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TURF RESEARCH REVIEW

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Acknowledgment

This edition of TURF RESEARCH REVIEW has been compiled and edited in the Southwestern Office of the USGA Green Section. We wish to acknowledge and express our appreciation for the efforts of all those who have cooperated in providing the information contained herein. Special recognition is due Mrs. R. E. Snuggs, who has done most of the work in compiling and arranging this material.

MARVIN H. FERGUSON
Southwestern Director and
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SUMMARY OF ACCOMPLISHMENTS IN TURFGRASS RESEARCH

Research continues to contribute to the turfgrass grower's knowledge. The contributions that are made enable him to manage his turfgrass areas in such a way that he can provide better quality turf more easily, efficiently and economically.

There are many facets of turfgrass research. This summary has been confined to the definite contributions in the field of turfgrass management which are considered to be applicable by the average growers. There are many cases where information from the fundamental sciences may be related to turfgrass management. The borrowed knowledge from these areas is very useful and extremely important. These contributions, however, are extremely hard to define and to relate precisely to the business of turfgrass management. Likewise, contributions which are concerned with techniques related to research efforts but which are of little or no importance to the practical grower of turfgrass, have not been discussed.

GRASSES

Several improved species or strains of grasses have been released for use since 1951. New bentgrasses include Pennlu and Penncross, both developed at the Pennsylvania Agricultural Experiment Station. Pennlu is a vegetative bentgrass for use on putting greens. It has been studied at the Pennsylvania State University for several years and has demonstrated superiority. Penncross is a bentgrass strain synthesized by the crossing of numerous selected parents. It is one of the first improved bentgrasses that can be propagated by seed. Research in the years since 1951 has confirmed the superiority of some of the older vegetative strains. Among those which have been outstanding are Arlington and Congressional.

New Bermudagrass strains include Tifgreen (Tifton 328), Tiffine, which was formerly designated Tifton 127; Gene Tift, which was selected in Florida; and two strains from the Texas Agricultural Experiment Station, which bear the designations T-35A and T-47. T-47 is a rather coarse-bladed grass which forms a very dense, wear-resistant and drought-resistant turf. The other three strains mentioned are fine-leaved types which are suitable for putting green use. Tiffine is a result of a breeding program at the Georgia Coastal Plain Experiment Station. It has come to be used rather widely throughout the southeast.

Two new Zoysias are worthy of note. Meyer zoysia was released in 1951 by the U. S. Department of Agriculture and distributed to state experiment stations. It has been planted on a broad scale and has been publicized quite highly by commercial growers. Emerald zoysia is a named strain developed and released by the U. S. Department of Agriculture. Emerald is a hybrid zoysia produced by Ian Forbes, Jr., and resulting from a cross involving selected parents of *Zoysia japonica* and *Zoysia tenuifolia*. This particular hybrid was selected by Forbes as being outstanding among the progeny of this cross. Emerald zoysia has not yet been extensively planted but it appears to be a superior strain.

Merion bluegrass has been planted extensively, has found considerable favor in some areas, and has encountered difficulties in other areas. Merion bluegrass originally was selected primarily for Helminthosporium leaf spot resistance. Leaf rust and smut are two of the ills that have befallen Merion bluegrass.

Pennlawn Creeping Red Fescue has been released by the Pennsylvania State University. This grass results from the random crossing of three strains which demonstrated superior turf forming qualities. Seed of the synthetic variety, Pennlawn, is producing turf superior to that formed by any of the three parent strains.

Penngift Crown Vetch has also been released by the Pennsylvania State University and described as an excellent cover for road shoulders.

In addition to the release of new strains and observation of strains released earlier, there has been considerable work done in the way of variety testing. Variety testing in some cases is quite important to the turf users within a particular area. An outstanding example of this type of testing is that carried on at Kansas State College in cooperation with the Central Plains Turf Foundation. The following paragraphs are quoted from a report by Dr. William Pickett:

