
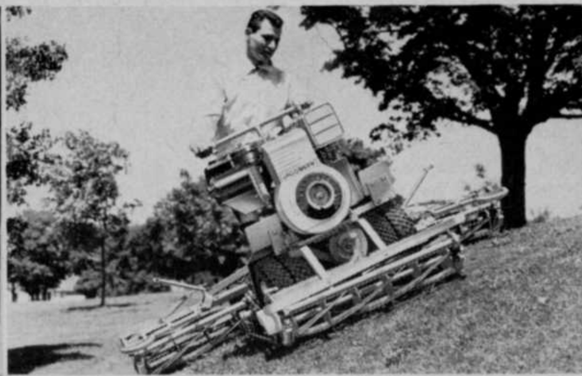


Far right: Worker carries out hybridization on St. augustinegrass plants. In the future, turfmen can look forward to improved, vegetatively-propagated varieties of St. Augustine, the author suggests. Right: Two workers check experimental grasses for seeding characteristics, which will largely determine methods selected to improve the grass. Data on breeding behavior of perennial grasses is not easily obtained, Dr. Long points out.

Breeding Improved Turfgrasses

By
J. A. LONG
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ORGANIZED research for breeding improved turfgrasses represents a relatively recent development in the turf industry. Activities of early turf research and development programs were concentrated primarily on fertilization, pest control, and other factors related to maintaining lawn grasses.

With significant progress in developing a wide and effective array of products for maintaining turf, attention now appears to be shifting to the basic ingredient of the landscape plan: the turfgrass itself. Examining the industry approach to turfgrass breeding may give the impression of starting at the wrong end. Should turf research have begun in breeding studies rather than concentrating on other aspects of grass culture?

The answer may in part be related to the growth of the United States. As recently as two decades ago, a large part of U. S. population was concentrated in rural areas and presented a limited economic factor in the turf industry of that period. Also, most of the financial support of public research programs, along with limited private research, was directed to food, animal, and fiber crop categories.

Improved grasses developed in agricultural research programs primarily for forage application have found some turf use. These and nonimproved grasses such as common Kentucky bluegrass, common bermudagrass, red fescue, and St. augustinegrass have provided the major source of turfgrasses. Even today, nonimproved varieties still supply a large part of lawn and turf requirements.

Turfgrass Breeding: A Decade of Progress

Most organized and sustained breeding programs now in progress date back only about a decade. Thus, a point has not been reached when a significant number of new and improved grasses can be made commercially available. Chief reason for this time delay is the technology gap. Effective plant breeding requires an understanding of the behavior of the plant species to be improved, and data on breeding behavior of perennial grasses is not obtained as quickly on an annual crop species, such as small grains.

Breeding studies investigate such factors as cytological characteristics (chromosome numbers, embryo-sac development) and whether the source material is cross-fertile or self-fertile. Selection of plant breeding methods depends on this data. As of this point, basic research that should provide grounds for new turfgrass developments is well underway.

A number of breeding programs are building up a source of material to work with. U. S. Department of Agriculture's Plant Introduction section provides experimental grasses from world collections to both public and private plant breeders. Both types of programs actively collect source breeding material and often will concentrate collections from pastures, golf courses, and home lawns. Much of the material collected requires modification before it is usable, but it plays an important part in the search for disease and insect resistance, improved growth habits, adaptation to regional demands, etc.

More recently, agents to increase mutation in grasses and ground covers are being used to supplement breeding programs. Radiation and chemical mutagenics represent this means of generating breeding material.

Dr. J. A. Long, Scott's researcher.

Selection Pressures Imposed on Grasses

"Selection pressure" and "survival of the fittest" are two important concepts guiding plant breeders. Once a program has collected source material, the sorting process begins. This represents the major part of the breeding program in terms of labor requirements, money, and physical facilities, and has undoubtedly limited the extent and number of organizations actively engaged in turfgrass breeding.

Most breeders feel that an improved grass must equal existing commercial varieties in desired qualities and have at least one additional quality characteristic before it will be accepted by the consumer. With this in mind, a program is designed to impose selection pressure on a large population of experimental grasses. Kinds of selection pressure used in typical programs include:

1. Differences in mowing heights with emphasis on low cuts to isolate superior turf formers.
2. Disease and insect infestations at a level sufficient to sort out genetic resistance.
3. Controlled levels of sunlight to find types exhibiting shade tolerance.
4. Regional evaluation to study effects of temperature and its interaction with disease on plant survival.
5. Variations in nutrition level.
6. Tolerances to chemical pest controls.
7. Seed production capabilities of experimentals that are propagated by seed.
8. Establishment rate of experimentals propagated vegetatively.

