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A map of Utah’s privately owned pastures shows areas sprinkled throughout the state, tiny jewels fitting their status as “a rare, high-value resource,” according to USU range scientist Layne Coppock.

But Coppock also characterized pastures as a “low-priority resource,” which is an academic way of saying they have received short shrift, often relegated to the poorest soils with the lowest irrigation priority.

Fortunately, that’s changing, spurred in part by a renewed recognition of pasture’s productive potential. Thousands of farmers in the Midwest and East now rely on extensive pasture grazing systems in their beef and dairy operations. They claim these systems are more ecologically sound than confinement systems, and that they cut production costs, helping them remain competitive against producers in New Zealand and other countries where pasture-based production is the rule rather than the exception.

There’s ample evidence to back up their claims. It’s also apparent that such systems can’t simply be transplanted to the Intermountain Region, which is why USU is systematically assessing the economic feasibility and management options for privately owned forage resources in the state. Several research efforts, including the evaluation of forage varieties and a pasture-based system of producing slaughterweight calves, are already underway.

Coppock coordinates the multidisciplinary effort, known as the Utah Pasture Committee. One of the committee’s objectives is to evaluate possible alternatives to grazing on public lands.

Decades ago, lush pastures were the cornerstone of dairy production. The advent of confinement livestock production changed that. Most of the good land was allocated to crops. Remaining irrigated pastures were often over-utilized and under-managed. Thousands of acres were swallowed by urban development or subdivided into “ranchettes.”

Pasture-based agriculture in Utah will never achieve the prominence it has in many other states, given the limited water and land necessary for intensive production. Nonetheless, there are nearly 1 million acres of irrigated pasture in Utah. Economic incentives could encourage the conversion of other cropland to intensively grazed pastures.

This year’s Land Grant Days, “Ranching for Profit” and “Searching for Greener Pastures,” focused on the current status of pasture-based livestock production.

Views during the sessions differed, sometimes dramatically. Still, it was apparent that pastures warrant more attention. Moreover, there are a variety of ways—some old, some new—to wrest more profits from pastures. KG

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Land Grant Days is held every other year. This year’s event was cosponsored by the Steve Regan Co., the Utah Agricultural Experiment Station, the Cooperative Extension Service, and the Agricultural Research Service (USDA).
Stan Parsons dished out plenty of gloom before he doled out the hope. And the successful ranches he portrayed are mighty lean operations—few employees and little equipment, and not much “cowboy ing” either.

“Look at the beef producers sitting next to you. One of you will be doing very well, one will be hanging on, and one will be out of business in five years. The question is who will be doing what,” he told more than 300 people attending the “Ranching for Profit” seminar during Land Grant Days.

“If you want to keep on accepting cowboy wages, chances are someone else will be paying your wages five years from now.”

“The beef industry isn’t just a mature industry, it’s a sick, sick industry,” he added. And, according to him, it’s not likely to get better, at least for most ranchers.

Parsons, who heads the consulting firm, Ranch Management Consultants, Inc., Albuquerque, N.M., outlined a business strategy that focuses on the real objectives of ranching—raising livestock and producing forage.

These goals seem obvious, but Parsons said relatively few ranchers actually focus on them because relatively few raise cattle as a business. About 150,000 of the 1.3 million cattle producers in the United States have 200 cows or more, and fewer than 500 producers have 500 cows or more. He contended that 90 percent of ranchers don’t break even, and couldn’t survive if they relied solely on ranching revenue to pay rent, salary and other expenses.

“If anyone is going to survive, it will be the part-time producers. They pay no overhead because beef production is their hobby, so they really don’t charge costs of land, labor or vehicles against beef production.”

An Aversion to Machinery

Overhead accounts for 65 to 85 percent of the cost of production, so part-time producers have a huge advantage. He said the “three secrets” to improve a profit are to slash overhead, improve the gross margin (gross income minus direct costs), and increase the number of production units.

Get rid of deadwood, he said. Unfortunately, many producers try to shave costs without ascertaining whether they’ve identified the real problem. Many try to increase production by increasing direct costs and overhead.
Machinery is one of the biggest culprits in bloated overhead.

"Machinery and livestock do not go together. The largest piece of machinery on a ranch should be a wheelbarrow, and then only if you are madly keen on machinery," he said. Many ranchers become too "technologically involved" in their operations. "If technology were the answer, we would have no problems in agriculture."

He cited the "80-20" axiom, namely, that most people spend 80 percent of their time on tasks that result in only 20 percent of their income. The solution—focus on strategic planning instead of operational details, and concentrate on effectiveness instead of efficiency. That may require spending one day a week planning the business, something few ranchers do.

Parsons, former partner of Allan Savory, often considered the guru of "holistic" range management, criticized land-grant universities and other conventional sources of information for not providing the right kind of help, in large part because information available to everyone really doesn't provide anyone with a competitive advantage.

He said his program utilized meetings in which ranchers examine each other's operations.

INTERNATIONAL COMPETITION

Mike Walker, a rancher from Zimbabwe who works with Parsons, painted a grim international scenario—an avalanche of cheap beef from Central and South America, Argentina, Australia and Africa poised to enter the country as trade barriers collapse. In many of these areas, labor costs are much lower than in the United States. Moreover, many of these producers haven't yet adopted many modern management practices, which will further pare their production costs. Even in Australia, where prices are two-thirds of U.S. prices, producers fear competition from Argentina and Brazil.

"Cattle ranchers in the United States are the next endangered species. I guarantee that very few ranchers are making a decent profit in relation to their investment in equipment, land, and livestock," Walker warned.

"Education means to draw out of, not push into. We already have enough knowledge, but we need to utilize it better," Parsons claimed.

"What we do, we do very well indeed. The question is whether we are doing the right thing."

So what's the "right thing"? "Very few things are really impossible," he said, citing Alice in Wonderland. "It's all a question of attitude."

Some of Parsons' message may have the aura of a New Age self-help movement, but there's nothing fluffy about Parsons, who earned a doctorate in animal physiology and a master's in agricultural economics. He said he took what universities taught him, started ranching, and promptly went broke.

ALLIANCES WITH ENVIRONMENTALISTS?

Ditto for Jim Winder, a rancher from New Mexico, who also earned a master's degree in agricultural economics and started ranching by the book until a $100,000 deficit and his bankers pulled him up short. Unwilling to sell out, he sought out Parsons and
employed his tactics, which utilize controlled grazing—a carefully planned system in which cattle are rotated among pastures to utilize forage at its most nutritious stage.