> "In the variety trials the failures are as important, in saving money for the growers of turfgrasses, as are the successful grasses. For example, F-74 creeping red fescue made a beautiful showing from October to June, but was badly damaged by heat and disease in July. Manilagrass has been so slow in becoming established in the trials, and is green only from June to October, that it cannot be considered at all satisfactory for any lawn use in this region, even though it is perfectly hardy. Blue grama has no place in the turfgrass picture since it is a bunch grass. Its presence in native buffalo sod is not detrimental, but its presence has no advantage.
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> "The warm-cool mixture of Manilagrass and Arlington bentgrass was dominated by the bentgrass under irrigation. Without irrigation, crabgrass would have overgrown both grasses. The same is true of Arlington bentgrass and buffalograss, except that the buffalo will survive unirrigated.
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> "Perennial ryegrass was discontinued from the trials because it was felt that its behavior was confirmed after three seasons. It continues to be recommended as an excellent temporary lawngrass.
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> "Merion bluegrass has not proved greatly superior to Kentucky bluegrass. It does stand close regular mowing somewhat better, but tall mowing is one of the better ways of controlling crabgrass invasion. Merion bluegrass has proved highly susceptible to wheat rust, curvularia, and white grub damage—so much that it must be considered but slightly superior to Kentucky bluegrass and perennial ryegrass under Central Plains conditions.
>
> "During the warm season, with no irrigation, Meyer Zoysia and U-3 Bermudagrass have been outstanding grasses. Results indicate these grasses should be mowed less than one inch and should receive between five and ten pounds of elemental nitrogen per thousand square feet during the growing season. Perhaps the Zoysia could hold good color with less.

Mixtures of Zoysia and Merion are being established this season for future trial.

"The tall fescues, such as Kentucky-31, have performed well at the taller mowing heights. Their drought resistance and ability to hold good color are desirable characteristics. The coarse texture and bunchy growth habit are distinct disadvantages for good turf production."

Workers at UCLA and at Rhode Island have grown mixtures of warm-season and cool-season grasses. While the correct balance of these mixtures is controlled by management and local conditions, it is significant that the effort to grow warm-season and cool-season grasses in permanent combinations has met with success in some areas.

MANAGEMENT

Management involves many practices. One of these practices which is extremely important is that of fertilization. Because of diversity in soils, in climatic conditions, and in species involved, fertilizer tests sometimes are of value only to localized areas. Some of the fertilizer investigations that have been carried on, however, are of such a nature that they can be applied over a wide area. Studies concerned with the nitrogen, phosphorus, and potassium requirements of Bermuda have been carried on for a number of years at Texas A. & M. Findings indicate that Bermudagrass turf responds to as much as 12 pounds of elemental nitrogen per 1,000 square feet per year. Nitrogen fertilization at these rates is considered almost beyond the limits of practicality. Therefore, recommendations have been made whereby nitrogen would be used at a lighter rate. Eight pounds of nitrogen per 1,000 square feet per year has been suggested. Tests showed a rather poor response to both phosphorus and potassium. However, when clippings are removed, and when nitrogen is applied at sufficiently heavy rates to promote rapid vegetative growth, phosphorus and potash will be removed from the soil in rather large quantities. For these reasons fertilizer recommendations have followed a 2-1-1 ratio.

One of the significant advances in fertilizer practice has been the development of urea-formaldehyde materials. These are high nitrogen materials which will release the nitrogen to plants rather slowly. In this respect the materials behave in a manner similar to organic nitrogen carriers. Urea-formaldehyde materials have been tested at numerous stations and results have been reported in appropriate publications. Urea-formaldehyde materials are now commercially available and are in use to a limited extent.

Liquid fertilizer materials are finding a more prominent place in turfgrass fertilization. For many years liquid fertilizers were considerably higher in price and turf users were advised to buy them only when the price was comparable to that paid for conventional type fertilizers. The relatively new practice of marketing the liquid products of ammoniated phosphoric acid has made liquid fertilizers plentiful enough that they compare favorably in many cases with the dry, granular type materials. The fact that liquid fertilizer materials can be used at the same time as fungicides and insecticides makes them much more appealing to many turf growers.

Chelated iron compounds are new products which are finding some use on turfgrass areas. These materials work better on acid than on alkaline soils at the present time. Unfortunately much of the trouble with chlorosis in turfgrasses occurs on alkaline soils. This is a very fertile field for research and it is to be expected that scientists in the field of chemistry will not be long delayed in the development of chelated iron compounds which will be equally effective on alkaline as well as acid soils.

Irrigation is another important phase of management studies. Some of the most important preliminary work on turfgrass irrigation has been done at the University of California at Davis. Studies at this station have called attention to some of the fundamental principles involved in turf irrigation. Among these are the rooting capabilities of grasses in terms of depth; the water intake capacity of the soil; the water storage capacity of the soil; and the water use rate of plants in a particular area. Recommendations based on studies at Davis may be briefly stated in these words: "Water infrequently and water enough." There is a great amount of work to be done in connection with the irrigation of turfgrasses. It is believed that the statement of these principles underlying the practice of irrigation is a significant step in learning to irrigate more effectively and efficiently.

