the lowest leaf area indices also were characterized by the lowest transpiration rates. The flurprimidol treatments resulted in water conservation ranging from 11 to 29 percent when compared to the mowed untreated plots. The amount of water conservation achieved varied with turfgrass species, application rate, and the specific atmospheric evaporative demand on a given day.

Thus, the principle that transpiration from a turf can be reduced by means of growth inhibitors has been demonstrated. A great deal more research is needed to refine these initial findings in terms of the effects of various types of growth inhibitors, application rates, and timing, as well as potential differential responses across turfgrass species and cultivars. These investigations will continue. The research was partially supported by a grant from the Elanco Products Company.

PR-4041

An Assessment of Antitranspirants on Creeping Bentgrass and Bermudagrass Turfs

G.K. Stahnke and J.B. Beard

Water conservation in turfgrass culture is of increasing concern due to the decline in available water supplies in certain regions of the country plus continued increases in water demands by both municipalities and rural areas of Texas. Techniques that would lower the transpirational level of turf would reduce the irrigation water required, save water, save energy, save pumping costs, and cost of water.

Water use rate is defined as the amount of water required for growth plus the quantity lost by transpiration and evaporation (evapotranspiration) from the plant and soil surfaces. A normal evapotranspiration rate for turfs would be 0.1 to 0.3 inch per day, with rates as high as 0.45 inch per day having been measured at College Station, Texas. Several antitranspirants are either being commercially marketed or have been under experimental testing on a range of plant species. The objective of this investigation was to assess the relative effectiveness of five potential antitranspirants in reducing the water use rates of turfs.

Research Procedure

Five potential antitranspirants--abscisic acid (ABA), B-naphthoxyacetic acid, Stoma-Seal® (a mixture of phenylmercuric acetate (PMA) and Aqua-Gro®), Aqua-Gro® (a soil wetting agent), and Experimental #913 (a monoglycerol ester of decenyl succinic acid in Aqua-Gro®)-- were assessed for their use in reducing the water use rates of turfs. The chemicals were applied as a foliar spray or as a soil drench to two turfgrasses that are commonly used as sport turfs: Penncross creeping bentgrass *(Agrostis palustris)* and Tifway bermudagrass *(Cynodon dactylon x C. transvalensis)*. The turfs were clipped to a 2.5 cm mowing height during the study. Testing was done in a controlled environment growth chamber where the environmental conditions were chosen to give the maximum evapotranspiration rate possible for a well-watered turf. Air temperature, dew point, carbon dioxide level, photosynthetic photon flux density, and wind speed were controlled throughout the study. Experiments lasted between 48 and 72 hours.

Water loss from the turf was measured by weighing at 4-hour intervals during the daytime, with one overnight reading. The hourly rate was calculated from the weight loss. Growth rate was measured by clipping the grass when it reached 2 inches and comparing the length of time it took to reach that height. Usefulness of the antitranspirants was determined by the difference in the transpiration rate of the treated plants versus the untreated plants and by whether or not the plants were damaged by the treatment. Total chlorophyll content, plant color, and relative shoot growth rate were used to determine damage.

To calculate an approximate value for the transpiration rate from the plants, the evaporation rate of a dead turfgrass sod was subtracted from the evapotranspiration rate of a live turfgrass sod exposed to the same conditions.

Results

The initial striking comparison from this investigation was that the base evapotranspiration of bermudagrass was 1/3 less than the base transpiration rate of creeping bentgrass when maintained under comparable environmental, cutting height, and nutritional conditions. Two treatments, ABA and Experimental

#913 in combination with Aqua Gro®, reduced the transpiration rate of creeping bentgrass on the order of 59 percent and 26 percent, respectively, for 48 hours without visual damage or increase in leaf temperatures. In the case of bermudagrass, the ABA applied at 1 x 10^{-4}M was effective in reducing transpiration on the order of 25 percent, but there was also a 23 percent reduction in shoot growth rate. Application rates which produced significant reductions in transpiration for Stoma-Seal® and B-naphthoxyacetic acid also caused browning of the shoots and eventual death of the turf.

It was concluded from these initial studies that ABA and Experimental #913 are promising antitranspirants which warrant further investigation. Unfortunately, the current cost of ABA does not make it economically feasible for use in large scale applications. These comparative investigations were conducted in a controlled environment chamber under nonlimiting soil water conditions. Further research is warranted with Experimental #913 to assess its potential as an antitranspirant on turfgrasses as well as with Stoma-Seal . under typical field conditions.

PR 4042

Effects of the Atmospheric Pollutant Sulfur Dioxide on Four St. Augustinegrass Cultivars

J.S. Amthor and J.B. Beard

Sulfur dioxide is one of the primary atmospheric pollutants found in Texas, especially in the Houston area. Levels monitored periodically in the Houston area indicate there may be a potential for injury to turfgrasses. Thus, this investigation was initiated to assess the effects of atmospheric sulfur dioxide on St. Augustinegrass, which is the major lawn species utilized in the Houston area.

Research Procedure

Four cultivars of St. Augustinegrass *(Stenotaphrum secundatum)* were included in this study--Floratam, Raleigh, Seville, and Texas Common. Two distinct levels of exposure were utilized. In the case of acute exposure, the four cultivars were exposed to 1.0 ul liter^{-1} of SO^2 for 10 hours per day for 4 consecutive days. In the case of the longer term, lower level chronic exposure, the St. Augustinegrass turfs were exposed to 0.2 ul liter^{-1} of SO^2 for 4 hours per day, 6 days a week for 5 weeks. Assessments were made of injury by visual examination plus measurements of shoot growth rate, stolon internode elongation, leaf chlorophyll content, and dry matter accumulation.

Results

Floratam was the most susceptible to injury, Texas Common ranked intermediate, and both Raleigh and Seville were the least susceptible to acute exposures to sulfur dioxide. In the case of longer term, low level chronic exposures, the St. Augustinegrasses proved relatively resistant to sulfur dioxide exposure. In terms of total dry weight accumulation, Raleigh, Seville, and Texas Common were unaffected by chronic exposures. However, dry matter was reduced by 15 percent in comparison to the untreated turfs of Floratam when exposed to the 5 week chronic SO^2 fumigation.

Thus, it appears that the potential for injury to St. Augustinegrass from sulfur dioxide atmospheric pollution is minimal based on the current level of atmospheric SO^2 being monitored in the region. Furthermore, preliminary experiments with bermudagrass and zoysiagrass revealed that these two species are even less susceptible to sulfur dioxide injury than St. Augustinegrass.

PR 4043

White Grub of Southern Masked Chafer, *Cyclocephala immaculata*, Found in Texas Turfgrass

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Abstract

Preliminary samples from turfs in Collin, Dallas, Tarrant, and Tom Green Counties, Texas, indicate that the larvae of the southern masked chafer, *Cyclocephala immaculata* Olivier, may be a major, previously unrecognized pest of turfgrass in Texas.

Introduction

The southern masked chafer, *Cyclocephala immaculata* Oliver (Coleoptera:Scarabaeidae), is a distant relative of the June beetles *(Phyllophaga spp.)* so familiar to many Texans. Adults of this species fly in the summer at the same general time as do June beetles. Southern masked chafer adults can be distinguished from June beetles, however, by their black (versus brown) head, prominent eyes, mandibles that protrude, tusk-like, slightly in front of the clypeus, a black spot on each side of the pronotum, and by the uniform distinctness of the segmental lines on the venter of the abdomen (in *Phyllophaga* these lines appear weak near the midline of the abdomen). Larve of *C. Immaculata* can easily be differentiated from those of *Phyllophaga* by the presence of a linear (vs. vaguely V-shaped) anal slit and by the absence of palidia (a pair of parallel rows of short spine-like hairs somewhat below the anal slit of *Phyllophaga* larvae).

The southern masked chafer has a 1-year life cycle. In Kentucky, adults usually emerge from the soil, mate, and oviposit in June and July (Ritcher 1940). A sex pheromone secreted by the female apparently attracts males to the females (Potter 1980). Eggs hatch after about 2 weeks; by fall, the resulting larvae have reached the third and final larval instar. These third instar larvae overwinter in the soil, feed for a short time in the spring, then pupate and transform into adults in the soil in May or June in Kentucky (Ritcher 1940). Although the rate of development of southern masked chafer larvae is a function of temperature, rainfall patterns strongly influence when reproductive flights actually take place (Potter 1981). Davis (1916) reported that *C. immaculata* larvae can develop on a diet of decaying organic matter, or by feeding on plant roots as do *Phyllophaga* larvae. Davis (1916) further stated that the adult beetle appears to feed solely on decaying organic matter and does not attack foliage as do *Phyllophaga* adults.

Larvae of the southern masked chafer have long been recognized as major pests of turfgrass in Kentucky (Ritcher 1940; Potter 1980, 1981), and as crop pests in Indiana (Davis 1916) and Kansas (Hayes 1918, 1925). In Texas, however, only white grubs in genus *Phyllophaga,* especially the southwestern grass scarab*, *P. crinita* (Burmeister), have been identified as being destructive of turfgrass (Reinhard 1940, 1950, Frankie et al. 1973, Gaylor and Frankie 1979). The objective of this report is to document that larvae of *C. immaculata* also appear to be important turf pests in at least some parts of Texas.

Materials and Methods

Nineteen collections of white grubs were taken from turfs (primarily bermudagrass, *Cynodon* spp.) of golf courses, residences, parks, and research grass plots from experimental turfs in Collin, Dallas, Tarrant, and Tom Green Counties, Texas, on various dates during 1979-1982. Larvae were identified on the basis of larval characters or from resulting laboratory-reared adults. Samples were of various sizes. In those cases where the larvae were collected from insecticide tests, only data from untreated plots were utilized in the present study.

Results and Discussion

Southern masked chafer larvae were recovered from 15 of 19 collections (17 sites) from turf. This species was present in turf from all four counties sampled: Collin (three sites), Dallas (two of four sites), Tarrant (seven of nine sites), and Tom Green (one site). For all 19 collections, an overall mean of 39 percent (range=0-100 percent) of the white grubs collected were *C. immaculata*, the rest were primarily *P. crinita.* If data from the four collections from which no *Cyclocephala* were recovered are excluded, the infestations in the other 15 collections averaged 50 percent *C. immaculata.*

More data are needed to document how widespread and serious a problem *C. immaculata* is in Texas turfgrass. The limited data available, however, indicate that it may rank in importance near the southwestern grass scrarab, *P. crinita,* and that in some instances larvae of the southern masked chafer may be the dominant species. This could have important implications in the management of white grubs in Texas turfgrass.

Literature Cited

Davis, J.J. 1916. A progress report on white grub investigations. J. Econ. Entomol. 9: 261-81.

Frankie, G.W., H.A. Turney, and M.J. Gaylor. 1973. White grubs in Texas Turfgrass. Tex. Agric. Ext. Serv. House and Landscape Pests No. L-1131.

Gaylor, M.J., and G.W. Frankie. 1979. The relationship of rainfall to adult flight activity; and of soil moisture to ovipositional behavior and egg and first instar survival in *Phyllophaga crinita.* Environ. Entomol. 8: 791-4.

Hayes, W.P. 1918. Studies on the life-histories of some Kansas *Lachnosterna.* J. Econ. Entomol. B: 303-18.

Hayes, W.P. 1925. A comparative study of the life-cycle of certain phytophagous scarbaeid beetles. Kans. Agric. Exper. Stn. Bul. No. 16. 146pp.

Potter, D.A. 1980. Flight activity and sex attraction of northern and southern masked chafers in Kentucky turfgrass. Ann. Entomol. Soc. Amer. 73: 414-17.

Potter, D.A. 1981. Seasonal emergence and flight of northern and southern masked chafers in relation to air and soil temperature and rainfall patterns. Environ. Entomol. 10: 793-7.

Reinhard, H.J. 1940. The life history of *Phyllophaga lanceolata* (Say) and *Phyllophaga crinita* Burmeister. J. Econ. Entomol. 33: 572-8.

Reinhard, H.J. 1950. The Phyllophaga of Texas (Scarabaeidae). J. Kans. Entomol. Soc. 23: 27-51.

Ritcher, P.O. 1940. Kentucky white grubs. Ken. Agric. Exper. Stn. Bul. No. 401. 157pp.

Footnote

*Offered herein as an appropriate common name for *Phyllophaga crinita* (Burmeister). Previously no common name has existed, necessitating the use of a scientific name to separate it from the many other white grubs found in Texas.

PR 4044

Field Records of Pathogens and Parasites of Scarabs in Texas

Robert L. Crocker, Michael J. Gaylor,
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Abstract

Field records are presented of parasitization and disease of scarabs, principally *Phyllophaga* spp., in Texas.

Introduction

In some cases, natural enemies (predators, parasites, and pathogens) inflict sufficiently high rates of mortality on a pest species to reduce or remove the need to apply chemical pesticides for the control of the pest. Little is known about what natural enemies affect white grubs in Texas. The purpose of the following list is to provide a basis for future research by documenting several instances of disease and parasitism detected by the authors on adult scarabs and white grubs in Texas.

Pathogens

Virus--

1. An entomopox virus[1]; host= *Cyclocephala immaculata* (Olivier), 3rd instar larva. Macroscopic spheroid white inclusions visible through skin of caudal segments of larva were determined to be hypertrophic fat body cells infected by an entomopox virus. TX:Dallas Co., Dallas.

2. An entomopox virus[2]; host= *Phyllophaga* sp. prob. *crinita* (Burmeister), larva. TX:Dallas Co., Dallas.

Bacteria--

3. *Bacillus cereus*[3]
host= *Phyllophaga* sp. prob. *crinita,* larva. This common soil bacterium can infect stressed or wounded insects and is considered a potential pathogen rather than a primary pathogen. TX:Dallas Co., Dallas.

4. *B. popilliae*[2,3]
host= *P. crinita,* 3rd instar larvae. These infections appear to be from native bacteria. TX:Dallas Co., Dallas, and Cameron Co., San Benito.

5. *B. thuringrensis*[2]
host= *Phyllophaga* sp. prob. *crinita,* larva. TX:Dallas Co., Dallas.

6. *Pseudomonas aeruginosa*
host= Phyllophaga sp., larva. A facultative pathogen. TX:Dallas Co., Dallas.

Yeast--

7. Undet. yeast[3]; host = *Phyllophaga* sp. prob. *crinita,* larva. Larva's haemolymph appeared milky due to yeast in it. TX:Tarrant Co., Haltom City.

8. Undet. yeast-like cells[3]; host = *Pelidnota punctata* L., adults. Macroscopic, pale mycetomes containing yeast-like cells (probably symbionts, not pathogens) were recovered from the posterior portion of the abdominal cavity. TX:Dallas Co., Dallas.

Protozoa--

9. *Pseudomonocystis* sp. prob. undescribed[3]; host= *Phyllophaga sp. prob. crinita or Cyclocephala immaculata* (based on det. of other spms. at site), larva. Protozoan is subphylum Sporoza, order Eugregarinida, suborder Acephalina. Infection by most eugregarines seldom cause mortality; infection by *Pseudomonocystis,* however, results in death of the larva before pupation. TX:Tom Green Co., San Angelo.

Parasites

Nematode--
10. Undet. encysted nematode[3]; host= *P. congrua* LeConte, adults. Nematode in macroscopic, pale spheroid inclusion in posterior end of abdomen. TX:Dallas Co., Dallas.

11. Neoaplectana sp.[2]; host = *Phyllophaga* sp. prob. *crinita,* larva. TX:Dallas Co., Dallas.

Insect--
12. Ptilodexia sp.[2]; host = *P. hirtiventris* (Horn), larva. TX:Dallas Co., Duncanville. What may be the same parasite has also been recovered from *P. crassissima* (Blanchard) and *P. torta* (LeConte) adults.

Hymenoptera--
13. Undet. expoparasite *(Tiphia*[4]*)* on *Phyllophaga* sp. larva. Host and parasite died in laboratory. TX:Dallas Co., Dallas.

Footnotes

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PR 4045

BIOASSAY BY INJECTION OF BACILLUS POPILLIAE ON LARVAE OF PHYLLOPHAGA CRINITA

R.L. Crocker and M. Grismer

Abstract

Cardiac injection of spores of the insect pathogen, *Bacillus popilliae,* was performed on third instar larvae of *Phyllophaga crinita* (Burmeister). Of the larvae, 77 percent became infected. A second experiment indicated that a hypodermic jet injection apparatus developed for use on man is unsuitable for inoculating *P. crinita* larvae with *B. popilliae* spores.

