



2022 Ag Times

- Drainage water recycling systems improve corn yields
- Plan now for antibiotic changes on the horizon
- Missouri freezing temperature trends
- Tips to offset high nitrogen prices

PHOTO BY NEAL JOHNSON



With high fertilizer prices, are you better off buying fertilizer or supplemental hay?

PHOTO BY DAVE MARNER

BY LINDA GEIST
University Extension

COLUMBIA — Increases in fertilizer prices add to the cost of growing forage for grazing. This leads farmers to ask if they should buy hay or fertilizer, says University of Missouri Extension nutrient management specialist John Lory.

Comparing the benefits of buying hay vs. applying fertilizer for better yields is complicated, but it is crucial to the bottom line, says Lory.

A fair comparison looks at the costs of hay vs. fer-

tilizer, whether the farmer can use the grown forage or purchased hay, and the nutrient efficiency of the grown forage vs. purchased feed.

Studies at the MU Forage Systems Research Center in Linneus and MU Southwest Research Center in Mount Vernon give some insight, he says.

MU researchers found that 50 pounds per acre of nitrogen boosted spring pasture yield an average of 1,100 pounds per acre. With nitrogen fertilizer prices near \$1 per pound, the cost of that feed is 5 cents per pound.

WHAT IS THE COST BASED ON UTILIZATION RATE?

Lory explains that cattle only eat part of the forage available to them, leaving the rest to waste. High prices make it critical to manage pastures for high forage utilization rates.

Research shows that cattle eat about 60 percent of available forage in highly efficient spring grazing systems, but rates typically dip below 50 percent. That

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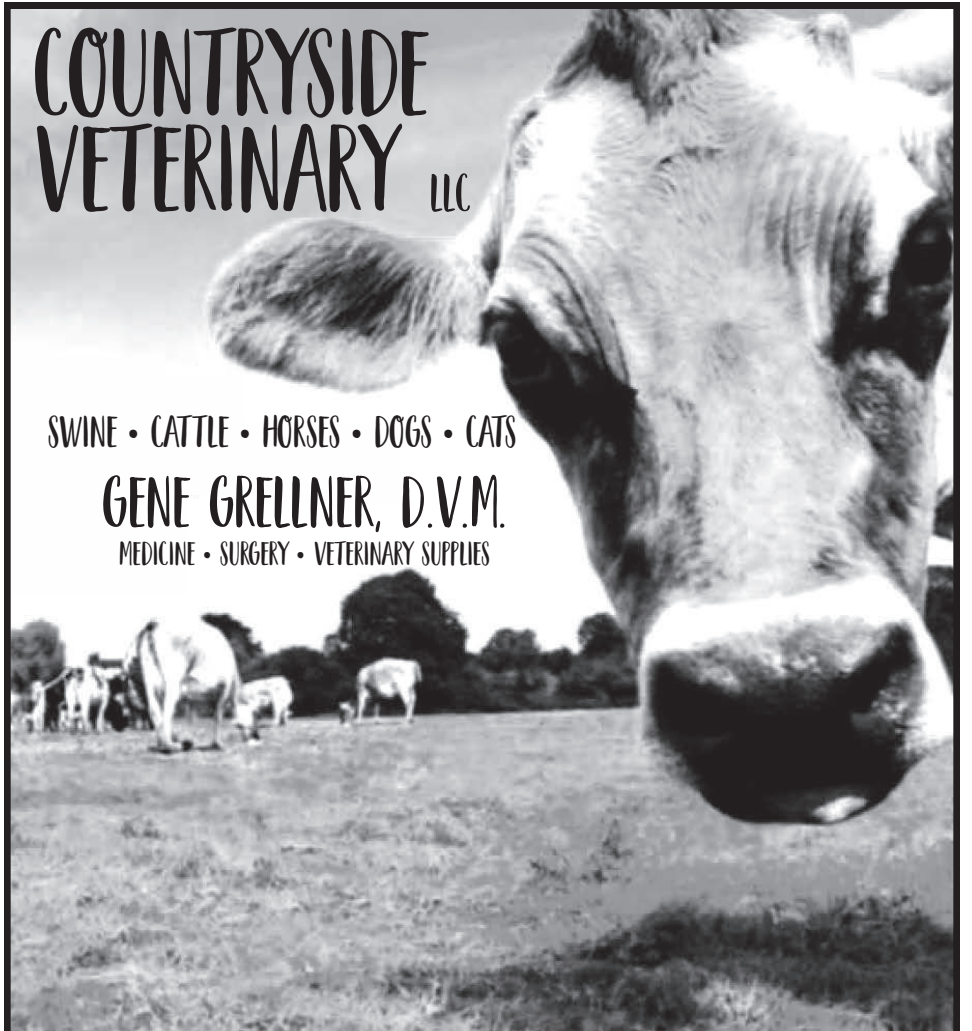
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High prices • from page 2B