Soil managment as a phase of turfgrass management is relatively new. It has been customary to think that there was little one could do in the way of soil management under turf. Aeration, or the cultivation of soil under turf, has become a standard maintenance practice within relatively recent times. The relief of compaction, or the maintenance of good tilth, helps water infiltration, fertilizer penetration, and the diffusion of oxygen in the root zone. As cultivation is important to field crops so is aeration beneficial to turfgrasses.

There have been numerous studies which have made contributions to the building of synthetic soil mixtures for putting green purposes. The studies indicate that clay should fall within the limits of four to eight percent by volume of the total mixture. The peat content should be kept somewhere between 10 and 15 percent, by volume. The remainder of the mixture should be sand. Extremely coarse particles are not necessary in the sand, but the very fine sand and silt fractions should be eliminated if possible. Studies at UCLA indicate that the placing of a sand layer over soil will reduce compaction and will also facilitate water intake.

Thatch control is another phase of management which has received a considerable amount of attention. The principles which contribute to the formation of thatch are being studied and practical means of eliminating thatch are being investigated concurrently. The Rhode Island Experiment Station reports that Piper Velvet bent develops less thatch when topdressed with both lime and compost than when it is untreated or when either of the treatments is left off. The use of vertical mowing machinery has found a place on many golf courses and it is a practical method of eliminating or reducing thatch.

PEST CONTROL

Diseases

Considerable progress has been made in the matter of controlling diseases. Recent studies at the Georgia Coastal Plain Experiment Station have resulted in the positive identification of a disease which attacks ryegrass. This disease is

Pythium aphanidermatum. This station also reports that many of the southern turfgrass diseases which resemble northern turfgrass diseases insofar as symptoms are concerned, are actually caused by different organisms.

F. L. Howard, of the Rhode Island Agricultural Experiment Station, reports that malachite green, one of the components of the product Auragreen, is a specific control for pythium. The Rhode Island Station also reports the development of a fungicide for controlling a number of turfgrass diseases. This "broad spectrum" fungicide is a complex synthesized from several fungicidal materials.

The Washington Experiment Station reports excellent snow mold control through the use of phenyl mercury acetate at the rate of 2 ounces of 10% material per 1,000 square feet of turf. The New Jersey Experiment Station reports that mercury and cadmium fungicides have been most consistent for copper spot control.

Weeds

There have been no startling discoveries in the field of weed control in turf. However, significant progress has been made. Crabgrass control has become practical on areas of high value through the use of phenyl mercury acetate materials. Pre-emergence crabgrass control materials show considerable promise, though they are not yet used extensively. The Rhode Island station reports 100 percent crabgrass control through the use of phenyl mercury acetate and adequate fertility levels. At least two stations have reported that chlordane is an effective crabgrass control material. Chlordane, of course, is normally considered to be an insecticide but it appears to have some herbicidal effectiveness. Kansas State College has demonstration areas where compounds containing lead arsenate have controlled crabgrass. One of the newer herbicides for use in crabgrass control is disodium methyl arsonate. This material is likely to be used more extensively in the future.

Poa annua is another weedy grass which is receiving a great deal of attention. Studies at Purdue indicate that lead arsenate is effective in preventing the development of *Poa annua* plants when phosphorus levels are low. It has been suggested that arsenic interferes with the function of phosphorus in some manner. Workers at the Georgia Coastal Plain Experiment Station suggest that *Poa annua* may be kept vegetative by the use of growth regulators.

Comprehensive life history studies of *Poa annua* are being pursued at the University of Illinois. V. T. Stoutemyer, of UCLA, reports that he and his associates have collected numerous types of *Poa annua* and have found many variations. They report perennial forms of *Poa annua* and this finding is also reported by Daniel at Purdue.

Workers at Rutgers University have found that 2,4-D, used in small quantities, will increase the activity of potassium cyanate and sodium arsenite in controlling crabgrass.

Maleic hydrazide has found considerable use in turf management. It has been used in the vegetative propagation of grasses into existing turf. Workers at UCLA report that it reduces competition sufficiently to allow the introduced turf to become well established. It has been reported by workers at Rhode Island to be useful in controlling vegetation in hard to mow areas. Preliminary studies at the Texas Agricultural Experiment Station suggest that the use of maleic hydrazide may be a first step in the killing out of rhizomatous perennial species, such as Bermudagrass. The effect of maleic hydrazide is one of upsetting normal metabolic functions of the plant. If leaf surfaces are subsequently destroyed by herbicidal oils, or by other contact sprays, plants will usually not recover.

