

On the Research Front

Turfgrass research has been accelerated greatly in the past decade. While it is impossible for the GREEN SECTION RECORD to carry accounts of all turfgrass research being done in the United States, the following abstracts will indicate the kind and amount of

investigative effort being expended.

These abstracts are reproduced from *Agronomy Abstracts—1963*. They summarize the papers presented to the turfgrass division at the Agronomy Society's annual meeting, held in Denver in November, 1963.

Causal Factors in the Winter Injury of Turfgrasses

J. B. BEARD, Michigan State University

The causes and conditions resulting in winter injury associated with ice sheets were studied utilizing three grasses; *Poa pratensis* 'common,' *Agrostis palustris* 'Toronto,' and *Poa annua*. All vegetative materials were allowed to harden naturally in the field. On November 26, 1962, four-inch plugs were taken and the following treatments applied: (1) flooding, then freezing, (2) freezing, then applying thin ice layers, (3) freezing, then applying a snow layer followed by an ice layer, (4) placing in a sealed container and freezing, (5) bulk pressure freezing, (6) no treatment, and (7) submerging

in water at 35° F. All treatments were held at 25° F. except for No. 7. At 15-day intervals, replicated samples from each variety and treatment were removed from the low temperature chamber, thawed, and placed in a 70° F. growth chamber. Results of this study showed that during the 90-day period winter injury by oxygen suffocation, toxic accumulations, cellular leaching, or outward water diffusion into ice was of no significant importance. No injury occurred in *A. palustris* while some injury was observed in *P. pratensis* with *P. annua* intermediate between the two.

The Effect of Various Mulches on Microclimate and Turf Establishment

R. E. BLASER AND D. G. BARKLEY, Virginia Polytechnic Institute

Experiments involve the effect of mulching materials and irrigation on microclimate and turf establishment. Straw, sawdust, Turfiber (wood fiber cellulose) and Soil Saver (jute net) moderated soil temperatures in the seed zone and improved grass germination, emergence, and growth. Soilset was not consistently beneficial to seedlings. Straw mulch tended to be more effective in moderating soil temperature and conserving soil moisture than the other mulches, but the results varied among the four experiments. Weeds and small grain were most prevalent with straw mulching. Sawdust

improved turf establishment, but it washed off easily. Turfiber eliminated the introduction of undesirable plant species; had a favorable influence on soil temperature and moisture; and increased seedling germination, emergence, and growth. Soil Saver increased seedling height, weights, density, and soil moisture. Soilset conserved more soil moisture than no mulch, but soil temperatures were usually higher than for no mulch. Irrigation was usually beneficial with all grasses and mulches, but of least benefit with no mulch. Tall fescue was less sensitive to high temperatures than bluegrass.

Effects of Silvex on the Physiology and Survival of Colonial Bentgrass

(*Agrostis tenuis*)

L. M. CALLAHAN AND R. E. ENGEL, Rutgers University

The purpose of this study is to determine the tolerance and the response of Colonial bentgrass to several rates of silvex under various environmental influences. Ten-week-old Colonial bentgrass seedlings were treated with $\frac{1}{2}$, 1, $1\frac{1}{2}$, or 3 pounds per acre of silvex and maintained in a growth chamber under 75-97° F., or 50-60° F., alternate temperatures. These tests were conducted in solution cultures regulated at a pH 7.0 or a pH 4.8 and short or long day conditions. The significant re-

sponses obtained showed that silvex caused much greater injury to Colonial bentgrass seedlings under high temperatures than under low temperatures. In general, a gradual decrease in root length and density and an increase in leaf burn occurred with increasing silvex rate. The most detrimental rates appeared to be 1 and $1\frac{1}{2}$ pounds per acre. With low pH and long day conditions, silvex treatments appeared to give more severe action.

