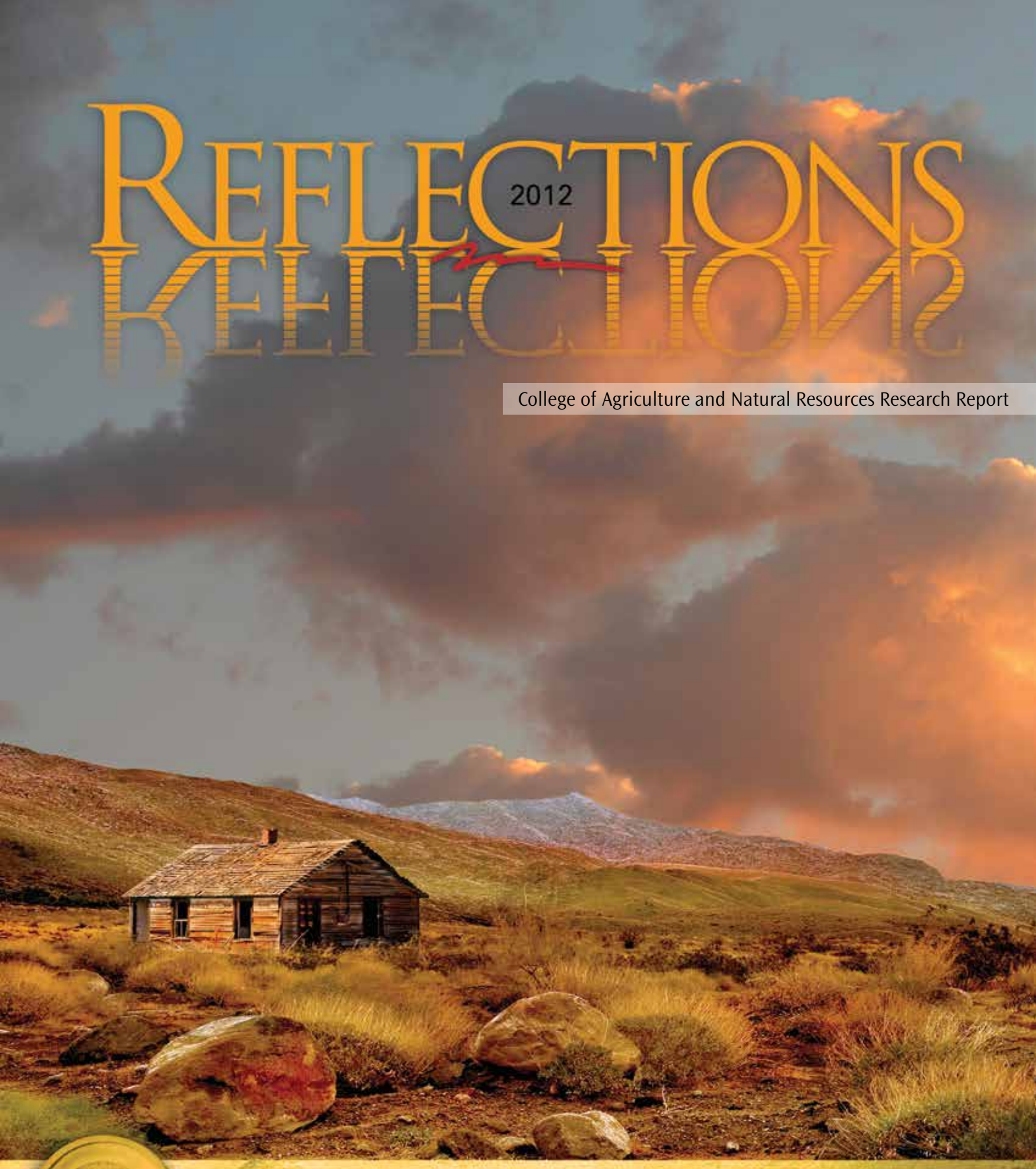
Reflections 2012

College of Agriculture and Natural Resources Research Report



University of Wyoming

College of Agriculture and Natural Resources

The theme "Wyoming is our laboratory" is perfectly suitable for a magazine published by the University of Wyoming College of Agriculture and Natural Resources. Since its inception, the Wyoming Agricultural Experiment Station has conducted applied and basic research to help solve problems that affect the agricultural sector and communities of Wyoming. The University of Wyoming Extension has had a similar standing commitment to providing lifelong learning opportunities to the citizens of Wyoming.

Wyoming is our laboratory exudes a connotation self-evident to members of the college. Researchers and educators work closely with the people of Wyoming to apply the land-grant principles of learning, engagement, and discovery. With personnel in every county and with research and extension centers strategically located across the state, the College of Agriculture and Natural Resources provides research and outreach responsive to the needs of stakeholders throughout Wyoming. This issue of *Reflections* is another classic example of the college's commitment to providing relevant outcomes through the use of Wyoming as our laboratory.

Associate Dean Bret Hess

Readers of *Reflections* will learn about how members of the college utilize resources of Wyoming as their laboratory as authors describe projects and programs geared toward improving the lives and livelihoods of Wyomingites. The magazine's authors explain how Wyoming's intensively managed land and water plus its extensively managed rangeland provide critical resources to support the state's livestock. The state's livestock return nutrients that may then be used for growing local foods. Scientists are studying the forage and grain potential of small grains for Wyoming producers and if lupins could be a potential crop to replace fallow in wheat/fallow rotations. Education on local food topics to better the health of Wyoming residents and research on the benefits of breast-feeding – with results affecting not only Wyoming residents but people around the world – are additional examples of how members of the college are engaging the people of Wyoming in outreach and research.

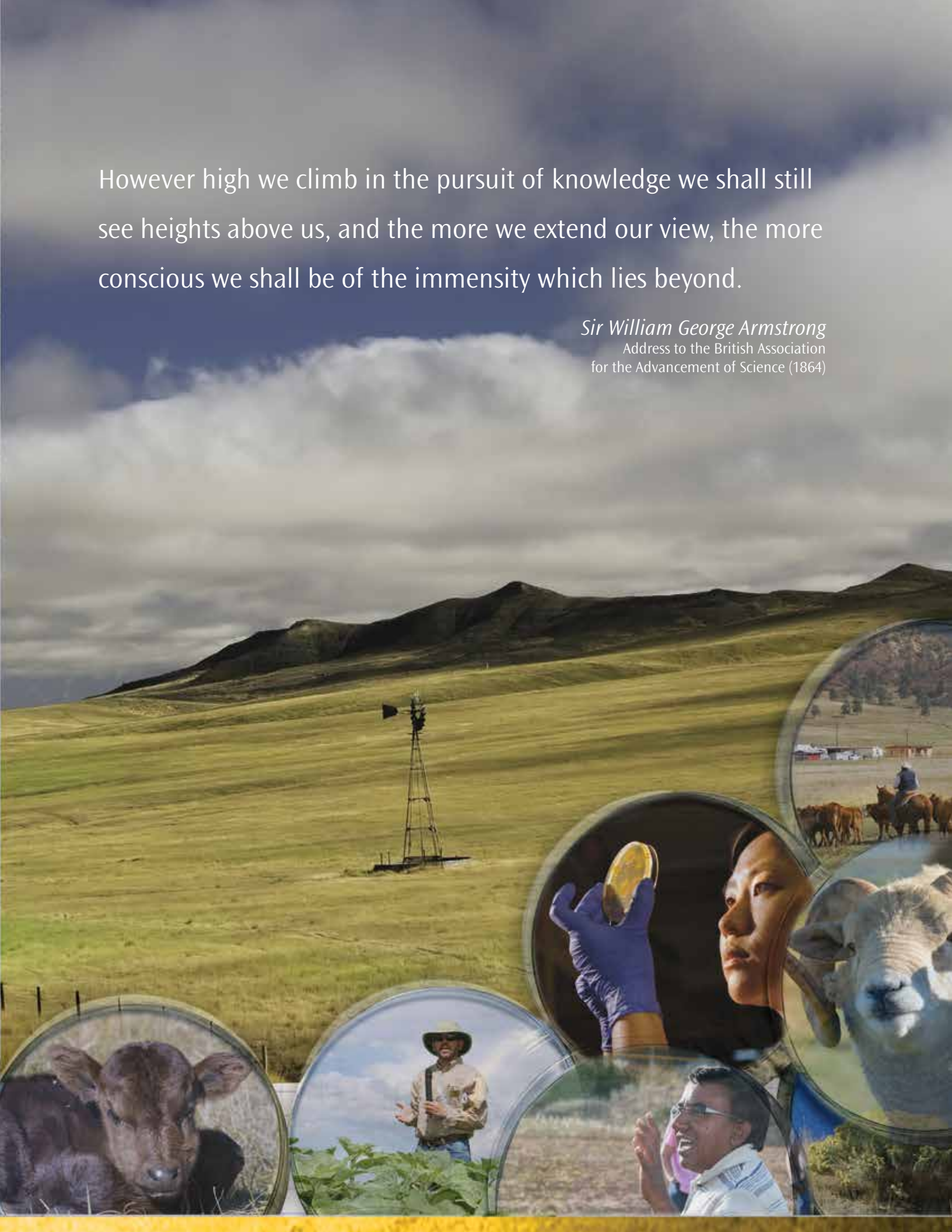
I sincerely hope you enjoy reading about how our college's researchers and educators have adopted the phrase "Wyoming is our laboratory" as common practice in their work.

As always, we welcome your input. Please feel free to contact me with your comments, suggestions, and questions at (307) 766-3667 or aes@uwyo.edu.

Best regards,

Bret W. Hess
Associate Dean for Research and Director of the
Wyoming Agricultural Experiment Station

WYOMING IS OUR LABORATORY

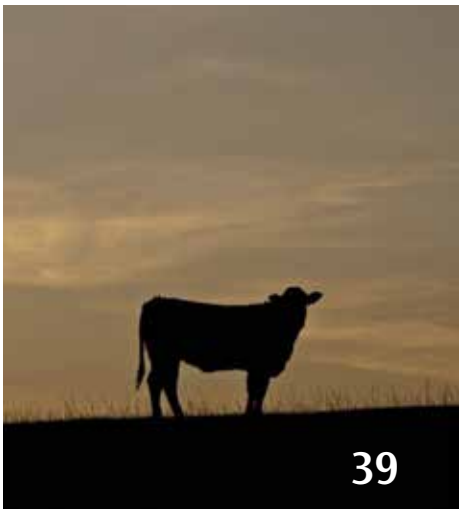


However high we climb in the pursuit of knowledge we shall still see heights above us, and the more we extend our view, the more conscious we shall be of the immensity which lies beyond.

Sir William George Armstrong
Address to the British Association
for the Advancement of Science (1864)

contents

REFLECTIONS



Selected as the
Reflections 2012 top story

Scientists explore benefits arising from WEANING, CORNSTALKS, and CATTLE FEEDING OPTIONS

This research suggests profitable alternatives may exist that reduce dependency on high-priced corn for cattle feeding while maintaining high-quality beef products for consumers.

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biofuel production and the resulting higher corn prices mean less profits for cattle feeders. That also translates into less potential profits for cow-calf producers who retain ownership of calves into feedlots.

Calf prices are strong now but increased feeder cattle supplies could also translate into lower prices to cow-calf producers as feeders attempt to reduce overall feeding costs. All this means traditional cattle feeding practices need to change.

Previous animal science research suggests placing feeder cattle on high-quality grain diets early in life can increase carcass quality by causing some cells to turn to marbling in the muscle, even if placed on lower nutritional feeds later in life. Animal science research also indicates weaning calves at 120 days and feeding until about 205 days provides an excellent window for nutritional management to improve marbling. Such research points to the possibility of alternative weaning dates coupled with feeding less corn as a way to potentially reduce feeding costs while maintaining carcass quality.

Researchers in the Departments of Animal Science and Agricultural and Applied Economics received a grant from a five-state ruminant grant consortium to investigate this critical issue. The research investigated feeding corn-based

diets to early-weaned calves followed by a period of slow growth that allowed for "compensatory" skeletal growth. Researchers wanted to determine if this alternative approach could create equivalent-sized market cattle with higher quality grades but at lower feeding costs.

Test Four Alternatives

Four alternative management and feeding strategies were tested at the University of Wyoming's James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle. Researchers then analyzed the economic outcomes using simulations of different input and output prices for the following:

1) Early wean, graze on cornstalks followed by a short feeding program (EWCS),
2) Early wean with regular or traditional feeding program (EWF),
3) October wean, then graze cornstalks before a short feeding program (OWCS), and
4) October wean followed by a traditional feeding program (OWF).

Should Cow-calf Producers Change Weaning Dates?

If a producer plans to sell a calf at weaning, is early weaning (EW) or normal October weaning (OW) more profitable?

Results from this research indicate normal October weaning is more profitable for the cow-calf producer (see Table 1, page 8). The improvement in returns over variable costs was more than $160 per head for weaning in October as compared to early weaning (assuming 180 calves sold from a 200-head herd). This is largely due to lower weights for calves weaned in July as opposed to October. Even though the lighter-weight calves are worth more per pound at the sale barn, the lighter sale weight reduces returns overall. These results suggest if cow-calf producers do not plan to retain their calves, they should wean as they normally would in the fall.

If You Are a Feeder, Are Any of These Alternatives Attractive?

With cow/calf producers preferring the typical October weaning date, determining if this strategy is also preferred for feeders who buy these calves is important. Table 1 reports "feeding profitability" across the alternative

(Photo by Kelly Greenwald)

Upper left, cattle in a feed trial using the GrowSafe system at the James C. Hageman Sustainable Agriculture Research and Extension Center near Lingle. GrowSafe feed intake systems are a series of feed bunks electronically linked to a computer and

feeding and weaning options analyzed. Table 1 reveals the differences among the "feeding profitability" (profitability of just the feeding stage) in all four treatments when in an operation such as a feedlot. Mean profit is greatest for early weaning cornstalk-short fed (EWCS) at $8,483 for 90 steers. The next highest average profit of $4,494 occurs for the early wean – traditional fed (EWF) strategy. The least profitable strategy is the October wean traditional fed strategy (OWF). This suggests feedlot operations should prefer early weaned calves overall.

