Breeding Forage Crops

The breeding and use of improved forage varieties have progressed rapidly in the last few decades, but this has not always been so. In the United States, the breeding of forage varieties did not receive the same attention in the early part of this century as the breeding of cereal varieties. As late as 1950, seed of many forage species was sold without identity of variety because improved varieties were not available. There are several reasons for the late start in forage breeding research in the United States.

Early U.S. farmers were endowed with a wealth of natural grassland. Not until the cultivated areas expanded and encroached upon the native grasslands were they forced to rely upon seeded grasses and legumes for their forage needs. Gradually, the value of improved grasses and legumes for economical feed production, or for soil conservation, was recognized; and with this recognition came increased interest and support for forage-breeding research. Passage of the Plant Variety Protection Act of 1970 stimulated private seed companies to start forage-breeding programs, adding to the total breeding research effort. In European agriculture, grasslands occupied a prominent position earlier than in U.S. agriculture, and in Great Britain and the Scandinavian countries intensive breeding research on forages was initiated at an earlier date than in the United States. In western Europe variety protection programs were also in place much earlier. The information obtained and the methods developed from breeding research in Europe provided the background for starting forage breeding research in the United States and in other countries.

The large number of forage species and the recentness in which many were domesticated have handicapped forage breeders. Domestication and improvement of a raw species require many generations of selection and recombination. Yet some forage species are relatively recent newcomers: bromegrass was first cultivated about 1860, crested wheatgrass about 1920, tall fescue and Korean lespedeza about 1930. Some forage species are still in the process of being domesticated. In 1980, the first varieties of polar grass and bluejoint reedgrass were developed in Alaska from indigenous collections. Compare
these with cereals or cotton, which have been cultivated for several thousand years. With some forage species, the presence of a serious disease, such as bacterial wilt in alfalfa, or the presence of toxic substances, such as the cyanogenetic glycoside that produces prussic acid poisoning in sudangrass, focused attention on the need for breeding improved varieties.

FORAGE CROP BREEDING PROBLEMS

Although procedures in breeding forage crops are based upon the same genetic principles utilized in the breeding of other crops, forage breeding presents new problems to be recognized and overcome by the breeder. The problems arise from the diversity in pollination of the different species, irregularities in fertilization and seed setting, the perennial nature of most forage species, and differences in the evaluation and maintenance of new strains. For example:

- Most important forage species are cross-pollinated. The heterozygosity in cross-pollinated species makes it difficult to propagate individual lines from seed and maintain their identity.
- Many forage species have small floral parts, making artificial hybridization tedious and pollination control difficult.
- Self-incompatibility is common in many forage species, limiting the extent to which they may be self-pollinated.
- Some grasses reproduce largely by apomixis (seed setting without union of sperm and egg) presenting problems in crossing and obtaining gene recombination.
- Many forages are poor seed producers, or produce seed of low viability.
- Many forages produce weak seedlings and stands are not easily established.
- Isolation and clean land on which new strains may be increased without contamination are not always available.
- The initial evaluation of selected plants or lines in the breeding nursery is generally based on the performance of spaced plants, or rows, which may not accurately represent the performance of the strain in a thickly seeded stand or sward as forage species are commonly grown.
- Forage species are often seeded in mixtures with other species, which complicates the evaluation of individual strains.
- Strains may perform differently with different systems of grazing management.
- Most forages are long-lived perennials and many years are required to evaluate persistence and productiveness of new strains.
- Many forage species are polyploids, which increases their genetic complexity.

Basic information on breeding behavior, diseases, methods of breeding, and evaluation of strains has been developed for many forage species. The large number of forage crops being grown (over 100 species of forage grasses and