Breeding For Increased Persistence in Pasture Legumes

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Improving pasture legume persistence or longevity has been a goal of plant breeders for years. At the U.S. Dairy Forage Research Center (USDFRC), the legume breeding program emphasizes non-alfalfa pasture legumes. Ideally, grazed forage intake should be around 30% forage legume DM. Forage legumes are a good protein source for animals and nitrogen source for the soil.

Due to various natural conditions and management practices, grasses persist better than legumes in pastures. However, progress is being made towards keeping legumes in pastures for longer periods. The following is an update on four ongoing research projects at the USDFRC.

Red clover *(Trifolium pretense L.)* is an excellent forage legume for grazing systems. Red clover has excellent seedling vigor and broad establishment versatility, and is a great pasture protein source. Historically, red clover has been limited by its lack of stand persistence in hay and grazed systems compared to other small-seeded forage legumes such as alfalfa. Breeding over the past 50 years has extended red clover persistence in hay management systems up to four years. However, no trials have examined grazing tolerance of historic and current red clover varieties.

To address this lack of information, a red clover grazing trial was conducted at the University of Wisconsin Agricultural Research Station at Lancaster, WI. Over 50 varieties of red clover were included in the trial. Each variety was seeded in mixture with tall fescue *(Lolium arundinaceum)* in April 2004. Seeding rates were 10 lbs/ac of red clover and 10 lbs/ac of the tall fescue.

Beginning in June 2004, stands were rotationally grazed when the forage was between 12-15 inches tall. Grazing lasted 24 hours with 40,000 lbs/ac of cow-calf pairs grazed on the pasture. In 2004 and 2005, the grazing events occurred at four week intervals. In 2006 and 2007, grazing occurred at three week intervals in order to increase grazing stress on the pasture plants. Plants/ft² were measured in July 2004, May and October 2005 and 2006, and May 2007.

Figure 1. *Persistence of red clover varieties.*

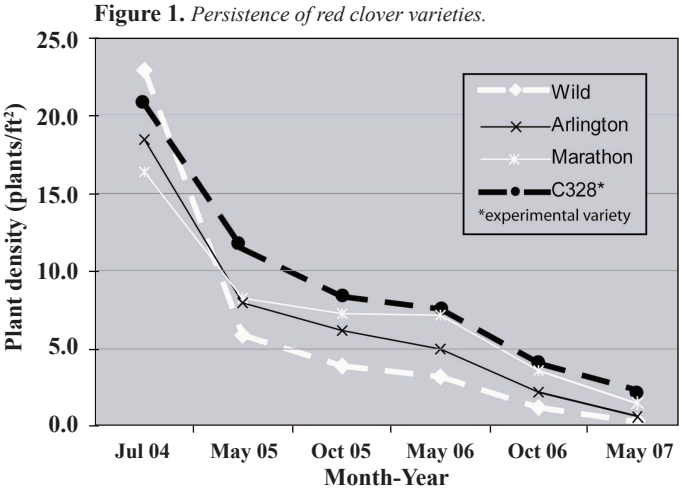
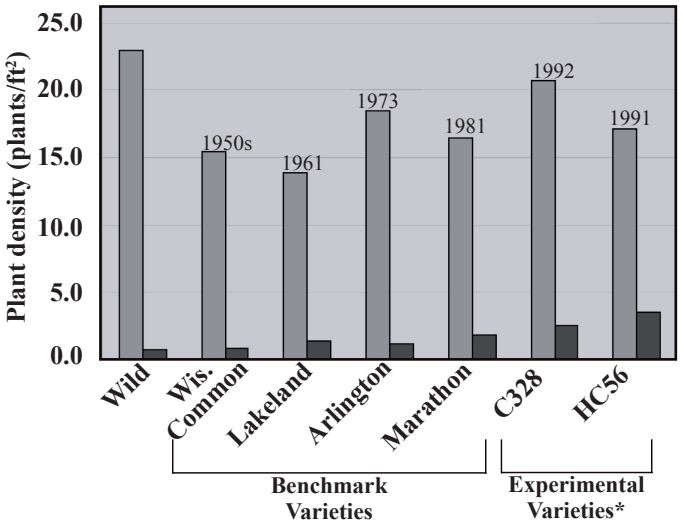


Figure 2. *Persistence of red clover (plant density) as measured from establishment (July 2004) to 37 months later (May 2007).*



**Under development at USDFRC; may be available in future.*

Conclusions:

- Persistence of modern compared to historic Wisconsin benchmark varieties used in the last 50 years has increased (Figures 1 and 2).
- Among modern versus older red clover varieties in general, no increase in persistence is observed; this indicates that relying on newer red clover varieties alone to increase grazing tolerance is not enough; one must look for newer varieties with a measurable improvement.
- Varieties currently under development at the USDFRC generally show an even greater increase in persistence than recent benchmark varieties.
- Achieving good stand establishment will lead to increased stand persistence in the short and medium term, and improved establishment can be achieved by choosing modern varieties that have been improved over the past 50 years.

