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T urns out that the surest way to reduce crop yield, digestibility and profit of alfalfa is to harvest it. Making hay, even when the sun shines, is a losing prospect, and losses continue even after the hay is in the barn or silo.

In fact, by the time it is fed to an animal, hay will lose 30 percent or more of the nutritional value it had standing in the field, according to a detailed assessment of haymaking methods presented at the first Intermountain Nutrition Conference in Salt Lake City.

Several factors can decrease the crop's value even more, and not much can be done about any of them, said Alan Rotz, a USDA Agricultural Research Service scientist in Pennsylvania.

First, between 25 and 30 percent of the crop will be lost in cutting, drying and baling, Rotz said, adding that rainfall during the normal three to seven days required to dry the hay can greatly prolong the curing and can increase loss by another 30 percent.

Storage methods also decrease yields, especially if hay is stored outside, in silos or under high-moisture conditions, Rotz's research shows.

Rotz reported similar figures for silage production, says losses at harvest occur in two ways: detachment of leaves and the internal depletion or degradation of plant nutrients. Soluble carbohydrates are lost in the drying, and soluble nutrients are leached out by rain.

"Overall, the sum of these losses causes a gain in fiber concentration, a decrease in digestibility, and a small change in crude protein concentration," Rotz said.

Plant respiration rates decrease as the plant material
Losses in large round bales stored outside can vary from 3% to 40%. Factors with the greatest impact are weather, length of storage, and storage method.

**Baling can cause between a 2% and 5% loss.**

**Raking hay can cause anywhere from 1% to 20% loss.**

**Cutting hay can cause about a 5% loss.**

dries, approaching zero at about 30 percent moisture, Rotz noted. (Hay is normally dried in the field to a moisture content below 20 percent.) If the crop is rewetted by dew or rain, enzyme activity is reactivated, which prolongs respiration and allows bacteria, yeast and fungi to develop that then cause further respiration loss.

Rotz reported that the key factor in determining how extensive rain damage will be is the moisture content of the crop at the time of the rainfall.

He said most data indicate that rain early in the drying process causes less loss, but he added that any delay in harvest can retard the growth of the next crop, thereby further reducing the yield of the entire season.

The impact of raindrops on the crop causes leaves to be severed from the stem and fall to the soil. Because leaves contain a higher concentration of important nutrients for the animal, any loss of leaves can reduce forage quality.

“This is particularly true for legume species; less so for grasses,” he said.

Loss caused by rain damage can greatly alter the quality of the remaining forage. Leaching loss and the microbial respiration resulting from rain damage have a more marked effect than leaf loss on the concentration of many plant nutrients. These nutrients come primarily from the cell contents of the plant, and they are highly digestible nutrients for the animal, he said.

“Therefore, rain damage causes a decrease in crude protein concentration, a substantial decrease in digestibility, and an increase in fiber concentration.”

Cutting hay can cause about a 5 percent loss in crop yield, according to the research. The loss, which depends on the maturity of the crop, increases as the plants mature from a late vegetative stage to full bloom.

Crop loss from raking varies widely with reported values ranging from 1 to 20 percent of crop yield. Loss is influenced by crop moisture content and the density of the forage swath.

Speeding up drying with a rotary windrower rake tends to cause loss, Rotz said, because the sweeping action allows plant material to become entangled with
the stubble and increases the loss of high-nutrient leaves.

Crop yield loss from baling varies between 2 and 5 percent, with a slightly greater loss from large round balers than from small rectangular balers, he said.

When hay is baled at night, leaf moisture is higher, and loss from compression in the baling chamber can be cut in half, according to the research. Chamber loss is mostly high-quality leaf material and therefore has the greatest effect on the quality of the remaining forage than most other machine losses, Rotz said.

Storage can also further degrade quality. Unprotected hay stored outside experiences the same loss as hay stored inside plus an additional loss from weathering on the exposed bale surface.

Losses in large round bales stored outside vary widely, ranging from 3 to 40 percent. Of the factors affecting this loss, weather, length of storage, and storage method have the greatest impact.

Loss in stored hay is primarily caused by microorganisms, and the biological activity is greatest when the hay is moist and warm.

Rotz said field losses in haymaking can be reduced by baling at a moisture content near 25 percent. Baling moist hay reduces baler chamber losses while providing a small increase in harvest yield (up to 2 percent) and harvested quality. Raking and pickup losses also may be reduced slightly. Field curing time on average is reduced one day, which reduces the potential for rain damage.

With all factors combined, harvested dry matter yield is increased an average of 7 percent, he said. Most hay deteriorates rapidly in storage, however, offsetting the benefit of reduced field losses unless treated to enhance preservation.

