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

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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.

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

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

population of experimental grasses. Kinds of selection pressure used in typical programs include:

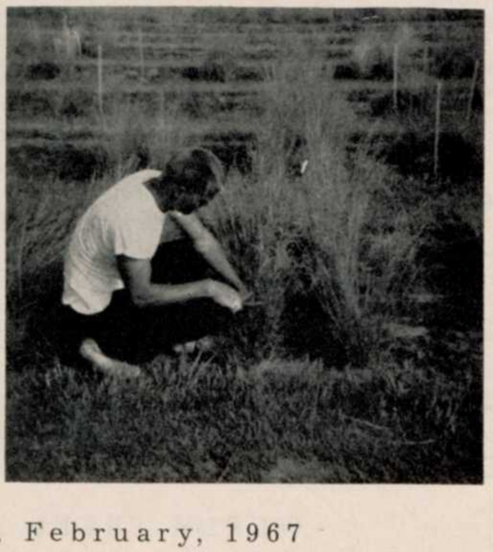
1. Differences in mowing heights with emphasis on low cuts to isolate superior turf formers.
2. Disease and insect infestations at a level sufficient to sort out genetic resistance.
3. Controlled levels of sunlight to find types exhibiting shade tolerance.
4. Regional evaluation to study effects of temperature 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.

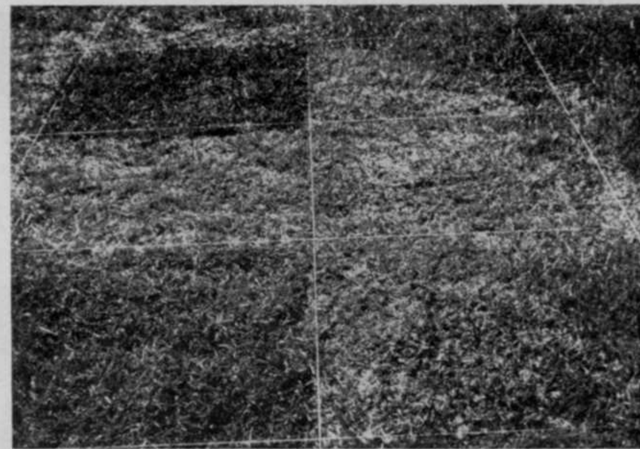
With Kentucky bluegrass and bahiagrass it is very difficult to modify an exceptional selection because of barriers (apomixis) to effective hybridization. Breeders must usually evaluate large, variable populations of these grasses to make significant progress.

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.