Some selection pressures can be applied in common test systems, while others require that specific tests be set up. Experimental grasses may show outstanding characteristics under certain selection pressures and important weaknesses under others. For example, a variety may be highly disease resistant, yet a very poor seed producer. When this happens, the experimental selection may be moved back to the initial phase of the breeding program, where hybridization or other means will be attempted to overcome the weakness.

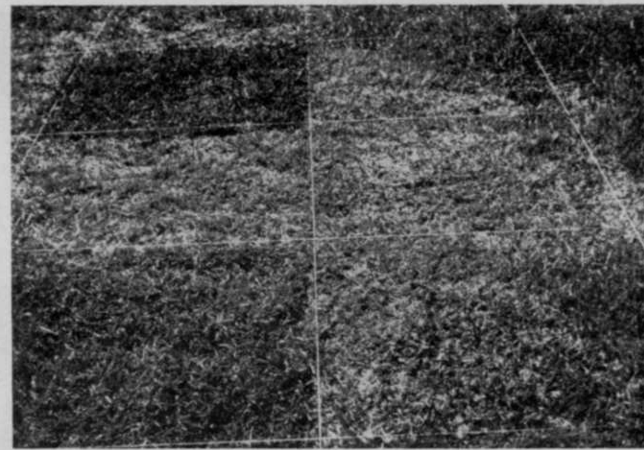
With Kentucky bluegrass and bahiagrass it is very difficult to modify an exceptional selection because of barriers (apomixis) to effective hybridization. Breeders must usually evaluate large, variable populations of these grasses to make significant progress.

Recent research from the Texas Agricultural Experiment Station and USDA relating to inheritance of apomixis should assist breeders working with apomictic grasses. In addition, breeding results from Rutgers University may also increase the effectiveness of Kentucky bluegrass programs.

It often requires from three to five years of subjecting grasses to different selection pressures before sufficient evidence of superior turf characteristics is available to move into advance testing and then to commercial seed or sod production. These stages add from three to five more years to the time required before a new turfgrass candidate reaches the consumer. Total time, then, needed to develop an

Far left: Experimental grasses are checked for reaction to stripe smut inoculations. Subjecting grasses to high levels of disease and insect infestations is one kind of "selection pressure" applied to sort out varietal resistances. *Left:* Individual experimental selections are harvested by hand to prevent intermixing of seed. Sufficient seed is collected from such plantings to establish test plots for evaluating selections under mowing.

Plots (right) show experimental selections of St. Augustine installed in turf areas heavily infested with chinch bugs to check susceptibilities to this damaging insect.



improved turfgrass is in the range of 10 to 15 years.

Looking Ahead to Grass Improvements

Based on current progress of breeding programs in the U. S. and Europe, improvements in some of the following grass characteristics can be anticipated:

1. Lower profile grasses with improved turf forming qualities that should perform better under lower heights of cut.
2. Grasses that are better adapted to specific regional conditions.
3. Increased resistance to leaf spot, smut, and some insects.
4. Improved performance in shade.

Experimental grasses showing some of the above characteristics may have certain limitations, however. Dwarf or low-growing grasses seem to establish a mature turf more slowly than some present varieties. Variation in maximum growth has also been observed. In this respect, certain dwarf types appear to produce more clippings at lower heights (¾ and 1 in.) than present taller growing varieties. When the height of cut is increased, the dwarf characteristic is shown by a drop in clippings removed compared to today's commercial grasses. This suggests that more attention to mowing height may be required to benefit from improved growth habit.

In the future, new varieties of such warm season grasses as Bermuda and St. Augustine no doubt will be vegetatively propagated as at present. This takes advantage of the greater vigor of F1 hybrids and makes it possible to release improved grasses where it would not be possible by seed propagation because of high sterility levels.

Increased interest and research activity is being devoted to turfgrass breeding programs. Consumer demands as a result of population shifts from rural to urban areas, plus the rapid increase of industrial and recreational turf applications, provides the basis for this increased activity.

Introduction of improved grasses to consumers will initially be slow due to a lack of technological background on important plant species. A shortage of trained specialists in this field until recently will no doubt influence the number and quality of new grasses developed in the near future.