Introduction

White grubs at times become infected with any of several bacteria which multiply in the insects' blood. The spores of these organisms typically become so numerous that the insect's normally clear blood appears milky. One such "milky disease" organism, *Bacillus popilliae,* has been found to be a highly effective biological control for white grubs of the Japanese beetle, *Popillia japonica* Newman. Numerous other scarabs, including some species of *Phyllophaga,* can also be infected with *B. popilliae* (Fleming 1968).

Cardiac injection of spores into white grubs with a hypodermic needle is tedious. Both for the purpose of screening potential pathogens on new hosts and for mass-producing infective spores, it would be desirable to have a less demanding inoculation technique. Pressure-injection procedures have been used successfully for several years by the military and by public health agencies for vaccination of people. If such a procedure could be used for injecting bacterial spores into white grubs it could considerably reduce the labor involved in such operations.

The purposes of the present research were 1) to perform a preliminary bioassay of the pathogenicity of *B. popilliae* spores from Japanese beetle on *P. crinita* (Burmeister) larvae, and 2) to assess the feasibility of using a pressure-injection device designed for use on man to inoculate white grubs with *B. popilliae* spores.

Materials and Methods

Cardiac injection

Haemolymph from Japanese beetles infected with *B. popilliae* previously had been deposited onto sterile microscope slides and air dried. This haemolymph was reconstituted in sterile water to yield about 8 million *B. popilliae* spores/ml.

Thirty-three third-instar larvae of *P. crinita* were rinsed in tap water, in sterile distilled water, and placed individually in clean 7 dram snap-cap plastic vials. Just prior to injecting each grub with 0.25 ml of an aqueous spore suspension (about 2 million spores), the grub was removed from its holding vial and swabbed with a 0.5 percent solution of sodium hypochlorite. Injection was through the dorsal surface of the abdomen into the grub's heart using a 0.25 cc hypodermic syringe mounted in a Model M micro-applicator (Isco Instrumentation Co., Lincoln, Nebraska) and fitted with a 27 gauge needle. Following inoculation, each grub was returned to its plastic vial and provided with grass roots (surface sterilized in 0.5 percent sodium hypochlorite solution) and moist, heat-sterilized soil. Inoculations were performed January 28, 1980.

Eighteen days following inoculation, each larva was rinsed in sterile distilled water, immersed 10 minutes in 48–49 degree C water, and then soaked 10 minutes in 50 percent ethanol. Following that procedure, each grub was pricked through the prothorax into the aorta with a sterile insect pin. Haemolymph was gently expressed from the wound onto a sterile microscope slide. If the grub's gut bur[illegible] (producing a brown color in the haemolymph), the contaminated blood was not allowed to fall onto the slide.

When all of the uncontaminated haemolymph had been deposited on the slide, a second slide was then dragged across it, spreading the haemolymph evenly across the two slides. The slides were then dried by a warm air flow. Slides were subsequently examined at 500X for the presence of *B. popilliae* spores.

Pressure injection

The procedure was as in the previous section, except as follows. Inoculation was by use of a Ped-o-jet(TM) hypodermic jet injection apparatus, model POJ (Vernitron Medical Products, Inc., Carlstadt, New Jersey). The device was fitted with a general purpose jet nozzle.

Preliminary tests with the injector had indicated that about 0.2 cm^3 was the minimum effective output of the device. Test injections of sterile distilled water (0.2 cc) were with the gun against the side of the larva's thorax. Subsequent tests (in which *B. popilliae* spore suspension was used) were with the muzzle of the gun 4, 8, 12, 16, and 20 cm from the side of the larva's thorax (n=20 third instar larvae/treatment). One treatment group was not inoculated. The inoculum contained 7.2×10^7 spores/cm^3; thus, the 0.2 cm^3 inoculum applied to each larva contained 1.4×10 spores of *B. popilliae* (determined using Levy-Hauser hemocytometer).

Immediately prior to treatment, the larvae were placed for 2 minutes in 0.5 percent sodium hypochlorite solution, instead of merely being swabbed. Afterwards, they were rinsed in sterile distilled water. Treatments were applied April 16, 1980. Following treatment, larvae were returned to their individual snap-cap vials for 1 day's observation at about 22 degrees C before soil and fescue thatch (non-sterile) were added. The larvae were then removed to a 30 plus or minus 1 degree C chamber for 15 days; after which their haemolymph was collected as previously described.

Results and Discussion

Cardiac injection

Of the 33 third instar larvae of *P. crinita* that were injected with *B. popilliae* spores, 7 died of unknown causes, 1 was uninfected, and 25 developed *B. popilliae* spores in their haemolymph. In those larvae that became infected, the spores in their haemolymph were so numerous that they formed a solid matt on the haemolymph slides.

These results indicate that *B. popilliae* can multiply well in the haemolymph of *P. crinita.* Moreover, *B. popilliae* reared in *P. crinita* were able to return to Japanese beetle; 78 percent of Japanese beetle larvae injected with spores recovered from these *P. crinita* became infected (Grismer, 1980 unpub. data).

Data now are needed to determine whether or not *B. popilliae* are capable of infecting *P. crinita* by means of its gut.

Pressure injection

The preliminary test in which only water was applied with the muzzle of the injection gun against the thorax of the larvae caused immediate extrusion of tissue and loss of fluid through the wound, followed by reduced larval activity; extensive tissue blackening around the injection site developed within 24 hours.

The results (Table 1) indicate that the present pressure- injection technique is ineffective in producing an infection of *B. popilliae in P. crinita,* even at distances where the force of the liquid hitting the larva causes considerable mortality. Possibly an equipment modification which would produce a much smaller volume of output would improve the efficacy of this procedure.

Literature Cited

Fleming, W.E. 1968. Biological control of the Japanese beetle. USDA Tech. Bul. No. 1383. 78pp.

TABLE 1. MORTALITY AND INFECTION RATES OF THIRD–INSTAR *PHYLLOPHAGA CRINITA* WITH *BACILLUS POPILLIAE* SPORES SUSPENSION UNDER PRESSURE AT VARIOUS DISTANCES FROM MUZZLE OF INJECTION GUN

Treatment Distance (cm)	Number died during experiment of apparent trauma (bleeding)			Cause Unknown	Numbers of Grubs (after 15 days)	
	After 24h	After 48h	Later		Haemolymph w/spores	Haemolymph w/o spores
4	4	2	2	0	2	10
8	1	0	0	0	1	18
12	0	1	0	2	0	17
16	1	0	0	2	1	16
20	0	0	0	2	0	18
Untreated Control	0	0	0	1	1	18

PR 4046

Field Test of a Dual-Attractant Japanese Beetle Trap for Cross-Effectiveness on Texas *Phyllophaga* spp. and Other Scarab Beetles

R.L. Crocker

Abstract

An insect trap baited with synthetic Japanese beetle pheromone and a synthetic floral lure was field-tested in Dallas, Texas, for possible cross-effectiveness on Texas scarab beetles (not Japanese beetle). The results indicate that the trap is not attractive to *Phyllophaga spp., Cyclocephala immaculata* (Olivier) or other scarabs occurring at that site.

Introduction

The ability to determine the dates of occurrence of mating/dispersal flights of *Phyllophaga* spp. and other phytophagous scarabs in a particular year is important both to the study of their ecology and to the development and implementation of pest management practices. This information traditionally has been gained through the use of UV (black light) insect traps. Although such black light traps are highly attractive to many such beetles, they also catch huge numbers of moths and other insects. Recovering the desired species from such mixed collection samples can entail several hours of work, especially on occasions when the total sample catch may include many thousands of insects.

Insect sex pheromones and their artificial analogs have been found to be highly useful as selective lures for some species of insects. Such pheromones, however, tend to be highly selective, frequently attracting members of only one or a few closely related species of insects. Michelotti et al. (1980) reported the development and testing of a trap for Japanese beetles, *Popillia japonica* Newman, which uses a synthetic sex pheromone in combination with a synthetic floral scent. The purpose of the present research was to determine if this lure system might exhibit cross-attractiveness to one or more of the *Phyllophaga* spp. or other scarabs present in the Dallas, Texas area.

Materials and Methods

Two "Bag-a-bug"(TM) Japanese beetle traps (J.L. Baker Chemical Co., Phillipsburg, N.J. 08865) of the type tested by Michelotti et al. (1980) were assembled according to their instructions. The bottom of their collection bags then were removed, and the sealing ring to a one-quart, wide-mouth canning jar was slipped over the outside of the bag. Next, the canning jar itself was placed mouth-up within the bag. The jar ring was then tightened, trapping the jar inside the bag. This modification made it possible for each day's catch of insects to be removed easily from the trap. The traps and their respective jars were then firmly secured to ring-stand assemblies to prevent the weight of the jar from damaging the trap.

One trap was then rigidly installed under a street light in Dallas, Texas, known to attract many scarab bettles of several species. The other trap was similarly mounted in an unlit open area about 30 meters (m) away.

During this same time, a black light insect trap was being operated about 150 m away, in an area out of the line-of sight of the pheromone traps All three traps were emptied daily, March through August, 1980. Both the synthetic pheromone source and the floral lure were replaced monthly to ensure their potency. The manufacturer's instructions (J.T. Baker Chemical Co. no date) indicated that one synthetic sex pheromone tape should be effective for an entire season and that the floral lure should be replaced every 5 weeks for Japanese beetle trapping.

Results and Discussion

During the entire test period, the pheromone trap under the street light caught a total of 10 scarab beetles on 6 nights, and the pheromone trap in the unlit area caught 5 scarab beetles on 2 nights (Table 1). During the same period, the ground under the street light frequently was littered with numerous scarab beetles (none of which appeared to be attracted to the pheromone trap) and the black light trap caught several thousand scarabs. Those scarabs caught in the black light trap were primarily *Phyllophaga spp. and Cyclocephala immaculata* (Olivier), along with a few *Pelidnota punctata L., Bolbocerosoma sp., Euethola rugiceps LeC., and Dyscinetus morator* (F.). Japanese beetle does not occur in the Dallas, Texas area. Only negligible numbers of any non-scarab insects were caught in the pheromone traps.

The results of this study indicate that the tested chemical attractant trapping system for Japanese beetles is completely ineffective on a broad range of other scarabs. The few beetles (with the possible exception of the lone specimen of *Euphoria sp.)* that were caught were considered accidental or random trappings.

Literature Cited

Michelotti, F.W., and J.E. Seidenberger. 1980. A new Japanese beetle trap containing pheromone and floral lure as synergistic attractants. J. New York Entomol. Soc. 88: 62.

TABLE 1. NUMBERS OF SCARAB BEETLES CAUGHT DAILY IN TWO TRAPS BAITED WITH SYNTHETIC SEX PHEROMONE OF THE JAPANESE BEETLE AND WITH SYNTHETIC FLORAL SCENT, DALLAS, TEXAS, 1980

Date	Trap Location: Under Street Light	Trap Location: Unlit Area
Mar. 1-Apr. 21	0	0
April 22	Phyllophaga congrua (LeC.) 1 ♂	0
April 23	P. congrua 2 ♂	0
April 24	0	P. congrua 2 ♂, 1 ♀
Apr. 25-May 5	0	0
May 6	P. congrua 1 ♂	0
May 7	0	P. congrua 1 ♀ Euphoria sp. 1
May 8-17	0	0
May 18	P. crassissima (Blanchard) 1 ♂	0
May 19-Jun. 25	0	0
June 26	P. crinita (Burmeister) 2 ♂ Cyclocephala immaculata (Olivier) 1 ♂	0
June 27	P. crinita 1 ♂ C. immaculata 1 ♀	0
June 28-Aug. 31	0	0

PR 4047

FIELD TEST OF CHEMICALS FOR CONTROL OF WHITE GRUBS IN TEXAS TURF

R.L. Crocker and C.L. Simpson

Abstract

Five insecticides at three rates each were applied to a mixed natural population of white grubs (larvae of *Cyclocephala immaculata* (Olivier) and *Phyllophaga crinita* (Burmeister)) in a common bermudagrass, *Cynodon dactylon* (L.) Persoon, turf in Dallas, Texas in September, 1980. Trichlorfon, chlorpyrifos, diazinon, and methoxychlor + diazion produced detectable levels of control (67–92 percent) at one or more of the tested rates. Dioxathion treatments were not statistically separable from the control.

Introduction

Obtaining adequate control of damaging infestations of white grubs continues to be a major turf problem in Texas. The purpose of this research was to test five insecticides at 0.5x, 1x, and 2x their label or experimental treatment rates for effectiveness against Texas populations of white grubs in turf.

Materials and Methods

The test was performed on an established, vigorous stand of common bermudagrass, *Cynodon dactylon* (L.) Persoon, on the grounds of the Texas A&M University Research and Extension Center at Dallas. Relatively little thatch was present in the turf.

The research involved application of five materials at three rates each and a control (16 treatments total) (Table 1). All plots were thoroughly irrigated immediately after treatment.

The experiment followed a randomized complete block design with six replications. Plots were 1.5 x 2.0 meters (m) and were separated from each other on all sides by 0.5 m of turf. Treatments were applied September 1, 1980, and data were collected October 7–8. Ten subsamples (1 subsample = 0.009 m^2=0.1 ft^2) were collected from each plot. Because sampling of untreated turf disclosed that white grub populations in replicates #2 and #4 had collapsed following a posttreatment period of heavy rain, no data were collected from those replicates, and they were excluded from the analysis.

Prior to statistical analysis, data from the four infested replicates were transformed according to $X^{Transformed} = (X + 0.25)^{1/2}$; where X is the number of live larvae recovered per plot. This was done in order to satisfy necessary statistical assumptions. The transformed data were subjected to an analysis of variance followed by Duncan's multiple range test (p=0.05). Reported treatment means (Table 1) have been transformed back to the original scale, using the inverse transformation and the correction factor recommended by Thoni (1967).

Results and Discussion

Preliminary samples indicated that the test population of white grubs consisted of southern masked chafer (>90 percent) and of *P. crinita* (<10 percent). Seven treatment means were statistically (p=0.05) separable from the control (Table 1). Of the materials examined, only diazinon 25 percent emulsified concentrate (EC) clearly was effective at all three tested rates. The 0.5x, 1x, and 2x rates (1x = 6.8 lbs active ingredient (ai) A^{-1}) of diazinon 25 percent EC produced white grub mortality rates of 78, 80, and 92 percent, respectively, in comparison to the control (=7.1 larvae per 0.09 m^2). These results are consistent with 1978 findings (Crocker, 1980), but contrast with 1979 failures to achieve statistically detectable levels of control with diazinon (Crocker, 1981).

The present results with chlorpyrifos 22.4 percent EC contrast with previous experiences. In 1979, chlorpyrifos 22.4 percent EC applied at 4 lbs ai A^{-1} yielded 81-84 percent control on three separate occasions in August and September, and 72 percent control as late as October 2 (Crocker, 1981). In the present (1980) experiment, an 8.0 lbs ai A^{-1} rate of chlorpyrifos 22.4 percent EC was necessary to produce 76 percent control. The reasons for these year-to-year differences in the performance of diazinon and chlorpyrifos are not immediately obvious, but minor differences in soil or thatch conditions cannot be ruled out as contributing factors. Trichlorfon 80 percent AP at 4.1 and at 16.3 lbs ai A^{-1} (0.5x and 2x the label rate) produced 68 and 90 percent control, respectively. The 1x rate was inseparable from the control (p=0.05). This apparent failure of the 1x rate of trichlorfon to perform may, however, be a statistical aberration. Random assignment of treatments to plots could have by chance produced a situation wherein more grubs initially were in the trichlorfon 1x rate plots than would have been expected. Such problems are to be expected occasionally when dealing with irregularly distributed populations where the use of blocked experimental designs is only partially effective. The methoxychlor + diazinon spray produced 90 percent control at its highest application rate (2x = 6.4 lbs methoxychlor ai A^{-1} + 3.2 lbs diazinon ai A^{-1} = 9.6 lbs total ai A^{-1}). Results of treatments with lesser tested rates of methoxychlor + diazinon were not significantly (p = 0.05) different from the control. No phytotoxic effects on the turfgrass were detected for any of the tested treatments.