Kura clover *(Trifolium ambiguum M. Bieb.)* is somewhat opposite of red clover. It is very difficult to establish; but once it is established, it is almost indestructible, making it ideal for permanent pastures; thus, it was the chosen species to focus on in collaboration with agronomist Ken Albrecht of the University of Wisconsin. Research goals include improving kura clover establishment and yield.

In a joint effort between the USDFRC and the University of Wisconsin (Ken Albrecht), an experimental variety of kura clover named 'Kura1' was publicly released. Selection for improved kura clover varieties out of Kura1 are currently in progress. During Fall 2007 a Kura1 derived family that had good establishment vigor, spreading ability, and DM production (Table 1) was

discovered. Initial seed increases of this family will occur over the next two years. An improved kura clover variety could be available to farmers within the next five years.

In 2005, seed mixture trials were initiated at two Wisconsin locations to see if farmers could blend kura clover and red clover for a more consistent legume-grass ratio over the life of a pasture stand. The thought is that the red clover, which is easy to establish, could provide the pasture with legumes for the first few years while the kura clover slowly establishes; then after a few years the kura clover would be well established as the red clover starts to die off. No results are available from these trials to date.

Birdsfoot trefoil 'WITT' *(Lotus corniculatus L.)* is a variety developed by Richard Smith (now retired) of the USDFRC, that has recently received new interest; plant variety protection is pending. The variety should soon enter seed production, with seed possibly being commercially available in 2009 or 2010. WITT has been selected for increased persistence and shows increased persistence in Wisconsin variety trials during the third year of stand compared to varieties Leo, Viking, and Norcen (Figure 3).

Figure 3. *Persistence of WITT birdsfoot trefoil as compared to 3 other varieties.*

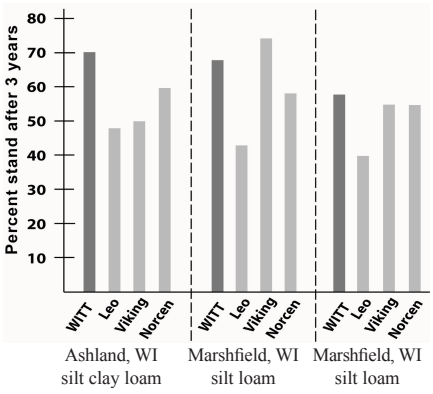


Table 1. *Forage DM yield of 'Kura1' germplasm compared with 3 other kura clover populations, one red clover, and one alfalfa. Trial planted in April 2005 at Arlington, WI and harvested during 2005, 2006, and 2007.*

Population	2005 Total	2006 Total	2007 Total	Trial Total
	-----Mg ha $^{-1}$-----			
'Genoa'‡	5.1	12.5	8.0	20.5
'C328'Δ	6.0	10.8	5.8	16.5
'Kura 1'	3.5	9.8	5.5	15.3
'Endura'	3.2	9.3	4.7	14.1
'Cossak'	3.4	8.5	4.9	13.4
'Rhizo'	2.6	7.7	4.3	12.0
LSD (p<0.05)	0.7	1.1	0.6	1.4
CV	12.8	8.4	8.5	6.5

‡ *Alfalfa variety (Medicago sativa)*

Δ *Red clover experimental population (Trifolium pratense)*

Frost seeding is a popular way to reestablish legumes into pastures without turning the soil. However, in Wisconsin, there is complete failure about 30% of the time. The USDFRC is in the early stages of research that attempts to find solutions to this problem. In one study it is being determined if there is a genetic variation related to the success rate of frost seeding. If genetic variation is found, a selection program for frost-seeded establishment will begin.

The use of near infrared spectroscopy (NIRS) scans of seed is being explored to determine if the NIRS spectra correlate to establishment success. If sufficient correlation is found, it would enable NIRS to be used as a rapid method for selecting seed. Red clover seed will be the first candidate since it is easy to establish and is used for frost seeding. If the process works well, the technology will be transfered to kura clover and birdsfoot trefoil which are more difficult to establish.