Table1. Returns over variable costs (ROVC) for early weaning versus October weaning and estimated profits for feeding calves after weaning across management alternatives

Scenario	Mean ($)	Standard Deviation ($)
Comparing Early versus October Weaning and Sell Calves		
ROVC Early Wean	-21,440.86[a]	10,668.53
ROVC October Wean	10,384.68[b]	16,251.14
Comparing Alternative Management Strategies for Feeding Calves		
Feeding Profit EWCS	8,483.60[a]	19,525.48
Feeding Profit EWF	4,494.00[b]	21,186.50
Feeding Profit OWCS	641.80[c]	17,675.90
Feeding Profit OWF	-4,718.10[d]	18,006.80

Note: Means with a different superscript letter indicate a statistically significant difference at the five percent level. EWCS - Early wean, graze on cornstalks; EWF - Early wean with regular or traditional feeding; OWCS - October wean, then graze cornstalks before a short feeding; OWF - October wean followed by a traditional feeding.

What Should Cow-calf Producers Do if They Want to Retain Ownership?

If a cow-calf producer were interested in retaining ownership of their steer calves, total profitability from birth to slaughter suggests different results than those reported in Table 1. Results indicate cow-calf producers should wean in October and then use the cornstalk alternative. There is nearly a $260 per head advantage for this alternative as compared to early weaning with cornstalks. This is largely due to the opportunity cost of the calf for the producer and total days on feed.

An early-weaned calf means fewer pounds to sell, and so the producer gives up that potential income for an early-weaned calf as compared to an October-weaned calf. This is coupled with total feeding costs over the life of the calf once weaned. The producer who weans the calf early would then have added costs of feeding as compared to an October-weaned calf. Thus, the producer who retains ownership is better off to wean in October and use cornstalks coupled with short feeding of corn.

Summary

Overall, these results suggest potential merits for feeding concentrates during critical life stages and utilizing cheaper feedstuffs

software system that continuously monitors feed present in the bunk. Each bunk is restricted to one animal at a time. Each time an animal enters a bunk, its electronic ID tag, the feed consumed, and the time spent at the bunk is recorded.

such as grazing residue. This would likely be most attractive to those feedlots able to buy early-weaned calves. Early-weaned calves may be attractive to feedlots from a profitability standpoint, but our results suggest cow-calf producers will generally have improved profitability with normal weaning strategies.

If feedlots want to attract earlier-weaned calves, they will have to pay premium prices to cow-calf producers. While the calves in our experiments did not show differences from a carcass quality standpoint, if further studies found such differences, potential premium prices for earlier-weaned calves could improve profits from retained ownership and the overall attractiveness of early-weaned calves.

This research suggests that profitable alternatives may exist that reduce dependency on high-priced corn for cattle feeding while maintaining high-quality beef products for consumers. While this reports only one year of data, it does suggest more research is warranted as the beef industry struggles to deal with high corn prices. ●

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Overall, these results suggest potential merits for feeding concentrates during critical life stages and utilizing cheaper feedstuffs such as grazing residue.

Ana Barbir and son, Thomas, were participants in research examining the compositional changes in human milk across single feedings.

Selected as the *Reflections* 2012 second-place story

The MAGIC of human milk

These results highlight the magical obesity-protective effects of human milk and serve as a reminder our continued research is important to human health well beyond infancy.

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Assistant Professor
Department of Animal Science

Human milk is the ideal food for the human infant.

It contains the right proportion of protein, carbohydrates, fat, vitamins, and minerals a baby needs. It is also rich in antibodies that protect babies from illnesses and reduce the immediate risk for ear infection, diarrhea, and lower-respiratory tract infection. Breast milk also reduces risk of chronic illness including asthma, diabetes, and obesity in childhood and later in life.

One magical aspect of human milk is that its composition changes in the mother as the human infant grows and develops. Scientists have known for some time that certain nutrients, such as protein and sugar lactose, change as the baby grows and that other components – particularly the fat content – change across a single feeding. The milk produced as the baby starts to nurse, termed **foremilk**, is much like skim or 2 % milk, but changes to a much richer cream by the end of feeding, called **hindmilk**. The dynamic change in the fat composition of the milk is thought to serve as a satiety signal, i.e., signaling the baby he/she is full.

Can Human Milk Regulate Appetite?

With the increased prevalence of childhood obesity, scientists have been increasingly interested in whether human milk contains obesity-protective components or hormones, which aid in short- and long-term appetite regulation or body weight control. Clinical researchers have found, for example, that exclusively breastfed babies consume fewer calories than babies given infant formula and are leaner at 8 to 11 months of age. Additional studies have found those who were breastfed weigh less as teenagers – on average, 13 pounds at the age of 14 – and are 25 percent less likely to be overweight/obese adults than their formula-fed counterparts.

Our work in the nutrition and exercise laboratory (supported by an INBRE [Wyoming IDeA Networks for Biomedical Excellence] grant from the National Center for Research Resources) in the College of Agriculture and Natural Resources has focused on identifying appetite-regulating hormones in breast milk. These include the hormone leptin, which plays a key role in regulating long-term

energy balance, and the gut peptides glucagon like peptide-1 (GLP-1) and peptide YY (PYY), which induce satiety and signal meal termination. These hormones interact with appetite centers in the brain to control satiety.

In addition to determining whether these hormones are present in human milk, we have also been interested in whether they change across a single feeding along with milk fat. Based on what is known about the obesity-protective effect of breastfeeding, we hypothesized these hormones would increase in concentration as a mother nurses her infant and be higher in hindmilk compared to foremilk. Increasing concentrations of these satiety hormones would potentially serve as a satiety signal preventing over-consumption.

Analyze Milk Fat Content

To date, we have collected breast milk samples from 15 first-time mothers at four-weeks postpartum. The mothers come to the laboratory during their normal morning feeding time and donate samples of both foremilk and hindmilk. A 1-ounce sample of foremilk is first collected using a breast pump. A mother nurses her infant for six to 10 minutes from the same breast and then pumps a similar volume sample of hindmilk.

Centrifugation forces fat in the milk to rise to the top.

Kathy Austin, a researcher in the Department of Animal Science but helping with the research in the nutrition and exercise laboratory, displays the test size of a sample of milk.

Milk fat content is immediately analyzed by centrifugation, which forces the fat in milk to rise to the top of the sample tube – the way cream rises to the top of non-homogenized milk (see photo lower left). The volume of fat is measured and removed. The remaining fat-free sample is frozen for later analysis of appetite-regulating hormones. The mothers are asked to return at six-months and 1-year postpartum to provide additional fore- and hindmilk samples, which allows us to measure how these hormones change as the infant grows.

Preliminary results from samples collected four weeks after delivery suggest human milk is even more magical than suspected.

First, all three satiety hormones – PYY, GLP-1 and leptin – are present in human milk. GLP-1 increases during individual feedings and is, on average, 31-percent higher in hindmilk compared to foremilk (Figure 1, page 13). PYY and leptin, however, do not change during feeding and are quite constant in content between foremilk and hindmilk.

Second, and in agreement with other laboratories, the leptin content of milk is dependent on maternal adiposity such that mothers with a higher body mass index (and higher body fat) produce milk that is higher in leptin (Figure 2, page 13).

May Regulate Energy Consumption

These preliminary findings offer a reasonable explanation for a protective effect of breastfeeding on obesity prevention, particularly in infants born to overweight or obese mothers. The dynamic changes in both milk fat and the appetite-suppressing hormone GLP-1 may act to regulate energy consumption during nursing and may be particularly important as the infant develops his/her own appetite-regulating circuits. Research in animal and human models has suggested appetite-regulating hormones are able to escape digestion (similar to immunoglobulins), enter the infant's circulation, and serve as appetite-regulating signals. This may be one way in which these active peptides help infants control energy intake and excess weight gain over the short-term.

A higher concentration of leptin may be an early advantage to the breastfed infant born to an overweight or obese mother by serving as an internal appetite-regulating cue, which helps maintain energy balance.

Infants born to overweight mothers are particularly prone to obesity later in life, which may be caused by a genetic predisposition and/or learned behaviors including physical inactivity and poor eating habits. Exposure to higher concentrations of leptin and

other appetite signals in human milk, however, may help breastfed infants overcome a genetic predisposition toward overweight and obesity by influencing the appetite-regulating circuits in the brain. A supporting study in rats found that pups treated with leptin in concentrations similar to that in milk had lower body mass and body adiposity at six months when compared to untreated pups.

Target to Increase Proportion Breastfeeding

The Healthy People 2020 (http://1.usa.gov/ihF9tJ) targets are aimed to increase the proportion of women initiating breastfeeding from 74 percent to 82 percent and increase the proportion of those mothers who continue to breastfeed at six months and one year from roughly 44 percent and 28 percent, respectively, to 61 percent and 34 percent.

Our results are of particular significance within the state of Wyoming, which exceeds the Healthy People 2020 objective for breastfeeding initiation, with 83.1 percent of mothers initiating breastfeeding, but falls short of the six-month and one-year objectives with 48.2 percent and 21.4 percent, respectively, continuing to breastfeed.

Knowledge of our findings may be helpful to mothers, in their decisions to initiate or continue breastfeeding, and healthcare providers, in their efforts to promote and support breastfeeding in the state. ●

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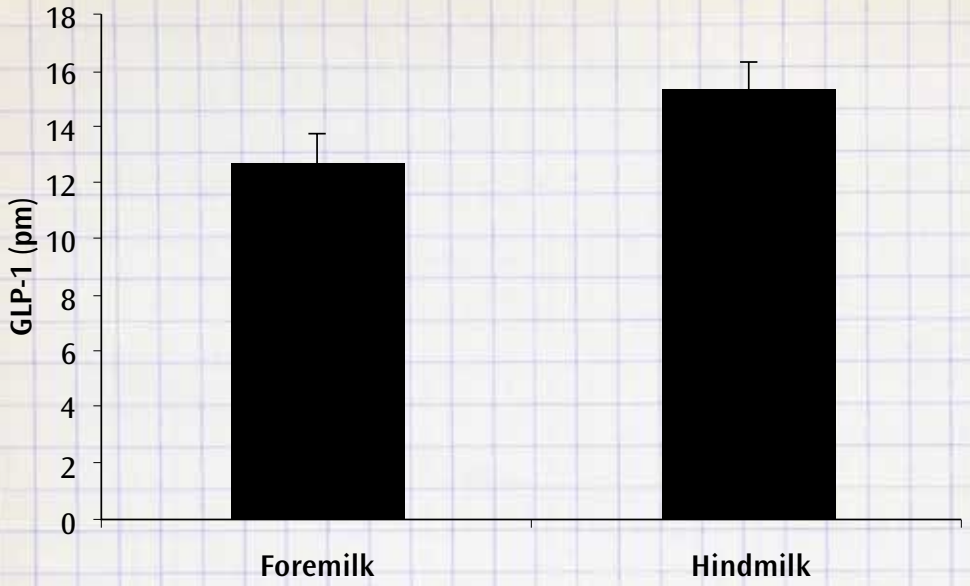

FIGURE 1. Concentration of GLP-1 in foremilk and hindmilk measured one month after delivery. There was a statistically significant increase in the concentration of milk GLP-1 from foremilk to hindmilk.

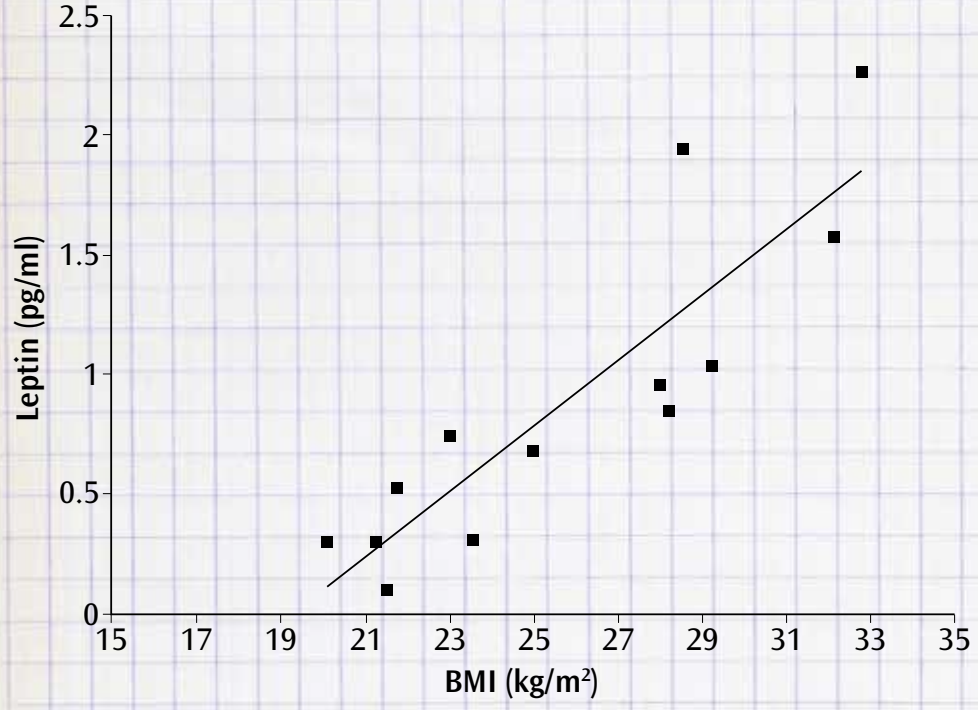

FIGURE 2. Concentration of leptin in foremilk compared to maternal body mass index (BMI) measured one month after delivery. There was a significant positive relationship between maternal BMI and foremilk leptin (r=0.85, p<0.001). A similar correlation was observed between maternal BMI and hindmilk leptin (r=0.78, p=0.002); data not shown).