One alternative to preservation treatments would be a low-cost drying system during storage that would push ambient air through the stack during the first month. The air movement dries the hay and prevents heating and mold. Losses and nutritive changes are maintained at a level similar to dry hay.

Improvements to reduce these component losses can be helpful, but most of the improvements will not provide a substantial change in the total system, he said, noting that one would be to reduce outside storage of hay and silo storage where losses often exceed 10 percent. JT
How in the world did animals ever become known as creatures of habit when the only habit the world has is change?

That’s easy, says USU animal behaviorist and range scientist Fred Provenza: “Habits can offer a sense of predictability and security in an unpredictable and dangerous world.”

The interesting question—the one that spurs Provenza’s research—is why creatures will stick to old habits or do their best—even die trying—to hang on to something familiar when change comes along and what causes them to ultimately change their ways.

Life for all animals, humans included, is a rock and a hard place, says Provenza, who has been exploring the territory in between for about 20 years. “While habits and being careful help us cope, having the ability to constantly adapt to change, not clinging to familiar routines in the face of change, is ultimately how we survive.”

The power of habit and the force of change are constantly colliding. It can be seen in everything from livestock walking a fence to get “home” after being moved to a new range or pasture to the relief in the face of a lost and hungry American tourist who has just spotted a McDonald’s in a foreign country.

The best that both the herbivore and tourist can do is act based on past experience in an attempt to find order or comfort in a strange situation, Provenza says.

Provenza has focused his research on the behavior of foraging livestock, which to most people looks like little more than an idle wandering search for food and place to rest.

“It is far from a routine activity,” he says. “Foraging is as vital and dynamic to the animals as making a living is to the guy overseeing them; life for both exists at the boundary between order and chaos.

“Animals do not innately know what to do when faced with change and have a habit of sticking with a situation, place or food that appears to be familiar,” Provenza says. “Life teaches over and over that a lack of cautious regard for novel environments or strange food is risky.”

However, he adds, any individual, population, or species that hangs on to old ways too long and cannot adapt become extinct.

Climate, soils, plants, herbivores and people are interrelated parts of systems that change constantly. “Habit is in a way phantom comfort because even those we have developed to try to make order out of life eventually must change.”

For grazing livestock, nutritional needs change, the quality, quantity and toxicity of plants change, sometimes within hours, and constantly alter food preferences.

Changes for both wild and domesticated animals also occur when they are moved by humans to unfamiliar environments. In an effort to hang on to what they know, they will walk farther, eat less food, and suffer more from malnutrition, toxicity and predation than animals in familiar environments.
Research shows that when moved to a new territory, sheep in an effort to find familiarity will stray as much as 90 miles from a herd that is used to the same rangeland.

Wild carnivores will search long and hard for the familiar after being moved, as is being shown in the Colorado program designed to reintroduce the lynx in areas near Vail and the San Juan Mountains. Many of the cats have strayed far from those areas and died of starvation.

Evidence provided by numerous controlled tests and from numerous ranchers and producers who are implementing Provenza’s research indicates those that continually and carefully adapt—those who learn new tricks even if they’re old dogs—manage to survive and thrive.

For managers and producers, that means being flexible and creative and taking a systems-level perspective of their operations rather than doing things simply because that’s the way the ranch or dairy or farm has always done them, Provenza says.

The fact animals aren’t born with but learn food and habitat selection behaviors creates opportunities for managers, he says. Animals also can be selected or culled based on food and habitat they choose.

He cites riparian areas as an example. Convention and tradition dictate that rivers and creeks are “sacrifice areas” that must be fenced to keep livestock out, years ago with barbed wire and now with electric fences.

Fences are expensive, they create boundaries within grazing allotments, and they interfere with the movement of wildlife and people. And unless streams are excluded from grazing, fences don’t limit use of riparian areas by livestock.

Bob Budd, manager of the Nature Conservancy’s Red Canyon Ranch near Lander, Wy., has found a behavioral alternative to fencing: herding on horseback.

Riding is not typically used as a means to enhance cattle dispersion because most people apparently believe the time and effort required to ride don’t offset the costs.

Budd says, however, that the costs of riding are more than made up by the benefits from additional forage,
improved herd care and health, and less-trampled creek areas.

At Red Canyon, a single rider on horseback has been training adult cows in a 900-head herd and their offspring to use uplands more and riparian areas less. The rider identifies cows and calves that consistently use riparian and upland areas so that undesirable individuals can be culled and desirable individuals kept.

Budd points out that most “wrecks” for producers occur because animals aren’t ready to move. Cows don’t move well without their calves, he says, and a cow without her calf moves slowly and eventually runs back, taking most of the herd with her.