Methyl bromide is an extremely useful material for the fumigation of areas where it becomes desirable to kill out all existing vegetation. Original research along this line was done by Elder at Oklahoma A. & M. College.

Substituted urea compounds have been used to some extent in controlling weedy species in turf areas. Their definite role, or place of usefulness, has not been definitely determined. White clover may be controlled by means of 2,4,5-T.

Insects

There has been a great deal of progress in the development of systemic insecticides and of organic phosphate insecticides. These are very powerful materials and are also quite dangerous. They have, therefore, not been recommended for use on most turf areas. Chlordane continues to be the most used insecticide in turf. Aldrin finds a place for control of sod webworms and similar leaf feeding insects. In alkaline soils, dieldrin appears to be more effective over a long period of time than chlordane for grub control or for the control of soil inhabiting insects.

A contribution that may be of rather extensive importance has been made by Polivka of Ohio State. He reports that Japanese beetles do not build destructive populations when pH is slightly acid or higher. This finding may lead the way to the control of other insects through manipulation of pH or through cultural methods.

Nematode studies are in progress at Florida and in Rhode Island, and in Georgia. The extent of nematode injury in turf is unknown. It is suspected that these pests may do considerable damage.

FOR THE FUTURE

A greater interest, awareness, and appreciation of good turf is evident throughout the country. It appears certain that demands for better turf, managed efficiently and economically, will increase. As these demands continue to grow, greater pressure will be exerted upon the research workers to provide new knowledge and new tools which the turf manager may use in practice. Let us expect turfgrass research to increase in volume and in quality in the immediate future.

EXPERIMENT STATIONS ENGAGED IN TURF RESEARCH, EXTENSION AND EDUCATION

Arizona Agricultural Experiment Station, University of Arizona, Tucson, Arizona.

Beltsville Turf Gardens, U. S. Department of Agriculture, Plant Industry Station, Beltsville, Md.

California, University of, at Los Angeles, and at Davis, Calif.

Colorado Agricultural Experiment Station, Colorado A. & M. College, Fort Collins, Colo.

Connecticut Agricultural Experiment Station, New Haven, Conn.

Florida Agricultural Experiment Station, University of Florida, Gainesville, Fla.

Georgia Coastal Plain Experiment Station, Tifton, Ga.

Illinois Drug & Horticultural Experiment Station, University of Illinois, Chicago, Ill.

Indiana Agricultural Experiment Station, Purdue University, Lafayette, Ind.

Iowa Agricultural Experiment Station, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.

Kansas Agricultural Experiment Station, Kansas State College, Manhattan, Kans.

Maryland Agricultural Experiment Station, University of Maryland, College Park, Md.

Massachusetts Agricultural Experiment Station, University of Massachusetts, Amherst, Mass.

Michigan Agricultural Experiment Station, Michigan State College, East Lansing, Mich.

New Jersey Agricultural Experiment Station, Rutgers University, New Brunswick, N. J.

New Mexico Agricultural Experiment Station, New Mexico College of Agriculture and Mechanic Arts, State College, New Mexico.

New York Agricultural Experiment Station, Cornell University, Ithaca, N. Y.

Ohio Agricultural Experiment Station, Wooster, Ohio.

Oklahoma Agricultural Experiment Station, Oklahoma A. & M. College, Stillwater, Okla.

Oregon Agricultural Experiment Station, Oregon State College, Corvallis, Ore.

Pennsylvania Agricultural Experiment Station, Pennsylvania State University, University Park, Pa.

Rhode Island Agricultural Experiment Station, University of Rhode Island, Kingston, R. I.

Texas Agricultural Experiment Station, Texas A. & M. College, College Station, Texas.

Texas Technological College, Department of Horticulture and Park Management, Lubbock, Texas.

Virginia Agricultural Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va.

Washington Agricultural Experiment Station, State College of Washington, Pullman, Wash.