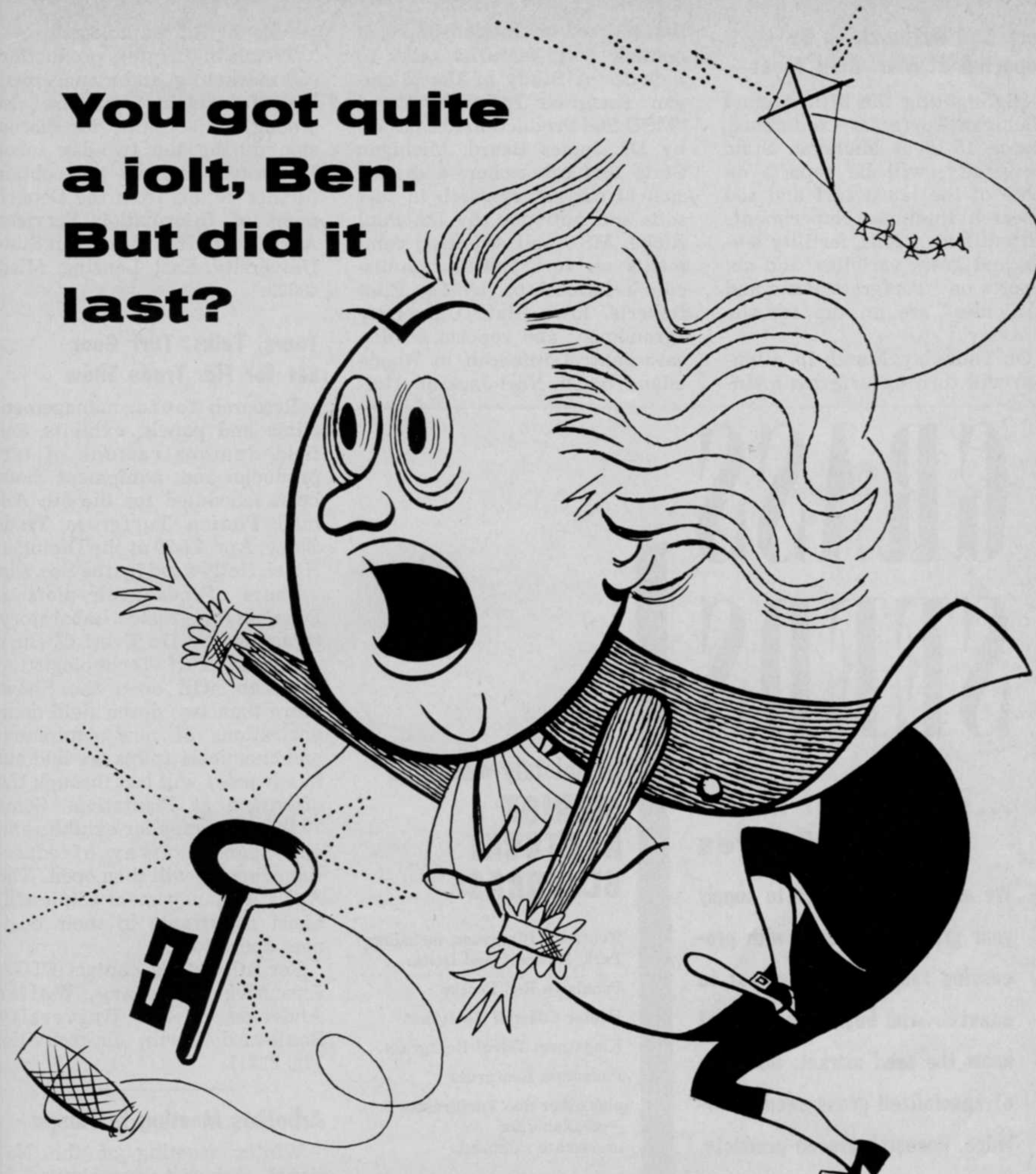
Progress in developing breeding methods and test systems for sorting out potentially desirable turfgrasses is being made by public and private workers. Based on current progress in the field, some degree of improvement in many important turf qualities can be expected in the next decade.

N. Calif. Turf Day Set

Latest equipment and materials for turf maintenance and landscaping will be exhibited at the 3rd Annual Northern California Turfgrass Exposition, Mar. 22-23 at Strybing Arboretum, San Francisco, Calif.

