BERMUDAGRASS RESEARCH plots at ⟵ UA's Yuma Branch Experiment Station. Note bagged plants in left foreground. Middles are kept free of weeds by use of herbicides.

# *Breeding Seeded Bermudagrass; Unique Arizona Research Problem*

By William R. Kneebone

The only intensively managed production of bermudagrass seed in the world is on some 9,000 acres in Yuma County, Ariz. Several million pounds of seed are sold annually in the southeastern United States, Mexico, Hawaii, and more exotic places like Australia and Africa.

Such a volume of seed for a specialty crop makes a substantial contribution to Arizona's economy. Recognizing that the seed market could be appreciably expanded if improved seeded varieties were available, the seed growers and seed dealers in the state joined with the UA Agricultural Experiment Station to organize research in this direction. A program has been under way since 1960, supported by grants from the seed industry and by Experiment Station funds.

**Produced for Outside Markets**

Since most of the bermudagrass seed produced in Arizona is used outside Arizona, the research program for variety development has been concerned as much with outside needs as with those within the state.

This is a unique situation. We are in the business of developing a better product for Arizonans to sell. To sell, it must not only be better in Arizona but in Georgia or Tennessee or Alabama.

Our program has two phases: 1. Development of superior varieties for turf and forage uses in Arizona and also in other parts of the United States. 2. Development of systems for more profitable production of seed of these varieties in Arizona.

Improved varieties of common bermudagrass that have been named, released and are in use in the United States are, without exception, vegetatively propagated. Most of them are quite infertile and none breed true to type from seed. In meeting the objectives of the Arizona program, we must find not only superior potential parents but must make sure that they will produce adequate amounts of seed that will in turn produce superior seeded pasture or turf. As with any other crop, bermudagrass varieties must be *Usable* as well as *Valuable*.

An essential part of the breeding program is evaluation for seed production. This is being done in the Yuma area at the University of Arizona Branch Experiment Station, with related studies in grower fields and at the University's Marana and Casa Grande Highway farms near Tucson.

Selections made at Tucson from among seedlings of many Arizona collections, introductions from other parts of the world, and experimental seed lots obtained from other stations are being grown at the Yuma Valley Station for evaluation of their seed potential and to produce seed for progeny testing. In addition, there are selections received from other workers for testing. Many of the selections at Yuma, plus some newer ones, were established in a replicated plot test at Marana in 1965.

From these studies many things are becoming clear, some of them expected, some of them not; some of them favorable to research progress, some disappointing. Most striking is the very wide range in seed production potential found among types of bermudagrass. Potential yields range from zero to a probable maximum of 1500 pounds per acre of hulled seed in two harvests. Selections that are good seed producers have been rare, and the best seed producing selections thus far have been from Arizona common.

**Controlled by Two Factors**

Studies on components of seed yield have shown that total yield is dependent primarily on two factors, number of heads per acre and percentage of florets setting seed. Since many sterile types produce numerous heads, the percentage seed-set becomes very important. In grower fields and in research plots, large heads tend to have lower seed-set.

Since types with large heads tend also to have fewer heads, their seed yield potential is still further reduced. Large-headed types, however, also have larger seed and their seedlings are more vigorous. The ideal variety from a seed production standpoint should have many large heads which have, as near as possible, 100 percent seed-set of large seed.

To combine the disease resistance, hardiness and seed size of large-headed types with the good seed production of small-headed types requires an extensive crossing program. To make crosses, and perhaps later develop hybrid varieties, we must know the degree of self-fertility and percentage of natural crossing in bermudagrass.