He says ranchers can help themselves by planning moves that coincide with a decrease in the abundance of nutritious forage in one location and an abundance of food in a new location. Doing so exchanges a negative motivator (lack of food) with a positive (abundant food). If the pattern is repeated enough, cattle will move readily because they have learned that good things happen when they move.

By encouraging cows and calves to use uplands, and discouraging use of riparian areas, it is possible to enhance dispersion and to obtain more uniform use of all land.

Provenza says because adult animals have a habit of returning to the home ranges of their mothers, riding can be used to change food and habitat selection behaviors of calves kept as replacements in a herd.

Eating particular foods and living in particular environments as young animals increases the fre-
quency of those behaviors when they become adults, he says.

“Calves that have learned to prefer foods in riparian areas frequent riparian areas as adults, just as people who have learned to like pizza as youngsters frequent pizza parlors as adults.

He says managers who retain replacement heifers from their own herd use the power of experience early in life. They select for animals reared in the environment where they will need to make a living, and save themselves the stress of the so-called “year from hell” that occurs as replacements from other areas adapt to new environments.

**Striving for the routine**

Habits or routines are patterns of acquired behavior that have been repeated so often they are automatic and thus often difficult to break.

Habits, by their nature, can become a deterrent to exploring new possibilities, for both foraging animal and humans, Provenza says.

“There is an on-going tension between curiosity about new things and a suspicion of them,” he says. “When nutritional and physiological conditions are adequate, familiarity breeds content and strange foods will be avoided.”

He says foraging behavior, after years of selecting particular foods and forage in specific locations, can become rigid to the point that the behavior appears to be the animal's nature. It is, in fact, habit that has been learned.

**Change Begets Change**

Animals are more reluctant to make transitions from the familiar to the unfamiliar as they age and become set in their ways.

However, change is inevitable at all ages due to fluctuations and perturbations in social and physical environments.

Nothing is more variable than the weather, and nothing has a bigger impact on plants and herbivores, yet it is one of the least predictable of natural phenomena. Weather influences if, when and how much plants produce; it also influences plant chemistry.

In turn, plants influence if, when and how much herbivores produce. Weather also influences where herbivores go. In studies on summer range in Idaho, drought caused marked changes in home ranges of cattle. During a drought, cattle that typically spent the summer in one valley were forced to walk to water in an adjacent canyon. They then returned to the home area to forage and rest.

Experiences early in life and drought interacted to influence cattle use of the environment.

Individuals preferred the home range of their mother, but drought caused them to move at least temporarily to unfamiliar locations.

*Animals learn many things from their mothers, including food and habitat selection behaviors.*
Calves reared by cows during a drought learned different habitat selection behaviors than calves reared during years of ample moisture.

Different experiences early in life help explain why some adult cows had home ranges that encompass several valleys, whereas others had home ranges that include only one valley.

The tendency to explore options that may or may not pay off is higher in animals that are nutritionally deficient than in animals that are meeting their nutritional needs. Ruminants experiencing deficits readily eat novel foods, including items that well-fed animals avoid.

Angora goats deficient in protein sample novel foods, including woodrat houses because chambers inside the houses contain a cake of urine-soaked (nitrogen-rich) vegetation that helps rectify the goats' nitrogen deficit.

Horses deficient in selenium eagerly eat supplemental blocks that contain selenium for similar reasons. Lambs fed a basal diet inadequate in macronutrients quickly ingest novel foods high in protein or energy while lambs fed a basal diet adequate in macronutrients are neophobic.

Research by Provenza's group shows that sheep in unfamiliar environments prefer food they know over food they don't, even if the familiar food has previously made them sick. The studies also show that when animals become ill after eating both familiar and novel foods, they will avoid the novel foods but not the familiar ones in ensuing meals.

If they become ill after a meal of novel foods, they avoid the foods whose flavors are most unfamiliar.

"Collectively, these results show the cautious regard animals have for new foods specifically and anything novel generally," Provenza says.

Typically as conditions in the environment worsen, animals are forced to explore new options. In a way, necessity becomes the mother of invention, he says.

"The key is not to let short-
Homebodies and wanderers

Homebodies stick with what works; they don’t readily get “fed up with” what is familiar to them. Wanderers behave in a whimsical way. They are satiated readily.

Provenza’s research shows that some lambs are homebodies and some are wanderers. Experiments on mother-offspring interactions show that most lambs are homebodies—they go with mother and do what she does. However, roughly 10 to 20 percent are adventurers—they go their own way and do their own thing.

Likewise, most lambs are neophobic—they regard novel foods with caution. But some lambs have little fear of eating novel foods or being in novel environments. Adventurers with little fear of the unknown either end up dead or they discover new resources.

