

## **Forage quality characteristics of barley irrigated with coalbed methane discharge water.**

A. L. Todd, S.D. Cash, L.M.M. Surber, B.L. Robinson, J.W. Bauder, and J.A. Pugh  
Montana State University, Bozeman, MT.

Livestock producers in southeastern Montana are dependent upon range use, irrigated hay production, and purchased hay. Production and quality of available range and hay production is reliant upon the climate (rainfall and temperatures) and available water for irrigation. Needs of livestock producers in southeastern Montana are not met with locally produced forage alone. Increased supplies of irrigation water of adequate quality and quantity could significantly increase forage production in southeastern Montana. Coalbed methane (CBM) discharge water could potentially meet this need.

Since CBM water is known to be high in salts and sodium (Na), consideration must be given to the potential effects on plant growth and forage quality (protein, fiber, and vitamin and mineral concentrations). The effect salinity will have on livestock performance is dependant upon water quality, species, breed, and age, physiological status, salt content of diet, and season. Salinity in the CBM water could not only alter salinity levels in the plants but in the available water sources for livestock. Animals do have the ability to adapt to saline water but abrupt changes from low salt concentrations to high salt concentrations will cause harm (Lardy, Stoltenow, 1999).

Much is known about the adaptation and production potential of different forages. However, very little is known about the impact of salt or sodicity on forage quality. Forage quality consists of protein, fiber, and vitamin and mineral concentrations. Livestock performance depends upon these nutrients and forage quality is generally measured against said performance such as growth or gain and reproductive efficiency. Usually species, stage of maturity at harvest, and growing conditions will determine the concentrations of these nutrients (Blunt, 2001). Suleiman et al. (1999) found that forages grown on saline affected sites had varying yields and reduced quality as well as trace mineral imbalances. Overall Ca levels declined with advanced grass maturity but maintained a level to meet requirements. Phosphorus (P) levels varied among species, none of them having levels high enough to meet requirements therefore requiring supplementation. Montana has such a wide variety of soil chemistry and characteristics that nutrient concentrations can vary widely across the state, particularly with minerals.

Since barley has proven to be adapted to saline conditions it could efficiently be used as a model to measure the effects of CBM water. Salt tolerant barley that is grown as forage can be a very useful tool in managing salinity while benefiting cattle production at the same time (Dadshani et al, 2004). Hay barley is a significant source of winter feed for livestock producers in Montana. It can be an inexpensive feed source with high yield. Barley has been shown to have equal or higher nutritive value and lower fiber concentrations than many other small grains. Livestock producers in Montana currently utilize irrigated annual barley hay for winter feed.

Limited data is available on the effects of CBM water on forage quality for beef cattle. The objectives of this research are to evaluate the effects of CBM water on forage yield, quality (protein, energy, fiber), and mineral concentrations of forage barley in relation to livestock requirements. If forage quality and mineral concentrations are not negatively impacted by CBM it would allow for continued use of CBM water as an irrigation source for livestock producers in south eastern Montana.

An elaborate greenhouse arrangement for CBM research has been established at MSU by Dr. Bauder's program. Two 20 x 50 greenhouses were erected in 2003. Prior to installation of the greenhouses, topsoil was removed to roughly 48 inches, the beds were lined, and soil closely matching the texture, EC, and sodium levels of soil in the Powder River drainage in Southeastern Montana were put into each greenhouse. Irrigation systems were installed and each greenhouse received either CBM or well water.

In 2004, 14 barley cultivars were irrigated with CBM water and well water. Barley lines were grown near Montana State University, Bozeman. All 14 varieties were grown in replicated ( $r=3$ ) plots under two greenhouses. Each greenhouse received one of the two water treatments. Sample clippings were taken at three stages of maturity (Early, Mid, Harvest), dried, ground to pass through a 1mm screen, and analyzed for dry matter (DM), nitrogen (N), nitrate ( $\text{NO}_3\text{-N}$ ) (AOAC, 2000), neutral detergent fiber (NDF), and acid detergent fiber (ADF) (Van Soest et al., 1991). Plot served as the experimental unit in the complete block designed experiment.

2004 results are considered preliminary. Mid yields were lower ( $P < 0.01$ ) for CBM forages than well forages 2.79 tons DM/A vs. 3.4 tons DM/A). Harvest yields were also lower ( $P < 0.01$ ) in CBM forages than well (3.27 tons DM/A vs. 3.82 tons DM/A). Nitrate levels were lower ( $P < 0.01$ ) in CBM forages than well forages at harvest stage of maturity (0.04 vs. 0.41%, respectively). Neutral detergent fiber values were higher ( $P < 0.01$ ) for well forages than CBM at harvest stage (62 vs. 58%, respectively). At the harvest stage ADF values were higher ( $P < 0.01$ ) for well forages than CBM forages. Crude protein levels were lower ( $P < 0.01$ ) at harvest stage in CBM forages than well (7.5 vs. 14.5 %, respectively).

Nitrate accumulation is a risk for barley and other cereal forages, particularly when grown under stressful conditions. In 2004, despite forage yield and protein reductions by CBM irrigation,  $\text{NO}_3\text{-N}$  and fiber levels were actually better under CBM irrigation. These results are preliminary and only after further testing will be able to confirm the value of CBM-irrigated forages with regards to beef cattle requirements.

### **Literature Cited**

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