And he eventually joined the local branch of the Sierra Club, and prodded other ranchers to do the same. "Everyone else was fighting the environmentalists, so I decided to join them," a move which he said provides him with a tremendous competitive advantage. Some environmentalists now actually offer him grazing land because of his cooperative attitude and management practices.

"It's not the environmentalists who are killing you, it's me. We're competitors," Winder added.

Winder said cell grazing allowed him to double his stocking rate and to quadruple the pounds of beef produced per acre. The system usually requires at least 25 paddocks. Winder utilizes 63 cells, along with improvements costing $50,000. The system allows for the on-the-ground "storage" of forage growth for use during the winter, thus avoiding the expense of making and feeding hay.

"I've never seen an overstocked ranch, but I have seen ranches that are overgrazed and undermanaged." Since switching ranching tactics, Winder has purchased additional ranches and now single-handedly manages 1,200 cows.

"The solution doesn't involve an outside quest. It requires an entrepreneurial attitude. If your neighbor doesn't think you're nuts, then you're not doing it right," Winder said.

Parsons also offered the following production advice:

- Virtually all producers calve too early. Delaying calving will substantially improve productivity and reduce costs.

- There's a difference between supplementary feed, which makes up for deficiencies in feed quality (and improves gross margins), and substitute feed, which makes up for differences in quantity, and requires additional machinery, labor, and investment.

- Minimize stress on livestock. "Cowboy has no place in ranching," Parsons said.

- Don't resort to fencing and creating grazing cells until you identify the problems in your ranching operation. "The last thing we recommend is putting in fencing," Parsons said.

- Although your own records are valuable information, "managing a ranch by records is like driving down the road by looking in the rear view mirror," Parsons warned.

- The single biggest mistake—too short a resting period for pastures.

- Match the breeding season to forage production.

Parsons also decried the selling of beef as a commodity rather than marketing it. "Poultry producers know how to market, and pork producers are learning." So will the beef industry, he predicted, a move that may involve strategic alliances, including the producer-owned feedlots and packing plants to sell branded beef. KG
Donald McMahon, Nutrition & Food Sciences Department, is studying the effect of homogenization conditions on the fat globule membrane of UHT milk. The research is supported by the National Dairy Promotion and Research Board.

Richard Peralta, Biological & Irrigation Engineering, studies the groundwater extraction and treatment system for March Air Force Base (California) with support from the Earth Tech Corporation.

David James, Plants, Soils & Biometeorology Department, studies the iodine enrichment of the soil environment via irrigation water at Hotan, Xiajian (China). The research is funded by the Thrasher Foundation.

Jeffrey Broadbent, Nutrition & Food Sciences Department, studies the source and amelioration of bitterness of cheddar cheese with support from the Office of International Cooperation and Development (USDA).

Richard Joerger, Agricultural Systems Technology & Education, is developing an agricultural education work-based learning curriculum with support from the Utah Board of Regents, and conducts agricultural education for new teachers with support from the Utah Office of Education.

The Utah Energy Office supports the development of energy-related computer software by Stephen Poe, Agricultural Systems Technology & Education Department.

Deloy Hendricks, Nutrition & Food Sciences Department, studies iron absorption in vegetable concentrate and taste-free iron chelates with support from Albion Laboratories.

Ann Sorenson, Nutrition & Food Sciences Department, develops and studies cream cheese and related products with support from Progressive Bagel Concepts, Inc.

V. Philip Rasmussen, Plants, Soils & Biometeorology Department, received funding from the Cooperative Research Education and Extension Service (USDA) for Extension training programs in sustainable agriculture. He also directs the Sustainable Agriculture Research and Education Program, and the Agriculture in Concert with the Environment Program, in the Western region, which are also funded by the Cooperative Research Education and Extension Service (USDA).

Gary Straquadine, Agricultural Systems Technology & Education Department, is developing curriculum materials in agricultural education with support from the Utah Office of Education. He also studies agricultural safety and health with support from the University of Utah.

Dee Von Bailey, Economics Department, is studying the feasibility of locating a fruit processing facility in Moab. The study is supported by Grand County.

The National Turfgrass Federation Inc. funds the work of Eric Milton, Plants, Soils & Biometeorology Department, concerning the evaluation of low-input cultivars of Kentucky bluegrass.

Layne Coppock, Rangeland Resources Department, studies pastoral systems in Ethiopia (Rockefeller Foundation), and sustainable agropastoral systems in Bolivia (University of California-Davis).

Randy Wiedmeier, Animal, Dairy & Veterinary Sciences, studies a cattle production system to make more efficient use of privately owned pastures. His research is supported by the Utah Department of Agriculture.

Roger Kjelgren, Plants, Soils & Biometeorology Department, is establishing an undergraduate curriculum in environmental horticulture with support from the Cooperative State Research, Education and Extension Service (USDA).
Ann Austin, Family & Human Development Department, studies child care resource and referral services with support from the Office of Child Care, Utah Department of Community and Economic Development.

Vincent Tepedino, Biology Department, studies pollination of the endangered Ute ladies-tresses orchid (*Spirathea diluvialis*) with support from the Forest Service (USDA).

Robert Lamb, Animal, Dairy & Veterinary Sciences, is developing a training program for management positions in the swine industry with support from the Iron County School District.

Anne Anderson, Biology Department, studies the biological control of Rhizoctonia seedling and root rot of sugar beet with support from the University of Idaho.

Dani Or, Plants, Soils & Biometeorology Department, conducts the in-situ evaluation of unsaturated hydraulic properties using subsurface point sources. His research is funded by the Binational Agricultural Research and Development Fund.

The Utah Department of Community and Economic Development funds research by Charles Carpenter, Daren Cornforth, Deloy Hendricks (Nutrition & Food Sciences Department) and Noelle Cockett (Animal, Dairy & Veterinary Sciences Department) in the Center for Meat Processing Technology, a USU Center of Excellence.

Kenneth White, Animal, Dairy & Veterinary Sciences Department, studies the effects of two signalling chemicals (IP3 and CADPR) on the activation of bovine oocytes. His research is supported by the Cooperative Research Education and Extension Service (USDA).

Janis Boettinger, Plants, Soils & Biometeorology Department, studies alpine soils in the Ashley National Forest. The research is support by the Forest Service (USDA).

Donald Jensen, Utah Climate Center (Plants, Soils & Biometeorology Department) gathers climate data on the Bonneville Salt Flats with funding from the Bureau of Land Management (USDI).

Reed Holyoak, Animal, Dairy & Veterinary Sciences, studies the modes and mechanisms of scrapie transmission with support from the Animal and Plant Health Inspection Service (USDA).

NEW FACULTY

Jeffrey Miller is assistant professor with Nutrition & Food Sciences Department’s culinary arts and food service program. He earned an MS degree in hotel, restaurant, and institutional management from Kansas State University.