means that cows waste about half of the fertilized forage. At 50 percent use, the actual cost of consumed forage doubles, says Lory. If nitrogen fertilizer is \$1 per pound, cost of consumed feed is 10 cents per pound. Many farmers can buy hay for less than that now.

Forage use for purchased feed usually runs higher than that for grazing, says Lory. Hay utilization rates can reach 80 percent but most often are closer to 65 percent. If hay is \$80 per ton, the cost per pound is 4 cents. However, at 65 percent utilization, the cost per pound of feed eaten goes to 6 cents.

“These examples show how purchased feed has the potential to be an economically competitive approach compared to buying fertilizer when prices are high,” says Lory.

HAY: FEED AND FERTILIZER

The fertilizer value of hay can offset cost.

“When you bring hay or other supplemental feed onto your farm, you are buying feed and fertilizer at the same time,” says Lory. “A ton of fescue hay contains nearly 100 pounds of fertilizer nutrients. If spread strategically on your farm, these nutrients provide fertilizer value to offset the cost of the hay.”

Beef cows typically excrete most of the nutrients they eat. To get the most value from hay, move the hay and cows to pastures that need fertilizer. Unroll hay bales, move hay rings or use some type of bale-graze system to spread across pastures. All of the excreted phosphate, potassium, sulfur and micronutrients in the hay is available to the pasture as fertilizer, but only about 25 percent of the nitrogen is available. The rest is lost or tied up in the soil organic matter. So, a ton of hay with 12.5 percent protein provides about 10 pounds of nitrogen fertilizer, 12 pounds of phosphate and 35 pounds of potash.

The fertilizer value of hay is usually a little over a penny per pound, or slightly more than \$20 per ton. Recently, nitrogen

prices rose to nearly \$1 per pound, and phosphate and potash prices more than doubled. This increases the fertilizer value of hay to more than 2.5 cents per pound.

In pastures, nutrients brought onto the farms as feed or fertilizer recycle and improve yields. When winter feeding hay, the hay’s fertilizer will increase spring pasture growth. When properly managed, about 5 tons of feed on a pasture with a total nitrogen fertilizer value of 50 pounds can provide an additional 1,000 pounds or more of quality spring forage growth.

Fertilizer value also can influence hay purchase decisions, says Lory. Buying high-quality hay increases the fertilizer value of the hay. With current costs, a ton of hay may have \$20 more fertilizer value than poor-quality hay, making the higher-quality hay the more economical feed, even if it costs more up front.

HAY: PREDICTABLE FEED AT A KNOWN PRICE WITH FERTILIZER VALUE

“Buying hay instead of fertilizer can provide a predictable feed supply to supplement spring pasture growth at a known price,” says Lory. “High utilization can be assured through judicious feeding practices, and unneeded hay can be stored if not used. With high prices, the fertilizer value of the hay has more than doubled, currently around 2 ½ cents per pound of forage or \$50 per ton, offsetting a significant fraction of cost of hay. The fertilizer value of the hay also will boost spring forage growth.”

No matter how you meet your herd forage needs, he adds, high prices require you to maximize forage utilization, both when feeding hay and managing pastures.

For more information, see the MU Extension publication “Calculating Fertilizer Value of Supplemental Feed for Cattle on Pasture.” The four-page guide is available for free download at extension.missouri.edu/g2083.

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B&H Well Drilling has thrived since 1989

BY NEAL A. JOHNSON
UD EDITOR
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B&H Well Drilling is a familiar name in the mid-Missouri area if you are looking to have a well drilled or service on your existing well system. Formed in 1989, Greg and Donna Bonnot started this venture and have been thriving since.

Hard work, long hours, and knowledge of the state of Missouri's geological system have proven to be a winning combination to make this a successful business. The Bonnot name has been associated with the water well industry since 1952 when Greg's dad, Edward (Cap), and uncle, Don Bonnot, started Bonnot Brothers Well Drilling.