PERSONNEL WHO SPEND ALL OR PART OF THEIR TIME ON TURF WORK

Aldrich, Richard J., New Jersey
Amstein, Wm. G., Kansas
Anderson, Kling L., Kansas
Austenson, Herman, Washington
Bachelder, Stephen, New Jersey
Beach, George, Colorado
Beck, Elmer C., Georgia
Bell, R. S., Rhode Island
Bengeyfield, Wm. H., California (USGA)
Bockholt, Eugene B., Texas
Boyle, Alice M., Arizona
Britton, Michael, Indiana
Brogden, James E., Florida
Burt, E. O., Florida
Burton, Glenn W., Georgia
Butler, George, Arizona
Christie, J. R., Florida
Cornman, John F., New York
Cory, Ernest N., Maryland
Cummins, George, Indiana
Crane, Frank A., Illinois
Daniel, Wm. H., Indiana
Davis, R. R., Ohio
Davis, Spencer H., New Jersey
DeFrance, J. A., Rhode Island
Dickinson, Lawrence S., Massachusetts
Drage, Charles M., Colorado
Duich, J. M., Pennsylvania
Duncan, D. B., Florida
Elder, W. C., Oklahoma
Engel, Ralph E., New Jersey
Fazio, Steve, Arizona
Ferguson, Marvin H., Texas (USGA)
Folkner, Joseph S., Arizona
Fuchigami, Torao, California
Fults, Jess, Colorado
Gallaher, Harold, Kansas
Goetze, Norman, Indiana
Goode, J. M., Georgia
Gosdin, Wm. M., Texas
Grigsby, Buford, Michigan
Hagan, Robert M., California
Hallowell, Charles K., Maryland (USGA)
Harrison, Carter, Michigan
Hart, Richard, Indiana
Hart, S. W., Rhode Island
Holt, Ethan C., Texas
Hovin, Arne W., California
Howard, F. L., Rhode Island
Huffine, Wayne W., Oklahoma
Jaynes, Chester, Texas
Jefferson, R. N., California
Joa, Hans, Massachusetts
Johanningsmeier, Eugene, Indiana
Johnson, B. Lennart, California
Johnson, I. J., Iowa
Joiner, Jasper N., Florida
Jordan, Edward, Indiana
Juska, Felix, Maryland
Keen, Ray A., Kansas
Kelsheimer, E. G., Florida
Kerr, Stratton H., Florida
Kreitlow, Kermit, Maryland
Kuhn, A. O., Maryland
Kuitert, L. C., Florida
Kunze, Raymond J., Texas
Lagasse, Robert A., Florida
Lantz, H. L., Iowa
Latham, James M., Georgia
Lee, Oliver C., Indiana
Lunt, O. R., California
MacLeod, Norman, Massachusetts
McCloud, D. E., Florida
Madison, John H., California
Meade, John, Maryland
Meiners, Jack, Washington
Miller, P. A., California
Musser, H. B., Pennsylvania
Nutter, Gene C., Florida
Odland, T. E., Rhode Island
Parks, Charles, Kansas
Peek, James, Florida
Pickett, Robert, Indiana
Pickett, Wm. F., Kansas
Polivka, J. B., Ohio
Pritchett, W. E., Florida
Quinlan, L. R., Kansas
Radko, Alexander M., New Jersey (USGA)
Railey, Dewain, Florida
Rampton, H. H., Oregon
Raney, Franklin C., California
Rasmussen, Chuck, Washington
Ries, V. H., Ohio
Roberts, C. R., Kansas
Roberts, E. C., Massachusetts
Robinson, B. P., Georgia (USGA)
Rumburg, C. B., New Jersey
Runnels, H. A., Ohio
Santelmann, Paul, Maryland
Schoth, H. A., Oregon
Schread, John C., Connecticut
Schudel, H. L., Oregon
Shaw, Warren, Maryland
Shurtleff, M. C., Rhode Island
Simecek, Stanley S., Texas
Smith, A. G., Jr., Virginia
Stoutemyer, V. T., California
Tate, Harvey, Arizona
Tavener, William B., California
Taylor, Beryl, Iowa
Trew, E. M., Texas
Tyson, James, Michigan
Van de Werken, Henk, Virginia
Vavra, Frank L., Texas
Voigt, Ralph F., Illinois
Watson, Clarence E., New Mexico
Wells, Homer, Georgia
White, Ralph W., Florida
Willard, C. J., Ohio
Wolfenbarger, D. O., Florida
Wyckoff, C. Gordon, California
Youngner, Victor B., California

RESEARCH PROJECTS LISTED AT THE VARIOUS STATIONS IN 1955

Management Studies

Turf Quality Investigations — Bermudagrasses, Zoysia Grasses, Cool-Season Grass Mixtures, Bluegrasses, Fescues. U. S. Department of Agriculture, Beltsville Md.

Clipping Investigations—Zoysia Grasses, Bluegrasses. U. S. Department of Agriculture, Beltsville, Md.

The Influence of Turf Management Practices on Composition and Quality of Turf. California Agricultural Experiment Station, UCLA, Los Angeles, Calif.