Fusarium Roseum as a Foliar Pathogen of Turfgrass

H. B. COURCH AND E. R. BEDFORD, Pennsylvania State University

Fusarium roseum was found capable of inciting severe foliar blighting of certain turfgrasses. Foliar infection by the pathogen is accomplished by both direct penetration of intact epidermal cells and by mycelial growth through cut leaf tips. Virulent strains of the organism have been isolated from commercial turfgrass seed lots. Using dew cabinets for post-inoculation environment, the interactions of three air temperatures (75° F., 85° F., 92° F.), three *F. roseum* isolates, and three turfgrass species (Highland bentgrass, Merion Kentucky bluegrass, and Illahee fescue) were studied.

Quartz sand was used as the plant support medium and irrigations were accomplished with balanced Hoagland's solution. The inoculum was prepared by growing the isolates on a corn meal-sand medium. Inoculations were performed eight weeks from the time of seedling emergence. Disease incidence was rated on the basis of percentage plants blighted. Within the temperature range studied, all isolates were pathogenic to all turfgrass species. At certain air temperatures, however, the isolates differed significantly in degrees of virulence.

Response of Bentgrass Putting Green Turf to Various Ratios of N, P, and K

Roy L. Goss, Washington State University

This study is being conducted to yield information on bentgrass response to high and low levels of nitrogen, phosphorus, and potassium fertilization. Poor quality putting green turf is common when fertilizer levels are low and some serious problems arise as a result of intensive fertilization practices. From this study it is

intended that a satisfactory level of N, P, and K can be derived for optimum fertility level maintenance. In this study, applications of 6, 12, and 20 pounds of N, O and 1.76#P, and O, 3.32 and 6.64# of K have been applied per 1,000 square feet per season. Treatments are arranged in a factorial design with four replications. Visual

ratings have been made for three years on the basis of color, density, texture, and the incidence of diseases. The highest levels of N, P, and K have produced excellent quality turf during cool portions of the year, but degenerate in quality during July and Au-

gust. The lowest fertility levels appear best during the hotter months. Extremely wide ratios of N:P have resulted in inferior turf. The intermediate level of N, P, and K consistently produce superior quality turf with the least amount of disease.

Seasonal Relationships between Nitrogen Nutrition and Soluble Carbohydrates in Leaves of Four Turfgrasses

D. G. GREEN AND J. B. BEARD, Michigan State University

The objectives of this study were (1) to determine the levels of applied nitrogen necessary to cause carbohydrate reserves to become a growth-limiting factor, and (2) to determine the quantitative effects of various nitrogen treatments on the individual sugar fractions which compose this carbohydrate reserve. *Agrostis palustris* 'Toronto,' *Poa pratensis* 'Merion' and 'common,' *Lolium perenne* 'common' and *Festuca rubra* 'Pennlawn' were the grasses studied. Nitrogen treatments providing 0, 3, 6, 9 and 12 pounds of

actual nitrogen per 1,000 square feet per season were administered in one application and in six monthly applications. Nitrogen applications of 6, 9, and 12 pounds uniformly lowered all carbohydrate fractions with the three-pound treatment having an intermediate effect. Oligosaccharide generally disappeared at nitrogen levels above three pounds, while fructosan remained in trace amounts. Sucrose, glucose and fructose appeared to maintain adequate levels under all nitrogen treatments.

Response of Common Kentucky Bluegrass and Red Fescue to Several Levels of Phosphorus

F. V. JUSKA, A. A. HANSON, AND C. J. ERICKSON
USDA Agricultural Research Service

In the greenhouse, common Kentucky bluegrass and red fescue were compared in a complete factorial with six levels of phosphorus (0-1745 pounds per acre), two pH levels (4.5 and 6.5), two levels of N, and two soils (sandy loam and silt loam). Cultures were clipped weekly at a height of two inches and treatments evaluated in terms of dry weight of clippings, crowns, roots, and rhizomes. Yield of plant material was greater for silt loam, red fescue, pH 6.5, and three pounds of N per 1,000 square feet. Red fescue outyielded bluegrass at all levels of P in total weight of plant ma-

terial. The two grasses showed a large increase in the weight of clippings at both pH levels with the first increment (109 pounds) of P. For bluegrass, an increase in clipping weight was obtained for each increment of P through 1,746 pounds, whereas the yield of red fescue declined after the 873-pound level. Red fescue produced a larger quantity of roots than bluegrass at each level of P and at each pH level. The weight of bluegrass rhizomes increased with each increment of P to 873 pounds per acre, after which a sharp decline was noted at pH of 6.5 and to a lesser degree at pH of 4.5.