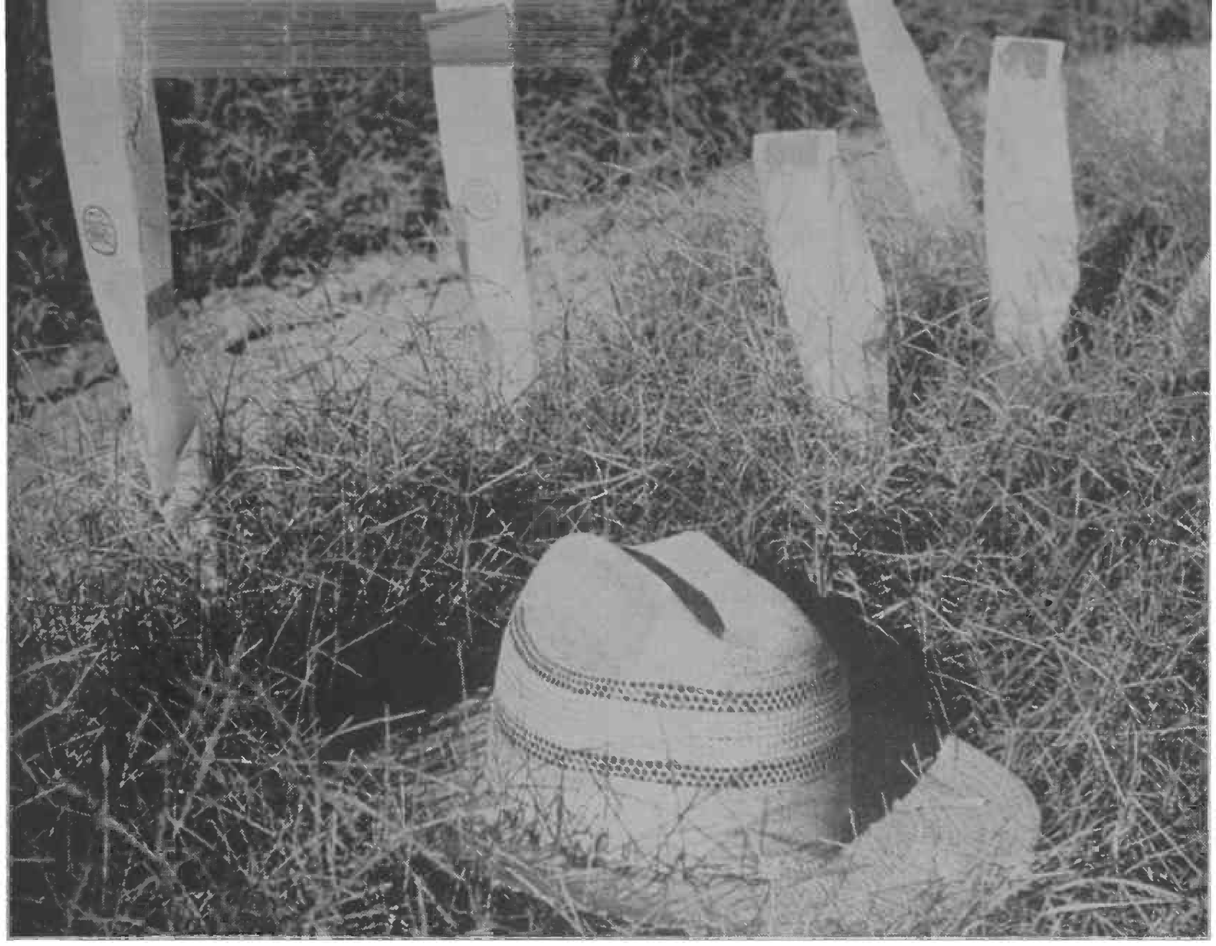
**Controlled Self-Pollenization**

To do this we take developing heads and cover them with a special paper bag before they have flowered. The bag prevents outside pollen from getting to the stigmas. Seed set under the bag must be from the plant's own pollen, and is a measure of self-fertility. Selfed seed-set is very near zero under bags in experimental plots at Yuma and Tucson and in grower fields in Yuma County. Normal seed-set in grower fields can be as high as 90 percent (a very high figure for grasses). Heads exposed to outside pollen and then bagged, set seed just as well as unbagged heads.

These data indicate that bermuda-

(Continued on Next Page)

Dr. Kneebone is a professor in the Department of Agronomy.



BAGGED PLANTS — Three to five heads of the female are enclosed in a bag, at the top of which is a vial of water with male heads, to give completely controlled pollenization.

(Continued from Previous Page)

grass is nearly 100 percent cross-pollinated. Here are two very important implications: 1. Vegetative propagation of a single selection for seed production is useless, because the only seed it will set must come by outcrossing. 2. This assurance of outcrossing allows us to make crosses without emasculation of the female parent. We can therefore bag the female and supply heads of the male parent set in vials of water within the same bag. As suitable parents are developed, commercial production of hybrids can be done by vegetatively propagating two or more lines in alternating rows with suitable isolation from other bermudagrass. All seed produced would then be the desired hybrid.

## Poses Many Problems

Studies of crossability between types have just begun after first working out techniques for crossing. They have brought other unexpected problems. Apparently there are barriers to crossing between certain types. These barriers must be overcome if characters are to be taken from one for use with the other. For example, some very promising forage types with cold hardiness and yield potential but low seed-set do not cross well with common even when used as male parents. Not only do we need seed production data, but we also need basic information on chromosome behavior and species relationships within the bermudagrass genus.

Another part of seed research concerns seed germination. A grower wants his seed to be of the highest quality possible, and germination is one measure of quality. Ideally, the seed should germinate well immediately after harvest. Seed from most common types and from some giant types does germinate well shortly after harvest. Most of the selections from other sources that we have tested have many hard seeds, seeds which refuse to take up water, and do not germinate under standard conditions. This is another of the unexpected research problems which have been identified and must be considered.

## Test of Management Factors

Commercial seed production systems have developed over the years which normally assure a profitable crop. Little information is available on the exact effect of various management practices, or on the effects that changing one or more might make. Tests of seed production from different selections also provide a way to investigate management factors. Nitrogen fertilizer, for example, appears to delay initiation of heads in the spring but also induces formation of more stems that will later head.

Phosphorus by itself does not improve seed yields, but may do so when high rates of nitrogen are applied. In the Yuma trial we applied a soil sterilant (Hyvar x) to the row middles to keep selections from growing together. There was a wide range of susceptibility among selections. This, along with greenhouse demonstrations of different reactions among selections to other herbicides, may have considerable importance both in development of varieties and in present control programs to remove giant from fields of common.

Much of the research effort to date has gone into definition of problems. Problems we have found, but we have also discovered the areas of greatest opportunity. These have not been the ones expected when the program was initiated, but perhaps the potentials are greater than originally hoped for. The opportunities are, like the goals of our research, unique. We aim to capitalize upon them for Arizona.

IN YUMA COUNTY Bermudagrass is cut for seed after irrigation has been stopped, the grass raked into swathes, then threshed with a pickup combine.