The percentage who try new things actually allow for the group to adapt.

It is the same with humans, Provenza says. People who weigh information carefully and seek to optimize their behavior provide stability and efficiency in society. However, the smaller number who behave randomly and ignore conventional rationality, enable the system to adapt creatively to new challenges.

Sightedness blind us to opportunities to change behavior—our own and that of the creatures we manage.”

New Mexico rancher Jim Winder uses a creative combination of supplemental food, water, sirens and motorbikes to move livestock.

The cattle learn that there will no longer be water available in the “old” area—the fence around the water will be closed—and there will be food and water available in the “new” area.

The key is to train the animals to recognize that the siren means positive reinforcement (food, water, salt) in the new area, and punishment (lack of water and salt) in the “old area.”

Winder, a 4th-generation rancher, says he is generally trying to move toward change and innovation instead of bucking it because he considers ranching in the West “a house on fire. We have to find ways to innovate or we’ll lose a way of life.” JT

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Some call it organic or alternative farming. Some call it crazy. John Borski, president of the Northern Utah Organic Group, calls it “responsible farming”.

Beyond the search for what to call it, finding a consistent definition of organic farming can be problematic as well. And the issues that crop up when discussing organic farming are often far more complicated and deeply felt than what’s in a name.

In general, organic farming refers to agricultural systems that produce food and fiber without the use of synthetic pesticides, fertilizers and other chemicals. Organic farmers rely on biological diversity, heavily composted soils, information shared with each other and a market comprised of consumers who believe that organic means safer, healthier and tastier.

But what is ‘organic’ in one place may not be somewhere else. There are currently no federal regulations defining organic for the country. The USDA began drafting regulations after the Organic Food Production Act of 1990 was passed by Congress. But the proposed rules were not published until 1997, and then met with criticism from growers and from state agencies that would be charged with enforcing the regulations. They still have not become law.

At this year’s Utah Green Industry conference, Ed Bianco of the Utah Department of Agriculture and Food explained that the state has not moved forward drafting rules of its own to define and regulate organic food production because local rules will have to comply with future federal regulations. And state agriculture leaders had plenty of concerns with the federal regulations proposed in 1997.

Bianco said language in the regulations was frequently unclear. Among the more serious ambiguities were not quantifying “insignificant” amounts of chemical residues that could be permitted, or the “small portion” of non-organic feed that could be given to organically raised animals “as necessary”, nor did they limit how often the non-organic feed might be deemed “necessary.” There were also big financial concerns among state agencies that would be responsible for monitoring organic certification but without compensation from the federal government, Bianco said.

At the conference, Borski said the Northern Utah Organic Group and organic grower organizations in other states were also unsatisfied by the USDA’s proposed rule. Among their objections were provisions allowing use of some synthetic chemicals, irradiation during food processing and use of hormones and antibiotics in cattle that could still be certified organic.

So for now, private certification groups offer their services, for a fee, but regulations vary from group to group, Borski said. Currently, the Northern Utah Organic Group has 25 growers seeking certification and 15 certified farmers. While Borski grows a wide variety of vegetables, fruits and flowers at his Kaysville farm, most growers in the group are grain farmers.
With precarious profit margins haunting growers, organic or not, why do people take on the added challenges of organic farming? Many have an almost evangelical zeal about promoting organic methods and very strong beliefs about the kinds of food they put into their bodies. They also have grave concerns about the effects of synthetic chemicals on human health and the land, Borski said. Some see the organic food market as a growing and highly profitable niche, causing Borski to stress the importance of ethics in addition to simply meeting certification requirements. Issues of being good stewards of the land, open space preservation and the importance of supporting small, local farms are also issues Borski and his colleagues promote.

In addition to a lack of consistent rules and guidelines, organic farmers often find a frustrating lack of information coming from sources that traditionally assist agriculture. Because research done on organic methods and outcomes is only a tiny piece of the agricultural research pie, Borski said he and other growers rely largely on sharing information with each other, reading whatever they can about plants, insects, soil and water, experimenting with their own ideas.

USU plant scientist Larry Rupp, an organizer of this year’s Green Industry Conference, said there is increasing interest in organic farming among growers, but little solid research on which to report. There are people willing to share anecdotal information about their practices, but scientists don’t base presentations and papers on stories of what may or may not have worked in a single, specific incidence. Scientists design and conduct experiments, study their colleagues’ findings, analyze data then write and present papers in hopes that others will validate their work by repeating the experiment and reaching the same conclusion.