Turf managers, contractors, and others interested can contact C. R. Staib, co-chairman, for more details. Address: Hercules Incorporated, 120 Montgomery St., San Francisco, Calif.

You got quite a jolt, Ben. But did it last?



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Turf, Sod Research To Be Reported at Mar. MSU Meet

Highlighting the 37th Annual Michigan Turfgrass Conference, March 15-16 at Michigan State University, will be reports on some of the latest turf and sod research findings. Experiments with different soils, fertility levels, and grass varieties, and six reports on "Turfgrass Pests and Pesticides" are on tap for the first day.

On Thursday, March 16, attention will turn to turfgrass maintenance, sod production, and economics, with featured talks to include "A Study of the Michigan Turfgrass Industry" and "MSU Sod Production Research," by Dr. James Beard, Michigan State turf researcher; a discussion of current research in turf soils and nutrition, by Dr. Paul Rieke, MSU soil scientist; comments on turf fertilization-disease relationships, by Dr. Eliot Roberts, Iowa State University agronomist; and reports on disease control research in Rhode Island, by Dr. Noel Jackson, University of R.I. pathologist.

Trends in turfgrass production, sod marketing, and management tools for cutting costs are also among subjects due for discussion during the two-day meet. Interested turfmen can obtain further details from the Department of Information Services, Agriculture Hall, Michigan State University, East Lansing, Mich. 48823.

Tours, Talks, Turf Gear Set for Fla. Trade Show

Research tours, management clinic and panels, exhibits, and field demonstrations of turf products and equipment have been scheduled for the 6th Annual Florida Turfgrass Trade Show, Apr. 27-29 at the Diplomat Hotel, Hollywood by the Sea, Fla.

Tours of research plots at Plantation Field Laboratory, conducted by Dr. Evert O. Burt, Associate Turf Technologist at the Lab, will open the Show. More than two dozen field demonstrations of new equipment and chemicals (plots are laid out in advance) will last through the afternoon at Plantation. Some 70 industry supplier exhibits and an expanded array of educational booths will then open. The April 28 Management Clinic will assist registrants in their business operations.

For full details, contact FTGA Executive Secretary, Walter Anderson, at 4065 University Boulevard North, Jacksonville, Fla. 32211.

Arborists Meeting in Tampa

Winter meeting of the National Arborist Association is being held at the International Inn, Tampa, Fla., Feb. 11-15. Business sessions occupy the first two days of the program, with a round of discussions scheduled for Feb. 13-15.

Arboriculture advances, a look at the future for utility men, and the national beautification effort lead off talks. Management techniques, systemic insecticides, records, and hidden costs are closing considerations of NAA members at this year's annual winter gathering.

VPI's Putting Greens Test Modified Soils

By
R. E. SCHMIDT
Assistant Professor of Agronomy
Virginia Polytechnic Institute
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GOLF is attaining greater popularity. National TV viewing, championship play, and more leisure hours have helped it to become the country's number one participating sport. Attesting to this is the National Golf Foundation's estimate that women and junior golfers alone have increased over 40% since 1961. There is even a trend toward night golf under lights on regulation-length courses to accommodate the increased play.

Greens that once were satisfactory now produce poor turf under this increased traffic. Many greens were reconstructed by blending materials with putting green soils to help lessen the compaction of heavy and constant traffic. Modification of soil for putting greens was realized as a necessity quite early. Then, as today, soil modification appeared to be generally a hit-or-miss practice. In 1950, H. B. Musser* reported a survey showing that most superintendents were using modified soils with volume ratios of 1-1-1 or 2-1-1 of soil, sand, and organic matter. Neither type of soil, sand, or organic matter was identified.

*Musser, H. B. Turf Management. McGraw-Hill Book Co., Inc., N.Y., 2nd Ed.

Many superintendents have modified soils to match the soil of satisfactory putting greens in their area. This is a good method, provided similar management and traffic is applied. Duplicating soil mixtures from a completely foreign ecological environment may result in unsatisfactory putting greens.

Only recently has any experimental effort been made to evaluate different soil mixtures. A few colleges and universities now have studies underway. In 1964 the Weblite Corporation awarded V.P.I. a grant-in-aid to evaluate their graded expanded shale, Weblite, for turfgrass soil

Table 1. Results obtained after one season of compacted soils modified with various percentages of sand and Weblite.

