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Evaluation of forage plants collected from permanent pastures throughout Iowa

Abstract
There has been no collection of forage plant germplasm in Iowa for more than 50 years. Researchers collected and evaluated several types of plants in Iowa pastures to see if they had traits associated with grazing tolerance or, on a larger scale, with long-term pasture persistence.

Keywords
Agronomy, Animal management and forage

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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Abstract: There has been no collection of forage plant germplasm in Iowa for more than 50 years. Researchers collected and evaluated several types of plants in Iowa pastures to see if they had traits associated with grazing tolerance or, on a larger scale, with long-term pasture persistence.

Background

Forage crops provide an important source of ruminant livestock nutrition. Their inclusion in agroecosystems also has desirable environmental benefits, including improved water quality and limited soil erosion when compared to row crop systems. Forage breeding is most effective if the populations from which superior plants are selected have high levels of variation for important traits.

One avenue to genetic diversity is through use of germplasm collected from throughout the world and maintained by the National Germplasm System. However, these materials may not be appropriate for growing in Iowa. Another source of diverse germplasm is Iowa’s old pastures where forage species have withstood the tests of time and climate. But no organized collections of Iowa pasture forage materials have been compiled in more than 50 years. Plants from these fields could provide an excellent basis for breeding varieties to improve Iowa’s forage crops.

The objective of this project was to evaluate various agronomic traits of the collected plants of several popular forage species (orchard grass, white clover, and birdsfoot trefoil) in common, replicated experiments at the Iowa State University Agronomy Farm.

Approach and methods

Researchers visited 20 pastures throughout Iowa in 1996 and collected orchardgrass, white clover, and birdsfoot trefoil plants. (The pastures were located in these counties: Jackson, Clinton, Clayton, Allamakee, Crawford, Cherokee, Woodbury, Lyon, Osceola, Audubon, Shelby, Ringgold, Clarke, Lucas, Appanoose, Davis, Van Buren, and Wapello.) The pastures were all more than ten years old (with some as old as 40 years) and had no overseeding during that time. The plants collected have withstood severe natural selection processes, such as a drought, ice sheeting, severe grazing, and other traumas. They were transported to a laboratory setting to isolate and test their particular agronomic qualities.

All plants of orchardgrass and white clover were clonally replicated and planted in the field during the spring or summer of 1997. In addition to the Iowa specimens, 15 genotypes were collected from an old sheep pasture in central Pennsylvania and 39 genotypes from two improved cultivars also were included for comparison.

Each genotype in the orchardgrass group was replicated six times. Less successful was the white clover collection, which was planted in two replications. The plants’ small size and a bout of very hot, dry weather immediately after transplanting resulted in high mortality;
59 genotypes out of 612 died in both replications. Another problem was that naturalized, volunteer clover invaded the white clover plots.

The birdsfoot trefoil clones died in the greenhouse, so their evaluation was postponed until the other species assessments were done. Parent plants have been maintained and investigators hope to evaluate them at a later date.

Results and discussion

**Orchardgrass** Of the three species, this collection was the most successful. After evaluation in 1998 and 1999, a number of superior orchardgrass plants from pastures in Iowa were identified. These plants had characteristics equal or superior to the commercial checks, and thus have considerable promise in breeding grazing-tolerant, persistent orchardgrass cultivars. In addition, seed was collected from each genotype and equal amounts were bulked to create an Iowa pasture-adapted orchardgrass germplasm that will form the base population for future selection.

Overall, the orchardgrass collections from Iowa had an earlier maturity than the check cultivars or the Pennsylvania populations. This is an undesirable characteristic for orchardgrass grown in mixtures with alfalfa for hay production; for pastures the early production may not be as problematic, provided farmers graze their animals at the appropriate time. Among the four Iowa regions, the northwest region collections matured later than the other three, which were similar. Scores showed the northwest collections to be the most vigorous of the Iowa collections, but they were less vigorous than the cultivars in 1998. In April 1999, the northwest collections were the most vigorous of all populations, and they maintained good vigor into the fall. The northeast collections generally had the lowest vigor. Some of the southern-based plants may have had trouble coping with the more harsh central Iowa winters on the ISU farm.

**White clover** The primary interest was in genotypes that could survive the summer and produce well into the fall. Although researchers obtained good plant vigor scores in the fall of 1998 after one year of growth, the plot was then overrun with naturalized clover and was abandoned. However, in greenhouse work 40 plants had previously been selected for large leaves, dense stolons, and generally high vigor. These were intercrossed to produce Iowa pasture-adapted white clover germplasm. This germplasm is highly diverse, and is being evaluated in several studies in Pennsylvania, West Virginia, and New Brunswick, Canada. Prospects are good that it will contribute useful germplasm for future breeding efforts.

The vigor of clover obtained from northwest Iowa was lower than the other three regions, in contrast to the orchardgrass data. The lower vigor could be attributed to the lower spreading ability, smaller leaves, and marginally lower stolon density. The clover from the other Iowa regions was generally similar for all traits. Overall scores for all regions were fairly low.

Two closely grazed pastures had plants with good vigor and large leaves when evaluated at Ames. When we collected them in the pasture, these plants were small with tiny leaves. This points to the difficulty of judging merit in the pasture itself.

Conclusions

**Orchardgrass** From this experiment, researchers were able to identify clearly superior genotypes that will be used to develop an improved pasture-adapted population. The overall population will serve as a source for further breeding. Even though many of the plants appear
undesirable in the spaced, planted nursery, they may be ideal for mixed species pastures, so future selection will be done under competitive conditions. We have not had a severe winter since planting was done in the nursery so more evaluation is needed to determine the true winter hardiness of some of these plants. Although they survived in the pasture, they may have been growing in protected locations and may lack optimal winter survival ability.

**White clover** Prior to transplanting, we selected some plants with large leaves and dense stolons that appeared to perform well in the greenhouse and intercrossed them using bees. The resulting seed offers a broad-based population with representation from all regions. Although not as ideal as seed developed after field evaluations, it will provide a diverse group of genotypes for future selection. The population is being evaluated at four locations (Iowa, West Virginia, Pennsylvania, and New Brunswick, Canada) for agronomic performance. However, the problem of volunteer clover needs to be addressed. If volunteer clover overwhelms introduced plants, the benefit from seeding improved germplasm is likely to be small. This is an issue that needs further investigation.

**Impact of results**

The germplasm collected for this project included superior genotypes and offers the potential for improving cultivars for Iowa pastures. Although some of the plants we collected (and maybe a majority of them) are inferior to the best cultivars, some were on a par with the best commercially available germplasm. Incorporating their adaptation to Iowa conditions should provide improved persistence, yield, and nutritive quality for Iowa forages.