Department graduate, now mother, participates in research with daughter

A family and consumer sciences graduate was excited to participate in the research. Stacy Berger received her degree with an emphasis in dietetics in 2010 and now lives on the family ranch north of Laramie with her husband, Kyle, and daughter, Bayla Rae Berger, born December 3, 2011.

She had heard about the research through Professor Larson-Meyer and had observed posters in the ag building and at women's clinics while pregnant. "What really interested me was studying the nutrient content of breast milk and how it changes in foremilk and hindmilk and how the hormones would change when breastfeeding," notes Berger.

Mothers are tested at four weeks, six months, and one year postpartum. In addition to breast milk samples, blood tests were taken during the first visit. During subsequent visits, blood tests, height, and weight were taken.

"The first appointment after I had Bayla, I came into the lab fasting, and they had provided food for me to eat," she says. "I could eat whichever food I wanted and the amount that I wanted to eat. They kept records on what I ate and how much I ate. It was really interesting."

In addition to the other tests, participants take the VO_2 test on a treadmill at the last appointment. The test measures maximum oxygen uptake, a measure of aerobic fitness.

"I had to run on the treadmill until I could not run anymore," says Berger. "I was really interested to see how I was able to come down from my post-delivery weight to normal weight."

She was pleased to learn she was in the top shape among participants. "That surprised me, but I had been trying to work out and stay healthy, but I was not able to do as much as I wanted," she notes. "I would also like to add that I really enjoyed working with all of the people who conducted the research. They were all very professional and kind. It was an honor to participate in research that will help mothers and the healthcare community in the future."

First harvest of green peppers from the high tunnel.

(Photo July 29, 2011)

Getting the most vegetables per acre, ensuring continuing soil quality requires

INTEGRATED NUTRIENT MANAGEMENT APPROACH

Augustine Obour
Research Scientist

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James. C. Hageman Sustainable Agriculture Research and Extension Center

UW researchers study integrated nutrient management effects on bell peppers under a high tunnel at the James C. Hageman Sustainable Agriculture Research and Extension Center

High tunnels are becoming increasingly important production tools for vegetables and other horticultural crops because they offer a warmer production environment during late fall, winter, and early spring in many colder regions in the United States.

Extending the growing season offers the advantage of starting crops earlier in the spring and harvesting crops later in the fall, which is not possible in open fields. High tunnels, sometimes referred to as hoop houses or unheated greenhouses, may be constructed to be semi-permanent or movable. Temperature and ventilation are controlled by rolling up the sides of the tunnel.

High tunnels typically range from 14 to 34 feet wide and 30 to 96 feet long covered with a single layer of 6-mil greenhouse grade polyethylene sheet. In Wyoming, the cost of building a high tunnel ranges from $560 to $3,500 depending upon size and materials. For instance, building a 16- by 32-foot long high tunnel will cost on average about $1,600.

Compared to open fields, high tunnels provide controlled environments and protect crops from inclement weather, pests, and diseases. There are more than 100 high tunnels in Wyoming built with support from the Wyoming Department of Agriculture, which manages a USDA Specialty Crop Grant program.

Potential benefits include:

1. Lengthening the growing season of vegetable crops
2. Protecting crops from environmental stressors like drought, wind, rainfall, and extreme temperatures
3. Protecting crops from insect and disease outbreaks
4. Providing suitable environments for producing specialty and warm-season vegetable crops
5. Permitting intensive crop production in a small land area

High Tunnel Soil Management

Unlike open fields, crop production in high tunnels is intensive, with crops normally grown on native soils under the tunnel. Therefore, soil quality and fertility management are critical.

Unskinned high tunnel (24 by 72 feet) at SAREC.

Jeff Edwards, left, and Augustine Obour put a single layer of 6-mil greenhouse grade polyethylene sheet on the high tunnel at SAREC.

Coarse or light-textured soils are best for high tunnel production because they will warm quicker in the spring, are easily worked, improve aeration and drainage, and provide a good media for root development. Clays are poorly drained with a tendency to accumulate salts and are the least-desirable soils for high tunnels.

Since perfect soils are difficult to come by, growers will have to make do with what is available, improving with amendments if necessary. For instance, heavy clay soils can be lightened by adding 4 to 6 inches of organic compost worked into the top 8 to 10 inches of the soil. This will improve drainage and increase the ability of the soil to hold oxygen.

Manage fertility in a high tunnel with routine soil tests submitted to a soil testing laboratory. Soil pH, phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), and micronutrients should be tested at least every two or three years. Testing for total soluble salts can help prevent salt buildup.

Applying Nutrients

Vegetable crops remove high amounts of nutrients from the soil. For instance, tomato plants need to absorb 5 to 6 pounds (lbs) N, 0.4 to 0.7 lbs P, and 6 to 7 lbs K to produce 1 ton of fresh fruit. Replacing nutrients is essential to ensure plant growth and maintain yields. Development of management strategies that supply adequate nutrients to meet crop demands while maintaining biological, physical, and chemical properties of soil is critical for long-term sustainability of a high tunnel production system.

For conventional (nonorganic) production, use soluble fertilizers for optimum growth. Common **nitrogen** sources include calcium nitrate, potassium nitrate, and urea-ammonium nitrate. **Phosphorus** sources include monoammonium phosphate and

Agricultural assistant Larry Miller, on tractor, and SAREC director Jim Freeburn fill raised beds inside the high tunnel.

diammonium phosphate. **Potassium** sources include potassium chloride and potassium sulfate.

Synthetic fertilizers are not permitted in organic high tunnel production systems. Instead, composted manure or certified organic sources of nutrients are used.

Applying inorganic fertilizers will increase soil nutrient supply, but this does not improve physical and biological properties of the soil. Nutrient management strategies that combine organic and inorganic sources of plant nutrients will increase crop productivity, prevent soil fertility depletion, and maintain soil quality. This is integrated nutrient management (INM).

Advantages of INM include:

(1) Enhancing soil productivity through increasing soil organic matter and microbial community structure,

(2) Improving soil chemical

Researchers recommend these vegetables for specific seasons

Warm-season vegetables: tomato, pepper, cucumber, eggplant, basil, squash.

Ensuring good ventilation (rolling up sides of structure) and irrigation during summer is very important. Use trellis and cages to provide support.

Cool-season vegetables for autumn and early spring: baby salad greens, cabbage, head lettuce, Asian greens, spinach, chard, carrot, beet, radish, turnip, leek, parsley, cilantro, Chinese cabbage, and pea. Schedule so crops are not planted when soil temperatures are low; most vegetable seeds will not germinate when soil temperatures are below 40 F.

High-value specialty crops: strawberries, raspberries, and cut flowers.

Bell peppers growing in a high tunnel at SAREC. (Photo August 2, 2011)

properties by increasing macro and micronutrient availability,

(3) Improving soil physical properties, such as structure, porosity, and water-holding capacity, and

(4) Enhancing fertilizer-use efficiency and reducing nutrient loss to the environment.

Peppers Grown in High Tunnel

In summer 2011, we investigated using organic and inorganic nutrient sources to improve soil fertility and bell pepper productivity under a high tunnel at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC) near Lingle.

We compared cattle manure compost (CM), NPK fertilizers, and their combination on bell pepper yields. Treatments consisted of a control, CM alone, NPK fertilizer, and substituting 75, 50 and 25 percent of the N requirement of bell pepper with CM. The NPK fertilizer application rates were 200, 100, and 150 lbs/acre N, P and K, respectively.

Bell pepper seedlings were transplanted into raised beds (8 x 4 feet) in the high tunnel May 16, 2011. Raised beds were used because the soil under the high tunnel is too shallow and gravely.

Each 4- by 4-foot plot contained four pepper plants 24 inches apart. Mature pepper fruits were harvested late July through the second week of October.

Preliminary results show bell pepper yields were highest for 100 percent NPK and 50 percent compost plus 50 percent inorganic nitrogen treatments during the first harvest. As the season progressed, yields of the compost-treated plots were similar to 100 percent NPK plots (see Table 1 page 19).

Total seasonal pepper fresh weights ranged from 86,460 lbs/ac (32 lbs/plot) [yield per-acre was calculated as lbs per plot x 43,560 square feet/16 square feet] for 100-percent compost treatments to 53,550 lbs/ac (20 lbs/plot) for the control plots. The performance of all the compost-treated plots, except the 25-percent compost plus 75-percent inorganic nitrogen plots, were similar to plots that received 100-percent NPK fertilization.

Table 1. Fresh weight yields (pounds per acre) of bell peppers as affected by composted cattle manure and inorganic nitrogen fertilization in the high tunnel at SAREC during summer 2011

Treatment	7/29/11	8/12/11	9/9/11	10/11/11	Total
	lbs/ac				
Control	6,630	23,050	18,110	5,760	53,550
100% CM	6,850	36,070	16,110	27,430	86,460
75% CM +25% AN	6,670	28,500	13,570	26,950	75,690
50% CM +50% AN	10,070	31,310	13,020	12,930	67,330
25% CM + 75% AN	4,990	34,890	10,570	5310	55,760
100% NPK	10,020	41,970	10,030	19,780	82,800
Average	7,540	32,630	13,570	16,360	70,100
SEM	1,930	5,850	3,000	7,670	10,400

CM= cattle manure compost
AN = ammonium nitrate
NPK= nitrogen, phosphorus and potassium
SEM = Standard error for mean comparison

Composted cattle manure provides highest pounds per acre for bell peppers through four harvests

Our preliminary data indicates that, if high tunnel producers want early-season pepper harvests, add inorganic nitrogen fertilizer to provide some form of readily available nutrients for optimum growth and crop performance. This study is ongoing, and the experiment will be repeated this growing season. ●

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Bell peppers and tomatoes growing on raised beds at SAREC. (Photo June 23, 2011)

Future Studies

Further evaluation of the residual effects of inorganic nitrogen and compost application on cabbage and other cool-season vegetable yields will continue this summer.

- Changes in soil quality parameters like soil organic carbon, microbial biomass, nitrogen, and phosphorus and micro-nutrient availability will be monitored.
- Crop variety trials to evaluate potential vegetable varieties that can be grown under high tunnels in Wyoming will be conducted.
- Irrigation water quality and quantity management under high tunnels will be examined.
- Pest management problems, especially aphids, will be studied. There was limited insect damage over a year of growing crops in the high tunnel, but aphids were one pest that had to be managed.

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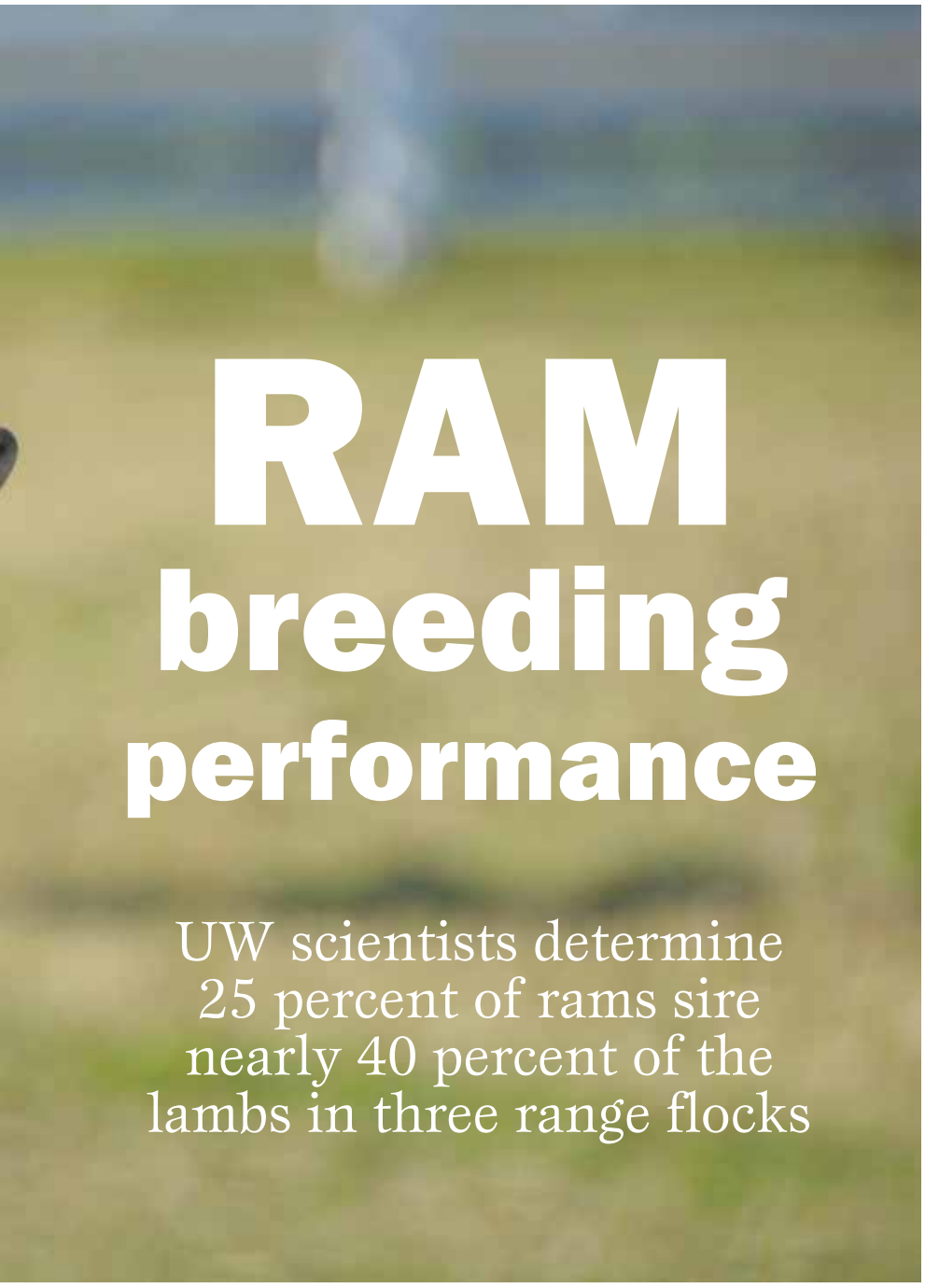
Department of Animal Science

Ram selection is fundamental to a flock's profitability and is based on desired physical and performance traits.