% vol. mod.	Porosity Cap.	Porosity Non-cap.	Moisture content	Percolation	Wilting resistance	Clipping wts.	Density	Color
				SAND				
24	high	low	good	fair	good	excellent	excellent	good
41	high	low	fair	fair	good	good	excellent	good
54	adequate	adequate	poor	good	fair	good	excellent	good
68	adequate	adequate	poor	good	poor	fair	fair	fair
86	low	excessive	very poor	excessive	very poor	fair	poor	fair
				WEBLITE				
24	high	low	excellent	good	excellent	excellent	excellent	good
41	high	low	good	good	good	excellent	excellent	good
54	adequate	good	good	good	good	excellent	excellent	good
68	adequate	high	poor	excessive	fair	fair	excellent	good

modification. We were looking for a modified soil that would have the following properties:

1. Resistance to compaction.
2. Adequate internal drainage and sufficient aeration after exposure to traffic.
3. Adequate moisture holding capacity.
4. Adequate nutrient holding capacity.
5. Adequate cation exchange capacity.
6. Firm, but resistant surface.
7. Economic feasibility of use.

Weblite is lightweight (bulk density 8.5), holds 15% of its weight in water, and can be uniformly graded so that 98% of the material will fall between the 10 and 60 mesh screens (medium to very coarse sand particle size). This material was evaluated in an experimental green by mixing it with various percentages of a Groseclose silt loam and 5% pinebark. The mixtures were then placed in 10 x 8 foot bins over a gravel and tile system, fumigated and seeded with Penncross bentgrass. Corresponding soil mixtures of a concrete sand with 90% of the particles between the 10 and 60 mesh screens were also incorporated into experimental greens.

A unique golfer with 15 spiked shoes, three hitting at a time, and weighing 450 pounds was employed in 1965 to compact greens. One trip was equivalent to ten golfers walking on the same surface.

After one season the following was observed:

1. Traffic reduced turf growth and quality on all mixtures.
2. Turf cover and color were satisfactory on all Weblite modified soils, but clippings, moisture capacity, and drought resistance were reduced when more than 54% Weblite was used.
3. On sand modified plots the density and color as well as clippings and wilt resistance were reduced when more than 54% sand was used.
4. Less Weblite than sand was needed to obtain similar results.
5. It appears that modified soils satisfactory for putting greens with heavy traffic should have the following physical properties:

Total porosity	40-45%
Capillary porosity	20-25%
Non-capillary porosity	18-22%
Percolation (in. per hour)	1-10

These physical properties are based on one season of field data and must not be considered absolute. Further evaluation is needed because, as workers at Penn State have indicated, after the second season of traffic their modified soils became increasingly compacted compared to the first season.

Construction of an experimental putting green at Virginia Polytechnic Institute for evaluating various soil mixtures adaptable to today's heavy golf traffic.

Daconil 2787 being applied on greens at Kirtland Country Club, Kirtland, Ohio

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Vertical Mulching Boosts Root Growth

By WAYNE C. MORGAN

WHERE do roots grow? Under what environmental conditions are they active? The answers to these questions are of prime importance to persons having responsibility for establishing and maintaining landscape plants. Health and beauty of most plants are usually in proportion to the extent and vigor of the root system.

Roots do not grow into soil. They grow in the pore spaces surrounding soil particles. If there are only small pore spaces due to compaction and breakdown of soil structure, the physical barrier of dense soil will restrict root elongation.

Roots do not grow where it is too dry. Neither do they grow where it is too wet. They grow only where there is a favorable soil-moisture-air relationship. Water penetrates very slowly into and through clay, silt, and compacted soils. With restricted water movement into the deeper rooting zone of such soils, lack of sufficient moisture will not allow root growth. Where water has infiltrated, root activity will be limited because of excess moisture and insufficient oxygen in the dense soil.

Unwise irrigation practices can create conditions unfavorable for plant health. Water applied too fast runs off rather than entering the soil. Shallow rooting is usually the result. Applying more water than needed not only is wasteful, but will severely limit roots from aiding top growth where poor soil conditions exist.

Backfilled Holes Help Restore Vigor

When faced with poor growing conditions, a method of drilling holes around trees or shrubs and replacing soil with an improved mix will probably help significantly to restore vigor and beauty to plants. Known as "vertical mulching," this method is similar to "deep-root feeding" and "perforated feeding," except that in the latter holes are not backfilled with an improved soil mix.

In vertical mulching, holes from 2 to 3 in. in diameter are drilled into soil beneath the plant's drip line, approximately one per square foot. These can