Utah Agricultural Experiment Station Director Paul Rasmussen said there have been relatively few requests for scientists to spend time on organic methods, with the exception of some integrated pest management techniques such as trapping, disrupting mating and using insect predators to control pests.
“There is also a misconception among many people that if it's organic it's safe,” said Rasmussen. “But there are many toxic compounds in plants that occur naturally.”

He added that price is what drives most consumers. While some are willing to pay a higher price for organic foods and accept produce that sometimes appears less than “perfect”, the larger part of the market wants to pay a lower price for produce with a predictable taste and appearance.

That raises the problem of making things difficult for farmers and processors in the United States who do use synthetic chemicals so that they leave the market and leave price-conscious consumers dependant on imported foods with lower price tags and unknown pesticide histories.

Borski said he has no problem marketing his produce, in part because selling things has always been one of his strengths and in part, he believes, because people search out good, organic food and flowers. His produce stand in Kaysville stays busy from late spring through the fall with a stream customers, though early on he sometimes took less than an “organic price” for the produce. He sees educating consumers about his methods and the results as part of being an organic farmer, and has developed a base of devoted customers who willingly look past an occasional worm to get to the sweet corn they desire and who know that the best tomatoes aren’t always uniform in size and color.

“People wonder why I do this, but to me it's just more practical to pay closer attention to my soil and water, treat my soil like a living thing and compost right than to spend thousands of dollars on chemicals and equipment,” Borski said.

“Chemical companies and big farm operations can promote their products to death. It's up to all of us in organic farming to tell our story and try to make a difference ourselves.”

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**TRANPLANTED TREES AND SLOWER GROWTH RATES**

In arid climates such as the Intermountain West, transplanted trees can recover fairly quickly from water stress after being moved, but their growth rates are much slower to catch up, new research shows.

The USU Department of Plants, Soils and Biometeorology reports that 18 weeks after the April 1995 transplanting of three Norway maples and three littleleaf linden the trees had recovered leaf water potential of nontransplanted trees.

However, even after two years, neither of the transplanted tree species had recovered to nontransplant apical growth rates.

The study was undertaken because the establishment rate of transplanted trees in low-humidity regions is not known. Research has primarily been conducted in areas where humidity is high and evaporation demand is much lower.

All six trees in the study survived, but researchers advise area arborists, landscape contractors and horticulturists working with transplanted field-grown trees with limited irrigation to be aware that the length of time required for trees to establish could be much longer than research in other parts of the country indicate.

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**SAGEBRUSH AS FORAGE?**

Although it's widespread, nutritious and dominates many plant communities, big sagebrush is all but ignored by grazing animals.

It is a nutritious plant but considered so toxic that it deters feeding by herbivores. Despite that, interest in increasing its value as a forage plant as well as suppressing its spread remains high.

New research with lambs shows that they will increase their intake of sagebrush by 50 to 100 percent if they are given supplements of barley and activated charcoal.

__continued on next page__
The study indicates that barley provides macronutrients that may facilitate detoxification of the terpenes and other poisons in sagebrush.

Activated charcoal may absorb the toxic compounds, allowing animals to increase sagebrush intake. Because it is highly porous and absorbent, activated charcoal is commonly used in poison control centers to counteract drug overdoses and accidental poisonings.

Increased use of sagebrush as feed would not only provide a new food source, grazing it would increase types of vegetation in those areas.

More info

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USU’S DAIRY BREEDING PROGRAM TOPS

Utah State University’s breeding program has been dubbed best in the nation by several prominent representatives of the dairy industry from several states.

At the Spring Western National Holstein show, which was part of Richmond’s Black and White Days, more than 150 dairy cattle from seven states were entered.

USU dairy received the Premier Breeder award, which was considered the top honor at the show. The Caine Dairy, a farm operated by USU, tied for Premier Exhibitor and exhibited Reserve Champion Bull and Reserve Champion Cow. First Place was also given to best three female cows.

There was also an All Utah Dairy Show in Plain City on April 23. USU placed first in six classes.

These awards are noteworthy because they let other people know about the breeding program, said Jonathan Merriam, an instructor in the dairy herdsman program. The goal is to develop highly productive cows through careful breeding and selection. Now the program is beginning to grow in enrollment, thanks to increased faculty, but there are still three times more jobs than there are graduates, he said.

At the rate the population is growing, there is less land on which to raise cattle—forcing the industry to become more efficient and productive. Research is focused on increasing milk flow and nutritional value such as calcium and butterfat per ounce of milk.

More info

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Utah farmers have a long history of regarding retirement much like the weather—a force pretty much beyond their control.

The attitude has been changing during the past 15 years, according to a new survey showing that farmers today look at retirement as something to plan for, not something to just try to get through.