Growth and Anatomical Characteristics of Zoysia

W. C. LECROY AND W. H. DANIEL, Purdue University

Zoysia is a slow growing, warm season, sod-forming grass that can be used for many turf purposes. The use of this species as a covering for playing fields has been limited due to the very dense turf formed. This study was initiated to find the relationship of growth rate and internode length to several environmental factors. An anatomical study also was carried out to see if the structure of the plant would help in answering some of the questions concerning Zoysia growth habits in relation to environmental factors. Measurement data from the field, when subjected to statistical analysis, showed the following relations: growth rate was dependent on internode length, growth rate and

internode length was correlated with minimum air temperature, and the number of leaves per square inch became less as the growth rate and internode length increased. As a general rule those plants that stop growth first in the fall are the ones which start regrowth first in the spring. The anatomical structure of the Zoysia stem and root is typical of a festucoid grass plant. The differences noted in above and below surface stems are ones which would be expected. The Zoysia leaf is composed of a large number of vascular bundles, varying from a wedge to a round shape arranged in an orderly sequence across the leaf.

Tolerance of Five Turfgrass Species to Soil Alkali

O. R. LUNT, C. KAEMPFER, AND V. B. YOUNGNER
University of California at Los Angeles

Yolo loam was made alkali by treatment with Na_2CO_3 to produce six levels of ESP ranging up to about 30. For all ESP treatments, a Krilium (VAMA) treated series was compared against soils not so treated. ESP levels were maintained by irrigation with solutions containing a total of 5 me. per liter of NaNO_3 and $\text{Ca}(\text{NO}_3)_2$ adjusted to give SAR values up to about 22. Allowing for a projected two-fold increase in the soil solution due to evapotranspiration, these solutions maintained the ESP's in approximately

the desired range. All grasses proved to be tolerant to ESP levels up to about 15. Above this level increasing sensitivity to ESP was observed in the following order: Seaside bentgrass, Kentucky bluegrass, alta fescue, common bermuda, Puccinellia. Treatment of the soil with Krilium improved growth by about 10 to 50% at nearly all ESP levels with bermuda, Kentucky bluegrass, and Seaside bent, but had little effect on the growth of alta fescue or Puccinellia.

Vertical Distribution of Dry Weight and Chlorophyll in Turf

JOHN H. MADISON, Department of Landscape Horticulture
University of California, Davis

Plots of *Poa pratensis*, *Agrostis tenuis* 'Highland' and *Agrostis palustris* 'Seaside' were established at various mowing heights from 1/4 to 2-1/2 inches. The plots were mowed down in

increments and the dry weight and chlorophyll of each increment was obtained. The data showed no effects of shading on chlorophyll development in turf mowed less than 7/8 inch. Below

1/2 inch the chlorophyll contained in new growth after mowing was a major fraction of that present. The full photosynthesizing capacity of turf in terms of chlorophyll was reached when turf was mowed 1-3/8 inches or higher. Dry weight continued to increase with increasing height but the greatest rate of increase occurred between

plots mowed 1/2 inch and 7/8 inch. The center of chlorophyll concentration was above the center of gravity of the turf. Highland bent appeared to grow optimally mowed at one inch or above two inches. Between these heights it produced false crowns and failed to make increasing increments of dry weight with increasing height.