After 31 years, they sold the business and Greg worked for the new owners during and after graduating high school in 1984. After five years, he and Donna decided with the help and knowledge of their parents to venture out on their own and start their own well drilling business.


Earl and Margaret Heinlein, who owned and operated Heinlein Pump Service in Stony Hill, helped Greg and Donna get established in the Hermann area and surrounding counties. B&H was named out of respect and appreciation for the Heinleins when choosing a name for the business.

According to Greg and Donna, who started with one employee for several years and now employ 22 local men and women, "We are blessed to work side by side with such great and knowledgeable men and women. We have to contribute a large portion of our success to them. Without them, we would not be where we are today. Our team is honest and hard-working and very knowledgeable

about the water well industry and the rules and regulations that DNR has set in place for the well industry."


During a Spotlight on Osage County presentation in 2016, Greg explained there is good quality and quantity of water in the mid-Missouri area, but in some surrounding counties the quantity may vary. Some wells may produce up to hundreds of gallons of water per minute and some only 2-3 gallons per minute. B&H Well Drilling provides drilling services to more than 21 counties in Missouri, and also works with 15 other pump companies to provide well-drilling services to their customers.

See **B&H Well Drilling**, Page 5B






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B&H Well Drilling

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Like most industries, updated equipment has transformed the well-drilling business. In the 1950s, an average 400-foot Osage County well would have taken anywhere from three to four weeks to drill a well with a cable rig. Now, with updated machinery, a well with the same depth and more casing can be drilled in a matter of six to eight hours.

Missouri Department of Natural Resources (DNR), the governing body for all well drillers and pump installers in the state, has put rules in place that protect wells from groundwater contamination. Any new well that is drilled has to be registered with DNR and that information is put into its database that B&H can access.

The company headquarters is at 157 Mari Osa Delta Lane, Jefferson City (at the Hwy. 50-63 junction), with a satellite site in Hermann. Most days B&H has three drill rigs on job sites drilling new wells and four to five pump trucks servicing wells that are either new constructions projects or repairs on existing wells.

Thirty-three years in this industry has given B&H a great deal of knowledge about the earth's formations and the opportunity to work with many great customers, contractors, and public water systems.

"We consider B & H Well Drilling a



family-oriented business," said Greg and Donna as two of their three children work for the company. "We consider all of our employees as part of our B & H family."

They offered a thank you to everyone

who has contacted them about their services. "We appreciate the opportunity you have given us to help you with your water well needs," they added. "We take great pride in the work that we do and are very proud

of what we have made this business into." For more information, visit <http://bhwell-drilling.com> or follow B & H Well Drilling & Pump Service on Facebook.



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How to incorporate tech into a farming business

The agricultural industry long has been a vital part of society, providing foods for billions of people across the globe. Farming can be a challenging profession, and farmers routinely find creative solutions to overcome obstacles to effective production. Thanks to technology, finding solutions has become that much easier.

Yet not every farmer who is set in his or her ways is ready to welcome changes that incorporate technology right away. In fact, reluctance to turn over operations in some part to artificial intelligence or smart technologies could be due in part to farming being such a nuanced skill and the role intuition plays in the growth of crops. The following are some ways for seasoned and novice farmers to seamlessly incorporate technology into their operations.

Start with peripheral tech

Farmers can begin implementing technology that does not directly relate to farming operations. Examples include switching to efficient and intuitive accounting and payroll systems to save time. If a farm also includes a retail enterprise, such as a farmers market, upgrading point-of-sale technology, like credit card readers or e-commerce websites for new

revenue potential, can be good a good starting point.

Assess operation weaknesses

Figure out where the business is lacking and could use some help. Perhaps you're having difficulty maintaining adequate irrigation or plant nutrition is compromised due to soil deficits? Precision automation farming advancements that employ remote sensors can assess conditions and fine tune adjustments to alleviate these issues.

Get training

Novel technologies can increase crop yield and make for more efficient use of limited resources. However, people who may never have employed drones, IoT devices or soil sensors can expect a learning curve. Visiting a nearby farm operation to learn how they have implemented technology and gaining hands-on experience can be invaluable. In addition, request that a tech vendor provide thorough instruction on products to make it easier to seamlessly integrate new technology into an agriculture business.