Literature Cited

Crocker, R.L. 1980. Insect research update 1978-79. TAES PR-3670, pp. 16-20 in Texas Turfgrass Research-- 1979-80; TAES Consol. PR 3667-3678. 52pp.

Crocker, R.L. 1981. White grub management in Texas Turfgrasses. PR 3846, pp.69-77 in Texas Turfgrass Research --1980-81; TAES Consol. PR 3831-3851.

Thoni, H. 1967. Transformation of variables used in the analysis of experimental and observational data; a review. Tech. Rep. No. 7. Statistical Laboratory, Iowa State University, Ames. 61pp.

TABLE 1. MEAN POPULATION DENSITY OF WHITE GRUBS IN COMMON BERMUDAGRASS PLOTS IN DALLAS, TX FOLLOWING SPRAY TREATMENT WITH FIVE CHEMICAL PESTICIDES AT THREE RATES EACH (4 REPLICATIONS, 10 SUBSAMPLES OF 0.009 M^2 (= 0.1 Ft^2) EA. PER PLOT). TREATMENTS APPLIED SEPTEMBER 1, 1980

Insecticide	Rate a.i.		Rate of Actual Formulation		Mean number of white grubs per 0.09 m^2 (= 1 ft^2)*/
	Kg ha^{-1}	lb A^{-1}	ml a^{-1}	fl oz $(1000\ ft^2)^{-1}$	
Untreated control	0	0	0	0	7.1 a
Chlorpyrifos 22.4% EC	2.25	2.00	95.5	3.00	6.9 a
Dioxathion 30% EC	12.4	11.1	414	13.0	6.4 a
Dioxathion 30% EC	6.20	5.53	207	6.50	5.3 ab
Chlorpyrifos 22.4% EC	4.50	4.00	191	6.00	3.8 abc
Methoxychlor (20%) + diazinon (10%) EC	2.70	2.40	95.5	3.00	3.7 abc
Dioxathion 30% EC	3.10	2.76	104	3.25	3.0 abcd
Trichlorfon 80% SP	9.20	8.20	116 g	3.80 oz	3.0 abcd
Methoxychlor (20%) + diazinon (10%) EC	5.40	4.80	191	6.00	2.9 abcde
Trichlorfon 80% SP	4.60	4.10	60.0 g	1.90 oz	2.3 bcde
Chlorpyrifos 22.4% EC	9.00	8.00	382	12.0	1.7 bcde
Diazinon(TM) 25% EC	3.80	3.40	159	5.00	1.6 cde
Diazinon 25% EC	7.60	6.80	318	10.0	1.4 cde
Trichlorfon 80% SP	18.4	16.3	229 g	7.50 oz	0.69 de
Methoxychlor (20%) + diazinon (10%) EC	10.8	9.60	382	12.0	0.69 de
Diazinon 25% EC	15.2	13.6	637	20.0	0.56 e

*/ Numbers followed by the same letter are not significantly (p = 0.05) different according to Duncan's new multiple range test.

PR 4048

Comparative Biology and Ecology of Phyllophaga spp. and Other Scarabs in Texas

R.L. Crocker, R.E. Woodruff, C.L. Simpson, and H. Painter

Abstract

The comparative biology and ecology of *Phyllophaga* spp. and other scarab beetles are being investigated at 17 sites covering the major vegetational areas of Texas. The purpose of this research is to provide a better basis for the development of pest management procedures.

Introduction

The cultivated turfs, prairies and other grassy habitats which cover large portions of the American Southwest support at least 96 local species of Phyllophaga* (Reinhard 1950) along with related white grubs representing several other genera. Some of these species of white grubs are severe pests of turfgrass and many other cultivated plants including nursery plantings, small grains, and sugar cane. The ecology of these regionally adapted species is unstudied for the most part, and little is known concerning precisely which species are pests in different portions of the state.

Major climatic differences separate the heat and drought dominated Southwest from cold dominated regions where most prior research has been done. This makes the transfer of ecological generalizations concerning species of white grubs which occur in other regions of the nation to the Southwest of doubtful value. Also, as was recognized by Ritcher (1958), although *Phyllophaga* spp. may be closely related taxonomically, the biologies of the different species are distinctive.

Even within the state of Texas, there are several major vegetational areas (Figure 1). These areas extend to the north and south over greater than 11 degrees latitude, and range from mountains to prairies, from forests to deserts. Because of this diversity, it is reasonable to expect that different species may achieve pest status in various parts of the state Also, the times when control practices should be applied could be expected to vary.

Beyond this, we face the problem of determining why some species of white grub are able to become so numerous that they become major pests. Most of the species are, after all, encountered only uncommonly. To address this question, we must learn more about the innate capacity of the species to reproduce and to exploit potential food resources. We also must know what natural enemies or physical environmental factors limit their ability to approximate their reproductive potential.

It is clear that before highly specialized work is undertaken, an overall analysis of the state's white grub problem is needed. Such an analysis will assure that future research can be formulated to produce findings with the broadest possible application. Also, from such a study, we can gain valuable information for use in the development of population sampling procedures. We may even find part of the answer to the problem of controlling the pest species.

Such a state-wide analysis has been undertaken. Because the adult stage of the June beetle can be sampled more efficiently than can eggs or larvae, that lifestage is receiving the initial research emphasis. Daily samples of flying adult beetles are being collected throughout the flight season from black-light insect traps at 17 sites distributed throughout the state (Figure 1). Problems being addressed are (1) comparative dominance of species among sites, 2) sampling precision of black light traps; 3) effects of weather on time of reproduction, 4) comparative fecundity patterns of species, and 5) comparative natural enemy complexes among sites and among species. A subsequent phase of this research will develop related information on larvae.

Already, we are seeing patterns emerge concerning the seasonal sequence of species, interspecies differences in rates of parasitism, and differences among areas as to relative dominance of species. Further data are needed to confirm these apparent trends. An immediate benefit of this program is that it provides a precise measurement of when local reproductive flights are taking place. Thus, cooperators in the test areas obtain an improved basis for formulating current-year recommendations on the optimal time for pesticide applications for white grub control.

Acknowledgments

A project of this magnitude requires the diligent assistance of many people. For their work in the daily collection and preservation of beetle samples we sincerely thank the following cooperators: Texas Agricultural Extension Service personnel Drs. Bart Drees (Bryan), Thomas W. Fuchs (San Angelo), Roy D. Parker (Corpus Christi), James V. Robinson (Overton), Messrs. Allen Knutson (Dimmitt), Phil Glogoza and Brian A. Lee (El Paso), John W. Norman, Jr. (Weslaco); Fort Worth Park and Recreation Department personnel John Beard, Pete Collins, Dana Diller, Bruce Frantz, J. D. Keller, George Kruzick, James Rist, John Lampe, Mike Schomburg, Randy Thompson, Ty Thompson; ChemLawn Corp. personnel John Custer (Houston), George Kippenberger (San Antonio), Phil Hooks, Rodney Johnson, Don Link (Dallas); Lake Hulings (Lester Humphrey Pest Control Service, Inc., El Paso); and H. E. Randell (Master Gardener Program, El Paso). We are also grateful to David Nivens (Fort Worth Park and Recreational Department) and, James A. McAfee (ChemLawn Corp.) for the continuing cooperation and support of this work by their respecitve organizations. Finally, we thank Mrs. Sarala N. Panicker and William T. Nailon, Jr., (Texas A&M University Research and Extension Center at Dallas) for taxonomically determining the many thousands of specimens involved in this project and Mrs. Brenda Beck (Division of Plant Industry, Florida Department of Agriculture, Gainesville) along with Web E. Brasher and R. Andy Rush (Texas A&M University Research and Extension Center at Dallas) for their dedicated technical assistance in the preparation of specimens for study.

Literature Cited

Reinhard, H.J. 1950. The *Phyllophaga* of Texas (Scarabaeidae:Coleoptera). J. Kansas Entomol. Soc. 23: 27-51.

Ritcher, P.O. 1958. Biology of Scarabaeidae. Ann. Rev. Entomol. 3: 311-34.

COOPERATIVE STATE-WIDE JUNE BEETLE TRAPPING PROGRAM – 1982

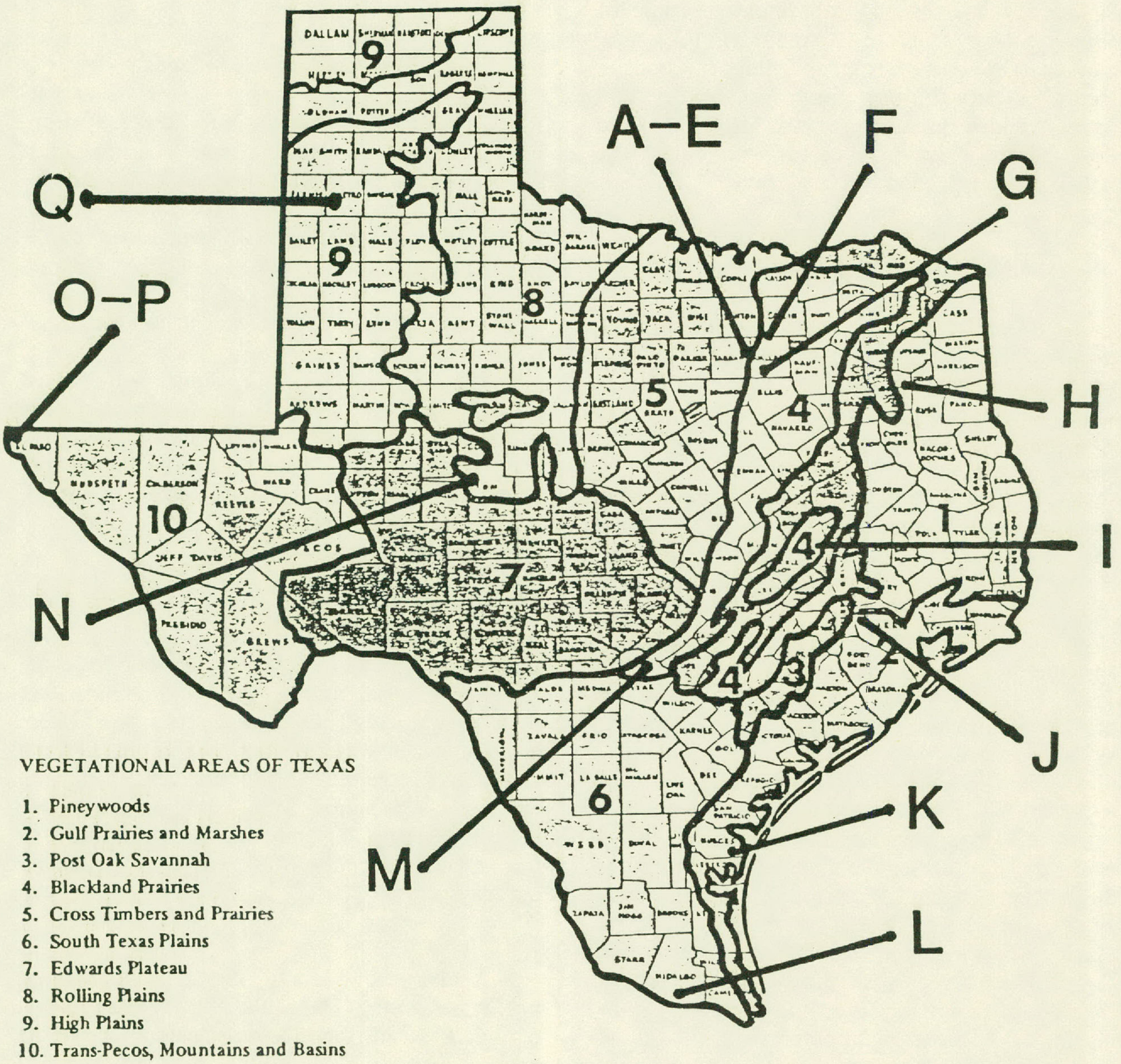


Figure 1. Sites for black-light sampling of June beetle flights in Texas. A-E = Tarrant Co., F-G = Dallas Co., H = Smith Co., I = Brazos Co., J = Harris Co., K = Nueces Co., L = Hidalgo Co., M = Bexar Co., N = Tom Green Co., O-P = El Paso Co., Q = Castro Co.

PR 4049

Evaluation of Various Diets for Rearing Phyllophaga Crinita (Coleoptera: Scarabaeide) Larvae in the Laboratory

R.L. Crocker

Abstract

Nine media were tested on third instar larvae for use in the laboratory rearing of *Phyllophaga crinita* (Burmeister) (Coleoptera: scarabaeidae). Thatch, Kellogg's Concentrate (TM) cereal, and grass roots plus culm nodes yielded greater growth rates than did Post Grape Nuts(TM) cereal, although the latter produced good survival rates.

Introduction

The difficulty in maintaining or rearing *Phyllophaga* larvae in the laboratory is a serious constraint to many types of research into their biology, ecology, and control. Availability of a suitable diet that could be readily obtained would overcome much of that problem. Some investigators have used sprouted kernels of grain as a food source for *Phyllophaga* larvae in the laboratory. Reinhard (1944), however, reported that such procedures produced high rates of mortality, especially in very young larvae. An alternative method developed by Reinhard (1940, 1941, 1942, 1944, and 1946) involved the use of "grapenuts" (in other sources, often written as "Grape Nuts") breakfast cereal. With this diet, he was able to rear several species of *Phyllophaga* from egg to adult with low rates of mortality. Reinhard's papers, however, do not present his technique in detail. Subsequent attempts to use it on *Phyllophaga* spp. have yielded poor results. M.J. Gaylor (personal communication, 1982) mixed Grape Nuts cereal with moist soil, but found that fungi rapidly invaded the medium. Autoclaving the medium apparently made it so crisp that the larvae could not feed on it, so he abandoned its use.

The purpose of this research was to evaluate Grape Nuts cereal and several other media as laboratory diets for *Phyllophaga* larvae.

Materials and Methods

Third-instar larvae of *P. crinita* (Burmeister) were collected from bermudagrass (*Cynodon dactylon* (L.) Persoon), St. Augustinegrass (*Stenotaphrum secundatum* (Walt.) Kuntze), and tall fescue (*Festuca arundinacea* Schreb.) turf in Dallas, Dallas County, Texas, in January, 1980. Ten larvae were randomly assigned to each of eight treatments.

Media consisted of damp soil mixed (except for the control) with one or more candidate diets. The soil was black clay topsoil from the Texas A&M University Research and Extension Center at Dallas. Diets and soil were mixed on a volume to volume basis.

Larvae were contained in 26 ml (7 dram) plastic vials equipped with snap-on caps. One larva and enough of the appropriate medium to fill the vial to its rim were placed in each container. The capped vials were kept grouped close together on a table in a room at about 21 degrees C (70 degrees F). Larvae were each weighed (to 0.01 g) at 7 day intervals, beginning on the first day of the test. Larval mortality was recorded on weighing days.

Analysis of larval mortality data was performed using Duncan's multiple range test on data transformed according to $(X + 0.375)^{1/2}$, where X is the number of dead larvae per replicate (=5 larvae) after 6 weeks. The effect of treatments on larval weight was determined by subtracting each larva's weight in a given week from its original weight. Such weight differences were subjected to Duncan's multiple range test.

Results and Discussion

The present results indicate that any of several media may produce greater rates of growth in *P. crinita* larvae that can be achieved with Grape Nuts cereal (Figure 1). Although larvae in Grape Nuts media experienced high survival rates in this experiment (Figure 2), weight gain on that diet was undetectable statistically (Figure 1).

It should be noted that the commercially produced foods became heavily infested with fungi. Miner (1952) found that *P. crassissima* (Blanchard) larvae in his laboratory fed primarily on fungi which developed on Grape Nuts cereal he offered (in preference to the cereal itself or to grass roots). It is possible that the third instar larvae in this experiment also fed to some extent on the fungi.

Miner (1952) also reported that it has been generally assumed that first instar *Phyllophaga* larvae feed largely on decaying organic matter in the soil. This may be true in fields where crop material remains or has been plowed into the soil. Those third instar larvae in this experiment which were placed in unamended blackland clay soil suffered weight loss (Figure 1) and a high rate of mortality (Figure 2). For them, the food value of blackland prairie soil was insufficient even for minimal body maintenance.