Daryll DeWald is assistant professor with the Biology Department. He earned a PhD in biochemistry from Texas A&M University and was a postdoctoral fellow with the Howard Hughes Medical Institute, University of California-San Diego.

Quinn Weninger is assistant professor, Economics Department. He earned a PhD from the University of Maryland in agricultural and resource economics.
R. Dean Plowman received the 1995 Land Grant Hall of Fame Award. The award recognizes those who foster productive relationships between USU and its constituents.

Dr. Plowman recently retired after holding several key administrative positions with the USDA's Agricultural Research Service.

Dr. Plowman was area director for the USDA-Agricultural Research Service, head of Utah State University's Department of Animal, Dairy and Veterinary Sciences, administrator of the Agricultural Research Service, and, most recently, acting undersecretary of research, education and economics for the USDA.

He also served as a county agriculture agent, and worked with Extension agents across the country to improve dairy herd management and genetics in his role as chief of USDA's dairy cattle research branch.

While head of the Animal, Dairy and Veterinary Sciences Department at USU, the Caine Dairy Teaching and Research Center was constructed, and the department received the largest single contract in its history to study bovine somatotropin, the first commercial biotechnology product in the country.

Plowman earned his BS degree in dairy science from USU.

In an address during Land Grant Days, Plowman noted that even though the country's $59.5 billion livestock industry depends on forage production, forage production receives much less research funding from the Agricultural Research Service than commodities such as corn and cotton.

The reason—forage producers don't ask for support. "In seven years (in Washington D.C.), not one time did groups come in to speak for pasture research. Pastures and forages are not receiving their fair share of funding," and they probably won't until dairy and livestock producers start asking for it, Plowman said.
Pasture Health Depends on Soil

Healthy pastures produce hearty animals. It is about as simple as that. And the key to a healthy soil is adequate soil fertility.

Soil fertility influences pasture productivity and longevity, as well as animal performance and health, said Richard Koenig, USU Extension soil specialist. Koenig recommended testing the pasture soil, fertilizing according to the results, and continuing to monitor soil fertility.

To test soil, collect at least two soil cores per acre at a depth of 12 inches. For a 7-acre plot, that requires at least 15 core samples. Combine all cores in a clean bucket, mix and remove one pint of soil for analysis. Collect samples evenly through transects or by following a diagonal or zigzag pattern across the field, making sure to cover the entire circumference, he said.

USU will analyze soil, or you can contact your USU County Extension office. (It's listed under Utah State University in the phone directory.) A basic soil test for phosphorus, potassium, pH, and micronutrients costs $10 to $20—"much less than what you would pay for fertilizer for one acre of land," Koenig said. Soil can also be sent to other reputable laboratories. Before sending samples, contact them and follow their guidelines for submitting samples.

Once you get test results back, closely follow fertilizer recommendations. Remember that suggestions are based on thousands of data points and that fertilizer recommendations are calculated to increase soil test levels to the point where cost for fertilizer no longer justifies crop yields.

"Recommendations for phosphorus, potassium and micronutrients vary little throughout the seven Western states," he says. "These tests are very reliable and predictable."

Monitor soil fertility levels once every two years and even more frequently if there are problems, such as poor pasture growth. JD

Weed Control Boosts Pasture Productivity

Free forage for livestock? Double pasture productivity? No, it's not a magical elixir or a pyramid scheme.

It's weed control.

Weeds can reduce a pasture's carrying capacity by as much as 90 percent, according to USU Extension weed specialist Steve Dewey. "Many pastures are so neglected that even a small effort can make a dramatic difference. Weed control is almost like getting free forage."

According to recent research, better weed control can increase corn and wheat yields by 30 or 40 percent. Livestock producers typically have even more to gain from weed control in pastures.

"I don't understand why people don't do it. It's not that hard to do it right," he said.

Unfortunately, many select the cheapest herbicide without determining whether it is effective against the weeds of...
Weed Control Boosts Pasture Productivity Continued

Concern. Improper application also limits a herbicide's effectiveness, burning the leaves but leaving the root or seeds unharmed.

Controlling weeds also reduces the risk of poisoning by toxic weeds such as houndstongue, star thistle, poison hemlock, bur buttercup, locoweed, and arrowgrass.

Dewey said an effective weed control program is much like treating an illness. Proper diagnosis and treatment are essential.

Frequently inventory weed species, other plants, and soil types. Early detection and eradication of newly introduced weeds—seeds and roots as well as foliage—will keep them from spreading by establishing small satellite infestations.

Even if an infestation is too large to eradicate, containing it is still worthwhile. Be sure to follow through with the entire prescribed treatment. It may be necessary to keep animals off treated areas for anywhere from a few days to a full month.

Proper cultural practices can stave off weeds. Overgrazing favors weeds, as do improper irrigation and forage varieties poorly suited to the area.

Use seed, hay, feed grain, straw and mulch that are free of weed seeds. Also clean the undercarriage of vehicles and machinery from weed-infested areas. Livestock that have been grazing in areas with flowering or seed-producing weeds should be held for 14 days before allowing them on weed-free areas.

Persistence pays off, Dewey said, because "...there is no silver bullet that will end your weed problems in a single shot." LH

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Overgrazing Plagues Wasatch Front Pastures

If you live along the Wasatch Front, you don’t need to travel far to notice overgrazing.

Of 106 small pastures studied along the Wasatch Front, 44 percent were overgrazed.

It gets worse. Seventeen percent of the pastures were unclipped, 12 percent had weed problems, 7 percent suffered from poor fertility, 5 percent were inadequately irrigated, and 3 percent suffered from "other" problems. Twelve percent of the pastures were in good condition.

The study was conducted by Dean Miner, USU Extension agent with Utah County, and James Barnhill, USU Extension agent with Weber County.

Overgrazing is relatively easy to avoid—don’t overstock and properly estimate the available feed, Miner said.

A typical pasture along the Wasatch Front provides a little more than 3 tons of feed per acre, although production may range from less than 2 tons to nearly 5 tons, depending upon management. A horse requires more than 1.6 tons of feed during a 160-day grazing season. A 400-pound steer needs slightly more than 1 ton. These amounts can be used to determine preliminary stocking rates, Miner said.

Also consider the seasonal availability of forage. More than half of the total forage production occurs before the end of June.
A pasture stocked at a rate for spring production will result in severe overgrazing in late summer, Miner said. “Pasture owners must compensate for this seasonal variation.”

Limit access to pastures. Establish a corral area and allow periodic grazing. Mares and colts could be limited to eight hours per day, other horses to four hours a day, and other animals between eight and 10 hours a day, Barnhill said.