Tap into workforce talent

The Food and Agriculture Organization



of the United Nations says agriculture and food production accounts for 28 percent of the entire global workforce. There are more than 570 million smallholder farms worldwide. Technology can be utilized by agricultural businesses to zero in on intelligent and qualified employees who can take operations to the next level. Websites

like Glassdoor, Indeed and ZipRecruiter remain helpful tools when looking for qualified job candidates. The internet is an essential employment resource, and farms can utilize it to acquire new hires.

Agricultural businesses can explore various ways to gradually and seamlessly make technology part of their operations.

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Did you know?

Farmers and growers face a significant threat in the years to come as industrial agriculture operations continue to expand. According to the National Resources Defense Council, industrial agriculture is the large-scale, intensive production of crops and animals. Such operations make it more difficult for small farmers and growers to turn a profit, and they often involve the use of chemical fertilizers and pesticides. The use of such products poses an additional threat to small farmers and growers, as the Union of Concerned Scientists notes that the heavy application of fertilizers and pesticides accelerates soil erosion and increases pest problems. Consumers concerned by the effects of industrial agriculture on the environment and on small farmers' and growers' ability to earn a good living can support efforts such as regenerative farming and organic farms.

Without pollinators, more than 100 crops grown in the United States would not be able to thrive. Plants, including various fruits, vegetables, nuts and more, rely on pollinators to ensure to transport pollen. Though many plants are self-pollinating and others are pollinated by the wind or water, many others rely on insects and animals to become pollinated. The U.S. Department of Agriculture says birds, bees, bats, butterflies, moths, flies, beetles, and small mammals all can work as pollinators. Examples of crops pollinated by pollinators include apples, squash and almonds. Animals and insects help pollinate more than 75 percent of the world's flowering plants, and nearly 75 percent of all crops, according to the U.S. Fish & Wildlife Service. Unfortunately, pesticide use can diminish the number of natural pollinators. Natural gardening and pest-control can help protect the habitats of pollinators.

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Weed electrocution research sparks interest as herbicide resistance impedes current methods

BY LINDA GEIST
University Extension

COLUMBIA — Move over, herbicides. There's a new sheriff in town. And he's toting some powerful guns loaded with electricity to kill weeds.

This shocking new method of weed control was demonstrated at the 2021 Pest Management Field Day at the University of Missouri Bradford Research Center in Columbia.

As more weeds develop resistance to herbicides, electrocution may be the weed management

approach of the future, says MU Extension weed scientist Kevin Bradley. MU graduate student Haylee Schreier has studied weed electrocution in row crops for the past two years under Bradley's direction.

The is of special interest to Bradley because it might be the answer to Missouri's growing waterhemp problem. A prolific producer of seeds, waterhemp is Missouri's No. 1 weed problem and one of 14 weeds that are

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PHOTO BY LINDA GEIST

WEED ELECTROCUTION research shows promising results for weed management, especially in waterhemp, Missouri's No. 1 weed problem. The Weed Zapper attaches to a tractor and kills in-row weeds with high-voltage electricity.

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herbicide-resistant.

Two brothers in Illinois with backgrounds in farming and engineering designed The Weed Zapper machine. A different pair of brothers purchased the technology and manufacture Weed Zappers at a plant in Sedalia, Missouri.

The Weed Zapper model used in MU research has a copper boom that attaches to the front of a tractor. Driven by a PTO, it hits weeds with 15,000 volts of electricity from a 110,000-watt generator on the back of the tractor. Models cost between \$42,000 and \$72,000.

Metal wheels are grounded, and booms adjust to different heights. Tractor speed is about 2-4 miles per hour, Bradley says. Weed kill is best at lower speeds and is even more effective on some of the more challenging weeds when used at seven-day intervals in late summer.

Schreier's data shows that by the end of the season there is almost complete control of giant ragweed, common ragweed, marehail and waterhemp. It is slightly less effective on grasses.

The growth stage of soybean and the degree of contact that the boom makes with the foliage influences soybean injury. Soybean yield loss is possible if the boom makes constant contact with the soybean canopy at growth stages R3 or later.

In addition to killing weeds, electrocution also affects viability of surviving weed seeds. The most impact is seen in waterhemp, where about 65 percent of seeds become nonviable.

Electrocution is not new to the weed management world, says Bradley. Sugar beet growers in North and South Dakota have been trying this method since the 1950s and 1960s.

The United Soybean Board, Missouri Soybean Merchandising Council and the Weed Zapper company are partners in this project.

Learn more about MU weed science research at weedsience.missouri.edu, on Facebook or @ShowMeWeedson Twitter.