Selection practices rarely include an evaluation of sexual behavior even though the ability and desire to mate with ewes in estrus is required to incorporate superior genetics into a flock. Poor mating behavior results in:

- Increased ram costs,
- An extended lambing season, and
- Decreased genetic progress from sires with desired production traits.

Producers recognize the importance of ram libido and consider rams with known libido more valuable. However, constraints of time, labor, and facilities generally limit routine evaluation of ram breeding behavior.



RAM breeding performance

UW scientists determine 25 percent of rams sire nearly 40 percent of the lambs in three range flocks

Examine Rams in Three Range Operations

To determine the breeding performance of individual rams in multi-sire flocks typical of Wyoming range operations, paternity was established in approximately one-third of the lamb crop in each of three Wyoming range sheep operations. Prior to breeding season, rams were evaluated for breeding soundness (structural soundness, semen quality, presence of *B. Ovis*, and palpation for epididymitis).

Expected number of lambs sired was calculated by dividing the number of lambs sampled in each flock by the number of rams in the flock (assuming that rams having equal access to ewes sire equal numbers of lambs). Rams above and below the assumed average were considered high performers and poor performers respectively (Figure 1, page 22).

Top Performers

The proportion of the lamb crop sired by each ram category is listed in Table 1 (see page 22). Rams in the high-performance category equaled about 25 percent of the total rams per flock but sired more than 40 percent of the lambs.

On the other end of the behavior spectrum, poor-performing rams comprised about 25-40 percent of total rams but only sire 3-16 percent of the lambs.

The small number of high-sexually performing sires in each flock sired as many or more lambs as the rams with expected or average breeding success. Since the majority or lambs are sired by a small percentage of sires, developing a simple means to identify low- and high-performance rams would be extremely useful for producers. A single ram that exhibits high breeding performance could replace all low-performing rams in a flock.

Identification of high-sexually performing rams would reduce ram costs, promote the incorporation of desired genetics in a flock, and improve the profitability of sheep producers. ●

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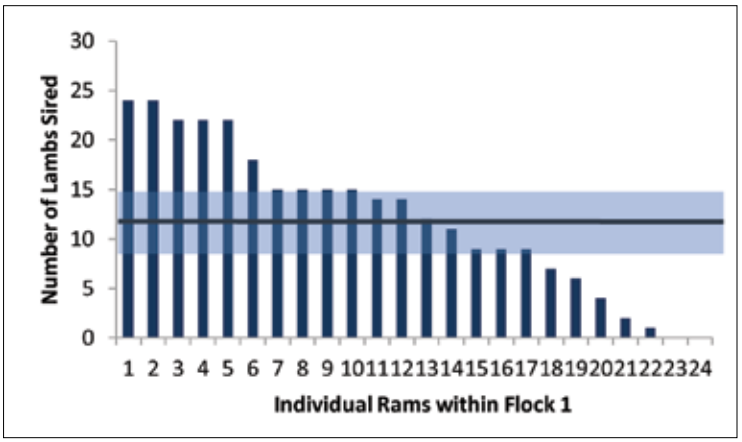
A simple means to identify low- and high-performing rams would benefit producers since a single ram that exhibits high breeding performance could replace all low-performing rams in a flock.

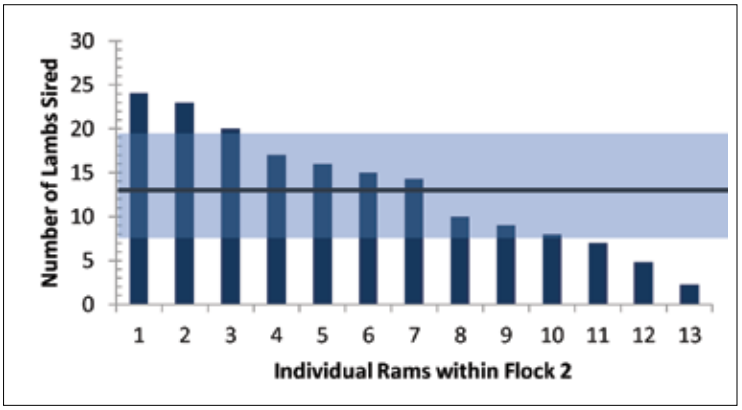
Table 1. Proportion of lamb crop sired by poor-, average-, and high-fecund rams in three producer flocks

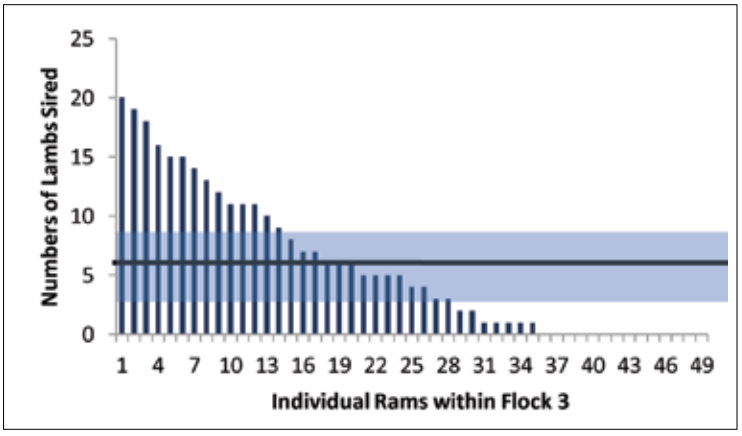
Performance category	Flock	Rams % (n)1	Lamb crop % (n)2
Poor	1	42% (n = 10)	16.2% (n = 47)
	2	23% (n = 3)	8.2% (n = 14)
	3	43% (n = 21)	3.2% (n = 9)
Average	1	33% (n = 8)	38.3% (n = 111)
	2	54% (n = 7)	52.4% (n = 89)
	3	28% (n = 14)	26.7% (n = 74)
High	1	25% (n = 6)	45.5% (n = 132)
	2	23% (n = 3)	39.4% (n = 67)
	3	29% (n = 14)	70.0% (n = 194)

[1]Total number of rams in each category from the respective flocks
[2]Total number of lambs sired by rams in each category from respective flocks

Figure 1. Number of lambs sired by each ram from the three separate flocks. The shaded area represents the number of lambs expected to be sired by each ram with 99% confidence.







Long-term project begins yielding results

Multi-layered research at the James C. Hageman Sustainable Agriculture Research and Extension Center examines conventional, reduced-input, and organic production approaches with crops and livestock

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Project Manager

Jay Norton
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Renée Gebault-King
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Agricultural producers continually battle unpredictable profit margins and are increasingly interested in ways to decrease costs, increase yields, or increase profits.

Our project aims to determine economic and environmental viability of integrated crop and livestock agriculture by studying:

- Conventional, reduced-input, and organic approaches under a cash-crop system involving common irrigated and non-irrigated crop rotations in the Western high plains, and
- A crop-livestock system comprised of cattle using forage and grain from the associated production systems.

SAREC Agricultural Systems Project

The SAREC Agricultural Systems Project (SASP) utilizes irrigated and non-irrigated cropland and cattle at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC) near Lingle. This framework evaluates three agricultural production approaches side by side in a statistical design that attempts to hold other factors constant.

The rotations and management practices under each approach are developed by an advisory team, which includes local producers who use these approaches (see Table 1, next page).

Soil Quality Assessment

Soil quality is extremely important to crop productivity and profitability. Practices and strategies that enhance soil quality include diversified crop rotations, minimizing soil disturbance, and enriching soil with organic matter. Rajan Ghimire is evaluating changes in soil physical, chemical, and biological parameters, including soil density, moisture content, pH, nitrogen content, and microbial community structure.

Table 1. Summary of differences between the three approaches.

	Irrigated Cash-Crop Rotation	Irrigated Management	Non-irrigated Management (wheat-fallow)	Cattle Management
Conventional	Dry beans, corn, sugar beets, corn	Synthetic fertilizer; herbicide, pesticide at recommended rates; conventional tillage	Wheat: Synthetic fertilizer and herbicide Fallow: Tillage for weed control	Feedlot from weaning to market (8 months)
Reduced-input	Dry beans with triticale cover crop, corn, sugar beets, corn	Synthetic fertilizer, herbicide, pesticide at precision rates; minimum tillage, maintain crop residue	Wheat: Synthetic herbicide, no fertilizer or tillage Fallow: No tillage, weeds controlled with herbicide	Crop residue and grass (10 months), feedlot (4 months)
Organic	Alfalfa/oats, alfalfa, corn, dry beans	Manure/compost fertilizer; tillage as needed for weeds, seed-bed preparation	Wheat: No fertilizer or herbicide Fallow: Tillage for weed control	Crop residue and grass (10 months), feedlot (3 months)

Accumulating and evaluating several years of data before drawing conclusions is essential.

In the irrigated trial, organic and reduced-input production approaches rapidly increased easily decomposed soil organic matter, total soil organic matter, and microbial biomass when compared to the conventional approach. Early indicators attribute these enhanced soil quality changes to less soil disturbances, manure applications, and use of crop rotations with legumes.

Soil Amendments for Organic Production

Organic acreage in the United States increased nearly four million acres between 1995 and 2008. According to a 2008 USDA Economic Research Service survey, Wyoming ranked second in total organic acreage and 17th in organic crop acreage with 660,076 and 56,979 acres, respectively. However, unique soil fertility challenges exist for Wyoming organic farmers.

Of particular concern are issues related to calcareous (lime-rich) soils that reduce the availability of phosphorus – a nutrient essential to healthy crops. Renée Gebault-King is assessing the effects of organic-friendly soil amendments on nutrient cycling, especially phosphorus, in calcareous soils under the organically managed portion of the SASP framework.

The four amendments are humic acids, compost tea, bone meal, and rock phosphate, each of which are applied alone and in combination.

Humic acids are a component of humus, which is decaying organic matter (plant residue, soil organisms, etc.).

Compost tea is a general term applied to a wide array of soil amendments that are literally brewed from raw materials such as compost, livestock manure, and other similar inputs. Compost teas are viewed favorably by many because they tend to be a source of microorganisms, and their application may enhance a soil's biological activity.

Bone meal is made from livestock bones that are steamed to remove any residual tissue and ground into small particles. Some have expressed a concern about the potential for BSE (mad cow disease) with the use of bone meal. The risk is extremely minimal because bone does not tend to harbor the prion, and the large size of prion proteins makes their uptake by plants highly unlikely.

Less soil disturbance, manure applications, and crop rotations with legumes enhance soil quality changes. Preliminary results from the non-irrigated experiment indicate reduced-input is most efficient to enhance soil organic matter building capacity and reduce carbon and nitrogen losses via greenhouse gases.

Rock phosphate is a raw material mined from deposits and ground into small particles for field application.

Two treatments, compost/manure and no amendment, were added as controls. Prior to application of amendments, soil tests revealed a low to very low baseline of available phosphorus in the soil. Soil data collected in 2011 and 2012 will provide insight into any effects of the soil amendments.

Greenhouse Gas Emissions

Prakriti Bista and Ghimire are monitoring soil trace gas emissions from irrigated and non-irrigated components of SASP. Soil comprises the largest terrestrial carbon pool so small management changes can have huge impacts on carbon storage and reducing greenhouse gas emissions.

Carbon dioxide, methane, and nitrous oxide measurements are indicators of soil biological activity and overall soil quality. Conventional practices involve frequent soil disturbances resulting in rapid soil organic matter mineralization and losses, while

alternative approaches such as reducing tillage frequency and converting to organic practices are considered beneficial for improving soil quality and minimizing losses of carbon and nitrogen as greenhouse gas emissions.

Preliminary results from the non-irrigated experiment indicate reduced-input is the most efficient system for enhancing soil organic matter building capacity and reducing carbon and nitrogen losses via greenhouse gases.

Non-irrigated organic practices, however, are quite different. Current organic winter wheat production is a crop-fallow system that relies on heavy tillage for weed control, with few inputs. Initial data analyses suggest that this approach does not build soil quality, and may lead to further depletion of soil organic matter already degraded from decades of crop-fallow. Organic amendments, cover crops, and crop rotations will be evaluated in the coming seasons to better understand advantages and limitations of transitioning to organic production.

Brekke Peterson (left) and Renee Gebault-King apply compost tea fertilizer to the organic plot, which was planted in corn.

Looking Ahead

Data collection and analysis for an integrated, complex project is a constant task. The economic analysis for each approach will be of considerable interest. Partial budgeting, flow of net revenue, carbon footprint, energy input-to-energy output ratio, and carbon sequestration options will be evaluated to understand the economic and environmental impacts of the systems.

These issues are often interrelated. For example, the emergence of opportunities to participate in voluntary carbon markets could provide insights into the responses to financial incentives associated with the sale of carbon offsets generated from reduced tillage operations.

Energy efficiency is a useful indicator of environmental and long-term sustainability when comparing cropping systems in multi-criteria analyses. Energy efficiency can be increased by either reducing energy-intensive inputs to the system or by increasing outputs of the system. Any increases in efficiency could ultimately help the bottom line. From the environmental point of view, reduction of energy needs by integrated farming is a highly promising climate change mitigation option.