Rotating pastures is also very beneficial, Miner said. Ideally, grass should reach 6 to 8 inches before grazing is allowed. Remove animals when grass is grazed to a height of about 3 inches, and allow regrowth to 6- to 8-inches, which would require 3 to 4 weeks with irrigated pastures. Grazing more than 50 percent of a grass quickly curtails root growth and severely limits future yields and jeopardizes plant vigor.

Clipping pastures promotes even grazing and aids regrowth, Miner said. Animals often avoid areas with coarse stubble. High growth in these areas also shades adjacent plants.

Clip early, using lawn mowers, weed trimmers and any other suitable device.

Herbicides are an option for weed control. Apply 2,4-D or 2,4-D with Banvel for broadleaf weeds. Spot treat grassy weeds with Roundup. Always follow label directions. Many species can be effectively removed with a shovel, especially if it is done consistently. Proper irrigation management can also reduce invasions of many grassy weeds.

Poor fertility is usually the result of a nitrogen deficiency. Most grass pastures would benefit from the application of nitrogen—about 100 pounds of nitrogen per acre is a basic amount for most Utah pastures. They also recommend annual soil testing to detect other nutrient deficiencies. (Many pastures lack adequate phosphorous.)

Improper irrigation of pastures is a widespread problem, according to Bob Hill, USU Extension irrigation specialist. Miner said flood irrigation is the most common irrigation method. Grasses need about 1 inch of water per week for most of the growing season, and up to 2 inches during the hottest weeks of the summer. Sandy soils need more frequent watering than heavier clay soils.

Some pastures are understocked, Miner said, and owners could harvest early growth as hay. Manure buildup can reduce grazing. Scattering the manure increases decomposition rate and promotes more uniform grazing. JD

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A similar compromise applies to height—pasture grasses should be grazed short enough to remove mature leaves and prevent shading of new growth, but not so short as to remove stubble required to support regrowth.

Good pasture management is based on the life cycle of grasses, which are the basis for most pastures in the Inter-
mountain West, said USU agronomist Jennifer MacAdam. Although much is known about which grasses are adapted for pasture use in the Intermountain West, it's not always clear how they can be managed for the best quality and productivity under intensive grazing in Utah, something she and other USU researchers are now studying at several sites.

Grasses rely on stored sugars stored in their aboveground stubble for the first growth in the spring and for regrowth later in the summer. These sugars are replenished during rest periods as new leaves are formed. Overgrazing that removes these leaves too soon can reduce pasture quality and cripple subsequent forage production.

For most traditional pasture grasses such as orchardgrass, timothy, and tall fescue, grazing should begin when they reach a height of 8-10 inches and cease when stubble height reaches 3-4 inches.

“Grasses don't store carbohydrates underground, like legumes, but in the lower part of the shoot,” MacAdam said. This is why it's important to remove livestock from a pasture before the stubble becomes too short. It is also the reason continuous grazing favors the least palatable species. As livestock continually remove new growth from the most palatable species, the storage reserves of these species are depleted. These grasses struggle to compete for water and nutrients from the soil, while the new leaves that would restore sugars are nipped off as they appear. Meanwhile, the least palatable grasses are left alone to produce new leaves, store sugars, shade out the over-grazed grasses, and quickly take over the pasture.

“Livestock can be very selective grazers under continuous grazing, and selective overgrazing favors the least desirable component of the mixture,” MacAdam said. A study conducted in Alberta, Canada, where conditions are somewhat similar to those in northern Utah, found that continuous grazing resulted in less than half the live weight gain per acre achieved with rotational grazing. In the study, forage intake plummeted to almost half the original amount in the third year of continuous grazing.

Providing the pasture with a rest period between grazings represents a compromise between reducing the gain of individual animals but improving the gain per acre, MacAdam said. It is also a simple way to improve the long-term value and productivity of any pasture. Pastures should be grazed as soon as the grass has regrown enough to store sugars for regrowth, but before the quality of the forage has begun to decline. In the Intermountain West, this is usually when individual tillers in stubble have produced about three new leaves.

It is also important to consider how grazing affects the ability of grasses (especially perennial ryegrass) to compete with legumes. Perennial ryegrass is a less hardy grass of excellent quality but is tricky to manage. Perennial ryegrass and white clover mixtures can be used under irrigation in this region. However, perennial ryegrass begins growth earlier in the spring than white clover, and early grazing favors the regrowth of the deeper-rooted white clover, which can also shade out newly grazed perennial ryegrass. Avoiding early grazing in alternate years by cutting silage in some paddocks in a rotation grazing system will let perennial ryegrass compete better against legumes, as will fertilization with nitrogen.
Because white clover is slow to begin growth in the spring, early grazing is harder on the grass than on the legume in this mixture. "Following early spring grazing, the grass must utilize reserves that are already depleted for the next cycle of regrowth, and also must compete with the legume, which has become well-established, for sunlight, water, and nutrients.

The goal in a pasture mix is to maintain about 25 percent legumes if white clover or another bloat-causing legume is used, MacAdam said. Promising alternative non-bloating legumes for pasture use, such as birdsfoot trefoil, are included in a newly established field trial of six grasses and four legumes adapted to grazing. MacAdam and USU Extension agronomist Ralph Whitesides are evaluating their quality and dry matter production under simulated grazing. Companion trials of the same species under grazing trials will also be conducted on the farm of Ellis Roberts, Fairview, Idaho, who uses an intensive grazing system based on perennial ryegrass in his dairy operation.

A study to identify perennial ryegrass plants capable of better winter survival under Utah conditions is also underway in collaboration with Kevin Jensen of the USDA/ARS Forage and Range Research Laboratory in Logan. KG

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NEW FORAGES FOR PASTURES

Researchers at the USDA-Agricultural Research Service’s Forage and Range Research Laboratory are developing several forages for irrigated pastures in the Intermountain West.

The new hybrids, which are based on plant materials from the United States and around the world, are tested in plots throughout the region. One goal—a perennial ryegrass that requires less water and is better able to withstand cold temperatures.

“For the past 30 years we have concentrated strictly on dryland forages. Now we are moving into studies of plants for irrigated pastures," said Kevin Jensen, USDA-ARS research plant geneticist. In addition to perennial ryegrass, forages now studied in irrigated plots include orchardgrass, meadow and smooth bromegrasses, NewHy wheatgrass hybrids, and an endophyte-free and endophyte-infested tall fescue.

Research also continues in dryland forages, including a dryland alfalfa for hay and grazing, as well as selections of birdsfoot trefoil and sainfoin, which couple alfalfa’s nutritional value but lack its ability to cause bloat.