Results of this research indicate that any of the better performing diets (Figures 1, 2; diets 1-5 or 6) might serve well as growth media for *Phyllophaga* larvae. Among the commercially available products, Kellogg's Concentrate cereal was especially promising. Further testing of candidate diets over the entire developmental period is needed, however. Although fungi tended to proliferate in many media, the harm or benefit of their presence is ambiguous. It would be useful to learn if and how these fungi should be controlled.

Literature Cited

Miner, F.D. 1952. Biology of the prairie white grub *Phyllophaga crassissima*. Arkansas Agric. Exper. Bul 521. 76pp.

Reinhard, J.H. 1940. The life history of *Phyllophaga lanceolata* (Say) and *Phyllophaga crinita* Burmeister. J. Econ. Entomol. 33: 572-8.

Reinhard, J.H. 1941. The life history of *Phyllophaga tristis* (F.) and allied forms. J. Econ. Entomol. 34: 526-32.

Reinhard, J.H. 1942. The life history of *Phyllophaga farcta and P. crassissima.* J. Econ. Entomol. 35: 576-82.

Reinhard, J.H. 1944. The life history of *Phyllophaga calceata and P. micans.* J. Econ. Entomol. 37: 581-7.

Reinhard, J.H. 1946. Life histories of some Texas *Phyllophaga.* J. Econ. Entomol. 39: 475-80.

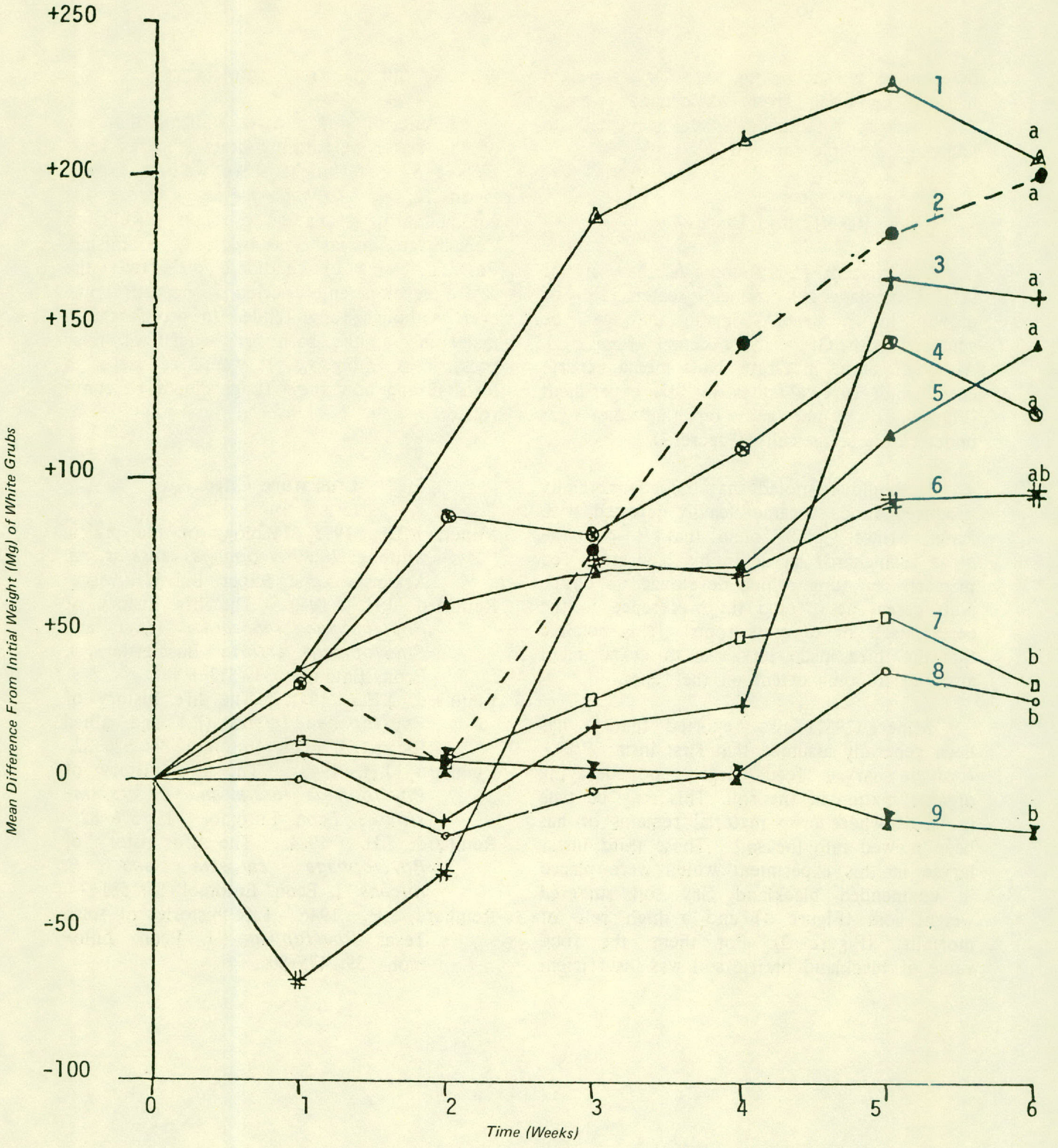


Figure 1. Weight change in 3rd instar larvae of Phyllophaga crinita in 9 media over a 6-week period. Media were: 1 = Thatch from tall fescue turf (50%), 2 = Kellogg's Concentrate (TM) (10%), 3 = Post Grape Nuts (TM)(10%) + Kretschmer (TM) wheat germ (regular) (10%), 4 = Common bermudagrass roots + culm nodes (50%), 5 = common St. Augustinegrass roots + culm nodes (50%), 6 = Kretschmer wheat germ (regular) (20%), 7 = Post Grape Nuts (10%), 8 = Post Grape Nuts (20%), 9 = no amendments; remainder (by volume) of each medium was dump soil. 10 larvae per treatment. Data for week 6 with same letter not significantly different (p = 0.05) according to Duncan's multiple range test.

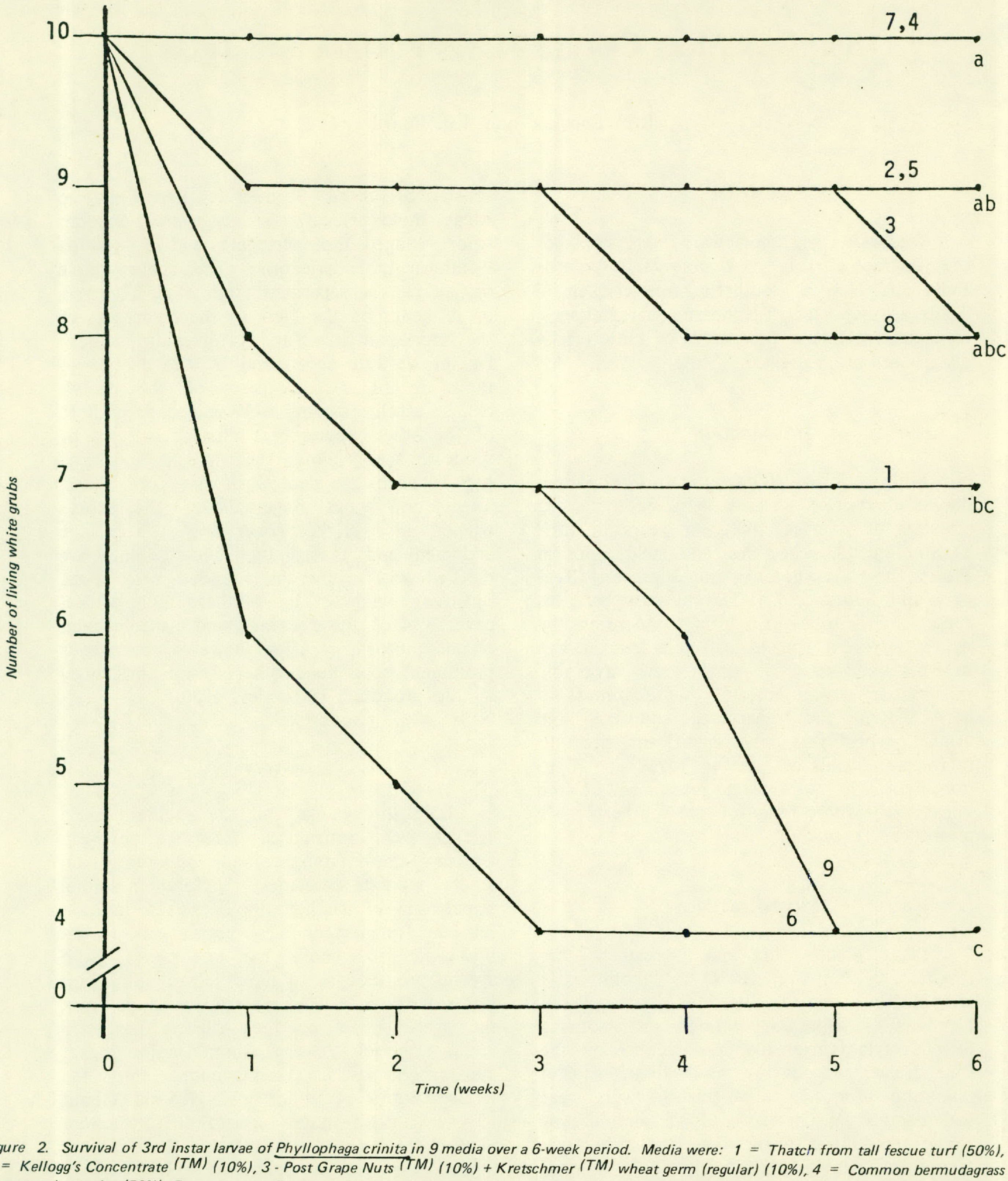


Figure 2. Survival of 3rd instar larvae of Phyllophaga crinita in 9 media over a 6-week period. Media were: 1 = Thatch from tall fescue turf (50%), 2 = Kellogg's Concentrate (TM) (10%), 3 - Post Grape Nuts (TM) (10%) + Kretschmer (TM) wheat germ (regular) (10%), 4 = Common bermudagrass roots + culm nodes (50%), 5 = common St. Augustinegrass roots + culm nodes (50%), 6 = Kretschmer wheat germ (regular) (20%), 7 = Post Grape Nuts (10%), 8 = Post Grape Nuts (20%), 9 = no amendments; remainder (by volume) of each medium was damp soil. Two replications, 5 larvae each. Data for week 6 with same letter not significantly different (p=0.05) according to Duncan's multiple range test.

PR 4050

Southern Mole Cricket Moves Further into Texas

R.L. Crocker and J.B. Beard

Abstract

Westward and northward extensions of the geographic range of *Scapteriscus acletus* Rehn and Hebard, southern mole cricket, in Texas are reported. Taxonomic characteristics, ecological role, and pest status of mole crickets in turf are reviewed.

Introduction

Mole crickets (Orthoptera: Gryllotalpidae) are reported to have inflicted increasing amounts of damage in recent years to turf, pasture grasses, vegetables, and field crops in Florida and elsewhere in the Southeast (Reinert and Short, 1980). The purposes of this report are 1) to explain briefly the means by which different species of mole cricket can be distinguished, 2) to review available information which indicates that *Scapteriscus acletus* Rehn and Hebard, the southern mole cricket, probably is not a significant threat to established stands of grass in Texas, and 3) to document and to evaluate extension of the known geographic range of the southern mole cricket in Texas.

Identification

Two genera of mole crickets are reported by Blatchley (1920) to inhabit eastern North America. Blatchley characterized members of genus *Gryllotalpa* as possessing four dactyls (finger-like projections) on the fore tibiae and having hind tibiae shorter than the pronotum. *Scapteriscus* spp. bear two dactyls on the fore tibiae and usually have hind tibiae longer than the pronotum, according to Blatchley.

In this report, we are concerned only with genus *Scapteriscus.* This genus is represented in eastern North America by three species: *S. vicinus* Scudder (changa or Puerto Rican mole cricket), *S. abreviatus* Scudder (short winged mole cricket), and *S. acletus* (southern mole cricket). The changa mole cricket can be separated from other members of its genus on the basis of the coloration of the pronotum (it bears an irregular pattern lacking definite spots) and by the dactyls of the fore tibiae (the bases of the dactyls almost touch, forming a V-shaped gap). Both of the other species bear distinct patterns of spots on the pronotum and have a U-shaped gap between the dactyls of the fore tibiae. The front wings (tegmina) of the short-winged mole cricket cover only 1/3 of the abdomen, and its pronotum and abdomen are mottled with numerous rounded pale spots. The front wings of the southern mole cricket cover 3/4 of the abdomen and its coloration is not mottled; it does, however, bear four prominent spots (and other weaker markings) on the pronotum (Blatchley, 1920).

History

Both the changa and the southern mole cricket were introduced into the southern United States from abroad, apparently on several separate occasions. Differences among populations of southern mole crickets indicate that the founders of these populations probably came from more than one source. Both species are thought to have gained entry into this country in ballast material of ships from the West Indies or the Atlantic coast of South America. The southern mole cricket apparently was first introduced into the United States at Brunswick, Georgia (about 1904), with subsequent entries at Charleston, South Carolina (about 1915), Mobile, Alabama (about 1919), and Galveston, Texas (about 1825) (Walker and Nickle, 1981). Present populations of southern mole cricket in Texas presumably sprang from the 1925 introduction into Galveston. Walker and Nickle (1981) reported that the earliest records of the changa mole cricket indicate that its only entry into the United States was at Brunswick, Georgia, in about 1899.

Ecology, and Importance

Reinert and Short (1980) reported that mole crickets prefer sandy soils, and that the insects may tunnel 3-6m/night when the soil is damp, such as after a rain. When the soil becomes dry, mole crickets tend to remain in their permanent burrows in the soil. Reinert and Short (1980) also reported that bermudagrass, *Cynodon dactylon* (L.) Pers., and bahiagrass, *Paspalum notatum* Flugge, show more damage from mole cricket activity than does St. Augustinegrass, *Stenotaphrum secundatum* (Walt.) Kuntze, perhaps because of differences in tolerance of the grasses to the insects' activities. They stated that centipedegrass, *Eremochloa orphiuroides* (Munro.) Hack., and zoysiagrass, *Zoysia* spp., have not been noticeably damaged by mole crickets.

It generally has been thought that both the southern and the changa mole cricket are destructive to cultivated grasses (Koehler and Short, 1976; Matheny and Kepner, 1980; Reinert and Short, 1980). However, Ulagaraj (1975) and Taylor (1979) found that whereas the gut of changa mole crickets contained primarily plant material, the gut of southern mole crickets held primarily the remains of insects they had eaten.

Walker et al., (1982), stated that the reputation of the changa and southern mole cricket as bahiagrass pests is based chiefly on finding large numbers of them in pastures showing severe loss of stand. In field experimentation, Walker et al., artificially augmented populations of changa and of southern mole cricket (about 16,000 and 9,000 mole crickets per plot, respectively) without reducing the stand of bahiagrass in an established pasture. Walker et al., concluded: 1) that mole crickets may not actually be responsible for much of the damage attributed to them, 2) that the changa mole cricket (a herbivore) and the southern mole cricket (a predator) may have very different effects on their environment, and 3) that the relative importance of tunneling and feeding damage in grass purported to be injured by mole crickets needs clarification.

Present Findings

Mole crickets were first noted in College Station, Brazos County, Texas, in the summer of 1980. The infestation, located on experimental turf plots on the Texas A&M University campus, has persisted through 1982 at the same site. In view of the known preference of mole crickets for sandy soils, it should be mentioned that much of the infested area is on a well drained, modified loamy sand root zone mix. The underlying native soil is Lufkin fine sandy loam.

Much of the evident tunneling is in alleyways (bare soil) between the grass plots. Many tunnels that run into the side of a plot subsequently continue along the plot's margin for a considerable distance. Such tunnels, appressed against the border of the plot, seldom appear actually to penetrate into the turf, except where the stand is thin. No plots have evidenced damage attributed to these insects. Limited sampling in May, 1982, using a soil drench (1 fl. oz. detergent in 2 gal. water (Short and Koehler, 1979)) indicated that only a relatively small number of mole crickets may actually be present in the College Station plots. Five adult mole crickets from the turf plots were taken to the laboratory for further study. These insects were taxonomically determined using Blatchley's (1920) key and description to be *Scapteriscus acletus,* the southern mole cricket.