Learn more about Weed Zappers at www.TheWeedZapper.com.

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MU Extension agronomist offers tips to offset high nitrogen prices

BY LINDA GEIST
University Extension

GALENA — If there was ever a time to do a soil test, this is it, says University of Missouri Extension agronomist Tim Schnakenberg.

Rising fertilizer prices make it too expensive to guess on how to apply nutrients, says Schnakenberg.

Soil tests can prevent buying and applying fertilizer where not needed. See the MU Extension publication “Soil Sampling Hayfields and Row Crops” at extension.missouri.edu/g9217.

Schnakenberg offers several other tips to offset high prices:

- When prices are high, producers might want to prioritize lime over fertilizer if the soil’s pH is low. Lime application improves nutrient availability in the soil, which leads to more fertility from resources already waiting to be tapped

- Using manure from dairy or poultry operations might be a good way to add needed nutrients. Consider demand, trucking costs and the source of the litter.

- Reduce nitrogen loss by injecting manure and commercial sources into the ground instead of spreading on top of the ground.

- Use nitrogen stabilizers with commercial sources unless applied in cooler weather.

- Split applications sometimes can be a more efficient way to reduce losses. Check with your local extension agronomist for the most precise method of nitrogen applications on specific crops and forages.

Don’t overlook ways to more efficiently distribute manure already generated on the farm, Schnakenberg says. If you feed grass hay solely in a bunk at the same location each time, move hay feeding areas around to distribute

the manure to other parts of the farm. MU research has also confirmed that a well-planned rotational grazing system greatly helps manure distribution in pastures.

Legumes such as clover and alfalfa are also good long-term sources of nutrients. They fix nitrogen for grass hay crops. Incorporate these legumes into pastures to potentially eliminate the need for nitrogen. Legumes take time to reach their full potential, especially if broadcast over the winter or sowed in the spring.

If prices continue to rise, Schnakenberg recommends applying phosphate and potash in the fall or early winter. There is little to no loss, and there may even be benefits from early application because there is time to work nutrients into the upper soil profile where roots can fully access them when needed next year.

This recent price hike is a reminder

to continuously monitor nutrient levels and maintain fertility as part of a management plan, says Schnakenberg. “It becomes economically unfeasible to fix problems that have developed over the last decade, leaving us suffering production losses that aren’t easily remedied.”

In any case, don’t get into the mindset of only applying nitrogen, he says. Many fields continue to show stress resulting from missed or reduced applications of phosphate and potash after the 2008 fertilizer price hike.

The plant structure of roots, stems and leaves must be built by nutrients like phosphorus and potassium before nitrogen can spur growth, Schnakenberg says. If large amounts are needed and you have to cut corners somewhere, consider at least addressing crop nutrient removal issues and forgoing build-up recommendations. Consult an agronomist for advice on this kind of management strategy.

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Managing potassium, phosphorus when prices are high

BY LINDA GEIST
University Extension

COLUMBIA — Farmers understand fertilizer prices fluctuate with time. “We are living through a substantial shift in potassium and phosphorus prices, from low prices in the 2020 growing season to the highest prices in the past decade for fertilizer purchased now for the 2022 growing season,” says John Lory, University of Missouri Extension nutrient management specialist.

A frequent question when high fertilizer prices shock the system is whether phosphorus and potassium applications can be delayed until next year when prices may be lower. The quick answer is yes—if your soil test levels are near recommended levels, says Lory.

“Soil test P (phosphorus) and K (potassium) levels act somewhat like a gas gauge on a car,” he says. “If your gas tank is full, you know you can travel 500 miles before the tank runs dry. If you are making a trip that is 200 miles, you can, with confidence, make that trip once without refilling your tank. The second trip is also likely fine. But you know you will need to refuel before completing the third trip.”

A soil test result at or above recommended levels is much like a gas gauge reading full. On most Missouri fields, an optimum soil test level indicates you should be able to plant multiple years of crops without refilling the tank. You should be fine skipping one year. Many farmers already apply P and K alternate years. But if you did not apply last year, can you take another year off? The way

MU Extension’s recommendation system is designed, one more year should not be a problem, says Lory.

What are options for managing high fertilizer prices?

