Collection of forage crop germplasm throughout Iowa

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Collection of forage crop germplasm throughout Iowa

Abstract
A successful forage breeding program starts with a supply of germplasm containing adequate genetic diversity to serve as the foundation for better cultivars. No collection of forage breeding materials unique to Iowa has been done in 50 years. In this project, plants were collected from 20 pastures throughout the state. The plants' mere presence suggested that they had already survived the drought, cold temperatures, and extensive grazing that occur in Iowa, which made them good subjects for breeding purposes.

Keywords
Agronomy, Animal management and forage

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences
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Abstract: A successful forage breeding program starts with a supply of germplasm containing adequate genetic diversity to serve as the foundation for better cultivars. No collection of forage breeding materials unique to Iowa has been done in 50 years. In this project, plants were collected from 20 pastures throughout the state. The plants’ mere presence suggested that they had already survived the drought, cold temperatures, and extensive grazing that occur in Iowa, which made them good subjects for breeding purposes.

Background

Iowa has between seven and ten million acres of forages, including pastures, hay, and silage, which are important components of sustainable agriculture systems. Future improvements are dependent on plant breeding innovations, which in turn rely on a broad-based, adapted germplasm collection from which to select superior plants.

Germplasm can come from the National Germplasm System of the USDA and from currently available cultivars of various forages. Neither of these provide materials fully suited to Iowa’s conditions. A better source would be germplasm from species currently growing in the state. This material has already undergone extensive selection by insects, diseases, and grazing animals, by harsh winters, by droughts and floods, or by other factors particular to a specific field. These plants are survivors, just the sort of plants needed by breeders developing new varieties.

Unlike corn or soybeans, which have been intensively improved, most forage crops, with the exception of alfalfa, have had comparatively little breeding effort devoted to them. Therefore native or naturalized forage germplasm would not prove detrimental to the breeding program because it would not contain the many poor traits that natural germplasm of major grain crops would carry. Additionally, as the importance of genetic biodiversity is further recognized, the value of preserving Iowa’s forage germplasm diversity through a broad-based collection is increased, both for current breeding progress and as a potential source of particular traits that may be desirable in the future.

Objectives of the project were to:

- collect plants of orchardgrass, white clover, birdsfoot trefoil, and other forage species from old pastures throughout Iowa, and
- maintain and clonally propagate the plants in the greenhouse for transplanting into replicated evaluation nurseries.

Approach and methods

With the help of ISU Extension Service staffers and Natural Resources Conservation Service field representatives, appropriate fields were identified for the collection efforts. Requirements were that no seed had been added to the field for at least ten years and that the pasture had been grazed heavily, preferably overgrazed. Pastures chosen for the project were separated by at least 20 miles and/or represented different microenvironments.

Samples were taken from cooperators’ land in these Iowa counties during late summer 1996:

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Budget:
$5,000 for one year
Allamakee, Appanoose, Audubon, Cherokee, Clarke, Clayton, Clinton, Crawford, Davis, Jackson, Lucas, Lyon, Osceola, Ringgold, Shelby, Van Buren, Wapello, and Woodbury.

Plants were sampled from throughout each pasture in hopes of representing all slopes, aspects, and soils. Selection focused on the most agronomically attractive plants in each area of the field. Desirable traits included freedom from disease, dark green color, evidence of high tillering/branching/stolon density, and general vigor.

Most of the choices were orchardgrass, white clover, and birdsfoot trefoil, three forages under selection in ISU’s forage breeding program. Researchers had hoped to collect switchgrass and eastern gamagrass, but none were found in the pastures visited. Some big bluestem, black medic, and sideoats gramma were collected instead.

The collected plants were potted and placed in the ISU greenhouse for the winter. Plants were clonally propagated in late spring and planted into randomized, replicated field plots in 1997, and will be evaluated over the next several years as part of another Leopold Center project (#98-69). Forty white clover plants were selected based on greenhouse vigor and intercrossed by bees in the greenhouse during the winter of 1996-97. The seed was used in regional forage trials planted in Iowa, West Virginia, Pennsylvania, and Nova Scotia to compare performance of five populations developed from pasture collections in all four locations, plus Georgia.

**Results and discussion**

Nearly 175 orchardgrass, 100 birdsfoot trefoil, 50 miscellaneous warm-season grasses, and 600 white clover plants were collected from 20 Iowa pastures. White clover was found at all sites, orchardgrass was absent from northwest Iowa pastures but generally present elsewhere, and trefoil was found only in south central, southeast, and northeast pastures. Warm season grasses were present only in western Iowa, though surprisingly they appeared in some heavily grazed bromegrass pastures.

Identifying genetically superior plants from various sections of a pasture was not an easy task. It was no surprise that the largest, most vigorous plants often were associated with manure piles. Even if no manure was readily apparent, it could have still been the cause of observed vigor. However, the researchers selected among the plants seeking to sample the variability present in the pasture.

All the pastures exhibited a wide variety of plant morphology, disease resistance, and other traits. Later observations in the greenhouse showed that some particularly interesting genotypes had been chosen. One orchardgrass that has survived in a pasture closely grazed by sheep for 40 years displayed a very unique morphology of many very thin leaves and prostrate growth. This may prove useful for pasture varieties, particularly if the high tiller numbers can be crossed into more productive types.

**Conclusions**

The plants in most Iowa pastures reflect a large diversity of traits; some genotypes are expected to contribute significantly to the ISU forage breeding efforts. The project investigators were successful in collecting plants from all areas of Iowa and replicating them for study in Ames. Future evaluations will assess the usefulness of the germplasm and identify areas from which further collections may be warranted. Including this Iowa-adapted material in a breeding program designed to concentrate all these desirable characteristics will result in superior forage varieties well adapted
Impacts of results

The germplasm collected here has several traits necessary to make successful forage varieties for Iowa: adaptation to Iowa climate and soils, tolerance to grazing animals, and the ability to grow in mixtures of species. Other important traits such as disease resistance, yield, and forage quality may or may not be part of their genetic packages. Adding Iowa-adapted material to an Iowa forage breeding program will help lead to superior forage varieties.

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