On June 12, 1982, Dr. Douglas T. Haws (U.S. Golf Assn.) collected and brought to us one mole cricket from a putting green on a golf course in Longview, Gregg County, Texas. He reported that a small number of the insects have inhabited that site at least since the summer of 1981 without noticeably injuring the grass. We determined the mole cricket to be *S. acletus.* As was the case with the specimens from College Station, this insect bore on its pronotum the pattern of four prominent pale spots typical of many members of its species.

The occurrence of *S. acletus* in College Station and Longview indicates that the insect has extended its geographic range somewhat west and north of the previously known limits of its range in Texas (Figure 1). At present, the authors do not view these extensions of the insect's geographic range as having serious implications for most of the rest of Texas. The known preference of the insect for sandy soils may exclude it from the blackland prairies and other clay soils, and its moisture requirements may bar its progress much farther west. If the insect does continue to move westward and northward into new parts of the state, we would expect that irrigated turfs on sandy or modified soils (such as are used on golf courses) might be the first or perhaps the only sites they would invade. Further information is needed, however, and observations of the population at College Station will be continued.

Literature Cited

Blatchley, W.S. 1920. Orthoptera of northeastern America. Nature Publishing Co., Indianapolis. 784pp.

Koehler, P.G., and D.E. Short. 1976. Control of mole crickets in pasturegrass. J. Econ. Entomol. 69: 229-32.

Matheny, E.L., Jr., and R.L. Kepner. 1980. Maxillae of the mole crickets, *Scapteriscus acletus* Rehn and Hebard and *S. vicinus* Scudder (Orthoptera: Gryllotalpidae): a new means of identification. Fla. Entomol. 63: 512-14.

Reinert, J.A., and D.E. Short. 1980. Southern turfgrass insect pests with emphasis on mole cricket biology and management. Proc. Fla. Turfgrass Conf. 28: 33-43.

Short, D.E., and P.G. Koehler. 1979. A sampling technique for mole crickets and other pests in turfgrass and pasture. Fla. Entomol. 62: 282-3.

Taylor, T.R. 1979. Crop contents of two species of mole crickets, *Scapteriscus acletus and S. vicinus* (Orthoptera: Gryllotalpidae). Fla. Entomol. 62: 278-9.

Ulagaraj, S.M. 1974. Effects of insecticides on mole crickets (Orthoptera: Gryllotalpidae: *Scapteriscus).* Fla. Entomol. 57: 414.

Walker, T.J., R.C. Littell, and N. Dong. 1982. Which mole crickets damage bahiagrass pastures? Fla. Entomol. 65: 110-16.

Walker, T.J., and D.A. Nickle. 1981. Introduction and spread of pest mole crickets: *Scapteriscus vicinus and S. acletus* reexamined. Ann. Entomol. Soc. Amer. 74: 158-63.

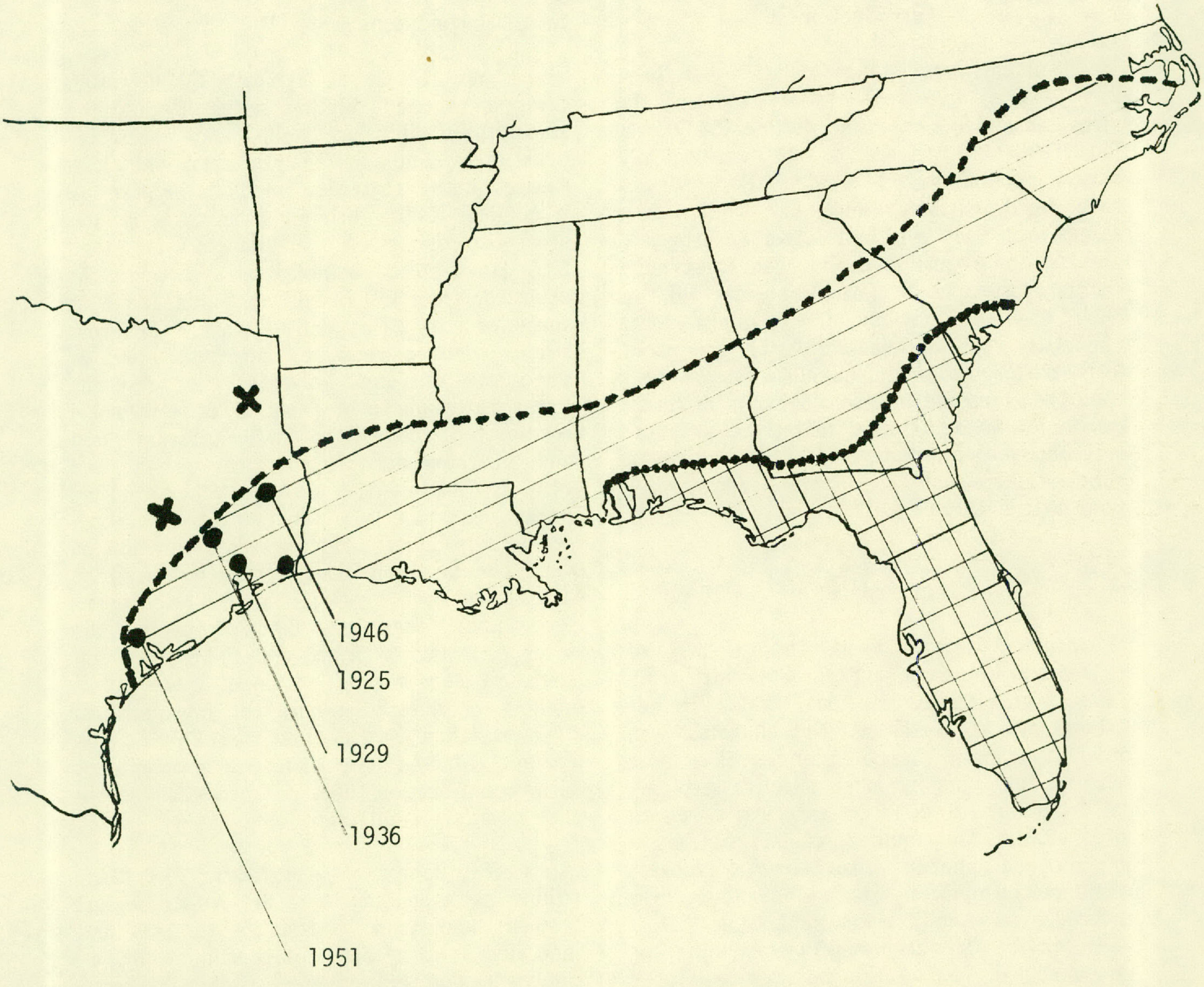


Fig. 1. The geographic ranges of the southern mole cricket (south of dashed line) and the changa mole cricket (south of dotted line) in the United States. Published collection sites in Texas are marked by dots, and the earliest collection dates at those sites are indicated (modified from Walker and Nickle 1981). An "X" marks each of the 2 range extensions of S. acletus documented herein.

PR 4051

Serological Recognition of Seven Strains of the St. Augustine Decline Strain of Panicum Mosiac Virus Using Immunoelectrophoresis

P.H. Berger and R. W. Toler

Introduction

Panicum mosaic virus (PMV) has been known since 1953 (5). More recently, the virus causing St. Augustine decline (SAD) was identified and shown to be serologically closely related to PMV (4,5). Both viruses have fairly extensive and very similar host ranges, but PMV will not infect St. Augustinegrass. St. Augustine decline can cause substantial losses in St. Augustinegrass (6). In 1974, G. E. Holcomb of Louisiana State University reported that serological strains of SAD existed, based on immunodiffusion tests (2). The presence of serologically different isolates of SAD indicated that there was heterogenecity withinthe SAD/PMV complex, although there were no differential host reactions to the various SAD strains.

Strain Separations

Panicum mosaic virus, four isolates of SAD from Louisiana, and three isolates from Texas were tested in the Plant Virology Laboratory at Texas A&M University in order to examine the potential use of a more sensitive and possibly more selective serological technique to differentiate closely related virus strains. This method, called quantitative immunoelectrophoresis (also known as "rocket" immunoelectrophores) has an advantage over the older immunodiffusion method in that it will provide an accurate determination of how much antigen (in this case, virus) is present in a given tissue sample (1). It is also rapid and inexpensive. Tests were conducted with crude extracts or infected plant tissue, using a single homologous antiserum. For all experimental work, all virus strains or isolates were in the same host and grown under identical conditions.

Figure 1A is a "typical" QIEP result, using an antigen dilution series. By using a standardized dilution series and measuring peak areas, one can analyze data with least squares linear regression methods. Figure 1B is a QIEP result when all seven SAD isolates are electrophoresed simultaneously. Here, SAD–H is the homologous reaction. As expected, from QIEP data on Table 1 and as suggested by Holcomb's work, different strains produce peaks of different area, or sometimes different shape. The resulting linear regression is a function of serological relationship relative to the antiserum used and the concentration of virus in the sap extract. That is, the slope of the resulting linear regression is a function of serological relationship and the intercept is a function of virus concentration. The regression should be unique for each virus strain. Table 1 represents linear regression comparisons of the seven SAD isolates tested and PMV. Based on statistical comparisons of slope, there are a number of distinct isolates (or now, strains) of SAD. These data suggest that PMV is the "parent" of SAD. (A different intercept, or virus concentration, does not necessarily mean that isolates are different.)

Recognition and identification of SAD strains has suggested that St. Augustinegrass cultivars known to be resistant to SAD and marketed as such, may not remain so indefinitely. It must be remembered that all serological tests examine only a small part of the virus coat protein, and this in turn represents only a small part of the virus' nucleic acid—its genome. And it is the genome which ultimately determines whether or not a virus will be capable of infecting a particular host.

Thus, we should expect, at some date in the future, to observe SAD in previously resistant hosts. This could happen soon, or more likely, many years in the future. Since St. Augustinegrass is propagated vegetatively, how currently established resistance is inherited is unknown. What is probably needed to reduce the likelihood of new SAD strains overcoming resistance is polygenic resistance in St. Augustinegrass. In the meantime, improved identification methods will be helpful-- recognition of a resistance breaking strain will allow us to try to prevent its spread.

Literature Cited

1. Berger, P.H. and R.W. Toler. 1981. Quantitative immunoelectrophoresis of panicum mosaic virus and St. Augustine decline strains. (Abstr.) Phytopathology 71: 860.
2. Holcomb, G.E. 1974. Serological strains of panicum mosaic virus. Proc. Am. Phytopath. Soc. 1:21.
3. Lee, T.A., Jr. 1973. Isolation, purification and characterization of the virus causing St. Augustine decline. Ph.D. Dissertation. Texas A&M University, College Station. 66pp.
4. Lee, T.A., Jr. and R.W. Toler. 1973. Purification and characterization of the virus causing St. Augustine decline (SAD). (Abstr.) Phytopathology 63: 444.
5. Sill, W.H., Jr. and R.C. Pickett. 1957. A new virus disease of switchgrass, Panicum virgatum* L. Plant Dis. Reptr. 41: 241-249.
6. Toler, R.W. 1974. Distribution, host range, and control of St. Augustine decline. In: E.C. Roberts (ed.) Proceedings of the Second Int. Turfgrass Res. Cong. Am. Soc. Agron. Madison, Wisconsin.

TABLE 1. LOG-LOG LEAST SQUARES LINEAR REGRESSIONS CHARACTERIZING PANICUM MOSAIC VIRUS AND ST. AUGUSTINE DECLINE STRAINS, AND THE PROPORTION VARIANCE ACCOUNTED FOR BY THE REGRESSIONS

VIRUS STRAIN	SLOPE 1/	INTERCEPT	R
SAD-BR	.559 a	.645 a	.935
SAD-A	.566 ab	.600 b	.975
SAD-H	.630 bc	.403 c	.940
SAD-I	.636 bcd	.470 d	.877
PMV	.652 cde	.546 e	.965
SAD-S	.706 def	.536 f	.981
SAD-N	.759 fg	.234 g	.982
SAD-II	.790 g	1.014 h	.938

1/ Slopes and intercepts not showing the same letter are significantly different at $\alpha = .05$ using the F-test.

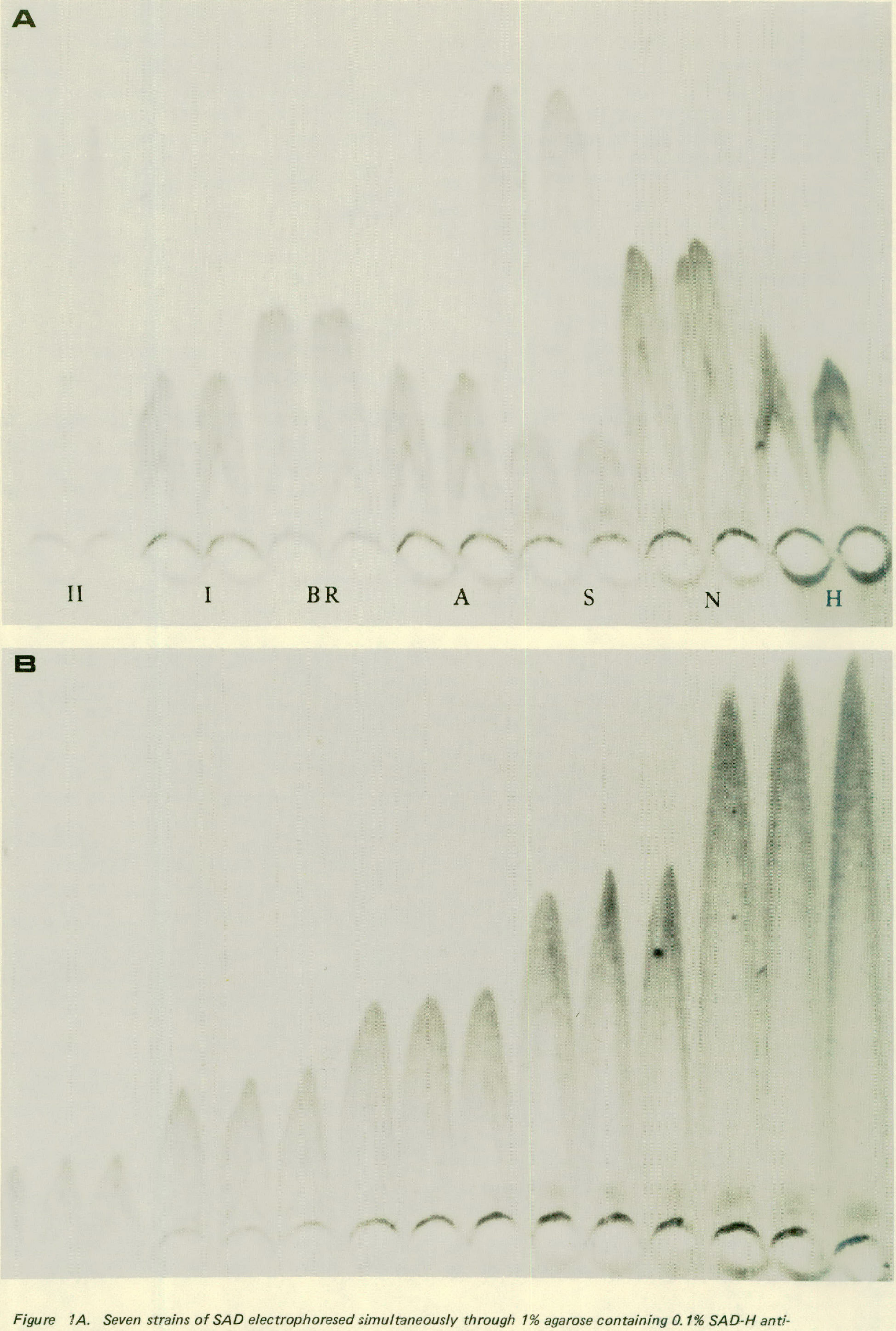


Figure 1A. Seven strains of SAD electrophoresed simultaneously through 1% agarose containing 0.1% SAD-H antiserum. Strains I, II, A, and BR are from Louisiana and strains H, N, and S are from Texas.
Figure 1B. A "typical" two-fold serial dilution series of SAD strain.