While data such as individual plot yields, soil microbiology activity, and calf weights are available, SASP is focusing on the entire production system. Accumulating and evaluating several years of data before drawing conclusions is essential. The longer this experiment is conducted, the greater the potential for valuable outcomes to future researchers and producers.

We hope SASP will become a permanent framework at SAREC to provide baseline information regarding conventional, reduced-input, and organic production approaches, that allows producers to quantitatively assess benefits and challenges of each system. ●

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SATELLITE IMAGES monitor vegetation response in Wyoming rangelands

Students capitalize on no-cost Landsat images to map rangeland vegetation

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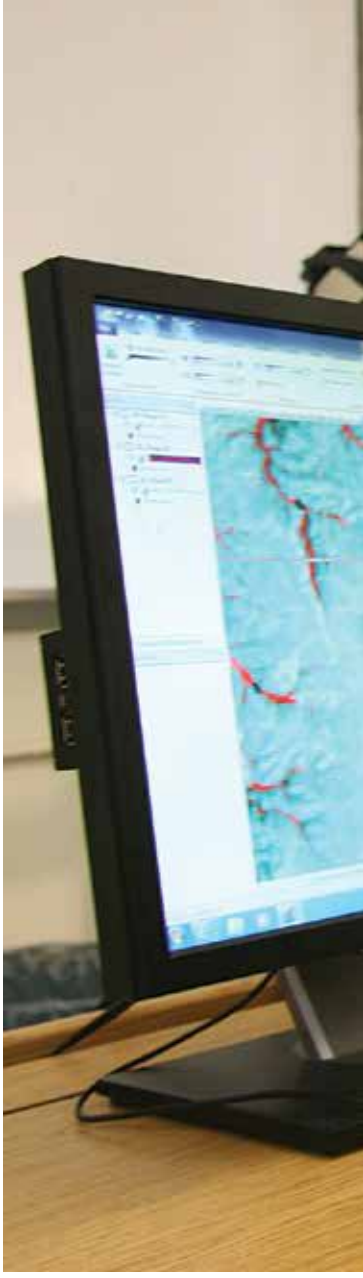


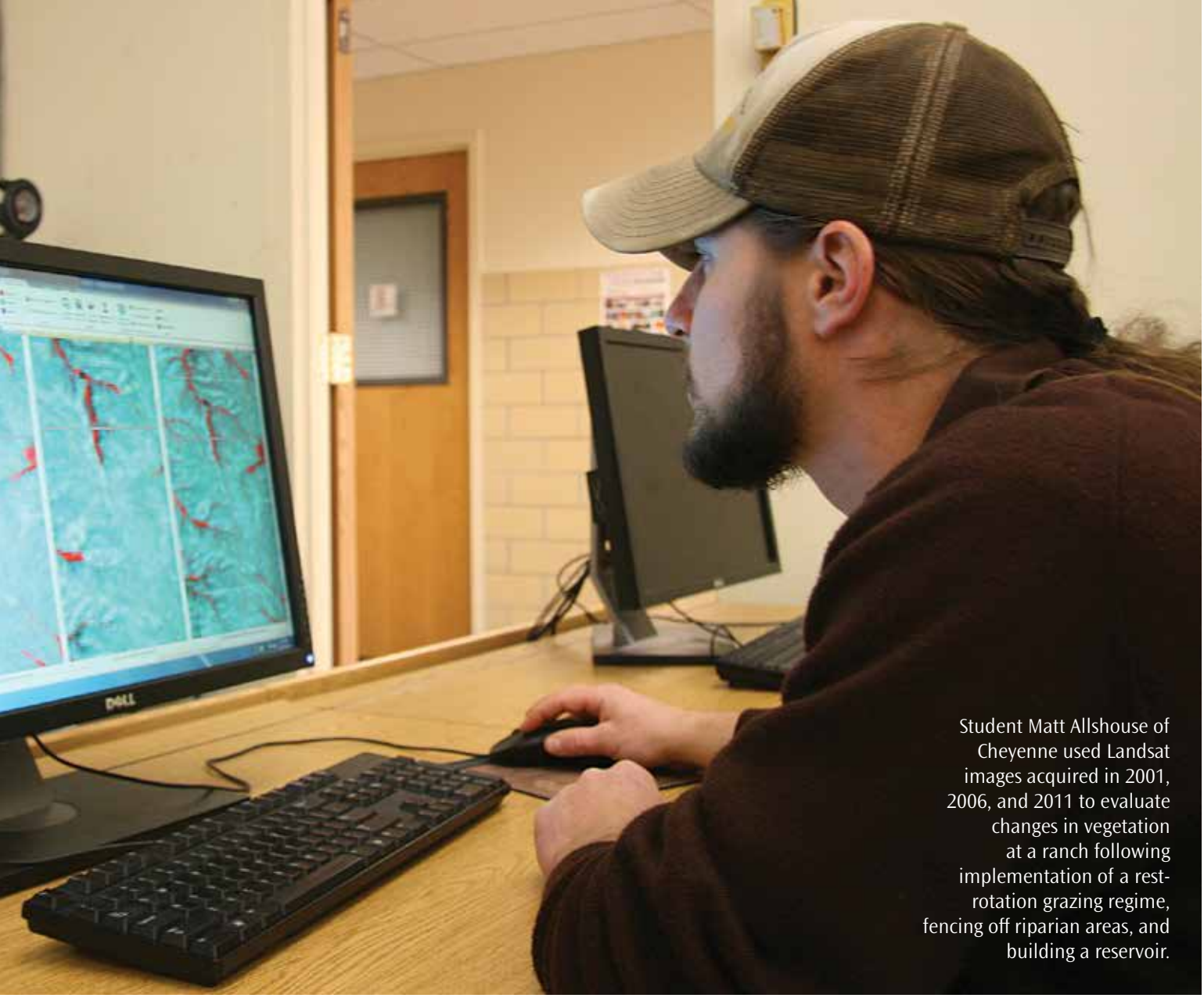
Rangeland vegetation responds to both environmental variations (e.g., drought, precipitation) and human interventions (e.g., grazing management). These responses can be rapid (*e.g.*, wildfire), seasonal (*e.g.,* grazing), or slow (*e.g.,* invasion of non-native species).

Ranchers, land managers, and planners need periodic information about where and how changes are occurring. Collecting change information through field surveys is expensive and time-consuming and often does not provide a complete picture because only a portion of the area is sampled.

Monitor and Map Vegetation Responses

One solution to this problem is to use remotely sensed images for monitoring and mapping vegetation response to environmental and human influences. Since information derived from remotely sensed data is not always similar to data collected in the field, researchers have developed indices and metrics that provide valuable insights for monitoring and mapping natural resources. With the availability of more types of remotely sensed data, new indices and metrics are also being developed for monitoring vegetation in rangelands and elsewhere.

University of Wyoming students enrolled in the Remote Sensing for Agricultural Management course train in the use of remotely sensed data for monitoring and mapping vegetation in rangelands and forests. In addition to learning remote sensing concepts, students are required to complete an inquiry-based research project of their choice involving use of remotely sensed data for answering questions pertaining to natural resource management.



Student Matt Allshouse of Cheyenne used Landsat images acquired in 2001, 2006, and 2011 to evaluate changes in vegetation at a ranch following implementation of a rest-rotation grazing regime, fencing off riparian areas, and building a reservoir.

Images Cover 100 x 100 miles

Most students use Landsat data provided by the U.S. Geological Survey (USGS) through the GloVis website for monitoring or mapping vegetation response in rangelands, forests, and agricultural fields. Each image (referred to as a scene) covers roughly 100 miles x 100 miles on the ground and contains information in the visible and infrared regions of the electromagnetic spectrum. Landsat images can be used for mapping present and past conditions of rangelands, forests, crop fields, lakes, and other earth surface features (Figure 1, page 28).

Although Landsat satellites have collected data since 1972, their widespread use was somewhat limited because of the high cost associated with acquiring those images. However, since December 2008, USGS is providing all Landsat images at no-cost to users, which has generated an unprecedented opportunity for students enrolled in this class.

Students interested in rangeland management have obtained numerous Landsat images for monitoring vegetation growth and mapping changes in vegetation conditions over time. Almost all students selected ranches either their parents owned or where they worked in the summer.

Monitors Rangeland Allotments

Selecting familiar study sites provides a unique opportunity for evaluating the utility of Landsat image information. Clint Beiermann, an agroecology major, analyzed vegetation responses in three rangeland allotments where he worked one summer. Analyses of Landsat images from May 17, June 2, June 18, and July 7, 2007,

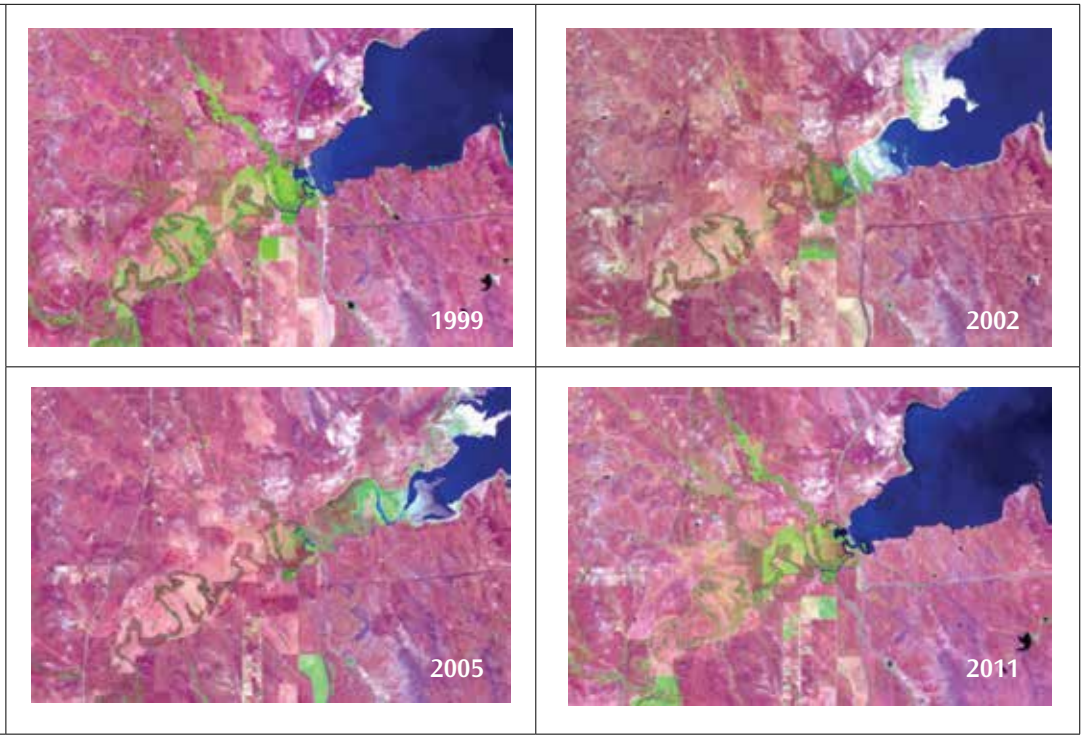
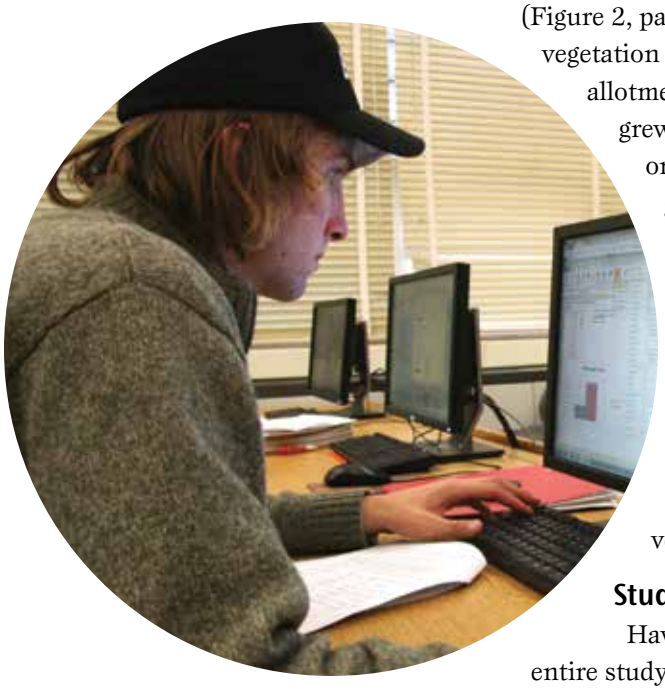


Figure 1: Landsat images acquired in 1999, 2002, 2005, and 2011 for an area adjacent to Keyhole Reservoir near Moorcroft demonstrate their utility for monitoring changes in natural resources such as vegetation rangeland and riparian zones and water. Intensity of green color can be associated with high (bright) and low (dark) vigor. Vegetation growth is low (few areas in green) during drought years (2002 and 2005) and relatively higher in normal and wet years (1999 and 2011). The surface area of the reservoir also fluctuates between these years as a result of natural and human influences.



Kellen Smith of Gillette analyzes early-season vegetation growth measured by Landsat images during drought (2003), normal (2007), and wet (2010) years for two pastures managed by his family in eastern Wyoming.

(Figure 2, page 29) showed different vegetation growth rates between allotments. Grasses and forbs grew early in the season in one type of allotment while growth was delayed in another. During the end of the growing season, differences between allotments were minimal. He concluded Landsat images can be used for routine monitoring of rangeland vegetation.

Studies Grazing Effects

Having image data for the entire study area enabled identification of patterns and anomalies (areas of high, medium, and low growth). Brandon Greet, also an agroecology major, monitored the grazing impact on a ranch in the Big Horn Mountains using Landsat images from June 29, August 25, and September 17, 2008. He categorized vegetation in this rangeland into high, medium, and low vigor and found the area of the low-vigor vegetation class increased during the growing season. Further, he noticed vegetation re-growth in September in some of the areas classified as bare ground in the August image. He generated maps that showed where these changes have occurred, which could help ranchers improve grazing by focusing cattle on under-utilized areas.