Lory outlines options for reducing fertilizer costs this year:

- Do not apply fertilizer to fields that are at or above optimum soil test levels. Extensive research shows that soils at optimum soil test levels do not see increases in yield from the fertilizer applied that year. A benefit of following soil tests is the flexibility to skip a year of application. Why not take advantage of this benefit in a year when the price is high?

- Not comfortable with going to zero? A second option is to cut fertilizer rate by 50 percent or less of removal rate. Most yield response to fertilizer is driven by the first 30 percent to 50 percent of the fertilizer applied. If you are nervous about going to zero, going halfway will likely provide 100 percent of the yield benefit this year, even on soils that tested low.

- The most conservative option is to limit fertilizer rate to removal rate. In a high fertilizer price year there is no reason to apply more than the crop removal rate. “If your field happens to be responsive to added P and K this year — a big if! — crop removal rate is guaranteed to maximize yield,” says Lory.

There is another option to reduce your fertilizer bill and learn about fertilizer response on your fields, says Lory. Work with the “MU Certified” Strip Trial Program and put strips with and without either P or K.

If you use this strategy on the whole field, the amount

applied will drop by 50 percent. Strip trial program participants will work with Lory and his team to document if fertilized strips have higher yield than the unfertilized strips.

“Our expectation is a field with optimum soil test will have no increase in yield on the fertilized strips,” says Lory. “This test confirms MU Extension recommendations are working as expected on your field and contributes to a statewide effort to document fertilizer responses on Missouri farms.”

If you are interested in strip trials, contact your local MU Extension agronomist or agricultural engineer, or visit striptrial.missouri.edu.

There are situations where soil test recommendations may not fully identify fertilizer need. Lory has seen potassium deficiency symptoms in highly compacted areas of the field because restricted root growth prevents the plant from getting to the potassium in the soil. Cool soils also can temporarily limit the availability of phosphorus.

“Often these conditions lead to transient deficiency symptoms that the plant grows out of as soils warm and become less saturated,” says Lory.

Finally, sandy soils and soils with low organic matter may not have the same capacity to withstand multiple years with no fertilizer application; they have a smaller gas tank, he says.

Fertilizers help sustain crop production. Soil testing helps farmers understand the nutrient status of soils. “When fertilizer prices are high, we can also use soil testing to understand the risks of not applying fertilizer,” Lory says.

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Career paths in agriculture

As the world population grows, the role of the agricultural sector will become even more prominent. There should be significant demand for agricultural professionals capable of meeting the challenges facing the world as it confronts climate change and food shortages. That makes now a perfect time for students to explore potential career paths in the agricultural sector.

• **Agricultural engineer:** Agricultural engineers employ engineering principles to solve issues related to agricultural production. An agricultural engineer may design facilities or machinery or develop solutions to address problems related to irrigation and soil conservation, among other projects. Students interested in a career as an agricultural engineer can expect to study mathematics, physics, chemistry, computer engineering, and, of course, engineering analysis and design as they pursue their degrees.

• **Agronomist:** Agronomists work with crops and soil management and may work as analysts, environmentalists or forecasters. Agronomists may be tasked with analyzing soil structure and chemistry and study how water is moving within soil.

Students will study agriculture, biology, chemistry, and physics en route to earning a degree that will help them become an agronomist. Mathematics also will be part of their studies, and statistics courses will be part of those studies.

• **Biochemist:** Biochemists study the chemical and physical principles of living things and biological processes. Within the agricultural sector, biochemists will contribute to the development of agricultural products, including those that will serve a medicinal function. Biochemistry, chemistry, biology, calculus, and physics will be part of students' coursework as they pursue degrees that prepare them for a career as a biochemist.

• **Climatologist:** Climatologists will figure prominently in the agricultural sector as the effects of climate change manifest themselves more readily over the next several decades. Climatologists study climate change, variability and the biosphere. Climatologists offer insight about the effects of climate change on the growth and development of agricul-

See **Career paths**, Page 13B





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Planning budgets from MU Extension can help manage high farm operating costs

BY KYLIE JOHNSON
MU Extension

COLUMBIA — Farms will pay significantly more for operating expenses this year. 2022 planning budgets from the University of Missouri can help livestock, row crop and forage operations quantify how much costs have increased and determine what those higher costs mean for the bottom line.

For crops, fertilizer represents one cost that has sharply increased in recent months, says Ryan Milhollin, extension agricultural economist.

“Fertilizer prices have gone through the roof since October,” Milhollin said. “I don’t think anybody would have predicted fertilizer prices doing what they did.”