PR 4052

Fungicide Control of St. Augustinegrass Diseases

M.P. Grisham and J.B. Beard

The three most significant fungal diseases of St. Augustinegrass in Texas are Rhizoctonia brown patch, gray leaf spot, and downy mildew. Although cultural practices may influence severity and incidence of these diseases, maintaining acceptable levels of disease is usually not possible by cultural means when environmental conditions favoring disease development exist. Cultivars of St. Augustinegrass are known to vary in susceptibility to the fungi which cause these diseases, but none of the currently available cultivars are resistant to these pathogens. Consequently, fungicides are necessary for the control of these fungal diseases. Selected fungicides were tested in trials conducted at the Texas A&M University Turfgrass Field Laboratory, College Station, Texas during the Fall of 1981 and the Spring of 1982. Commercially available materials and advanced experimental materials were applied.

Reseach Procedure

Fungicides were applied to an established stand of "Texas Common" St. Augustinegrass. Fall applications were made on October 5 and October 21, 1981; spring applications were made on March 26 and April 12, 1982. The design was a randomized block with 18 treatments and four replications with each plot 4 x 8 feet. Fungicide applications were made with a hand operated CO^2 sprayer with a delivery of approximately 25 psi. Test plots were rated for brown patch development in the fall and spring. The incidence of downy mildew and gray leaf spot was high enough to evaluate only in the spring. Symptoms of phytotoxicity were also noted. Disease severity ratings were made on November 10, 1981, and on May 10, 1982. The experimental area was maintained at a 1-1/2 inch mowing height and fertilized at the rate of 1 lb of nitrogen per 1,000 ft^2 per growing month. Irrigation was applied as needed to prevent wilting.

Materials tested included the following available turf fungicides: PCNB, Ipridione, Triadimefon, Benomyl, Clorothalonil, Cycloheximide, Cycloheximide plus PCNB, and Metalaxyl (currently registered on turfgrasses for Pythium blight and damping-off caused by *Pythium* spp.). Three experimental fungicides were also included: EL 222, CGA 64261, and OAC 3890. Rates of application are included in Table 1.

Results and Discussion

The mean area affected by Rhizoctonia brown patch is given in Table 1. Because of the large number of treatments and the irregular distribution of the pathogen, means of the diseased areas were not significantly different for the Fall 1981 brown patch evaluations. However, PCNB and OAC 3890 treatments demonstrated clear inhibition of expanding brown patch areas. Severe effects of brown patch were observed in the fall on replication one. Spring activity of the disease on that replication was difficult to determine and was therefore not included in the analysis of the spring data. Of the three experimental fungicides tested, OAC 3890 appears to have the most potential as an effective control agent of Rhizoctonia brown patch. EL 222 appeared to be effective only at higher concentrations, while CGA 64251 was the least effective of the experimental fungicides in this test for control of brown patch. PCNB appeared to be the most consistently effective available material.

No downy mildew was observed in the Metalaxyl treated plots. As a systemic material, Metalaxyl exhibits both eradicative and protective properties. Because of the extremely low incidence of gray leaf spot at one end of the experimental area, only three replications were evaluated for fungicide efficacy. For gray leaf spot control, CGA 64251 at the higher concentration appears to have potential efficacy. Significantly higher gray leaf spot was observed in OAC 3890 treatments.

Phytotoxicity evaluations of the tested materials are presented in Table 4. Although some materials caused phytotoxic effects, recovery of the turfgrass from the adverse effects was rapid.

TABLE 1. EFFECT OF FUNGICIDES ON RHIZOCTONIA BROWN PATCH OF 'TEXAS COMMON' ST. AUGUSTINEGRASS AT TAMU IN COLLEGE STATION, TEXAS 1981 - 1982

Fungicide	Rate of Application (oz / 1000 ft²)	Area Diseased Fall 1982	(%)* Spring 1982
El 222	.3	8.4 a	5.2 a
PCNB	12	11.2 a	2.0 a
OAC 3890	6	15.1 a	0 a
EL 222	.4	16.3 a	3.0 a
OAC 3890	3	16.9 a	3.7 a
EL 222	.2	20.0 a	5.2 a
Ipridione	2	23.5 a	4.3 a
Control		28.2 a	3.7 a
Metalaxyl	.5	28.3 a	6.0 ab
CGA 64251	4	28.8 a	6.0 ab
Metalaxyl	1.0	30.3 a	2.0 a
CGA 64251	8	30.6 a	10.8 a
Chlorothalonil	6	34.2 a	1.0 a
Cycloheximide	1.2	38.7 a	1.0 a
Benomyl	1.6	39.8 a	4.3 a
Cycloheximide plus PCNB	1.2	42.0 a	3.7 a
Triadimefon	.18	42.5 a	4.3 a
EL 222	.1	55.9 a	4.3 a

* Mean area diseased of four replications in 1981 and three replications in 1982. Means followed by the same letter do not differ significantly (P=.05) by Duncan's multiple range test.

TABLE 2. EFFECT OF FUNGICIDE ON DOWNY MILDEW OF 'TEXAS COMMON' ST. AUGUSTINEGRASS AT TAMU IN COLLEGE STATION, TEXAS – 1982

Fungicide	Rate of Aplication (oz / 1000 ft²)	Disease Severity * (0 - 7)	
Metalaxyl	.5	0	a
Metalaxyl	1.0	0	a
Ipridione	2	.25	ab
PCNB	12	.50	ab
EL 222	.4	.50	ab
EL 222	.3	.50	ab
Cycloheximide	1.2	.50	ab
CGA 64251	8	.75	ab
OAC 3890	.6	1.00	abc
Triadimefon	.18	1.00	abc
Cycloheximide plus PCNB	1.2	1.00	abc
EL 222	.2	1.25	abcd
EL 222	.1	1.50	abcd
Control		1.50	abcd
CGA 64251	4	1.75	abcd
OAC 3890	.3	2.25	bcd
Benomyl	.16	3.00	cd
Chlorothalonil	6	3.25	d

* Mean disease severity of four replications. A disease severity rating of 0 - 7 was used 1 = slight infection, 2 - 3 moderate infection, 4 - 5 heavy infection, and 6 - 7 = severe infection. Means followed by the same letter do not differ significantly (P = .05) by Duncan's multiple range test.

TABLE 3. EFFECT OF FUNGICIDES ON GRAY LEAF SPOT ON 'TEXAS COMMON' ST. AUGUSTINEGRASS AT TAMU IN COLLEGE STATION, TEXAS - 1982

Fungicides	Rate of Application	Disease Incidence * (0 - 10)
Benomyl	1.6	0 a
CGA	8	0 a
PCNB	12	0 a
Chlorothalonil	6	.17 a
Triadimefon	.18	.33 a
EL 222	.4	.50 a
Metalaxyl	.5	.67 a
EL 222	.3	.67 a
EL 222	.1	.67 a
Cycloheximide	1.2	.67 a
Control		1.00 a
Ipridione	2	1.00 a
Cycloheximide plus PCNB	1.2	1.00 a
CGA 64251	4	1.16 a
Metalaxyl	1.0	1.33 a
EL 222	.2	1.33 a
OAC 3890	.6	2.67 b
OAC 3890	.3	4.50 c

* Mean disease incidence of three replications. A disease incidence scale of 0 - 10 was used where 0 = no visible disease and 10 = 91 - 100% of the leaves have lesions. Means followed by the same letter do not differ significantly (P = .05) by Duncan's multiple range test.

TABLE 4. PHYTOTOXIC EFFECTS OF FUNGICIDES ON 'TEXAS COMMON' ST. AUGUSTINEGRASS AT TAMU IN COLLEGE STATION, TEXAS 1981 - 1982

		Phytotoxicity Rating * (0 - 5)	
Fungicide	Rate of Application	Fall 1981	Spring 1981
PCNB	12	2	2
OAC 3890	6	2	2
OAC 3890	3	1	0
Cycloheximide plus PCNB	1.2	3	0
Cycloheximide	1.2	3	0
EL 222	.1	0	0
EL 222	.2	0	0
EL 222	.3	0	0
EL 222	.4	0	0
CGA 64251	.4	0	0
CGA 64251	8	0	0
Metalaxyl	.5	0	0
Metalaxyl	1.0	0	0
Chlorothalonil	6	0	0
Ipridione	2	0	0
Triadimefon	.18	0	0
Benomyl	1.6	0	0
Control		0	0

* A phytotoxicity rating of 0 - 5 was used where 0 = no effect, 1 = slight discoloration of some leaves, 2 = significant discoloration of most leaves, 3 = significant discoloration of all leaves with some chlorosis, 4 = discoloration of leaves, chlorosis, and some necrosis, 5 = extensive necrosis, leading to death of plants.

PR 4052-1

Nigrospora Stolon Rot of St. Augustinegrass Related to Summer Drought Conditions

P.F. Colbaugh and S.J. Terrell

Abstract

Dallas area landscapes were severely affected by an extended period of drought during the hot summer months of 1980. Unusually high temperatures and a virtual absence of rainfall during the summer were particularly damaging to established St. Augustinegrass lawns maintained under restricted water use programs. Large areas of poorly developed and dying St. Augustinegrass on residential landscapes were observed from June to September. Field studies of St. Augustinegrass homelawns indicated a common occurrence of a stolon die-back condition associated with dark brown to black lesions on stolon internodes recovered from declining areas of turf. Laboratory observations and isolations from infected stolons associated severe disease activity with a fungus identified as *Nigrospora spp.* Inoculation studies demonstrated pathogenicity of the fungus on stolon internodes. Diesease activity by the fungus contributed to poor development and die-back of St. Augustinegrass stolons during the hot summer months.

Plants stressed by unfavorable environmental conditions or poor cultural practices are easily attacked by turfgrass diseases. St. Augustinegrass turf in many areas of Texas was particularly damaged by high temperature and drought conditions during the 1980 growing season. Symptoms of sparsely developed or dying St. Augutstinegrass were frequently observed during the hot, dry summer on Dallas area homelawns. Common diseases of St. Augustinegrass including *Rhizoctonia* brown patch, the Helminthosporium diseases, and the grey leaf spot disease were markedly reduced during the summer, however, a fungal rot disease of stolons was very common during the year. Symptoms of dark brown lesions were most commonly observed on St. Augustinegrass stolons in thin or dying areas of homelawns. The present report is a summary of studies to determine the cause of the disease.

Research Procedure

Several field studies were conducted during the 1980 growing season to determine the nature of poorly developed and dying St. Augustinegrass lawns in Dallas. Observations of thinned and dying areas of St. Augustinegrass were made in late May through September during a period of severe drought in many areas of Texas. Infected St. Augustinegrass stolons were examined in the laboratory with a dissecting microscope to determine the presence of sporulating fungi on the surface of dark lesions found on stolon internodes. Potential pathogens were isolated from diseased areas of stolons following surface sterilization of the stolon internodes with 0.05 percent sodium hypochlorite.

A *Nigrospora sp.* was consistently observed as a spore producing fungus on lesions of St. Augustinegrass stolons. Inoculation studies were conducted with spores and mycelia of the fungus grown in 9.0 cm petri dishes on V/8 agar. Leaves and stolons of common St. Augustinegrass grown in greenhouse pots were inoculated with spore suspensions containing 7×10^4 *Nigrospora* spores/ml in water applied with a hand-held sprayer. Mycelia and spores of the fungus were also directly applied to wounded stolon internodes. Wounds on stolon internodes were made with a sterilized razor blade or by puncturing a 0.5 cm area with a sterile straight pin prior to inoculation. Inoculated test plants and noninoculated plants receiving only water were placed in a humidity chamber at 28C for 72 hours before assessing disease activity.

Germination studies were conducted with spores of *Nigrospora sp.* produced on autoclaved barley seed. Spores recovered from barley seed were collected by passing spore suspensions through a millipore filter. Small disks of the collection filters (0.5 cm diameter) were placed in 0.7 ml of a germination medium held in microbeakers (1 cm dia) maintained at 26 degrees C for a 24-hour period. Spore germination was determined after 5, 7, 10, 17, and 20 hours of incubation. Nutrient solutions tested for effects on spore germination were: leachates from tall fescue (Kentucky 31) clippings; leachates from common St. Augustinegrass clippings; and V/8 juice. The effect of desiccation on spore germination also was studied. Spores collected on millipore filter discs were allowed to desiccate at 26, 30, and 35 degrees C for 48 hours prior to placing the discs in liquid germination media. The influence of desiccation on spore germination was determined by comparing germination of desiccated and not dessicated spores in a germination medium composed of a 1:50 dilution of V/8 juice in water.

Results

Field and laboratory observations of diseased St. Augustinegrass stolons indicated a common occurrence of a fungal rot on the upper surface of internodes. Damage to stolon internodes was frequently observed on closely-cut turf where stolons were directly exposed to the sun. St. Augustinegrass lawns, showing symptoms of St. Augustine Decline Virus activity, were also severely affected with a rot condition on internodes. The rot of stolon internodes begins as a small dark-colored lesion on the stolon. Small lesions appear to slowly enlarge and eventually girdle the stolon forming a hard rot. Rotted areas on stolons were associated with a die-back and wilting of the terminal ends of stolons during the summer. Foliar growth on the terminal end of diseased stolons was typically thin and yellow reflecting a limited supply of nutrients to the growing point.

Observations of infected stolons were made in the laboratory to determine the presence of fungi producing spores on infected plant parts. Spore producing fungi indentified as *Nigrospora* and *Curvularia* sp. were commonly observed in the same lesions on infected stolons. Isolation from diseased stolon internodes following surface sterilization also indicated a high frequency of recovery of these fungi from diseased areas. Segments of infected St. Augustinegrass stolons were incubated on moistened filter paper in petri dishes for 72 hours to encourage growth and sporulation by fungi on lesions. Extensively branched, white mycelial growth appeared on the surface of the stolon segments following a 72-hour incubation period. Limited sporulation appeared on the mycelium and the fungus was identified as *Nigrospora* sp. Sporulation by other fungi, including *Fusarium* sp. and *Helminthosporium* sp., was also observed following incubation in the moist chamber, however, these fungi did not appear on infected areas of stolons.

Inoculation of wounded areas on internodes of surface sterilized stolons resulted in the formation of dark lesions typical of symptoms observed in the field. Lesions were observed on inoculated stolons incubated in moist chambers maintained at temperatures of 23, 27, and 33 degrees C for 72 hours. Continued growth of the lesions was not observed over a 14-day period and indicated the fungus was weakly pathogenic under the moist conditions of the study. The fungus was successfully re-isolated from the dark lesions 8 days after inoculation.

Attempts to use spore suspensions of *Nigrospora* sp. for inoculation of foliage and internodes of common St. Augustinegrass grown in greenhouse pots were not successful. An examination of spores of the fungus used in inoculation attempts indicated the spores did not germinate following application to test plants. Studies to determine the effects of nutrients on spore germination were conducted with one isolate of *Nigrospora* sp. (I-12). Nutrients supplied by leachates from tall fescue and St. Augustinegrass clippings on V/8 juice enhanced germination of the spores (Table 1). Increasing the dilution of leachates of V/8 juice resulted in a reduced germination of spores. Desiccation of

Nigrospora spores also improved the ability of the spores to germinate the weak nutrient solutions (Table 2). The germination of spores desiccated at 30 degrees C was greater than spores desiccated at 27 or 35 degrees C. Spores held in a moist chamber at the three temperatures failed to germinate.

Conclusions

The formation of dark lesions on stolons of St. Augustinegrass during the summer has previously been attributed to *Rhizoctonia solani* and fungi which cause the *Helminthosporium* diseases. These fungi were rarely isolated from infected stolons during the hot summer months. The present study indicates a high frequency of occurence of a *Nigrospora* sp. with disease symptoms on stolons collected during the summer. Inoculation studies demonstrated the fungus to be pathogenic on St. Augustinegrass stolon internodes. Research on the influence of nutrients and desiccation on increased germination of spores of the fungus indicate *Nigrospora* sp. are well adapted to drought conditions where symptoms of the disease are most commonly observed.