Most students (and owners of the ranches where they worked) had a general sense of the changes in vegetation composition and patterns. Visualizing those changes in Landsat images acquired several years apart sheds new light on the types and magnitude.

Researches Forage Availability

Matthew Allshouse (a rangeland and ecology management major) monitored forage availability and riparian vegetation at a ranch near Laramie. Over the last several years, this ranch

shifted from intensive grazing to multiple-objective management. Ranch owners have implemented a rest rotation grazing regime, fenced off riparian areas, and built a reservoir to improve riparian habitat. Allshouse obtained a Landsat image from 2001 to establish baseline vegetation conditions and used the 2006 and 2011 images for monitoring and mapping how vegetation responded to the changes in management practices.

Students gained experience processing remotely sensed data and extracting information pertinent to their research questions by working independently on their projects. They evaluated several vegetation indices derived from Landsat data and determined the suitability for monitoring and mapping rangeland vegetation. Over the past few years, students enrolled in this course have used Landsat and other remotely sensed data for monitoring natural resources in Wyoming and other states. Several students have also presented their research work at the Wyoming Undergraduate Research Days.

As more and more students take advantage of the no-cost Landsat data, findings from their research projects may benefit the community by providing insights about the utility and limitations of Landsat data for natural resource monitoring in Wyoming and elsewhere. ●

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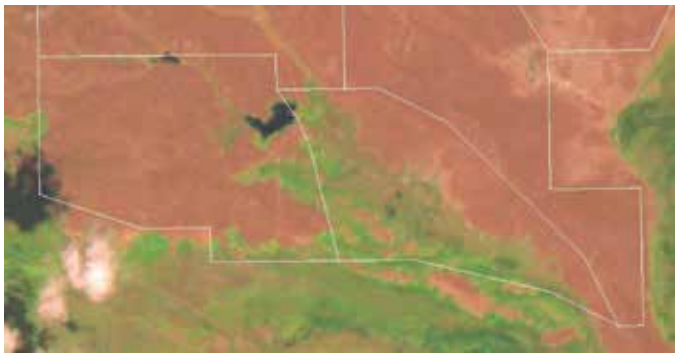
Figure 2: Landsat images acquired from May through July 2007 were used for monitoring vegetation (green) growth in allotments under different management regimes. Water in the ponds appears black, and allotment boundaries (white) were superimposed on the image. Clouds and their shadows (bottom left of July 7 image below) could limit the use of Landsat data.

May 17, 2007

June 2, 2007

June 18, 2007



July 7, 2007

EAT WYOMING

Outreach project increases awareness, knowledge about local food resources

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Locally grown foods and direct-to-consumer agricultural sales are a small but rapidly growing component of U.S. and Wyoming agriculture.

From 1997 to 2007, direct sales of agricultural products nationwide increased by 105 percent – twice the pace of total agricultural sales. In Wyoming, direct sales increased by nearly 250 percent. Nationally, farm-to-school programs doubled from 2005-2009, and farmers markets and community supported agriculture (CSA) operations have more than tripled in the last 15 years.

UW Extension nutrition and food safety educators developed the *Eat Wyoming* project in response to this increased interest and activity surrounding local foods systems. *Eat Wyoming* is focused on increasing knowledge and awareness of local foods through two statewide efforts:

- Local foods expos and educator training
- Food guide (website and print resource)

Training Inspires 2012 Statewide Program

The *Eat Wyoming* team piloted local foods expos in Sheridan and Pinedale in spring 2011. Each event was tailored specifically to the needs and preferences of the host community – this was reflected in session topics. Specific to the Sheridan event were energy efficiency, backyard beekeeping, and hoophouse building. Specific to Pinedale were backyard chickens, farm-to-school, short-season veggies, and child-specific workshops. Each expo was heavily supported by local sponsors, with more than $5,000 donated in cash, food, and other goods. This allowed the public to attend for free to learn from local, regional, and national speakers.

The two expos drew more than 600 participants excited about the opportunity to network with local growers and attend local foods educational workshops and seminars. An enthusiastic Pinedale crowd was so responsive that a week of events, workshops, and sessions are planned this year including:

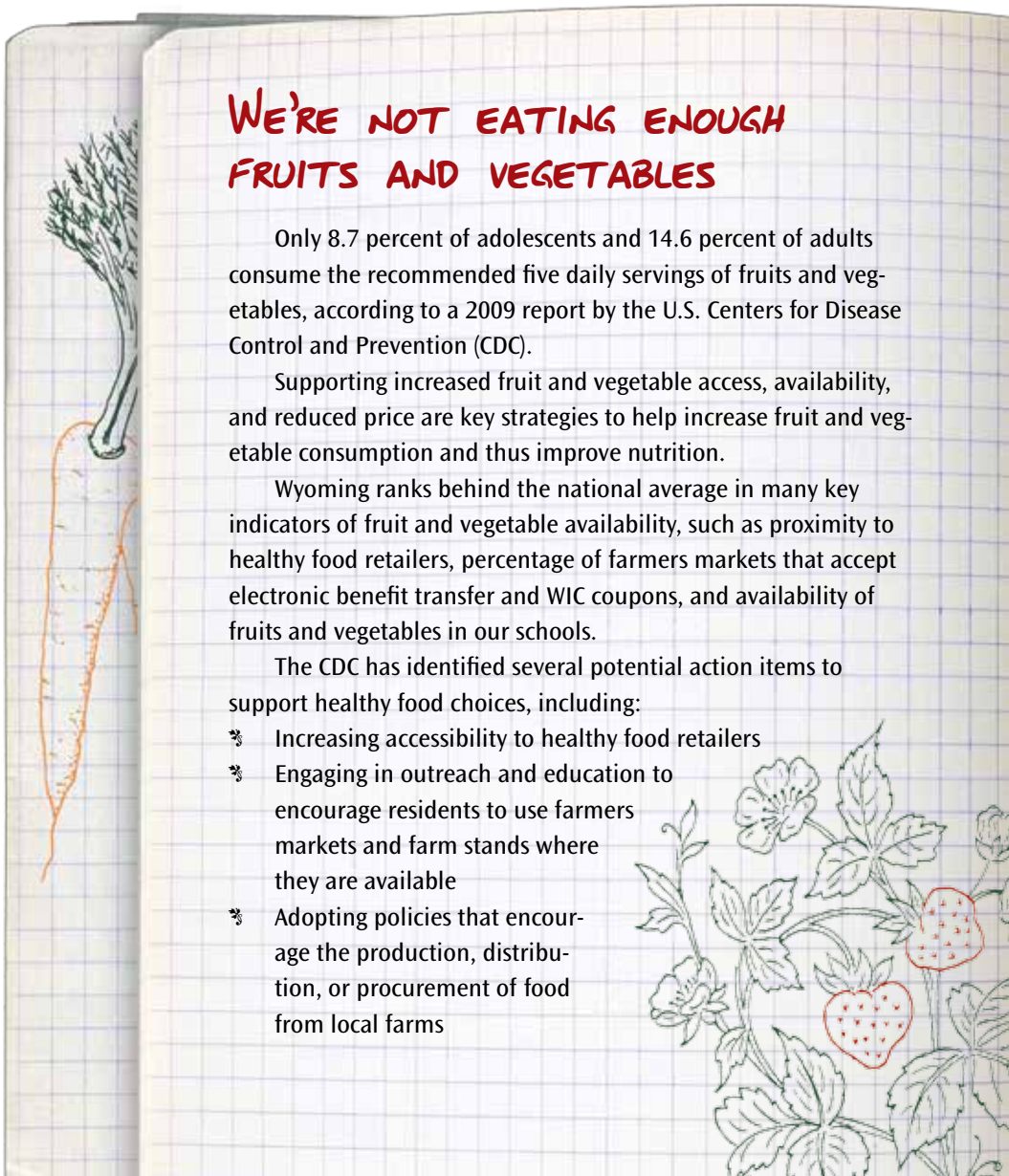
- beekeeping,
- beneficial bugs,
- chickens,
- composting,
- farm and garden tours,
- food preservation,
- hoop house construction, and
- a local foods movie screening.

Feedback was overwhelmingly positive, with many attendees planning to put their newly gained knowledge and skills to good use by beginning to compost, building their own hoop houses, cultivating beneficial bugs, improving gardening techniques, and incorporating efficiency and renewable energy usage into house plans. Those in Pinedale and Sheridan, and their respective steering committees, plan to make local food expos annual events.

Training the Trainers

To expand this programming success, the *Eat Wyoming* team shared their experiences with colleagues as part of an extension training event in fall 2011. This training highlighted multiple methods for educators to reach audiences using local foods.

The ***Eat Wyoming*** project is addressing a need for research-based information and education on local foods topics. This University of Wyoming Extension project is reaching out to Wyoming constituents via hands-on learning experiences as well as Web and print resources available statewide.



We're not eating enough fruits and vegetables

Only 8.7 percent of adolescents and 14.6 percent of adults consume the recommended five daily servings of fruits and vegetables, according to a 2009 report by the U.S. Centers for Disease Control and Prevention (CDC).

Supporting increased fruit and vegetable access, availability, and reduced price are key strategies to help increase fruit and vegetable consumption and thus improve nutrition.

Wyoming ranks behind the national average in many key indicators of fruit and vegetable availability, such as proximity to healthy food retailers, percentage of farmers markets that accept electronic benefit transfer and WIC coupons, and availability of fruits and vegetables in our schools.

The CDC has identified several potential action items to support healthy food choices, including:

- Increasing accessibility to healthy food retailers
- Engaging in outreach and education to encourage residents to use farmers markets and farm stands where they are available
- Adopting policies that encourage the production, distribution, or procurement of food from local farms

A field-to-plate edible foods education session provided educators tools to adapt recipes for individual taste palates using local foods and to use these simple recipes to promote healthful eating patterns. Other sessions focused on farm-to-school programs, beginning gardener programs (for example, extension's Backyard Beginnings program in Casper) and visits to local gardens, farms, and markets in Jackson.

The *Eat Wyoming* team expects at least four food expos to take place in communities across the state this year.

Food Guide Flying Off Shelves and the Web

The interactive website *Wyoming Local Foods: The Guide* launched in June 2011, and a print guide was distributed statewide. *Eat Wyoming* team members in collaboration with technical and subject-matter specialists researched, wrote, and organized references on local foods topics including food safety, storage, and preservation.

Team members also researched existing databases of local foods producers, verified listings, and compiled up-to-date information about Wyoming local foods producers. A comprehensive glossary of local foods terms was assembled to help consumers understand the often-confusing terms used to market local foods. Healthy, local foods recipes rounded out this compilation.

The local foods producer database and additional informational pieces were organized into the searchable website (www.wyomingextension.org/eatwyoming) and print guide. The print guides have been in demand – more than 2,000 copies were distributed to individuals in Wyoming within three months after the June 2011 printing. ●

"This training was awesome! One of the best I have attended in my extension career. It was very informative, and the hands-on cooking was great. I will definitely be using the materials and knowledge I gained from this training. Thank you!"

-feedback from a training attendee

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Eat Wyoming future looks strong

For the latest information, visit the Eat Wyoming website www.wyomingextension.org/eatwyoming or become a fan on Facebook. Search for Eat Wyoming – Wyoming local foods.

Wyoming residents are looking into ways to grow their own food or raise produce for markets.

UW researchers study forage, grain yield potential of

WHEAT, RYE, TRITICALE*

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Small grains such as wheat (*Triticum aestivum* L.), rye (*Secale cereale* L.), and triticale (X *Triticosecale* Wittmack) are used primarily as grain crops but also as annual forages.

They are well-adapted throughout the United States and southern Canada. Although wheat, rye, and triticale are primarily grown as winter pasture, they can be used for silage or hay crops. Additionally, small grains, especially triticale and rye, are often used as cover crops or in companion seedings with legumes, particularly alfalfa (*Medicago sativa* L.). However, the major limitations with these small grains are lack of appropriate varieties or selections and limited early fall/winter and spring growth.

What Work Has Been Done in Wyoming?

A field trial initiated in fall 2008 at the James C. Hageman Sustainable Agriculture Research and Extension Center (SAREC) near Lingle tested the potential for forage and grain yields of different experimental lines of wheat, rye, and triticale. Two experimental lines with a standard variety as a control were used from each species. The lines were seeded into two adjacent plots with three replicates. The adjacent plots represented forage-only use and dual purpose forage- and grain-use.

Harvesting for forage started at the same time for both plots but stopped for forage- and grain-use plots at the first hollow stem stage. The first harvest was November 26, 2008 (both plots), second harvest was May 11, 2009 (forage-only use plots), and third harvest June 16,

*Triticale is a hybrid of wheat and rye.

(Photo by Emi Kimura)

Seed harvesting at SAREC.

2009 (forage-only use plots). Seed harvest was on July 31, 2009 (forage- and grain-use plots).