Special Management Studies. Lawn and Athletic Field Renovation. Thatch and Mat Removal. Florida Agricultural Experiment Station, Gainesville, Fla.

Study of 20 or More Bentgrass Strains for Comparative Adaptability, Disease Resistance, and Value for Greens. Iowa Agricultural Experiment Station, Ames, Iowa.

Study of the Wearability of Zoysia and Bermuda Turf Under Practice Field Conditions. Maryland Agricultural Experiment Station, College Park, Md.

The Management of Merion and Kentucky Bluegrass, Creeping Red Fescue and Highland and Astoria Bents for Fairway Purposes. Michigan Agricultural Experiment Station, East Lansing, Mich.

A Study of the Effect of Mixtures, Height of Cut, and Fertility Levels on the Establishment of Merion Bluegrass. Michigan Agricultural Experiment Station, East Lansing, Mich.

A Study of the Role of Turf Cultivation and Vertical Cutting in the Maintenance of Fine Turfs on Greens, Lawns and Fairways. Michigan Agricultural Experiment Station, East Lansing, Mich.

Effect of Cultivation of ¼ and ¾ Inch Bentgrass Turf. New Jersey Agricultural Experiment Station, New Brunswick, N.J.

Methods of Controlling Thatch. New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Clover Control and Veronica Control. New York Agricultural Experiment Station, Ithaca, N. Y.

Turf Culture and Pest Control. Ohio Agricultural Experiment Station, Wooster, Ohio.

Fundamental Problems Associated with Accumulations of Pesticidal Chemicals in Soil. Ohio Agricultural Experiment Station, Wooster, Ohio.

Pesticidal Residues in Soils Following Pest Control Practices. Ohio Agricultural Experiment Station, Wooster, Ohio.

Management Studies and Evaluation of Species and Strains of Turf Plants for Oklahoma Conditions. Oklahoma Agricultural Experiment Station, Stillwater, Okla.

Lime and Compost Study on Piper Velvet to Determine Effect on Mat of Undecomposed Root Accumulation. Initiated 1944. Rhode Island Agricultural Experiment Station, Kingston, R. I.

Study of the Effect of Maleic Hydrazide as a Growth Retardant on Lawn Turf. Rhode Island Agricultural Experiment Station, Kingston, R. I.

Nutrition

Commercial Fertilizers and Amendment Demonstrations on Bluegrass Turf in Various Parts of the State and at Fort Collins. Colorado Agricultural Experiment Station, Fort Collins, Colo.

Nutritional Investigations and Fertility Studies. Florida Agricultural Experiment Station, Gainesvile, Fla.

Effect of Nitrogenous Fertilizers on the Growth of Turf Grasses. Georgia Coastal Plain Experiment Station, Tifton, Ga.

Calcium, Nitrogen, Phosphorus and Potassium Requirements of Southern Turf Grasses. Georgia Coastal Plain Experiment Station, Tifton, Ga.

Plant Metabolism and Carbohydrate Reserves. Indiana Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

Nitrogen Fertilizer Sources. Indiana Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

Phosphorus Requirements of Bentgrass. Indiana Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

Fertilizer on Bent and Turf Grasses. Iowa Agricultural Experiment Station, Ames, Iowa.

Use of Nitrogenous Fertilizer. Kansas Agricultural Experiment Station, Manhattan, Kans.

A Study of the Effects of Different Levels of Nitrogen, Phosphorus and Potassium on the Growth and Maintenance of Congressional, Arlington and Pennlu Creeping Bents for Putting Green Purposes. Michigan Agricultural Experiment Station, East Lansing, Mich.

A Study of the Effectiveness of Various Sources of Nitrogen and Other Materials on the Growth and Maintenance of Seaside, Highland and Astoria Bents Maintained at Fairway or Lawn Heights. Michigan Agricultural Experiment Station, East Lansing, Mich.

Fertilization of Meyer Zoysia and Merion Bluegrass. New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Effect of Rate and Season of Fertilization of ¼ and ¾ Inch Bentgrass Turf. New Jersey Agricultural Experiment Station, New Brunswick, N. J.

A Study on the Response of U-3 Bermudagrass to Different Rates of Nitrogen Fertilization from Various Nitrogen Containing Fertilizers Applied at Regular Intervals Throughout the Growing Season. Oklahoma Agricultural Experiment Station, Stillwater, Okla.

The Effect of Various Materials for Correction of Chlorosis in Seaside Bentgrass. Oklahoma Agricultural Experiment Station, Stillwater, Okla.