Nigrospora sp. appear to be weakly pathogenic under environmental conditions favoring growth and development of St. Augustinegrass. High temperatures and desiccation of exposed stolons in thin stands of poorly developed turf probably contribute to greater pathogenic activity by the fungus during the hot summer months. Increasing the cutting height on stands of St. Augustinegrass and supplying adequate moisture and fertility to sustain a green leaf canopy over the stolons appears to greatly reduce the incidence of the disease during the summer.

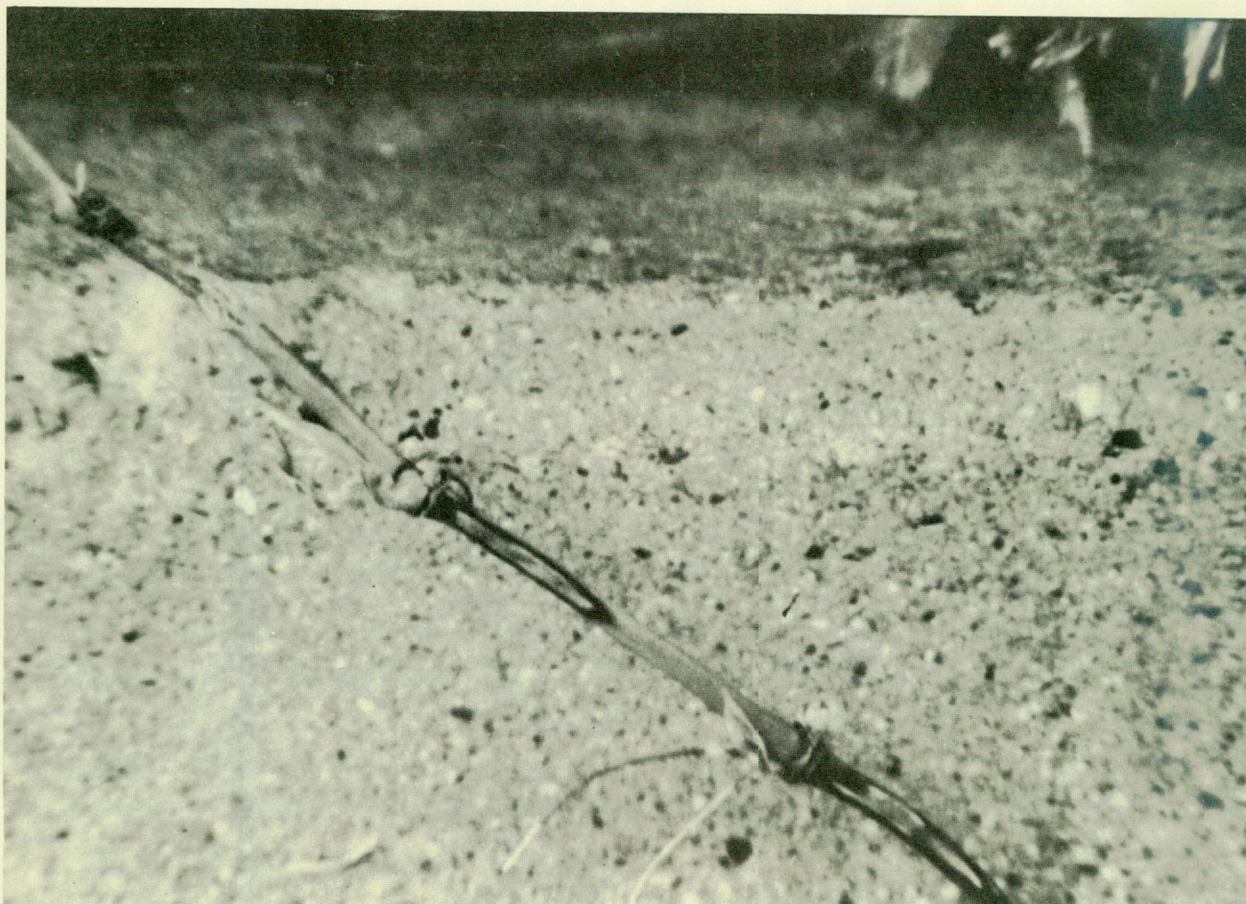


Figure 1. Nigrospora sp. on the surface of lesion of St. Augustinegrass stolon. Note dark colored spores and webb-like mycelium.

Table 1. Influence of varying nutrient composition of liquid media on spore germination by *Nigrospora* sp. during a 5-20 hr incubation at 26C

Treatment	Spore Germination[1]		
	5 hr	7 hr	20 hr
A. Tall Fescue Leachate			
Full strength	0	0	+++
1/2 strength	0	0	++
1/10 strength	0	0	0
B. St. Augustine Leachate			
Full strength	+++	+++	+++
C. V/8 Juice			
Full strength	+++	+++	+++
1/2 strength	+++	+++	+++
1/10 strength	+++	+++	+++
1/50 strength	0	+	++

1/Degree of spore germination where: 0=no germination, +=low, ++=moderate and, +++=high levels of germination.

Table 2. Effect of desiccation on the germinability of *Nigrospora* sp. spores in a weak nutrient solution over a 20-hour inoculation period.1/

Germination Solution	Preincubation Treatment (48 hrs)	Spore Germination2/ d			
		5 hr	7 hr	10 hr	20 hr
Water					
Water	Moist 27C	0	0	0	0
V/8 Juice (1/50 strength)	Moist 27C	0	0	0	0
V/8 Juice (1/50 strength)	Moist 30C	0	0	0	0
V/8 Juice (1/50 strength)	Moist 35C	0	0	0	0
Water	Dry 27C	0	0	0	0
V/8 Juice (1/50 strength)	Dry 27C	0	+	+	+
V/8 Juice (1/50 strength)	Dry 30C	0	+	++	++
V/8 Juice (1/50 strength)	Dry 35C	0	+	+	+

1/*Nigrospora* spores were collected on a millispore filter and desiccated or maintained in a humidity chamber for 48 hrs at 27, 30, or 35C.

2/Degree of spore germination where 0=none, +-slight, ++=moderate and, +++=high level of germination.

PR 4052-2

Spring Dead Spot of Bermudagrass in Texas

P.F Colbaugh, N.L. McCoy, and W.E. Knopp

Abstract

The distribution and severity of symptoms of Spring Dead Spot on Texas bermudagrass is described. Symptoms of the disease were observed on common and hybrid bermudagrasses in the area of north central Texas. The greatest severity of the disease was found on golf course fairways and homelawns receiving higher levels of cultural management. The occurrence of the disease varied from year to year. Highest levels of disease activity were observed following prolonged periods of low temperatures during winter. Applications of turfgrass fungicides at recommended rates during the dormant season failed to control the disease. The significance of related research on the Spring Dead Spot problem is discussed.

Symptoms of circular dead spots on bermudagrass turf as the grass breaks dormancy in the spring have been observed in Texas for many years. The problem was originally studied in Oklahoma over 40 years ago and given the name Spring Dead Spot (SDS) of Bermudagrass. The SDS problem is only associated with bermudagrass turfs and is particularly troublesome on intensively managed areas receiving high levels of fertility. Increasing incidence and severity of SDS in recent years has made the disease a major problem on bermudagrass in North Central Texas.

Characteristic symptoms of SDS are the presence of circular spots of dead grass ranging from 15 cm to several meters in diameter while turf outside of these areas turns green with new growth in the spring. Dead grass within the affected areas is typically white to light tan in color and lightly appressed to the soil giving the diseased area a sunken appearance. Dead roots and stolons in contact with the soil are dark brown to black in color suggesting the involvement of one or more soil-borne pathogens as causal agents of the disease. A major problem associated with SDS is the limited ability of the turf to recover by re-growth into diseased spots. The failure of turf to establish in these areas appears to be due to the presence of a residual toxin in the soil. Many problem weed species including *Poa annua* and several winter weeds commonly invade the bare spots and are persistent problems throughout most of the growing season.

The range of occurrence of SDS in the United States is primarily along the northern range of adaptation in the bermudagrass growing zone. All types of bermudagrass are considered to be susceptible to the disease. Severe symptoms of SDS have been observed as far north as Washington D.C. and in the south along the northern half of the gulf coast states. The occurrence of SDS in Texas is restricted to the north central area of the state and probably extends as far south as Waco. Symptoms of the disease are generally more severe in the northern locations of this zone and less severe in the southern regions.

Research Procedure and Results

Field studies were conducted during the Spring of 1978 to 1981 to determine the incidence and severity of the SDS disease on bermudagrass turfs in the Dallas-Fort Worth Metroplex. The following accounts are observations of this study.

Spring Dead Spot has probably occurred in the north central Texas area for many years. Following the first description of the disease in Oklahoma in 1936, SDS symptoms were mostly associated with bermudagrass fairways on Dallas area golf courses. The occurrence of SDS symptoms on fairways has varied considerably from year to year. A high incidence of symptoms can be associated with specific golf courses in the north central Texas region. Usually severe symptoms of SDS appear following prolonged periods of low temperatures during the winter. Less disease activity has occurred where winter temperatures are relatively mild. During successive years favoring the disease, SDS symptoms could be traced back to diseased areas which were present in the previous year. This observation has also been reported in other states and suggests the involvement of a soil-borne pathogen as a causal agent for the disease. Few disease patterns typical of SDS have been observed on golf greens, which are largely planted with Tifgreen bermudagrass. We have observed large irregular patterns of dead bermudagrass on greens following hard winters, however, most of this damage has been diagnosed as winter kill.

In recent years symptoms of SDS were observed on several bermudagrass homelawns in the Dallas area. Both common and hybrid bermudagrasses have been severely damaged by the disease. The occurrence of SDS symptoms on homelawns is restricted to intensively managed bermudagrass turfs. Many homelawn problems with SDS can be associated with higher cultural intensity used by lawn care companies which are relatively new to the Dallas area. Both higher rates of fertilization and an extended fertilization period into the fall growing season could be factors contributing to higher levels of disease activity on these homelawns.

Studies to define the cause of SDS have been in progress throughout the southern states for many years. Field symptoms of the problem appear similar to other turfgrass diseases caused by soil-borne fungal pathogens. Turfgrass pathologists in Kansas and Mississippi have transmitted the disease from infected turf to healthy stands of bermudagrass. This work supports the hypothesis of a soil-borne fungal organism associated with the disease. Many attempts have been made to isolate pathogens from SDS affected areas during the spring. Laboratory isolations from diseased bermudagrass have not given consistent results to explain how the disease occurs. Isolations from surface sterilized root and stolon sections obtained from diseased spots have yielded *Fusarium spp., Pythium spp., Helminthosporium spp., Rhizoctonia solani,* and several mycelial types which could not be identified. The cause of the SDS is unknown.

Applications of several turfgrass fungicides to control SDS on bermudagrass golf fairways in Texas have not been successful. The fungicides Captan, Terraclor, Terraclor Super X, Potassium Azide, and Benlate were applied during the winter months at recommended use ranges, however, these applications were not effective.

Recent research results with SDS in North Carolina indicate late fall application of fungicides are more effective in controlling the disease. The timing of fungicide application and rate of fungicide applied appear to be important factors to consider. Research by Dr. L.T. Lucas has demonstrated successful control of SDS with applications of Benlate. The use of Benlate (Tersan, 1991) at an 8-oz rate (116 g ai/93 m^2) resulted in excellent control of the disease when the fungicide was applied as a foliar spray during the period of October 15 to November 1. Late summer fertilization was also demonstrated to increase the severity of SDS in the same studies. Results of this research will provide pathologists with some interesting clues as to the nature of the SDS problem. The specificity of Benlate fungicide against certain fungal pathogens appears to eliminate several pathogens from the list of potential causal agents for the disease. Studies are in progress to verify the results of late fall Benlate applications for control of the problem in Texas.

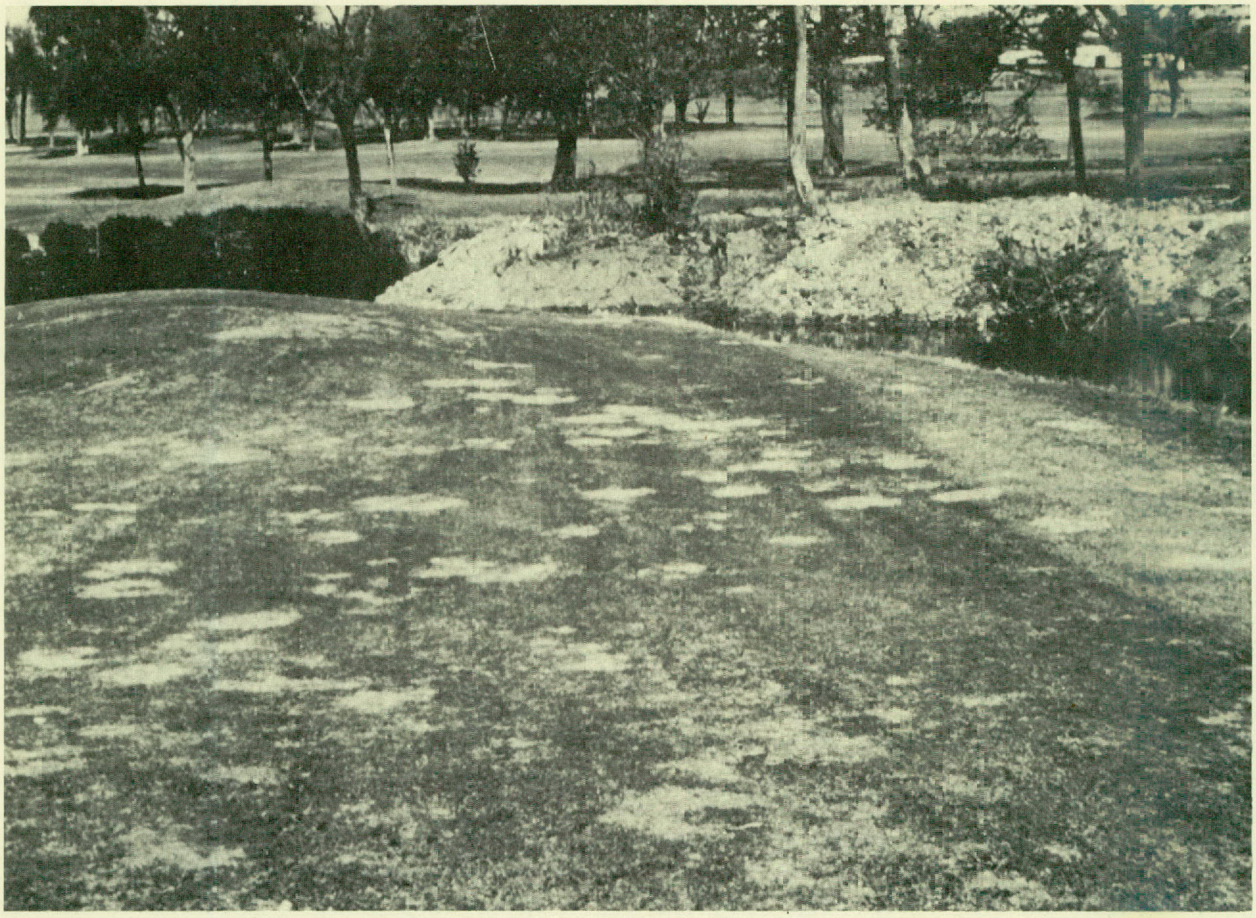


Figure 1. Symptoms of Spring Dead Spot on bermudagrass homelawn.

PR 4053

An Assessment of Slow Release Nitrogen Carriers

J.B. Beard, D. Johns, S.M. Batten, and W.G. Menn

A number of new slow release nitrogen carriers have become available in the last 3 years which need assessment under the alkaline soils and hot humid climatic conditions of the Southwest.

Research Procedure

This nitrogen carrier assessment study has been conducted during the past three growing seasons. The approach used involved the application of 2 lb of actual nitrogen per 1,000 square feet in a single application. This treatment was then evaluated over a 16-week period until the nitrogen responses had totally dissipated. The plant responses evaluated involved weekly assessments of visual turfgrass quality, shoot growth above the cutting height, and tissue nitrogen levels. The plot size utilized was 6 x 8 feet arranged in a randomized block design of four replications. The nitrogen studies were conducted at three distinct seasons of the year. Experiments were initiated in early April, July, and September and were applied in an alternating schedule involving summer-spring-fall.