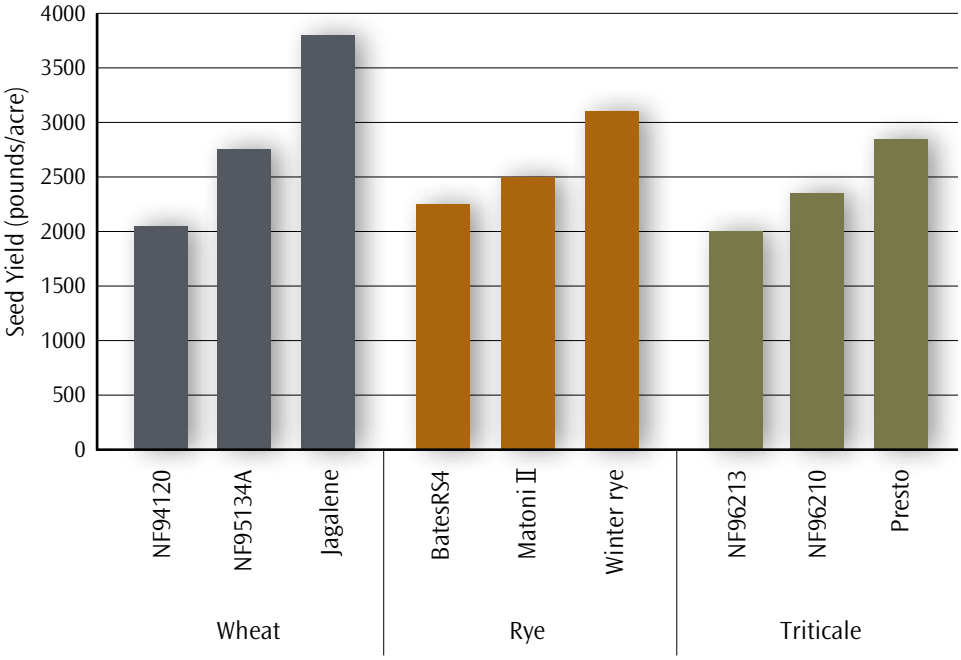
Study Yields Significant Differences

Although an ongoing experiment, the first harvest indicated a significant difference between forage yield lines (see Table 1). For example, the range of triticale forage yield varied from 408 lbs/acre (check 'Presto') to 980 lbs/acre (line NF96213) at first harvest. There was not enough winter rye forage to harvest at first cut. Rye and triticale lines seemed to produce more early growth compared to controls. Experimental lines performed similar to, or in some cases better than, controls.

Table 1. Forage yield of different small grains in 2008-09 growing season at SAREC.

	Dry matter yield (pounds/acre)				
	Line/variety	First cut	Second cut	Third cut	Total
Species		11/26/08	5/11/09	6/16/09	
Wheat	NF94120	784	1638	2624	5046
	NF95134A	760	2652	1763	5176
	Jagalene	557	3417	1931	5905
Rye	Bates RS4	768	3378	1196	5342
	Maton II	722	3610	872	5205
	Winter rye	0	2639	2345	4983
Triticale	NF96213	980	2025	1630	4635
	NF96210	845	3017	1373	5235
	Presto	408	2452	2011	4871
LSD (0.05)	214	641	993	1848	

Figure 1. Seed yield of different small grains in 2008-09 growing season at SAREC. Jagalene, winter rye, and presto are check varieties for wheat, rye, and triticale, respectively.



Differences were also observed for seed yield among the lines (e.g., wheat, 2,002-3,837 lbs/ac), (rye, 2,352-3,237 lbs/ac), and (triticale, 2,089-2,854 lbs/ac) (Figure 1). The controls had better seed yield than experimental lines; however, line NF95134A (wheat), Maton II (rye), and NF96210 (triticale) had the greatest seed yield potential. Higher forage production lines produced greater seed yield.

The study was repeated in the 2009-2010 and 2010-2011 growing seasons, and data is being analyzed. Significant differences between species or lines are expected, and the study should provide useful information to producers, scientists, academicians, and seed company personnel. For example, preliminary results indicate that small grains can provide acceptable forage yield with superior quality for feeding livestock during winter and early spring in Wyoming. ●

Acknowledgments

We acknowledge Associate Professor Malay Saha of The Samuel Roberts Noble Foundation, Ardmore, Oklahoma, for providing seeds for the experimental lines of small grains.

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(Photo by Anowar Islam)

Forage harvesting at SAREC.

Preliminary results indicate that small grains can provide acceptable forage yield with superior quality for feeding livestock during winter and early spring in Wyoming.

K-Line irrigation system offers Wyoming producers lower costs, greater efficiency

By Dallen Smith
University of Wyoming
Extension Educator

K-Line irrigation began about 12 years ago on the south island of New Zealand and has leapt across oceans to now assist producers in the United States. The system uses less irrigation water than traditional systems and can increase production on pastures and hay ground.

The system came to the U.S., Canada, and Mexico when K-Line North America was established June 2003 in Richmond, Virginia. K-Line Irrigation is sold through a system of established irrigation dealers that specialize in installation and support of pastureland products.

In 2005, Phil and Kate Boreen of Boreen Hay and Cattle Co. LLC west

Sprinklers housed in dome-shaped pods can water a 50-foot diameter area.

of Basin, began converting 200 acres to K-Line irrigation over the next four years. The cost to install the K-Line system was about $500 an acre.

"It works great for growing forage and for grazing management," says Phil Boreen. "The surprise was how well it produces alfalfa. Our tonnage in our K-Line fields this year was excellent and out-produced the tonnage under pivot. We also really like not having to remove the lines for winter storage and the fact it all seems to be indestructible by both cattle and horses."

Slow Absorption, No Runoff

K-Line systems are moved daily during the growing season. A series of sprinkler heads attached to long, flexible tubes is easily moved by towing or dragging behind a four-wheeler. Pre-molded and dome-shaped pods house sprinklers. Each sprinkler can water an area 50 feet in diameter. The system allows slow absorption, no water run-off, and saves water.

K-Line's lower cost, simplicity, and ease helped it to catch on quickly with New Zealand producers. They soon realized the system could be adapted to almost any shape and size field without costly changes in fencing, shade trees, and buildings. The slow absorption from smaller sprinklers irrigating over a longer period of time resulted in greater forage growth.

The tough pods are one-piece, rotary molded units made of impact and abrasion-resistant UV-protected polyethylene (see photo page 36). Their heavy-duty skid plates give pods a low center of gravity, and their heavy-duty construction withstands the rigors of being pulled across rough and uneven ground.

A ball at the end of the every pod line (left) is retrieved by a special device (right) attached to a four-wheeler for easy and quick moving.

Tubing Withstands Damage

Sixty to 80 pounds of pressure are needed at the pods. The low-density, polyethylene resins make the tubing very strong yet flexible. The tubing used for the feeder and pod lines can withstand abrasive soils, kinking, freezing, damage from UV light, and the various stresses exerted while moving set to set. K-Line's tubing is available in 32 millimeter (mm) and 40 mm diameter (slightly larger than 1¼- and 1½- inch pipe).

Two different kinds of heads with four different sizes of nozzles per head can apply water at rates of 2 to 5.5 inches in a 24-hour period depending upon application needs.

The water does not have to be shut off to move to the next set. The manufacturer recommends leaving the water on, which helps prevent kinking. A clothespin can stop the sprinkler head next to the four-wheeler to prevent the operator from getting wet. A quick shifter makes hooking up and moving the K-Line easy. A large, plastic ball (see photo above left) at the end of every pod line provides a simple way for a trailer towed behind a four-wheeler to attach to the line and tow the system from set to set. However, the only equipment really needed to move a system is a four-wheeler and a 4-foot rope with a hook to attach to a 3-inch ring, which attaches to the end of each K-Line.

New Zealand dairy farmer John Kirk collaborated with RX Plastics to create a grassland and forage irrigation system offering producers lower costs and simplicity.

A water tank can be towed from paddock to paddock.

A system is moved by a four-wheeler.

The underground plastic irrigation pipe (PIP) is available in 6- to 24-inch diameters and in standard lengths of 20 feet. The PIP is buried at least 30 inches. The PIP should withstand 80 pounds of pressure per square inch.

Cattle Watering Tank Available

An assortment of heavy-duty plastic fittings is available for coupling the tubing or connecting to valves, reducers, quick couplings, unions, and end rings. These fittings are made from high-grade, glass-reinforced nylon, which makes them extremely durable and impact resistant. The double-barbed insert is designed with extra length for maximum grip on the inner wall of the tubing. With the added strength from the threaded compression nut, these fittings bite into the inner and outer wall of the tubing creating a tough and durable connection.

A cattle watering tank has been introduced that works well for producers using rotational grazing. The water tank is pulled behind an ATV or small tow vehicle and is designed to be moved with the cattle as they move from grazing paddock to paddock.

A short rope attaches to the heavy-duty frame to tow the tank. Multiple 375-foot lengths of highly flexible K-Line 32 mm polyethylene tubing allows the driver to position the tank close to under-utilized portions of the pasture. The entire move can be done in a few minutes.

K-Line may just be the answer for your irrigation needs. Visit with those who have K-Line and look at the pros and cons of this system and others before investing time and money. If you pump or have enough pressure to run a K-Line system, installing a K-Line may make sense for you. ●

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System can spray irrigation water or fertilizer

Either water or animal effluent fertilizer can be sprayed. Natural Resources Conservation Service planners and engineers have used vegetative treatment systems to manage manure. NRCS has teamed with University of Nebraska-Lincoln Extension to develop practical options within vegetative treatment systems. K-Line has a system designed and approved for applying animal nutrients to fields.

Cattle improve reclamation efforts

Controlled livestock impact spurs reclamation success in southwest Wyoming

Calvin Strom
Research Associate
Assistant Director
Wyoming Reclamation and Restoration Center,

Jay Norton
Associate Professor
Department of Ecosystem Science and Management

If short-term results of this research are indicative of long-term success, the project may provide a role for ranchers and their livestock in reclaiming disturbed rangelands to productive states. Grasses and other seeded species are establishing in greater numbers on research plots that held 100 head of cattle per acre for 24 hours on well pads at the Wamsutter, Jonah, and Pinedale Anticline gas fields.

The project grew from conversations between Associate Professor Jay Norton, researcher Calvin Strom, and several Rawlins-area ranchers who had concerns about the effects of the Rocky Mountain Express pipeline running from northwest Colorado to Wheeling, West Virginia.

The pipeline corridor is 100 feet wide and traverses private and public ranchland in Wyoming. There were

TO LEARN MORE SEE

www.uwyo.edu/wrrc/index.html

Master's student Cally Driessen, right, takes soil samples with husband, Luke.

many weed issues and some areas where nothing seemed to grow after reclamation efforts.

After reviewing a number of articles that said using cattle after seeding provided organic matter and seed-to-soil contact, which had improved reclamation success in Nevada and Arizona on mine spoils, we decided why not try it on a pipeline corridor?

Most evidence in the articles was anecdotal observation and photographs – no peer-reviewed literature that demonstrated cattle had a lasting effect on the success of reclamation.

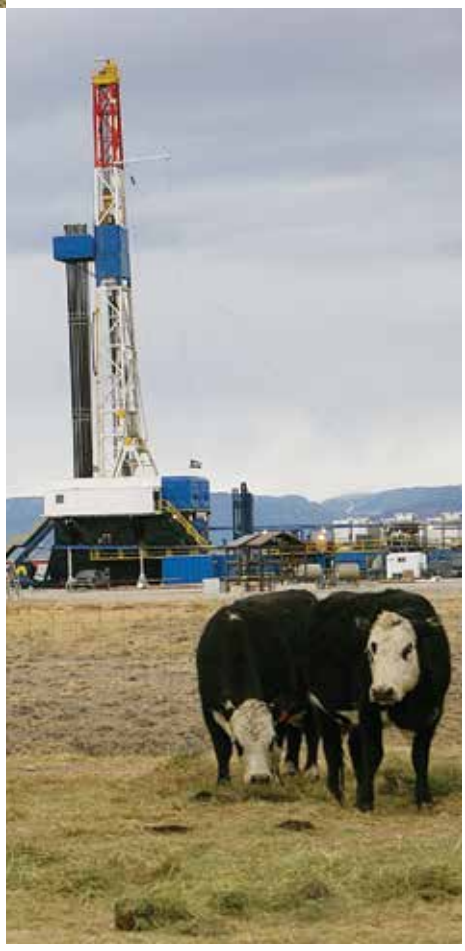
Conversations began in fall 2007. A proposal for funding a scientific study using cattle was developed by Norton and Strom and sent to various pipeline and energy companies seeking funding. None was forthcoming until the creation of the School of Energy Resources (SER) at the University of Wyoming. The proposal was edited and sent to SER, and in April 2008 was funded contingent on securing matching funds.

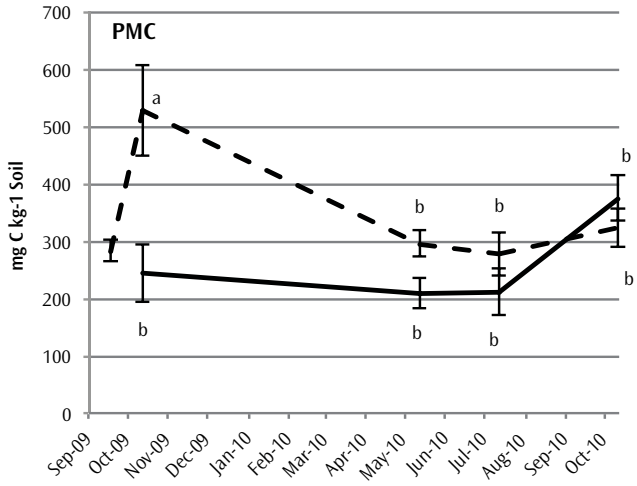
The proposal was again circulated among the energy companies seeking matching funds. Persistence paid off. In fall 2008, Encana agreed to donate matching funds, which seemed to open the gates for more funding. BP America and QEP Resources also provided funding. Finally, the project was off and running, with one problem – the project had no graduate students (a requirement).