The survey, which was sponsored by the Utah Agricultural Experiment Station and conducted by the Department of Human Environments in USU’s College of Family Life, shows that 80 percent of farmers in Utah now have a savings investment plan for retirement.

The survey, which addressed several aspects of financial planning, also shows that farmers are less indebted, with 35 percent reporting they are now debt-free, and another 11 percent saying they will be by the end of 1999.

The survey polled 280 working farmers across the state by mail this past year; results were compiled in May.

The survey clearly shows that farmers are making their financial plans almost in the same proportion as people in other businesses, said Joan McFadden, department head and co-coordinator of the survey. “This was not the case, even as late as the 1980s.”

Some farmers (23 percent) are banking on the sale of the farm as a source for retirement income, a figure that reflects the current pace at which farmland is being sold for development in the state.

That figure is counter to what farmers say they would like to see happen to their farm: 80 percent would like the farm to stay in the family and to use the income from the farm during retirement.
Of those who said they plan to sell their farm, 19 percent said they would sell to the highest bidder regardless of intended use. Fifteen percent said they would sell the farm only if it were used as a farm. About 6 percent said they would subdivide the property.

Most of the farmers (93 percent) said they consider Social Security a prominent source of income in retirement. Half said they have a pension plan. Roughly 60 percent said they plan to lease or rent their farmland.

The most common form of savings among farmers, according to the study, is the Individual Retirement Account (IRA)—42 percent said they have an IRA.

The survey shows that farmers not only match the desire of other American workers to make personal financial plans, they are saving at about the same or slightly less rate.

About 11 percent said they have savings accounts totaling between $75,000 and $100,000; 9 percent said they have IRAs at that level, and 15 percent said they have stocks totaling that amount.

The largest grouping of farmers (27 percent) say they have savings accounts totaling between $1,000 and $10,000. The next largest group (19 percent) reported they have IRAs in that range.

According to Stacy Smith, co-coordinator of the survey, while most farmers report using a professional financial planner to map out retirement, the planner's influence was not readily apparent in their responses of what they planned to do with the farm in retirement.

However, those who did/do not use financial planners, most do not plan to sell their farm for income in retirement. Of those who did/do use financial planners, 33 percent said they are planning to sell their farm property for retirement income.

The survey also reconfirms the notion that farmers in Utah supplement their farm incomes to a large degree: 33 percent of those reporting they worked full time on the farm also said they worked full time off the farm.

Additionally, 44 percent of those that said they worked full time on the farm said they worked part-time off the farm.

Fifty-eight percent of those who said they worked part time on the farm reported that they also worked full time off the farm.

By reporting you are a farmer you also report you are something else, Smith said. Obviously, not everyone chooses to farm full-time, but the long tradition of having to supplement the activity with other jobs shows through, she said.

Seventeen percent said their spouses also farm full-time; 42 percent said their spouses are part-time farmers. (Ninety-two percent of farmers in the survey were male.)

Just over half said farming represents about 25 percent of the family's income.

For farmers 40 years old or younger, only 40 percent said their total gross family income is made by
Sources which contribute to farm income...

- Grain: 60%
- Forage: 70%
- Beef: 50%
- Sheep: 5%
- Dairy: 40%
- Vegetables: 10%
- Fruit: 10%
- Other: 20%

Percentage of farmers who only grow or produce...

- Grain: 30%
- Forage: 30%
- Beef: 20%
- Sheep: 5%
- Dairy: 50%
- Vegetables: 10%
- Fruit: 10%
- Other: 20%
Percent of annual gross family income earned by farming...

- 100% of gross family income
- 75% of gross family income
- 50% of gross family income
- 25% of gross family income from farming

Total gross family income before taxes in 1996...

- $80,000-$95,000 or more
- Less than $10,000-$25,000
- $50,000-$80,000
- $25,000-$50,000

farming. Almost the same number of farmers in that age group said only a quarter of their family's income is from farming.

For those between 41 and 50, 31 percent said all of the family's income is made farming. Only 13 percent of farmers between 51 and 60 said all of the family's income is from farming. The same is true for farmers 61 to 70 years old.

Other findings in the survey:
- 70 percent of all farmers surveyed plan to remain living at their current location after retirement. Those most likely to move and retire completely from farming are those reporting incomes of between $50,000 and $80,000.
- 93 percent of those who earn all of their family's income from farming operate dairies. Most of those who report making 50 to 75 percent of their income from farming also operate dairies.
- 70 percent of those who want to sell the farm and invest the money for retirement had 50 percent or more of their income from dairy farming.
- Half of those farmers making $80,000 per year are between 61 and 70 years old.
- More than half of those in the 40 years old or younger age group made between $25,000 and $50,000.
- Asked about their financial activity in 1997, the last complete year prior to the survey, farmers said they invested between $1,000 and $5,000 in an IRA plan; 17 percent said they contributed the same amount into savings. Only 4 percent said they invested between $5,000 and $10,000 and 2 percent said they had saved between $10,000 and $25,000 in 1977. JT

MORE INFO

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The Utah Agricultural Experiment Station 19
A little straw or sawdust, some turning and some time are helping poultry producers dispose of manure even before it leaves the coop.