SEVERAL FACTORS CONSIDERED

Jensen said forage selection depends on several factors, including precipitation, soil type, availability of irrigation water, and soil salinity.

In spite of the increased popularity of intensive grazing, it's not certain that converting irrigated cropland to pasture is the best economic option for all farmers.

Jensen said marginally productive agricultural land, where water is limited in late summer, and areas with highly saline soils appear to offer the greatest potential for improvement and increased profitability.

The Utah Agricultural Experiment Station
Though precipitation patterns and other conditions vary widely in the Intermountain region, Jensen said the simplest way to classify pastures is to divide them into four groups: dryland pastures (usually receiving 6-13 inches annual precipitation), native pastures with different levels of subirrigation, pastures that are irrigated through mid-July (inadequate seasonal irrigation), and pastures with access to water on demand.

Pasture types and water availability determine the most suitable plant materials and management techniques.

The researchers welcome questions and reports from farmers. “Farmers are our greatest asset,” Jensen said. “They know what works on their land. We want to hear from them.”

And while they aren’t in the business of replacing Extension agents, Jensen said researchers frequently travel through the state and welcome opportunities to meet with farmers to discuss forage. Contact the laboratory at (801) 797-3066, or by e-mail at njchatt@cc.usu.edu. LH

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**FORAGE CULTIVARS**

**Unlimited water**

**Grasses**
- Perennial ryegrass (Zero Nui, BG3)
- Kentucky bluegrass (Park, Troy, Ginger - registered under turf and forage)
- Meadow bromegrass (Regar, Fleet, Paddock)
- Smooth bromegrass (Manchar)
- Tall fescue (Alta, Fawn)
- NewHy
- Orchardgrass (Latar, Hallmark)
- Timothy (Climax, Mohawk, Potomac)

**Legumes**
- Alfalfa
- Sweet clover
- White clover
- Birdsfoot trefoil
- Cicere milkvetch
- Sainfoin

**Precipitation plus limited irrigation**

**Grasses**
- Intermediate wheatgrass (Greenar, Oahe, Reliant, Mandan, Topar)
- Smooth bromegrass (Manchar)
- Meadow bromegrass (Regar)
- Slender wheatgrass (Pryor)
- Thickspike wheatgrass (Critana, Sodar)
- Tall fescue (Alta, Fawn)
- NewHy
- Orchardgrass (Latar, Hallmark)
- Timothy (Climax, Mohawk, Potomac)

**Legumes**
- Alfalfa
- Sweet clover
- White clover (Large types for western region include: California Ladino, Canopy, Sacramento, Titan, samuli-type star)
- Cicere milkvetch (Lutana, Oxley, Mondarch, Windsor)
- Sainfoin

---

**10-18 inches annual precipitation**

**Grasses**
- Crested wheatgrass (Douglas)
- Intermediate wheatgrass (Oahe, Manska, Greenar)
- Smooth bromegrass (Manchar)
- Meadow bromegrass (Regar)
- Altai wildrye (Ejay, Pearl Prarieland)
- Thickspike wheatgrass (Critana, Sodar, Bannock)
- Tall fescue (Alta, Fawn, Forager)
- NewHy (hybrid cross of bluebunch wheatgrass and quackgrass)

**Legumes**
- Alfalfa (Nomad, Rhizoma, Ladac, Rambler, Travois, Forager, Spreader-2, Teton, Sevelra, Drlander, Roamer, Heinrichs Rangelander, Alfagraze, Runner)
- Sweet clover (Prior to 1965 there were 21 cultivars. Recently developed are three biennials which are all low in coumarin: Polara, white flowers; Norgold, yellow flowers; Denta, yellow flowers)
- Sainfoin (Eski, Remont, Melrose, Nova, Renumex)
6-13 inches annual precipitation

Grasses
- Crested wheatgrass (Hycrest, Vavilov, P-27, Nordan, Ephriam, Fairway)
- Russian wildrye (Bozoisky-select, Mankota)
- Altai wildrye (Ejay, Pearl, Prairieland)

Legumes
- Sainfoin (Remont)

Saline Soils

Grasses
- Tall wheatgrass (Largo, Alkar, Jose, Orbit, Tyrell, Platte)
- NewHy
- Beardless wildrye (Shoshone)
- Garrison creeping foxtail

Legumes
- Red clover
- Birdsfoot trefoil
- Strawberry clover (Salina, Fresa)

Don’t Depend on Cows to Recycle Nutrients

Cow manure is great for gardens, but it won’t meet fertility needs of pastures, due in large part to its uneven distribution by grazing livestock, said Richard Koenig, USU Extension soil specialist.

Research by Koenig indicates only 18 to 23 percent of pasture is fertilized by cattle in one grazing event. Rather than relying on manure, it’s best to view soil fertility in terms of general soil inputs and outputs.

Nutrient inputs include irrigation water (sulfates and potassium), the atmosphere, supplemental feeds and mineral blocks (for grazing animals), soil reserves, and fertilizers. Outputs include leaching, erosion, and nutrients removed by grazing animals.

There are five main types of nutrients to consider in pasture fertility—nitrogen, phosphorus, potassium, sulfur, and micronutrients.

Nitrogen levels tend to decline in a typical pasture. Phosphorus levels generally remain stable or slightly increase. Potassium levels remain fairly stable. The amount of sulfur tends to remain stable or decline over time. Micronutrients may accumulate in the soil, Koenig said.

Nutrients that are stable or accumulate require little fertilizer beyond that required to correct any initial deficiencies. Nutrients that are declining, such as nitrogen, must be applied regularly to maintain pasture productivity.
The key ingredient is nitrogen, which is as slippery as water and is the most common deficiency in pastures. Most pastures require supplemental nitrogen, in part because nitrogen is not conserved in pasture systems.

About 50 percent of nitrogen in manure and urine is lost from the pasture system. The random distribution of manure and urine is often accompanied by excessive levels of nitrogen (nine times the normal amount). Once plants have taken up as much as they can, the remaining amount is lost to leaching or vapor loss (volatilization), Koenig said.

To make up for these losses, Koenig recommended the following.

For general purpose (hobby) pastures:

- Irrigated pastures with a grass-legume mixture (50 percent legumes): Apply 50 pounds of nitrogen per acre per year, 25 pounds in early June and 25 pounds in early August.

- Irrigated pure grass pastures: Apply 100 pounds of nitrogen per acre per year, divided equally between May, June, and August.

- Dryland pasture: Apply 25 pounds of nitrogen per acre per year in early spring.