Ben Brown, senior research associate at MU, says fertilizer costs and other variable expenses, such as labor, fuel and chemicals, have increased due to supply chain disruptions and market conditions. Fixed costs, such as those for land and machinery, have also risen based on expected returns in 2022 and increases in the money supply.

Livestock producers can expect higher costs for inputs such as protein supplements, grain, salt and minerals and labor.

Each 2022 planning budget estimates the total economic costs involved in an enterprise. Those costs include cash expenses and opportunity costs, such as those for owned land and your time.

You can tailor each budget to fit your farm and understand your cost structure for each farm enterprise. With this information, you can then determine how to best control input costs, set price targets for the year or size up and down farm enterprises to maximize profits.

“We really want to empower and encourage farmers, lenders and other people who use these budgets to customize them for their situation and when they need to make a decision,” Milhollin said.

MU Extension enterprise planning budgets and spreadsheets for customizing budget assumptions are available for free download at muext.us/MissouriAgBudgets.

Career paths • from page 12B

tural products, including fruits, grains and vegetables. The natural sciences feature prominently in climatologists’ educations, and students also will study meteorology as part of their coursework.

• Food scientist: Food scientists study chemistry, biochemistry, microbiology, and engineering so they can assist in the development of new food products. Food scientists may manage processing plants and some serve as researchers in an effort to solve problems related to food production.

• Plant pathologist: Plant pathologists specialize in analyzing issues related to plant diseases. Research features prom-

inently in plant pathologists’ work, and many work in university settings. Some plant pathologists work for companies attempting to develop pest-resistant plants. Advanced degrees are necessary to work as a plant pathologist, and students will study mycology, bacteriology, virology, and physiology, among other subjects, as they pursue their degrees.

The agricultural sector employs millions of people across the globe. Many of those people do interesting work as they attempt to address issues facing the agricultural sector.

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Missouri freezing temperature trends

PATRICK GUINAN
University Extension

Missouri air temperatures are trending warmer over the last couple of decades, which is extending the growing season. Figures 1 and 2 show the statewide averages for spring and autumn minimum air temperatures, respectively, over the last 127 years. The trend line indicates a warming of 1.4°F per century. Autumn air temperatures have trended 0.8°F higher.

Dates of last or earliest frost have also shifted. It seems good to focus in on those shifts as we approach the 2022 planting season. Here are 3 findings on Missouri freezing temperatures that stem from comparisons of 20-year averages to 127-year averages:

The last spring freeze is occurring earlier. Figure 3 shows that the average last spring freeze is occurring 3 to 6 days earlier than historical trends.

The first autumn freeze is

occurring later. Figure 4 shows that the average earliest autumn freeze is occurring almost one week later than historical trends.

The average increase in growing season days across Missouri ranged from 7 days (Barton County site) to 20 days (Lewis County site).

These are anticipated trends in a warming world, but Missouri weather is still variable and seemingly random freeze events can and will occur late in spring or earlier in the fall.

The 11 weather stations used in this analysis have a long, reliable track record. They are part of a network called the National Weather Service Cooperative Observer Program, which was established in 1890 when President Benjamin Harrison signed the Organic Act. A major premise of the program was to define the United States climate.

For more information on frost and freeze dates in Missouri, please check out the MU Frost Freeze Guide, which re-