In-house composting is replacing the traditional scrape, haul and spread method of manure disposal, and in the process, flies, odor and complaints from the neighbors are being kept to a minimum.

Because it is a relatively new option for high-rise layer facilities, many questions remain to be answered and operating parameters developed for in-house composting.

Local producers who are trying this new form of composting have had varying success, mainly because the type and amount of carbon source and turning frequency, plus how to adjust for the different ages of birds and time of year, are yet to be determined.

A 390,000-layer hen operation near Provo became the first facility in Utah to try in-house composting two years ago. Manager Mike Shepherd said he was initially interested in trying it to control flies, and was initially skeptical.

He said flies have been controlled much better than he had expected, the volume of manure has been reduced by 50 percent through composting, and much of the compost produced is sold to area urban residents as fertilizer.

Shepherd says the large amount of manure produced is the result of being what is considered a large operation in the West, and that size of the operation is dictated by competition by producers in the Midwest, some of which have 10 million chickens.

He noted that 40 years ago there were 500 egg producers in Utah. There are now four, even though the number of birds has not decreased.

Shepherd and Sons has experienced common problems related to fly control, odor and limited manure disposal options, problems that have been aggravated by urban encroachment.

Solving some of these problems was the goal of several trials requested by the company. They asked USU for help in determining specific schedules to successfully compost inside their facilities.
Most research into composting has been conducted in humid climates in other parts of the country, said Dean Miner, Utah County Extension Director. But if the process can ultimately be implemented here, many manure-related problems faced by egg producers would be eliminated, he said.

After conducting a series of trials at the plants, Miner and USU colleagues Rich Koenig and Bruce Miller report that the addition of a carbon source coupled with mechanical turning of manure in the layer houses generate temperatures high enough and moisture low enough to inhibit fly reproduction and larvae development.

Temperatures exceeding the lethal level for house flies can be achieved by composting manure inside layer houses with carbon-to-nitrogen ratios much lower than those recommended for standard composting operations. This increases allowable manure collection times before material volume exceeds the capacity of the compost turner, according to the report.

The growers have traditionally used a feed-based larvicide for fly control. Also, they removed manure from the buildings only for a few weeks during spring and fall when field use and weather conditions were conducive to land application.

Frequently, as much as eight months of manure was removed at one time. Neighbor complaints about flies and odor were common during those times.

The growers moved to in-house composting in February 1998 as an alternative.

According to the report, after six weeks of in-house composting there was less odor and flies were adequately controlled with a single topical application of a larvicide to the windrows.

The composting was unsuccessful in a building that housed pullets just beginning egg production. Adequate composting temperatures were never reached probably because of the greater moisture content in the pullet manure.
The compost was uniform, granular and had a dark color.

Researchers also found:

• In-house composting is incomplete, and additional composting of materials in the absence of continued additions of fresh manure will be required to complete the process.

• There are few differences between the sawdust and wheat straw used as carbon sources in these trials. Sufficiently high composting temperatures were achieved with either carbon source and where available, the lower cost material could be used.

• In-house windrow temperatures decline rapidly after turning, and proper turning frequency is critical to maintaining critical temperatures for fly control. Turning frequencies of two to three days are necessary for layer manure in the first two weeks of accumulation, while 3 to 4 days are adequate for layer manure later in the accumulation cycle.

• Increasing the carbon source may facilitate in-house composting of pullet manure, however, this also reduces the duration of manure collection before volumes exceed the capacity of the compost turner.

• Ammonia was not a problem in these trials, likely because high ambient air temperatures and ventilation of the buildings. However, under conditions of inadequate ventilation ammonia may be a problem for birds as well as workers. Ammonia concerns during in-house composting bear further research.

• The operators indicated that the switch from Larvadex in the feed to topical applications of Pyrenone when required to control flies saved enough money to equal the purchase cost of the compost turning machine in a little more than two years. (The compost turner attaches to a skid steer loader used for many other purposes on the farm. The two-year payback would cover only the turner.) JT

MORE INFO

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Erin Naegle can't say for sure, but her native chlorophyll-deprived landscape in eastern Utah might have had as much to do with her choosing plant science as the challenge she saw in the field.