For intensive production pastures:

- Apply 100 to 150 pounds of nitrogen per acre per year for grass-legume mixtures, split between at least two applications during the growing season.

- Apply 150 to 200 pounds of nitrogen per acre per year for pure grass pastures, split among at least three applications during the growing season.

DON’T UNDERESTIMATE PASTURE IRRIGATION NEEDS

Water management on pastures usually doesn’t receive as much attention as irrigation of other crops, even though it certainly deserves it, according to Robert Hill, USU Extension irrigation specialist.

Pastures require more frequent and lighter irrigations than some other crops. Pasture irrigation should be coordinated with other management practices such as grazing, fertilizer application, and grass clippings.

In a rotation-grazed pasture, the grazing period may extend from 3 to 7 days, followed by a 3- to 4-week rest period. Irrigate pastures as soon as animals are removed to allow for sufficient drying of soil, thereby reducing compaction of wetted soils during the next grazing cycle.

The timing and amount of irrigation water required by pastures, like any other crop, depends on the soil water-holding capacity, weather conditions, and crop growth.

Unless there is a limiting layer in the soil, most of the pasture roots occur in the upper 2 to 3 feet of soil. The soil water-holding capacity varies from about 1 inch per foot in sandy soil to about 2 inches per foot in loamy soil. In sandy soil, approximately 2 1/2 inches of water is available for plant use in the 2 1/2 foot root zone. In loamy soil, however, about 5 inches of water is available in the same 2 1/2 feet of soil.

For best growth, Hill recommended irrigation when about 50 percent of the water has been used or depleted from the 2 1/2-foot deep root zone, e.g., when approximately 1 1/4 inches of water has
been used by the pasture on sandy soil, and about 2 1/2 inches has been used on a loamy soil.

If pasture water use in midsummer is 1/4 inch per day, this would require application of 1 1/4 inch of water approximately every 5 days on sandy soil, or application of 2 1/2 inches every 10 days on loamy soil.

"A pasture needs to be irrigated about twice as often as a deeper-rooted alfalfa crop if daily water use is similar," he said. "Remember, though, that you can store only about half as much water in the root zone of a pasture as in the root zone of an alfalfa field."

Considering the principle that pastures require more frequent irrigations with lighter amounts than most crops, Hill recommended the following irrigation schedule for loamy soil pastures:

With a 5-day grazing period followed by 25 days of rest, irrigate about 5 days prior to the beginning of grazing, along with an irrigation immediately after grazing and again about 10 days later. This means that in each 4-week grazing cycle, there will be three 2 1/2-inch irrigations if crop water use rate is 1/4 inch per day.

These are net irrigation depths, or the amount actually stored in the root zone. Depending on irrigation application efficiency, the actual amount of water applied may be as much as double the net value, Hill said.

Irrigation practices must also reflect the changing air temperatures and weather conditions from early April through the fall. Daily crop water use rate of pastures is relatively low in the spring, increases toward the end of June through July, and then decreases from the end of August into October, Hill said.

The height of vegetation as well as leaf area affects water use. For example, grass that is about 10 inches tall prior to grazing requires more water than grass that is 4 inches tall immediately following grazing. Note that

Table 1. Monthly Pasture Evapotranspiration (or Water Use, Inches) for Selected Utah Sites.

<table>
<thead>
<tr>
<th>Site</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Season Total</th>
</tr>
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<tbody>
<tr>
<td>Cedar City</td>
<td>2.06</td>
<td>4.51</td>
<td>5.44</td>
<td>5.87</td>
<td>5.01</td>
<td>3.79</td>
<td>1.19</td>
<td></td>
<td></td>
<td></td>
<td>27.88 (inches)</td>
</tr>
<tr>
<td>Corinne</td>
<td>0.04</td>
<td>1.86</td>
<td>4.20</td>
<td>5.52</td>
<td>6.27</td>
<td>5.52</td>
<td>3.68</td>
<td>1.73</td>
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<td></td>
<td>28.83</td>
</tr>
<tr>
<td>Heber</td>
<td>0.51</td>
<td>3.65</td>
<td>4.94</td>
<td>5.70</td>
<td>4.87</td>
<td>3.34</td>
<td>0.65</td>
<td></td>
<td></td>
<td></td>
<td>23.66</td>
</tr>
<tr>
<td>Logan (USU)</td>
<td>1.74</td>
<td>3.75</td>
<td>5.00</td>
<td>5.55</td>
<td>4.89</td>
<td>3.08</td>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td>25.06</td>
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<td>Ogden (SF)</td>
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<td>2.37</td>
<td>4.18</td>
<td>5.55</td>
<td>6.05</td>
<td>5.14</td>
<td>3.18</td>
<td>1.91</td>
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<td>Pleasant Grove</td>
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<td>3.42</td>
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<td>5.31</td>
<td>4.67</td>
<td>2.86</td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
<td>23.08</td>
</tr>
<tr>
<td>Roosevelt</td>
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<td>4.15</td>
<td>5.76</td>
<td>6.24</td>
<td>5.20</td>
<td>3.34</td>
<td>1.12</td>
<td></td>
<td></td>
<td></td>
<td>27.20</td>
</tr>
<tr>
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<td>2.26</td>
<td>3.59</td>
<td>5.61</td>
<td>6.68</td>
<td>7.28</td>
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<td>4.25</td>
<td>2.50</td>
<td>0.80</td>
<td>38.89</td>
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<tr>
<td>Salt Lake (AP)</td>
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<td>3.93</td>
<td>5.39</td>
<td>6.26</td>
<td>5.26</td>
<td>3.16</td>
<td>1.60</td>
<td></td>
<td></td>
<td>28.22</td>
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<tr>
<td>Woodruff</td>
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<td>4.62</td>
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<td>4.66</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20.12</td>
</tr>
</tbody>
</table>

The height of vegetation as well as leaf area affects water use. For example, grass that is about 10 inches tall prior to grazing requires more water than grass that is 4 inches tall immediately following grazing. Note that
water use decreases during grazing and increases during the recovery period prior to the next grazing (Figure 1), which is based on a cycle consisting of 1 week of grazing followed by 4 weeks of recovery.

In Cache Valley, average pasture water use varies from 0.1 inch per day in April, to about 0.25 inches per day in late June through July and then declines to 0.1 inches per day in September (see Figure 2), which means the interval between irrigations on a loamy soil could vary from 20 days in May to 12 days in June and July, and increase again to 20 days in late August into September. (Typical seasonal variations in monthly pasture water use rates are given in Table 1 for selected Utah sites.) Seasonal crop water use of adequately watered pastures is about 80 percent of seasonal alfalfa crop water use, Hill said.