Effect of a Tallow Alcohol, a Non-ionic Wetting Agent and a Polyethylene Glycol on Foliar and Root Development of Kentucky Bluegrass

ELIOT C. ROBERTS AND DAVID P. LAGE, Iowa State University

Kentucky bluegrass was grown for four months in solution culture before treatment with standard nutrient solutions modified as follows: Carbowax 1000 was added to produce osmotic pressures varying from 2.6 to 9.6 atm.; Aqua-Gro was applied at rates to produce surface tensions of from 35 to 45 dynes/cm.; Hexadecanol was added at rates of from 25 to 200 pounds/acre. Effects of these solution modifications on growth of foliage and roots were determined. Osmotic pressures of the nutrient solution above 6.0 atm. were extremely detrimental to plant growth. Production of foliage was increased

up to 2.5 atm. when greenhouse temperatures were within the range of 70 to 80° F. Decreases in surface tension decreased fresh and dry weight yields of foliage. Hexadecanol increased fresh and dry weight yields of foliage. Root development was increased with increasing osmotic pressure and decreased with decreasing surface tension. Hexadecanol in the nutrient solution stimulated root growth. Variations in osmotic pressure and surface tension of root zone solutions affect turfgrass production. Turf response to Hexadecanol was favorable.

Effect of Soil Mixture and Cover on Residual Activity of *Poa Annu* Herbicides

R. A. SCHWABAUER AND N. R. GOETZE, Oregon State University

Greenhouse studies, using *Poa annua* L. as a bioassay to determine influence of cover and soil mixture on residual activity of herbicides, demonstrated significant interaction between herbicides and cover and herbicides and soil mixture. Four soil mixtures, including sand, clay, sand-organic matter, and clay-organic matter, were compounded. Equal volumes of seed were sown on all plots and covered with either sand or organic matter stripped from a Highland bentgrass lawn. Nine herbicides were applied at various

rates. Counts of healthy plants were made two weeks after planting. Residual activity of herbicides was measured by replanting four and eight weeks after original herbicide treatment. Diphenamide at 4, 6 and 8 pounds per acre, and trifluralin at 1 and 2 pounds per acre had strongest residual activity eight weeks after treatment. Endothal and one of its analogs exhibited better residual activity under sand cover; two experimental herbicides had better activity under organic matter cover. Trifluralin, zy-

tron, and two experimental herbicides had best residual activity in sand-soil mixture; endothal, dacthal, and an-

other experimental herbicide had highest activity in clay-organic soil mixture.

Evaluation of Cool Season Grasses for Winter Overseeding of Southern Golf Greens

C. G. WILSON, O. J. NOER AND J. M. LATHAM, JR.,
Sewerage Commission of the City of Milwaukee

Four years' evaluation of overseeding individual grasses and mixtures at various locations in the South indicate that the latter are superior to individual grasses. They provide the best season-long playing conditions and color, with no spring transition problems. The best quality ratings were from a mixture of *Poa trivialis*, Pennlawn creeping red fescue and Seaside bentgrass. Kentucky bluegrass increased

over-all quality in the Florida and Gulf Coast areas. Domestic ryegrass winterkilled in the upper South in early 1963. Seeding rates are dependent upon seedbed preparation. The 1962-1963 results show that rate of seeding can be reduced by thorough seedbed preparation and sandwiching the seed between heavy and light top-dressings.

Influence of Several Environmental Factors on Flowering of Bermudagrass

V. B. YOUNGNER AND S. E. SPAULDING, University of California

Flowering of 10 selected bermudagrass clones of common parentage was studied under several controlled environmental conditions. Low temperature pre-treatment induced early flowering of all clones but significantly reduced the total inflorescence production for three clones as compared with the controls. All clones flowered at photo-

periods from eight to 20 hours with maximum flowering occurring at day lengths of 14 hours or greater. Moderate day temperatures (70°-75° F) with cool nights (60°-65° F) were most favorable for flowering. Differences between clones for total inflorescence production were highly significant.

COMING EVENTS

January 24

U. S. Golf Association
Green Section Educational Turf Conference
Biltmore Hotel
New York City, N. Y.

February 9-14

GCSAA's International Turfgrass
Conference and Show
Philadelphia Sheraton Hotel
Philadelphia, Pennsylvania

February 24-25

Southern Turfgrass Conference
Memphis, Tennessee

February 24-27

Turfgrass Conference
Cornell University
Ithaca, New York

March 5-6

Turfgrass Conference
University of Massachusetts
Amherst, Massachusetts

March 18

Turf and Grass Conference
South Plains College
Levelland, Texas

March 18-19

Turf Short Course
University of Maine
Orono, Maine