The experiments were conducted on two species, one being a mature Texas Common St. Augustinegrass turf, which was growing on a well-drained, modified sand root zone with a pH of 7.8. The weekly mowing was at a cutting height of 1.5 inches. Phosphorus and potassium were applied as needed based on annual soil tests. The area was irrigated as needed to prevent visual wilt. No pesticides were applied during the duration of the investigation. The second species utilized was a mature stand of Tifway bermudagrass growing on a poorly drained, fine sandy loam having a pH of 8.2. The area was mowed weekly at 1 inch. Phosphorus and potassium were applied as needed based on annual soil tests. The area was irrigated as needed to prevent visual wilt. No pesticides were applied during the investigation.

Results

Seasonal Responses

A summer nitrogen application was applied to bermudagrass in July of 2 separate years and to St. Augustinegrass in July of 1 year. An observation common to all of those summer applications was the minimal differences among the major types of nitrogen carriers. In fact, most "slow release" types of nitrogen carriers tended to act more like water soluble quick release types under the hot, humid climate and alkaline soil conditions that existed on this experimental site. In contrast, distinct differences in turfgrass responses were observed among the major types of nitrogen carriers on both bermudagrass and St. Augustinegrass during both the spring and fall fertilizations.

Nitrogen Carrier Assessment

The nitrogen carriers which have been available for a number of years, such as ammonium sulfate, ammonium nitrate, urea, ureaformaldehyde, and IBDU, have been evaluated previously. In this study they performed basically the same as in earlier studies and need not be discussed in this report.

Seven different types of sulfur-coated urea nitrogen carriers from four manufacturers were evaluated. These sulfur coated nitrogen carriers show good promise for use in turf fertilization on both bermudagrass and St. Augustinegrass under the conditions of this study. They have reasonable slow release properties. Furthermore, the significant amount of sulfur present is an additional bonus, particularly on the high pH soils under which the studies have been conducted.

A new experimental nitrogen carier which is showing promise is oxamide. It is not yet commercially available, but may be particularly attractive to certain phases of the lawn-care industry. Oxamide has shown reasonably good slow release properties without the excessive shoot growth during the initial 6 weeks that is typical of many nitrogen carriers. It also has the capability to produce a distinctly darker green color than the other nitrogen carriers without excessive shoot growth. This response is particularly noticeable in terms of extended late fall color and early spring greenup. The exact mechanism involved in this response is not yet understood.

Among the remainder of the slow release nitrogen carriers under evaluation, including biuret and some ureaformaldehyde formulations from Israel, none have shown significant attributes in terms of potential use for turfgrass fertilization under the conditions of this study.

PR-4054

Assessment of Growth Regulators for Use in Chemical Trimming

S.M. Batten and J.B. Beard

Mechanical trimming of turf perimeters along sidewalks, roadways, garden beds, and bunkers is a time consuming and costly practice. One potential cost-efficient alternative involves the use of the technique termed chemical trimming. Studies conducted during the past 2 years at Texas A&M University reveal flurprimidol (EL-500), mefluidide (Embark*R), and MBR 18337 to have potential as chemical trimming materials.

Reseach Procedure

The feasibility of growth inhibitors for use in chemical edging was assessed at two locations. The first experiment was conducted at the Bryan Municipal Golf Course in Bryan, Texas, along a series of bunker perimeters. The dominant grass present was common bermudagrass *(Cynodon dactylon)*. Nine treatments were applied in 10 x 1 ft bands along the perimeter, just 1 day after mechanically trimming the stolons using a power edger. This initial mechanical edging was considered the "0" centimeter length for observations as to stolon encroachment. The application rates selected were based on prior 1980 growth inhibitor studies conducted at Texas A&M University. The turfs were irrigated regularly to sustain plant growth. Ten stolon measurements were recorded on each of three replications at the end of 6 weeks.

The second experiment was conducted at the Briarcrest Country Club, Bryan, Texas, along a series of bunker perimeters. The dominant grasses were hybrid bermudagrasses composed primarily of Tifway. The rates selected for this second study were adjusted slightly higher based on the responses achieved in the initial experiment. The rates utilized in both studies are summarized in Tables 1 and 2. The experimental procedure utilized was basically the same as described for the first experiment.

Results

The stolon growth reduction from the eight growth inhibitor treatments are summarized in Table 1. The percent reduction in stolon growth on common bermudagrass ranged from 23 to 36 percent after a 6-week period under adequate soil moisture conditions. Both flurprimidol and MBR 18337, each applied alone, ranked highest in terms of growth suppression, with mefluidide ranking somewhat lower. This preliminary feasibility experiment suggested that the chemical edging technique can reduce the frequency of mechanical trimming.

The effects of seven growth inhibitor treatments on hybrid bermudagrass stolon extension 10 weeks after application to a bunker perimeter are summarized in Table 2. The degree of stolon suppression ranged from 42 to 70 percent. When adjusted for the time frame within which the stolon extension measurements were made, it is apparent that the same order of magnitude of growth suppression was achieved on the hybrid bermudagrass as in the earlier experiment with common bermudagrass. Top-ranked treatments were combinations of flurprimidol + MBR 18337. The rates used in this combination treatment were higher than used in the previous experiment with common bermudagrass.

Shoot discoloration of the bermudagrasses from the application rates used for the three growth inhibitors included in this study was of no significance. Thus, it appears that the feasibility of utilizing these new growth inhibitors for chemical edging is promising. Futher comprehensive studies are warranted with these three growth inhibitors, both alone and in combinations, and utilizing a broader range of application rates.

The cooperation of Gary Rogers and Bobby Holt in conducting these studies is gratefully acknowledged. The study was partially supported by grants from the Elanco Products Company and the 3M Company.

TABLE 1. THE EFFECTS OF EIGHT GROWTH INHIBITOR TREATMENTS ON COMMON BERMUDAGRASS STOLEN EXTENSION 6 WEEKS AFTER APPLICATION TO BUNKER PERIMETERS AT BRYAN MUNICIPAL GOLF COURSE

Treatment		Stolon Length (cm)	Percent Reduction in Stolon Length
Growth Inhibitor	Rate (lb. ai./A)		
Flurprimidol	1.25	8.5 a[1]	36.1
MBR 18337	0.75	8.7 a	34.6
MBR 18337	0.5	8.8 a	33.8
Flurprimidol	1.0	9.1 ab	31.6
MBR 18337	0.25	9.2 ab	30.8
Flurprimidol + MBR 18337	0.75 + 0.25	9.7 ab	27.1
Mefluidide	0.25	10.2 b	23.0
Flurprimidol	0.75	10.8 b	18.8
Untreated	-	13.3 c	-

[1]Values followed by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

TABLE 2. THE EFFECTS OF SEVEN GROWTH INHIBITOR TREATMENTS ON HYBRID BERMUDAGRASS STOLON EXTENSION 10 WEEKS AFTER APPLICATION TO BUNKER PERIMETERS OF BRIARCREST CC., BRYAN, TEXAS

Treatment		Stolon Length (cm)	Percent Reduction in Stolon Length
Growth Inhibitor	Rate (lb. ai./A)		
Flurprimidol + MBR18337	1.25 + 0.5	1.8 a[1]	69.5
Flurprimidol + MBR18337	1.25 + 0.38	2.2 b	62.7
Flurprimidol	1.25	2.5 c	57.6
MBR 18337	0.38	2.9 c	50.8
Flurprimidol + Melfluidide	1.25 + 0.5	3.2 d	45.8
Mefluidide	0.25	3.2 d	45.8
Flurprimidol + Mefluidide	1.25 + 0.25	3.4 d	42.4
Untreated	-	5.9 e	-

[1]Values followed by the same letter are not significantly different at the 5% level for Duncan's multiple range test.

PR-4055

An Assessment of the Preferred Cool-Season Turfgrasses for Winter Overseeding Under Suboptimum Temperatures of Late Fall

J.B Beard, S.M. Batten, and S.D. Griggs

There are situations where winter overseedings must be attempted under suboptimum temperature conditions. This may be due to an earlier seeding failure or to scheduled sporting events or other activities which necessitate delaying the winter overseeding operation. The question arises as to the preferred turfgrass species and cultivars to utilize under these suboptimum temperature conditions for seed germination and seedling growth.

Research Procedure

Seven turfgrasses were utilized in this study-- Sabre rough bluegrass and six perennial ryegrass cultivars. The latter consisted of Barry, Belle, Citation, Delray, Loretta, and Yorktown II. These seven were selected because they all had ranked high in overall seasonal turfgrass quality when utilized in the winter overseeding of dormant bermudagrass turfs. The perennial ryegrasses were seeded at 35 lb per 1,000 square feet and the rough bluegrass at 10 lb per 1,000 square feet.

The experiment was conducted on a Tifgreen bermudagrass green at the TAMU Turfgrass Field Laboratory. The plot size was 5 x 8 feet arranged in a randomized block design with three replications. Ten days prior to overseeding the surface was vertically cut in three directions with the clippings removed by a mechanically powered vacuum. The seven cool-season turfgrasses were seeded on November 7, 1981, with a Scotts 2-foot drop spreader and subsequently mechanically topdressed with 1/8 inch of sand. Mowing was withheld for 8 days after seeding and then the cutting height was set at 5/16 inch. The height was lowered to 1/4 inch 3 weeks after seeding and was maintained at this height throughout the remainder of the study. The turf plots were irrigated as needed to prevent visual wilt. Monthly nitrogen applications were made at a rate of 1 lb nitrogen per 1,000 square feet. No pesticide applications were made. Soil test results indicated that adequate phosphorus and potassium levels existed on the experimental site and that the soil pH was 8.0.

Results

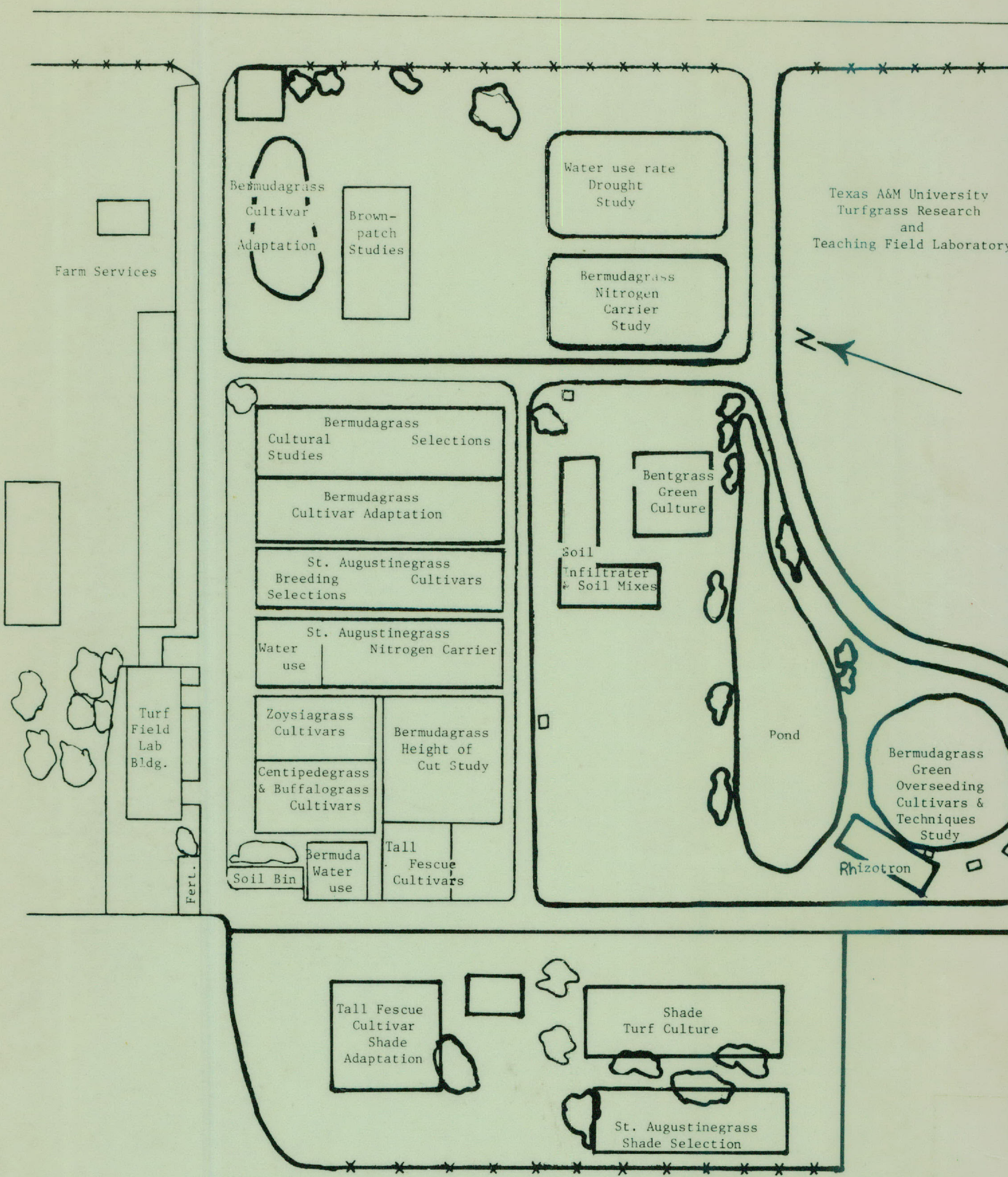
The early winter turfgrass performance of the seven overseeded cool-season turfgrasses are summarized in Table 1. The winter of 1982 was characterized by an extremely cold January and February period. In addition, the early November timing of the overseeding presented soil temperatures during the seed germination and seedling growth period which were marginal at best for successful establishment. The initial establishment density on more than 50 percent of the monostands was unacceptable and even on the three top ranked grasses was marginal. Under these experimental conditions of suboptimal soil temperatures, Sabre rough bluegrass and Loretta perennial ryegrass exhibited a better capability for seed germination and seedling growth. Studies reported in earlier Progress Reports had shown that both Sabre and Loretta possessed the capability to sustain shoot growth under extremely low soil temperatures during the January-February period. Evidently this low temperature growth response also extends to the seed germination and seedling establishment phases. It should be pointed out again that all seven cultivars utilized in this experiment had ranked quite high overall in seasonal turfgrass performance when winter overseeded under optimum fall temperature conditions. However, under those situations where the turfgrass manager is forced to overseed unusually late under suboptimum soil temperatures, it appears that the strategy in turfgrass species and cultivar selection should be adjusted. Serious consideration should be given to cultivars such as Sabre and Loretta, when compared to the other five cultivars utilized in this investigation.

TABLE 1. COMPARATIVE WINTER TURFGRASS QUALITY OF SEVEN OVERSEEDED COOL SEASON TURFGRASSES IN 1981-1982 AT COLLEGE STATION, TEXAS

	Turfgrass Quality (1-best & 9-poorest)		
Cultivar[1]	December	January	February
Sabre rb	6.5 a[2]	6.7	7.7
Lorétta pr	6.2 ab	6.3	6.0
Barry pr	5.6 abc	4.8	4.7
Belle pr	5.3 bcd	5.3	5.3
Delray pr	5.3 bcd	4.3	4.7
Citation pr	4.5 cd	4.2	4.0
Yorktown II pr	3.7 d	4.3	3.7

[1] rb = rough bluegrass and pr = perennial ryegrass

[2] Values joined by the same letter are not significantly different at the 5% level for the Duncan's multiple range test.


Texas A&M University
Turfgrass Research
and
Teaching Field Laboratory
N
Farm Services
Bermudagrass Cultivar Adaptation
Brown-patch Studies
Water use rate Drought Study
Bermudagrass Nitrogen Carrier Study
Bermudagrass Cultural Studies Selections
Bermudagrass Cultivar Adaptation
St. Augustinegrass Breeding Selections Cultivars
St. Augustinegrass Water use Nitrogen Carrier
Zoysiagrass Cultivars
Bermudagrass Height of Cut Study
Centipedegrass & Buffalograss Cultivars
Turf Field Lab Bldg.
Soil Bin
Bermuda Water use
Tall Fescue Cultivars
Fert.
Bentgrass Green Culture
Soil Infiltrater & Soil Mixes
Pond
Bermudagrass Green Overseeding Cultivars & Techniques Study
Rhizotron
Tall Fescue Cultivar Shade Adaptation
Shade Turf Culture
St. Augustinegrass Shade Selection