For optimum growth and forage production of pastures, couple adequate nitrogen fertilizer with irrigation, particularly following grazing, Hill said. Avoid excessive irrigation, which could leach nitrogen. JD

**GUIDELINES FOR PASTURE RENOVATION**

A pasture contains living forages and grazing livestock. A corral is used to capture and hold animals.

It’s an obvious distinction. Unfortunately, many so-called pastures in the state bear a striking resemblance to corrals—overgrazed, weed-choked, and under-managed, according to USU soil scientist Robert Newhall.

When productivity of a pasture is less than 50–75 percent of potential, it’s time to renovate, Newhall said. It may also be time to change management tactics.

First create a clean slate by eliminating weeds and other plants by applying the appropriate herbicides in late summer and again in the spring.

USDA-ARS range scientist Howard Horton said it may be beneficial to split herbicide into two or three applications.

Dividing the amount recommended for one application among the treatments will reduce toxicity to germinating and emerging seedlings.

Select the correct mixture of species and varieties for the site to extend the grazing season and improve forage quality. Make sure varieties complement each other and limit the duration of grazing so preferential selection doesn’t foster conversion to a single species.

**A NITROGEN BOOST**

Include a nitrogen-fixing legume, such as alfalfa, trefoil, safflower, or cicer milk vetch, in grass seedings. The nitrogen benefits grass growth and reduces the need for commercial fertilizer.
A lot hinges on seedbed preparation. The seedbed should be free of competition—firm but not packed, fine but not powdery, and moist but not soggy. Horton said a loose seedbed allows too much moisture to escape, thereby impeding germination and early establishment.

As a test, stand on the seedbed while wearing a pair of cowboy boots. If the boot impression shows the heel, toe and ball of the foot, but not the instep, the surface is right for seeding, Horton said.

Seed legumes about 1/4-inch deep (slightly deeper in sand for adequate moisture) and grasses about 1/2-inch deep.

"Seed placement is crucial," Horton said. An added half inch of depth can reduce the stand by 25 percent.

**SEVERAL SEEDING OPTIONS**

Double-disk furrow openers with depth bands provide good seed placement. Many grain drills, corn planters, and minimum-till drills can be converted to grass drills by adding a depth band to one side of a double disk furrow opener.

Broadcasting seed can be successful if drill seeding isn’t possible. Increase the seeding rate by 25 percent and cover the seed with a harrow, or press it into the surface with a cultipacker.

"A spike toothed harrow is about the last choice. But if the choice is between broadcasting and harrowing or drilling too deep, use the harrow," Horton said.

Fertilizer may be necessary, but don’t apply it too close to the seed. Band the fertilizer away from the seed and let water transport the nutrients.

On flood-irrigated pastures, plant in the early spring to reduce the risk of surface crusting. Plant sprinkler-irrigated pastures before May 15, or from mid-August to mid-September so plants are established before winter.

Don’t graze new seedlings until they can withstand being pulled up or trampled by grazing animals. Dryland pastures may require two growing seasons of restricted use. Many irrigated pastures can be grazed after just one growing season.

Pasture renovation also improves esthetics, and can aid farmland preservation.

"Let’s not put houses on pastures," Newhall said. "Don’t let the land deteriorate so much that there is nothing you want to do but sell it." LH

**MORE INFO**

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MANAGEMENT'S
THE KEY TO
INTENSIVE GRAZING

Utah lags behind several eastern states in the popularity of intensive grazing, but there's certainly plenty of interest in the technique—and a few solid examples of its success.

There are also plenty of caveats. “Rotation grazing is a widely popular concept, but one that's seldom implemented,” said USU Extension range specialist Allen Rasmussen.

One adherent of the technique is Ron Boman, USU Extension dairy scientist. For several months, Boman was skeptical of the feasibility of intensive grazing, but the more he visited the dairy operation of Ellis Roberts, Fairview, Idaho, the more convinced he was that the technique worked.

Based on the parameters used in Roberts' operation, such as pasture size and grazing intensity, Boman converted 80 acres of his family’s alfalfa farm to a system of intensive grazing to raise replacement dairy heifers on a contract basis. Pastures largely consist of perennial ryegrass, with some alfalfa remaining from the previous stand. He estimated the cost of conversion (fencing, water tanks, etc.) at $300 per acre, and thinks he can recover those costs in a year or two.

So far, things have worked in his favor. Heifers gained about 2 pounds per day. Boman grazes 60 1,000-pound heifers on pasture cells of about 1.2 acres, after cutting a crop of hay in early June. To extend the grazing season, Boman also planted some turnips, which are grazed in strips by advancing the fence. Heifers eat the top first, then tackle the tubers.

Boman said the key to intensive grazing for dairy production is to begin grazing when grass is 6-8 inches high, and to provide paddocks that are grazed down to a height of 3-4 inches in 12 to 24 hours, when they are moved to another cell. If planned properly, the grass remains in a highly nutritive, vegetative state. Adherents claim that it slashes production costs by reducing investment in equipment and facilities.

Roberts has 140 milking cows and 100 dry cows and dairy heifers on 100 acres of ryegrass-white clover pasture. Boman said Roberts’ milk production cost is about $7.00 per cwt., similar to costs in New Zealand and other countries where the system is widely practiced.

Intensive pasture-based dairying slightly reduces milk production, but appears to improve animal health and longevity. On Roberts’ farm, the culling rate has declined to 20 percent from 35 percent.

Still it's a management-intensive system. Water on demand is essential. Boman irrigates every 7-10 days and after each grazing.

HEFTIER CALVES

USU animal scientist Randy Wiedmeier is studying an accelerated system of raising slaughter weight calves on pastures, a possible option for some ranchers seeking alternatives to public lands.

The system involves more management than traditional cow-calf operations, and requires slightly larger cows (1,300 pounds vs. 1,100 pounds for cows on rangeland) capable of producing 20 pounds of milk daily, along with artificial insemination to bulls proven to pass the propensity for rapid growth to offspring. In addition, calves receive creep feed starting at 100 days of age. Calves weigh 850-900 pounds when they are weaned at 240 days. They then enter a feedlot for 90 days and are finished on a ration containing 60 percent grain and 40 percent forage.

Although the cost of production varies, Wiedmeier said the system has consistently resulted in average returns of about $300 per cow, which about triple returns from a well-managed cow-calf operation selling feeder calves.
There are still several questions about the accelerated production system, such as the source of replacement calves and the suitability of natural service. Nonetheless, several more demonstrations are scheduled for next year, including a 60-cow herd at the Redd Ranches in LaSal, Utah.

Wiedmeier hasn’t yet utilized improved pastures or intensive pasture rotations in his system. Improved forage quality would probably reduce the amount of creep feed required.