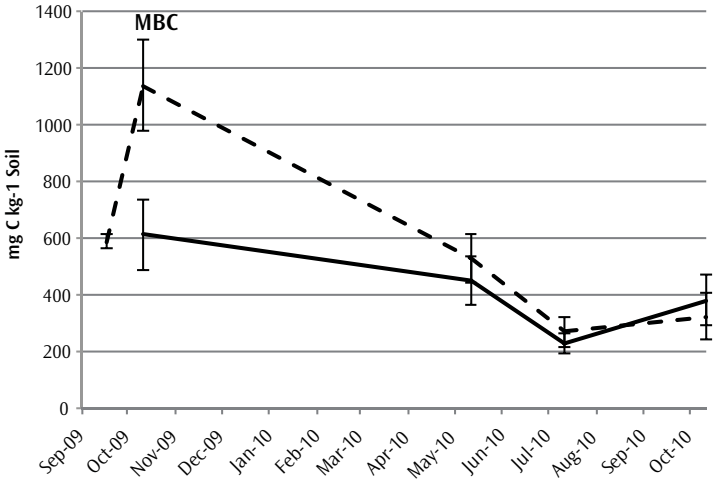
Recruitment was our next business; master's student Cally Driessen was recruited for the cattle portion, and doctoral student Amber Mason for the non-cattle treatment. Both began in 2009.

The study was conducted on 10 gas well pads: four in the Jonah (Encana), and three each in Pinedale Anticline (QEP Resources) and Wamsutter (BP America) gas fields. Two one-tenth acre plots (cattle treatment and control) were laid out on each well pad. Three 30-meter long transects were established on each plot. Soil was collected at three points along each transect at depths of 0-5 centimeter (cm), 5-20 cm and 20-30 cm each spring and fall for two years. A total of 2,330 soil samples were collected, which were then bulked by depth and resulted in 775 samples analyzed in the laboratory.

The cattle portion of the project was the result of many conversations and exchanges of







PMC is potentially mineralizable carbon and represents the portion of the total soil organic material that is most easily decomposed when temperature and moisture conditions are favorable. MBC is microbial biomass carbon and indicates the size of the microbial population in the soil. Dashed line is cattle treatment, solid line is no cattle.

information on the purpose and design of the project and how many cattle were needed. The stocking rate was determined by estimating the amount of soil organic matter lost through construction and reclamation activities and then calculating how much organic material, in the form of feces, urine, and excess feed, a single cow contributes in a day.

Neils and Barb Hansen of P&H Livestock, Rawlins, were the first to come on board. From there, young entrepreneurs Ben Erramouspe and Josh Skorz wanted to participate (they were interested in forming an enterprise using livestock for reclamation in southwest Wyoming) on the Jonah. The last piece of the puzzle was found when Charles Price volunteered Price Cattle Ranch LLC to participate on the Pinedale Anticline.

The Hansens provided 10 bulls, Erramouspe and Skorz provided 25 heifers, and Price provided 20 cows. The livestock were confined on the plots and fed hay twice during the 24 hours they were on the plots. The bulls were held 48 hours. The objective was to achieve a stocking rate of 100 head per acre for 24 hours after the plots were seeded during the fall of 2009. Soil samples were collected on the cattle treatment sites immediately after livestock were removed from the plots, which added another 90 samples for analysis.

Vegetation data collected in the first growing season after reclamation on controlled livestock treatment (CLT) and control (No CLT) plots. Desired species include those that were seeded as well as native species recruited from the seed bank. Undesired species include weedy species. Asterisks represent significance at the p<0.1* and p<0.01** levels between treatments.

	Plant Cover		Surface	Richness	Density		Biomass	
	Desired	Undesired	Cover	Desired	Desired	Undesired	Desired	Undesired
	——%——			*No. of species*	——*stems m* $^{-2}$——		——*gm* $^{-2}$——	
CLT	1.8	4.2	36.0**	2.0*	84.9**	25.7	3.1	9.9
No-CLT	1.3	3.7	16.1	1.5	41.7	21.8	2.8	10.6

Driessen 2011

The data demonstrate soil structure was definitely improved by inputs from the cattle, the additional organic matter, and other waste (excess hay). The plant community on the livestock treatments contains more species and percent cover than the no-cow control after one growing season (which may be the result of seed-to-soil contact and increase in organic matter). Further investigation will determine if the cattle treatment continues to influence the long-term recovery of these reclaimed sites. Vegetation on these sites will be monitored through 2014. ●

Extension Bulletins

A list of free bulletins published through the University of Wyoming Extension are available at the Wyoming Reclamation and Restoration Center website. Go to www.uwyo.edu/wrrc/index.html and click on Bulletins on the left-hand side of the page.

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Lupin:

A crop that doesn't like water!

James Krall
Professor, retired
Department of Plant Sciences
James C. Hageman Sustainable Agriculture Research and Extension Center

Lupine: a crop that doesn't like water! What's this all about?

Let me explain. Lupine a crop? It's not a crop. It's a weed – and a toxic one. At least that is what I thought until I visited Australia.

The University of Wyoming in 1993 approved and funded my travel down under to study annual medic and ley farming. This led to the release of the first winter annual medic "Laramie," suitable for ley farming on the central high plains.

The concept behind ley farming is the rotation between annual pasture and cereal grain production. I discovered that lupin spelled without "e" is a major high protein (35 percent approximate) grain crop used primarily as stockfeed. Australia was producing 1.27 million metric tons of grain lupin annually at the time of my visit.

I was excited because, like soybean, lupin produces a large seed in pods that are on a high, rigid stalk (see left photo page 43) making it easy to harvest. Unlike soybean, it was growing on millions of acres of land with limited rainfall similar to what we deal with on the central high plains.

Obtain Seed for Trials

I gathered some seed from an Australian scientist for testing. I made sure I got domesticated varieties, ones in which the genes for low seed alkaloid content (0.010 percent approximate) had been incorporated along with the trait for a "softer seed coat." These wonders of plant breeding had made lupin a "crop." The seed was now easy on livestock and easy to establish in the field.

Trials were conducted at the former UW Torrington Research and Extension Center (TREC). Because seed was limited, initial trials were under sprinkler irrigation where I believed I could maximize seed yield and increase my limited seed supply. Results were disappointing. The plants would start out looking okay but, more often than not, they would turn yellow and die before producing any seed.

Lupin is a legume, and, like most legumes, they require a specific bacterium to nodulate and fix nitrogen. Maybe this was the problem! Were the plants running out of nitrogen?

I had been careful to inoculate seed with the proper commercial rhizobium

Lupine vs. Lupin

There are 150+ species within the genus lupinus world. Most are annuals, but some are perennials. Lupines the weed as we know them in Wyoming come from different species of Lupinus than the crops. The best way to think of them is as cousins. Lupin the crop will not cross with lupines the weed.

bacteria before planting. So, what else might explain the problem? I knew that the lupins I had tested might not perform well in our high pH calcareous soils. Perhaps the poor plant performance was due to the bicarbonate in the soil out-competing iron and magnesium in terms of root uptake resulting in nutrient deficiency.

End of story.

Except for two things!

I became aware of a breeding program headed up by Dr. Bevan Buirchell of the University of Western Australia in Perth focusing on developing lupins for calcareous soils. I contacted him, and he sent me some domesticated experimental lines for testing. The second thing was that I decided to try lupins on a dryland site as well as an irrigated site. Thanks to Dan Smith at the Sheridan Research and Extension Center, a dryland trial was conducted in 2004.

Sheridan Results Encouraging

The irrigated trial at Torrington is not worth talking about, but the dryland trial at Sheridan produced some encouraging results (see photo upper right). The plants on the right in the photo were of the greatest interest. They were very dark green and healthy, but the season ended before they produced seed, and the seed supply I held was all but exhausted.

Until recently, I have been concentrating on other crops, other research activities, and other duties; however, my passion has been crop variety development. Therefore, once again I am pondering the lupin question.

Why did they do so well at Sheridan and flop in Torrington?

An Answer to the Puzzle

After reading more on the subject, I think I have come up with a possible answer. I learned that lupins do not like water – at least not too much water. A group of Australian scientists headed by J.D. Brand at the University of Adelaide found that "lupin genotypes were able to recover from chlorotic symptoms at 80-percent moisture in calcareous soil." They survived much better than in soil at 100 percent and 120 percent field moisture capacity.

Apparently, as soil moisture drops, less bicarbonate is available to interfere with root nutrient uptake.

Had I been testing them under the wrong soil moisture conditions?

Is the lupin a potential crop in replacement of fallow in our wheat/fallow rotations?

I want to know so am gearing up to look again at lupin.

This year, I hope to increase the limited seed of lines I received from Buirchell in 2004, and, with the help of my colleagues at the James C. Hageman Sustainable Agriculture Research and Extension Center, establish a field trial on a dryland site containing four modern lupin varieties I hope to get from Australia.

Who knows! If this trial pans out, developing this legume into a viable crop for the central high plains will take some time. I have become an emeritus faculty of the university, but I still plan to work toward the release of an adapted lupin variety because I believe the benefit of potentially having an easily harvestable, high-protein dryland grain crop that can be used by the livestock industry is worth it. ●

I was excited because, like soybean, lupin produces a large seed in pods that are on a high, rigid stalk making it easy to harvest. But, unlike soybean, it was growing on millions of acres of land with limited rainfall similar to what we deal with on the central high plains.

— Jim Krall
Professor emeritus

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FEARS, TEARS, AND LOVE

By Dawn Sanchez
University Extension Educator
Uinta County

Youth join this program to nurture animals but we think you'll find it's the animals that nurture the youth

The need: Create a program and facility for urban youth to not only learn about agriculture but have an active role in it regardless of socio-economic status.

The answer: The Uinta County Youth Agriculture Program, which has youth learning life skills through the aid of animals in a project that fosters hands-on, active learning.

"The Uinta County Youth Agriculture Program started in 1999, with a small group of 12 youth who raised goats and tested the feasibility of the program," explains Debbie Fitch, 4-H volunteer and barn leader.

The program now averages more than 100 youth per year.

With only 6 percent of the population of Evanston having a direct connection to agriculture, many youth lack the opportunity – but not the desire – to learn about or participate in agriculture.

"I believe that the Youth Agriculture Program offers local youth an experience that is hard to duplicate. I know of no other single activity that provides as many learning opportunities as this program. What the county 4-H offers in this program is the best I have seen anywhere."

– Alex Morrill, barn leader and volunteer leader

Groups Combine Resources

A collaborative effort among local stakeholders and supporters established the program. The effort was initially financed through a grant from the University of Wyoming and Wyoming Small Business Administration with in-kind contributions from Uinta County Commissioners, county maintenance personnel, Uinta County Fair Board, and area producers. After the initial equipment was secured, the program continues today through in-kind assistance from stakeholders, fees paid by participants, and fund-raising by volunteer leaders.

The program provides a means for youth to connect with agriculture while teaching entrepreneurship and life skills, such as patience, improved peer relations, team building, self-worth, motivation, self-esteem, nurturing, humor, group interaction, recordkeeping, and animal management. The animals also serve as a therapeutic tool for the youth-at-risk clientele.

From the original 12, the program has grown to include youth from the Uinta County Youth Shelter, Uinta County Group Home, and other urban-based youth (see story page 46).

All care for their animals daily at the fairgrounds. This interaction with animals is an opportunity for youth to not only connect to agriculture, but to also develop a bond with another living creature and feel needed on a daily basis.

One observer shared, "Animals are creatures with individual personalities that are capable of loving and relying on people to survive. The magic is that they give back to us. When these kids go to the fairgrounds, the animals are just waiting at the fence for their boys or girls to come. When a little calf licks the hand of a boy, the boy reaches down and gives it a hug. Animals learn to be caring and loyal, too."

Youth Transform

One young woman was not keen on the idea of raising an animal. She thought all she was going to do was shovel manure. So, she responded by trying to kill the pigeons living in the barn. Then she saw other youth getting involved, setting up pens, and bringing in sawdust. When the animals

arrived, she realized the pigeons were excited for her to feed them, the goats were friendly, and they all responded positively to her. In a short time, she wanted to build bird feeders for the pigeons, wanted to name the goats, and wanted to make a pen nice and neat for "her" goat.

The therapeutic value of the program is immense. "Hardened" kids become softer and abused kids come out of their shells, while pride and a sense of accomplishment rise. In a three- to four-month period, volunteers and youth service staff members have seen youth transform from not wanting to be part of the program to shedding tears when time to sell their animals.

Keys to Success

The commitment and dedication of the youth services staff, volunteer leaders, and parents are the keys to success. Youth and adults work together in family and community environments to create real-life learning laboratories, which help develop and practice skills needed throughout life. Evaluations show 67 percent of those connected to the program identify responsibility as the number one thing a participant learns. The program gives at-risk youth stability, something to look forward to each day, ownership, something that depends on them for livelihood, something to love and be loved back by, and a sense of self-pride and accomplishment.

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Youth come from varied backgrounds

1. One group of Uinta County Youth Shelter participants is youth who, for whatever reason, are disconnected from their family structures for a short time. Over the last several years, they have raised goats, rabbits, miniature horses, and calves.
2. The second group of participants consists of members of the Uinta County Group Home. These youth-at-risk are removed from their family structures for a longer period of time while they solve individual problems. These youth have raised lambs and pigs.
3. The third group is urban youth who reside in housing that does not enable them to raise an animal. This program provides a location to house projects. These youth have taken on a variety of projects including goats, poultry, rabbits, swine, and lambs.

College of Agriculture and Natural Resources

FEATURED OFFICE

Members of the Wyoming Agricultural Experiment Station are, from left, Joanne Newcomb, staff assistant, Joleen Pantier, senior accounting associate, and Professor Bret Hess, associate dean of research for the College of Agriculture and Natural Resources and director of the Wyoming Agricultural Experiment Station.

AGRICULTURAL EXPERIMENT STATION

The Wyoming Agricultural Experiment Station serves as the research arm for the College of Agriculture and Natural Resources. The office administers two internal grants programs plus provides administrative oversight for the college's four research and extension centers. In addition to facilitating research, the office publishes *Reflections* magazine and the Field Days Bulletin plus *Agademics*, a monthly, online series that describes the latest developments in the college.

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http://multimedia.uwyo.edu/UWAG_STREAM/reflections2012/index.html for additional photographs not used in this edition and to interact with the online e-magazine.

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