Finding a cost effective, persistent legume for Wisconsin pastures

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Is there a legume that establishes and yields well, persists and is cost effective? Through on-farm research, Wisconsin beef grazier Jim Munsch set out to answer this important question on his Deer Run Farm.

Following a three-year study and two additional years of observation, Munsch was able to establish lush stands of Kopu II white clover with endophyte-free, soft-leaf tall fescue through both frost seeding and pasture renovation. Persistence has improved compared to the red clover he usually has to reseed every three years: white clover has persisted for five years so far in his certified organic pastures. The favorable yields and persistence of this improved white clover variety make it a cost effective alternative to red clover. Nonetheless, farmers should investigate the performance of varieties in their area because UW-Madison research has shown large differences in persistence and yield for white clover varieties.

Finding a persistent legume was a priority for Munsch. Because legumes fix atmospheric nitrogen, they are important for organic farmers with limited nitrogen fertilizer options and of interest to non-organic farmers facing high fertilizer prices. Legumes are also desirable to improve the nutrient intake of ruminants on pasture. Legumes generally have a higher concentration of crude protein and minerals and greater digestibility than grasses. In addition, total dry matter yield of mixed grass and legume pasture is generally higher than a grass pasture. Overall feed values hold better through the grazing season when pastures include legumes.

Munsch's farm is located in the Driftless Region of southwestern Wisconsin. He runs cow-calf pairs on pasture stands that are 15 to 25 years old and have been in managed grazing that entire time.

Munsch participated in a 2005-08 USDA-CSREES funded study conducted by UW-Madison faculty Jeff Lehmkuhler of Animal Science and Ken Albrecht of Agronomy (see Research Brief #76). It compared pastures seeded with orchardgrass, tall fescue and soft-leaf tall fescue alone and with Kopu II white clover and kura clover. (Kura is not a red or white clover, but is a distinct species.) Munsch is extending this research on his farm through 2011 with support from the Grazing Lands Conservation Initiative (GLCI).

Deer Run Farm pasture treatments

In 2005, Munsch selected two paddocks that had been grazed heavily the previous year, and frost seeded one with kura clover and the other with Kopu II white clover. Two additional paddocks were renovated through minimum tillage with a disk, leaving about 30 percent cover from existing stands of orchardgrass, meadow fescue, Kentucky bluegrass, timothy, red clover and some alfalfa. The renovated paddocks were hand seeded with soft-leaf tall fescue and either kura clover or white clover; this was followed by dragging. One control paddock remained in Munsch's regular management program of reseeding red clover every three years to provide a comparison to the treated pastures. Frost seeded and control paddocks were grazed five times in the establishment year and renovated paddocks three times. All five paddocks were adjacent to each other and had similar soil nutrient levels, and no soil nutrient additives were made. Data collection started the following year.

Pasture samples were clipped to a three-inch residual just prior to grazing the paddock. Samples were dried in a dehydrator on the farm to calculate true dry matter and pounds of dry matter yield per acre.They were then sent to the Marshfield Ag Research Station forage lab for nutrient analysis. Yield was measured as forage available—feed consumed and animal weight gain were not measured. It was assumed that consumption versus waste was the same for all paddocks and thus consumption was proportional to yield.

Findings

Forage yields improved significantly in both the frost seeded and renovated white clover paddocks compared to the control paddock, and the white clover was persistent. From 2006 to 2008, the renovated paddock with white clover produced 21 percent more forage than the control paddock, while the frost seeded paddock with white clover had 15 percent higher yields than the control paddock. After the third year, stand vigor of the frost seeded white clover paddocks equaled that of renovated paddocks.

Both paddocks with kura clover yielded less forage than the control paddock. Munsch said, "It was clear from observation that the white clover established

Kopu II white clover performed well in pastures on Munsch's farm.

Cost comparison of paddocks: control, frost seeded white clover and renovated white clover	Control paddock	Frost Seeded Kopu II white clover	Renovated Kopu II white clover + soft-leaf tall fescue
Establishment cost/acre	$17.00	$36.50	$69.00
Establishment cost amortized over three years/acre	$5.67	$12.17	$23.00
Average pasture cost/acre-whole farm	$61.33	$61.33	$61.33
Total annual cost over 3 years/acre	$67.00	$73.50	$84.33
Average annual yield (lbs/acre)	5,030	5,770	6,100
Cost per ton of available forage per year over three years ($/ton)	$26.64	$25.48	$27.64

easily, while the kura clover was almost non-existent from frost seeding and had poor establishment with renovation." These results confirm other observations that kura clover is very sensitive to competition from existing vegetation during establishment. Some colonies of kura in the renovated paddock persisted and grew slowly. Both clovers performed poorly in extremely dry conditions, but they survived.

The effects of the soft-leaf tall fescue planted in the renovated paddocks were unknown. It was difficult to determine whether the stands of fescue in these paddocks were seeded or pre-existing meadow fescue.

Over the three-year period, the renovated white clover paddock produced 900 pounds per acre more crude protein than the control paddock, and the white clover frost seeded paddock produced an additional 600 pounds per acre. White clover pastures had slightly higher crude protein concentrations and digestibility percentages than the control paddock, but these were not statistically significant. The increased yield of crude protein was principally due to increased forage yield.

Cost effectiveness

Munsch compared the yields and establishment costs of the renovated and frost-seeded white clover paddocks to the control paddock. From a solely agronomic perspective, he found that over the original three-year study period, the costs per ton of forage in the white clover and control paddocks were similar. Forage in the renovated white clover paddock cost slightly more per ton than forage from the control paddock, and frost seeded white clover cost slightly less (see table). Munsch uses an enterprise costing system that accounts for all actual expenditures (direct and overhead), depreciation, an assumed labor cost of $14/hour and land charges based on a four percent return on appraised values, plus taxes. The cost of his regular pasture management (reflected in the control paddock) averaged $67/acre across the farm for the three years of the study. This includes the cost of frost seeding red clover every three years.

However, the 15 to 21 percent yield increase in the white clover paddocks over the control paddock translates into increased carrying capacity. This means that, each year, 15 to 21 percent more animals can be supported by the same land, or the increased yield can be harvested as winter feed or stockpiled to extend the grazing season. If used as stockpiled feed to extend the grazing season, for example, the cost of the available forage—$25 to $28 per ton of dry matter—translates to $33 to $37 per ton or $50 to $56 per ton dry matter consumed, assuming a harvest efficiency of either 75 or 50 percent, respectively. More trampling of the forage stand would occur in a paddock with taller stands than in one with shorter stands, which would result in the lower harvest efficiency of 50 percent. Compared to average non-alfalfa hay prices of $70 per ton reported for January-February of 2011 in Wisconsin, this represents a cost savings.

In addition, grazing stockpiled feed has lower labor, facility and machinery costs compared to hay feeding. When this is taken into consideration, Munsch says "… it was advantageous to add an improved white clover like Kopu II … it adds forage yield at a cost that is competitive with other methods of maintaining legumes and grasses in our pastures." Munsch particularly likes the renovation method of establishment—it allows him to adjust the grass component of his pastures better than frost seeding.

In addition, the white clover has persisted five years after seeding, with these paddocks continuing to yield more than the control paddocks. Lower maintenance costs and higher yields over time would further lower the cost per ton. While these results are specific to one farm, they look promising for other farmers looking for alternatives to nitrogen fertilizer for their pastures.

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