**Few Health Risks**

Intensive pasture production may increase the risk of infection by some internal parasites such as roundworms, said USU Extension veterinarian Clell Bagley. Producers should consider worming animals before putting them on pasture. Monitor roundworm infestations by counting eggs in the droppings of 6-10 of 100 animals two to four times during the year.

Roundworms are less of a threat if forage is harvested once, or if pastures are alternately grazed by other species.

Liver flukes may be a problem if there is standing water. Fortunately, a new diagnostic test aids detection of this parasite.

Bleached hair coats may be a symptom of copper deficiency associated with a pasture-based system of production. It can be treated by providing salt containing copper sulfate.

**Basic Calculations**

Those considering intensive rotation grazing should answer a basic—and surprisingly complex—question: What size should pastures be?

"Intensive rotational grazing isn’t a panacea. I’ve seen every system work, and I’ve seen every grazing system fail," said Rasmussen. With rotation grazing, a miscalculation can mean you could run out of forage—and will be out of business. It has happened.

Success hinges on commitment to more intensive management, which includes carefully monitoring forage condition and making the appropriate adjustments.

The principles underlying an intensive grazing system for beef cattle are similar to those for dairy herds, except there’s no advantage in pasture rotations shorter than 1 week for beef cattle (or about 3 days for steers), Rasmussen said.

Rasmussen worked with Utah Power & Light Co. to establish a system of rotational grazing involving four pastures and 2-week grazing periods on about 1,200 acres of nonirrigated pasture at Cutler Reservoir.

Before the system of rotation, cattle tended to congregate on high points in the wetlands pasture. Now, however, they’re making more use of cattails, aiding the spread of sedges and maintaining watershed and improving wildlife values.

Forage production for the site was calculated based on information about range condition and forage yields available from the Natural Resource Conservation Service. Forage yields were underestimated during a poor year, but adjustments were made. This year, forage utilization closely matched supply on all but one pasture.

Rasmussen said determining stocking rates is a complex question, especially if pastures don’t receive water uniformly and quickly after grazing.

He is also concerned about the ability of some grasses to avoid winterkill under the pressure of intensive grazing.
"Perhaps some pastures can't handle being grazed down every fall. Winterkill might be reduced by allowing more regrowth during fall."

If not, the cost of pasture renovation every 4 years or so would be prohibitive. On many wet meadows, renovation may not be possible.

Another problem—grasses tend to be more productive in the spring and fall, which may require the use of additional areas as a "buffer" during the summer. KG

Go Figure. . .

Intensive rotational grazing has an intuitive appeal—it's a "green" alternative to intensive confinement production systems, one that's seemingly less costly. But don't be deluded into thinking that it's a simple option, said Allen Rasmussen, USU Extension range management specialist. If anything, it's a system that requires top-notch management—and a willingness to do some math.

The key is to balance the supply of forage with the demand, and then determine the appropriate rotation. It sounds simple, but it's not.

Determine forage supply

Hay yields are a reasonably good indication of potential yields. If those aren't available, use the following figures.

Forage production

<table>
<thead>
<tr>
<th>Type of forage</th>
<th>Yield (tons/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perennial ryegrass</td>
<td>6-7</td>
</tr>
<tr>
<td>Brome grass</td>
<td>3-4</td>
</tr>
<tr>
<td>Orchard grass</td>
<td>3-6</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>3-6</td>
</tr>
<tr>
<td>Native grasses</td>
<td>1.5-6</td>
</tr>
</tbody>
</table>

Number of pastures

The number of pastures is determined by dividing the number of days rest by the length of the grazing period. The grazing period for beef is about 7 days, with a rest period of 20 days in the spring and 40 days in the summer and fall. Thus, six pastures would be required for a cow-calf operation (40 days rest / 7 days grazing period). Areas not grazed during the spring should be cut for hay.

Determine forage demand

The daily forage demand for a cow-calf operation is 2.5% of average body weight. Multiply that amount by the number of days in a grazing period to determine forage demand per rotation.

In a 100-cow herd with an average weight of 1,000 lbs., 2,500 lbs. of forage would be required daily (100 cows x 1,000 lbs./cow x 0.025%)

Size of pastures

In the example above, determine the size of each pasture by dividing the forage demand per rotation (2,500 lbs./day x 7 days) by the amount of forage produced in each rotation. In the example above, if 1,800 lbs. of forage are produced per rotation, each of the six pastures should be 9.7 acres, e.g., forage demand per rotation of 17,500 lbs. (2,500 lbs./day x 7 days) divided by forage production/acre/rotation of 1,800 lbs.

Adjust the rotation grazing system according to forage supplies, which depend on weather conditions, the accuracy of initial estimates, and pasture conditions.
USU's reputation in agricultural research attracts students from around the world.

The exchange is mutually beneficial—the students gain valuable expertise and USU enlists their support on a variety of important research projects.

Among the international students is Isabel Souza, a research agronomist with the Brazilian Corporation for Agricultural Research (EMBRAPA), the equivalent of the USDA's Agricultural Research Service. She and her husband, Camilo Andrade, are employed at a research station in southeast Brazil that specializes in corn and sorghum. While her husband earns a PhD in Biological and Irrigation Engineering at USU, Isabel is earning her PhD in the Plants, Soils & Biometeorology Department.

Corn yields in southern Brazil are about half those in the United States.

Souza and USU agronomist Jennifer MacAdam are studying the regulation of leaf growth in the B73 corn inbred. Of particular interest is the role of peroxidases, enzymes that, at a critical period during leaf growth, cross-link components of the cell wall, preventing further growth.

Souza found that levels of one particular peroxidase peak in the region where leaf elongation ceases, an indication of peroxidase's important role in leaf growth. Moreover, she has manipulated the leaf growth zone length, by using a closely related dwarf mutant of b73 and by adding gibberellic acid, a growth hormone, to the normal plant.

The ability to control peroxidase levels, either through breeding or genetic engineering, promises to be a key factor in altering leaf growth in a variety of agronomic crops.

For example, crop breeders may want to increase growth of palatable leaves in forages. In corn, however, they might want to do the opposite—modify growth so each plant supports only enough leaf growth necessary for a single ear of corn, thus making it possible to increase planting density, results that are as useful in Utah as in Brazil. KG
PHOTOQUIZ

Clue: Microscopic granules inside a common field crop.

Correction: Last issue we featured cowboy and writer Lyman Hafen's interview with environmentalist and writer, Edward Abbey. The interview was excerpted from Hafen's recent book, *Roping the Wind*, available from USU Press. The correct phone number for USU Press is 1-800-239-9974.