Nitrogenous Fertilizers for Turf Grasses. Pennsylvania Agricultural Experiment Station, University Park, Pa.

Fertilizer Ratio Study on Velvet Bent. Initiated 1931. Rhode Island Agricultural Experiment Station, Kingston, R. I.

Nutritional Requirements of Bermuda Turf. Texas Agricultural Experiment Station, College Station, Texas.

Effects of Fertilizers on Seed Production of Merion Bluegrass at the Pullman Station. Washington Agricultural Experiment Station, Pullman, Wash.

Water Management

The Amount and Intervals Between Applications of Water to Maintain a Satisfactory Bluegrass Turf. Colorado Agricultural Experiment Station, Fort Collins, Colo.

The Influence of Four Levels of Moisture on Root Development of Certain Species and Strains of Turf Grass. Texas Technological College, Lubbock, Texas.

Climatology and Water Usage. Florida Agricultural Experiment Station, Gainesville, Fla.

Soils

Putting Green Turf Artificial Soil. Indiana Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

Moisture Relationships—Studies to Determine the Relative Importance of Moisture Condensation from the Soil Atmosphere in a Region of High Humidity with Fluctuating Day and Night Temperatures. Massachusetts Agricultural Experiment Station, Amherst, Mass.

Fundamental Problems Associated with Accumulations of Pesticidal Chemicals in the Soil. Ohio Agricultural Experiment Station, Wooster, Ohio.

Pesticidal Residues in Soils Following Pest Control Practices. Ohio Agricultural Experiment Station, Wooster, Ohio.

Effects of Physical Modification of Soil on Turf Quality. Pennsylvania Agricultural Experiment Station, University Park, Pa.

Study of the Effect of Various Soil Conditioners on the Establishment of New Seedings and on Compaction, Drainage and Drought. Initiated 1952. Rhode Island Agricultural Experiment Station, Kingston, R. I.

The Effect of Sand Particle Size on Compaction in a Golf Green Mixture. Texas Agricultural Experiment Station, College Station, Texas.

Effect of Krilium on Compaction under Green Conditions at the Western Washington Experiment Station. Washington Agricultural Experiment Station, Pullman, Wash.

Topdressing

Lime and Compost Study on Piper Velvet to Determine Effect on Mat of Undecomposed Root Accumulation. Initiated 1944. Rhode Island Agricultural Experiment Station, Kingston, R. I.

Grasses

Search for a Grass that Will Stay Green the Year-Round in the Desert Areas. Arizona Agricultural Experiment Station, Tucson, Arizona.

Study of the Zoysias and a Number of Strains of Bermudagrass for Both Home Owners and Special Purpose Areas Such as Play Fields, Tees, and Greens. Arizona Agricultural Experiment Station, Tucson, Arizona.

The Introduction and Breeding of Superior Turfgrasses for California Conditions. California Agricultural Experiment Station, UCLA, Los Angeles, Calif.

Testing Different Species of Grass Alone and in Combination. Colorado Agricultural Experiment Station, Fort Collins, Colo.

Improvement of Turf Grasses for Florida. (Variety Testing and Breeding.) Florida Agricultural Experiment Station, Gainesville, Fla.

Investigations on Date of Planting Major Turf Grasses. Florida Agricultural Experiment Station, Gainesville, Fla.

Determination of Growth Curves — Major Turf Grasses. Florida Agricultural Experiment Station, Gainesville, Fla.

Method of Planting Vegetative Turf Grasses. Florida Agricultural Experiment Station, Gainesville, Fla.

Development of Superior Turf Grasses—Evaluation of Bermudagrass Types for Close Cut Turf. Georgia Coastal Plain Experiment Station, Tifton, Ga.

A Comprehensive Study of the Natural History of Annual Bluegrass (*Poa annua*), Chickweed, and Crabgrass. Illinois Drug & Horticultural Experiment Station, University of Illionis, Chicago, Ill.

Bluegrass Selections for Turf. Begun 1953, enlarged 1955. Indiana Agricultural Experiment Station, Purdue University, Lafayette, Indiana.

A Study of 20 or More Bentgrass Strains for Comparative Adaptability, Disease Resistance, and Value for Greens. Iowa Agricultural Experiment Station, Ames, Iowa.

Turf Quality Investigations—Bermudagrasses, Zoysia Grasses, Cool-Season Grass Mixtures, Bluegrasses, Fescues. U. S. Department of Agriculture, Beltsville, Md.