"Maybe it was the stark beauty around Helper that made green plants so interesting to me," says Naegle, the 1998-99 scholar of the year in the College of Agriculture. "But I've just always been intrigued by plants; they may not walk around, but they are complicated and vital and we still don't know everything about them."

Naegle's award-winning work the past two years at USU has helped science learn a little more about them. She, along with mentor and plant scientist William Campbell, helped determine the reason why wheat in experiments aboard the space stations Mir and Svet didn't grow. The NASA-supported research showed that an excess of ethylene gas in the space stations dwarfed the wheat as well as prohibited normal pollen development.

She received the best poster award and first place in biological sciences at the 1998 Pacific Division meeting of the American Association for the Advancement of Science. The work is aimed at finding ways for astronauts to grow their own food on extended space flight missions.

Naegle has been studying plant structure by means of an electron microscope about the size of a washing machine. She said she was reluctant at first to spend so much time with a microscope because it was so foreign. But she soon discovered a whole new world in there. "It was like the first time I went snorkeling. The detail and intricacy in a plant on a microscopic level is astounding, just to see how much work a plant puts into itself."

This microscope works with a higher resolution for a closer view, using an electron light instead of the usual white light. Magnets are used where normally glass lenses would be to bend electrons to a point of focus. The cylindrically shaped lens is kept under a high power vacuum to keep outside elements from interfering with the delicate electrons.

Naegle, who already has three papers published, this summer begins a graduate program at North Carolina State University. She will be part of a new research project investigating structure and stress of weeds on soybeans.

She says after graduate school she wants to teach as well as focus her own research on the effects of chemical and other nonbiological stresses on plant structure, noting that such fundamental scientific research would improve the efficiency and quality of field crops.

She says that the mixture of fundamental and applied science courses at USU gave her a firm foundation in the fundamental sciences along with an appreciation of how basic science is an integral component of field crop production.

"From my own undergraduate experience, I know the influences that motivating professors can have on students' lives," she says. "There is a need for professors who show through example how stimulating the sciences are and what a tremendous measure can be accomplished in one lifetime."

"I want to feel like I know a philosophy of science inside and out so I don't need a textbook to give correct answers when students come knocking. I want to ask those questions and pursue answers that will advance society's understanding of the fascinatingly complex world in which we live."

The world is full of unanswered and unasked questions, she says. "I want to ask some of those questions and pursue answers that will advance society's understanding of the fascinatingly complex world in which we live."

By Laura Anderson

Erin Naegle
The Rock of Ages and the ages of rocks collided again in Kansas this summer when the state board of public education there decided that students will no longer need to know about evolution or the Big Bang theory in order to graduate.

The new standards do not forbid the teaching of evolution, but students won’t be tested on it. The reaction of many scientists around the country and on this campus has ranged from indifference to aggravation. Some have said the decision is like making students study chemistry without the periodic table or discuss literature without including Shakespeare.

The general scientific community’s response aside, the general public, which probably hasn’t followed the debate and has only a vague association with the sciences, can’t help but wonder what it is about evolution that threatens religious tradition or other human ethical values. They must be getting the notion that science inherently runs counter to religion and might even be faith’s anti-matter.

The real question, however, is why does this debate continue. The nature of science—hypothesis, careful observation, evaluation and peer criticism—does not dictate or devalue whatever purpose in life or religious orientation people choose.

Stephen Jay Gould, the noted Harvard paleontologist, puts it this way: “They are the two great tools of human understanding and endeavor and ought to be able to operate in complementary—not contrary—fashion in their own realms. Science and religion should be equal, mutually respecting partners, each the master of its own domain, and with each domain vital to human life in a different way.”

Before other school boards become emboldened to change their own science standards they should understand that at the center of the debate in Kansas is the question of how the world originated, less about what has happened since. Because no one can turn back the giant clock, that question ultimately becomes a matter of faith to both the fundamental creationist and to the fundamental evolutionist. Deep down, one view or the other or a combination of the two just seems to be true.

The more advanced approach in the evolution of the religion vs. science debate would be to move past telling students what to think (or what not to think, in this case) and toward teaching them how to think. Instead of bickering over the man-ape questions, a more evolved approach here would be to teach students the role of science in life today, such as the dramatic new understanding of plant metabolism or how evolution is the process by which microbes become resistant to antibiotics.

**PHOTOQUIZ Clue: This object does a lot of scientists’ work for them.**

Answer to last issue’s photoquiz (left): This is a Precision Herbicide Applicator used to spray herbicide on small test plots on the Experiment Station’s farms. The applicator was invented, designed, and built at USU.
Utah Science is on line.
Check out our Web page at:
http://agx.usu.edu/agx/