Turf Breeding Investigations. U. S. Department of Agriculture, Beltsville, Md.

Evaluation of Merion Bluegrass Seed Lots. Individual Plants Maintained from Registered, Certified and Uncertified Seed Lots. U. S. Department of Agriculture, Beltsville, Md.

Fifty (50) Plots Devoted to Lawn and Fairway Grasses. A Dry Land Area. No Irrigation. Kentucky, Arboretum and Merion Bluegrasses. Fescues, Illahee, Pa 74 and Common Creeping Red Fescue. Alta and Kentucky 31. Zoysias, common, Meyer, Z-72 and Z-73. Iowa Agricultural Experiment Station, Ames, Iowa.

A Study of Species and Mixtures of Species, Height of Mowing, and the Use of Nitrogen Fertilizer. Kansas Agricultural Experiment Station, Manhattan, Kans.

The Evaluation of Old and New Strains of Grasses Under Southern Michigan Conditions for Putting Greens, Lawns, Fairways and Other Uses. Michigan Agricultural Experiment Station, East Lansing, Mich.

Trial Areas of Zoysia, Bermudagrasses and Other Types of Grasses. Michigan Agricultural Experiment Station, East Lansing, Mich.

Evaluation of Kentucky Bluegrass, Red Fescue, and Bentgrass Strains. New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Turf Culture and Pest Control. Ohio Agricultural Experiment Station, Wooster, Ohio.

Evaluation of Species and Strains of Turf Plants for Oklahoma Conditions. Oklahoma Agricultural Experiment Station, Stillwater, Okla.

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FIELD DAYS AND TURF CONFERENCES

National and Regional

(Site announced annually)

American Society of Agronomy Annual Meeting

Annual Turf Conference and Show

Golf Course Superintendents Association of America

Central Plains Turf Foundation Field Day

Oklahoma Turf Field Day

Southern Turf Conference

Texas Turfgrass Association Field Day

Arizona

Annual Arizona Turfgrass Conference
University of Arizona
Tucson, Arizona

California

Northern California Turfgrass Conference
University of California
Davis, Calif.

Southern California Conference on Turf Culture and Field Day
University of California
Los Angeles, Calif.

Colorado

Annual Rocky Mountain Turfgrass Conference

Colorado A. & M. College
Ft. Collins, Colo.

Florida

Annual Florida Turf Conference and Field Day
University of Florida
Gainesville, Fla.

Georgia

Annual Southeastern Turfgrass Management Conference
Georgia Coastal Plain Experiment Station
Tifton, Ga.

Indiana

Mid-West Regional Turf Foundation Field Days
Purdue University
Lafayette, Indiana

Mid-West Regional Turf Conference
Purdue University
Lafayette, Indiana

Iowa

Annual Short Course for Iowa Golf Course Superintendents Association
Iowa State College
Ames, Iowa

Kansas

Annual Central Plains Turf Foundation Conference
Kansas State College
Manhattan, Kans.

Maryland

Annual Conference of Mid-Atlantic Association of Golf Course Superintendents
Baltimore, Md.

Michigan

Annual Greenkeepers Turf Conference
Michigan State College
East Lansing, Mich.

Minnesota

Minnesota Golf Course Superintendents Association Turf Conference
Minneapolis, Minn.

Missouri

Annual Turf Field Day
Westwood Country Club
St. Louis, Mo.

New Jersey

Turf Field Day
Rutgers University
New Brunswick, N. J.

One Week Course in Turf Management
Rutgers University
New Brunswick, N. J.

New Mexico

Annual New Mexico Turfgrass Conference
New Mexico College of Agriculture and Mechanic Arts
State College, N. M.

New York

Annual Cornell Turf Conference
Cornell University
Ithaca, N. Y.

Ohio

Ohio State Turfgrass Conference
Ohio State University
Columbus, Ohio

Turfgrass Field Day
Wooster, Ohio

Oklahoma

Annual Oklahoma Turfgrass Conference
Oklahoma A. & M. College
Stillwater, Okla.

Pennsylvania

Penn State Turf Conference
Pennsylvania State University
University Park, Pa.

Turf Field Days
Pennsylvania State University
University Park, Pa.

Rhode Island

Annual Turf Field Days
University of Rhode Island
Kingston, R. I.

Texas

Annual Texas Turfgrass Conference
Texas A. & M. College
College Station, Texas

Utah

Utah Turfgrass Conference
Salt Lake City, Utah

Washington

Annual Regional Turf Conference
State College of Washington
Pullman, Wash.

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