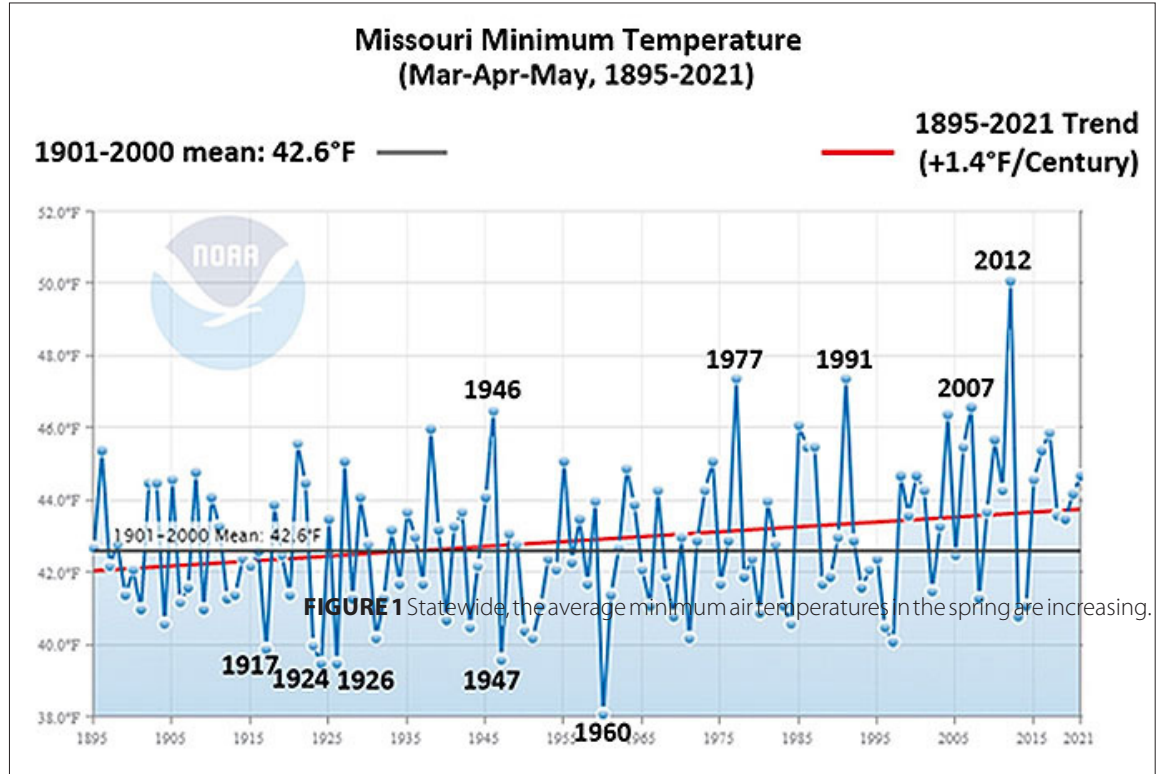


FIGURE 1 Statewide, the average minimum air temperatures in the spring are increasing.

ceives a lot of interest this time of year. The web site includes contour maps that show variations in frost/freeze tempera-

ture patterns across Missouri. Extreme dates maps are also included. These maps show the most extreme frost/freeze

dates in spring and autumn at 25 weather stations across Missouri.



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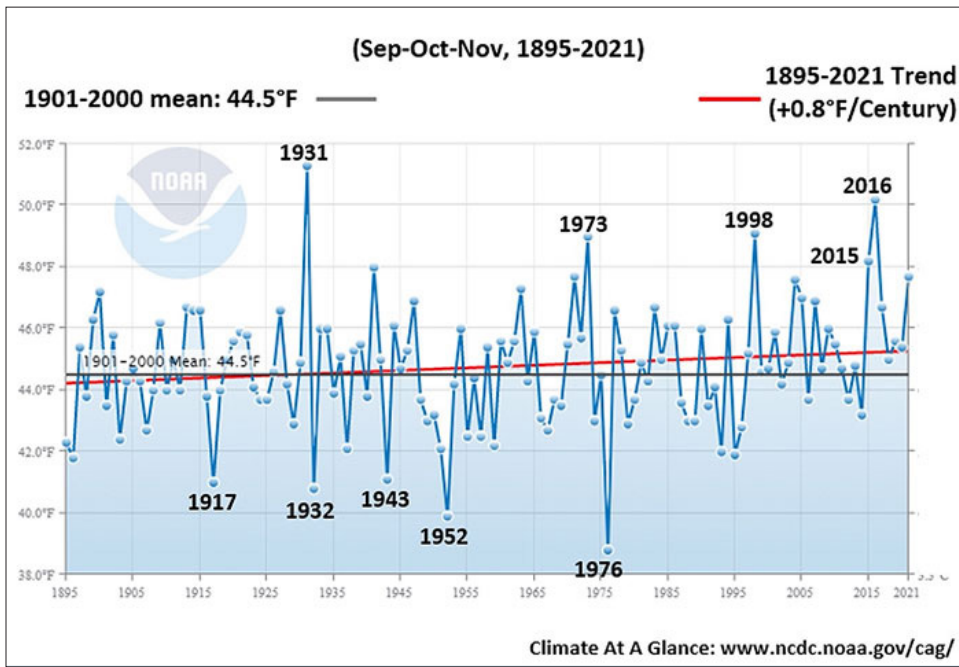


FIGURE 2 Statewide, the average minimum air temperatures in the autumn are rising.

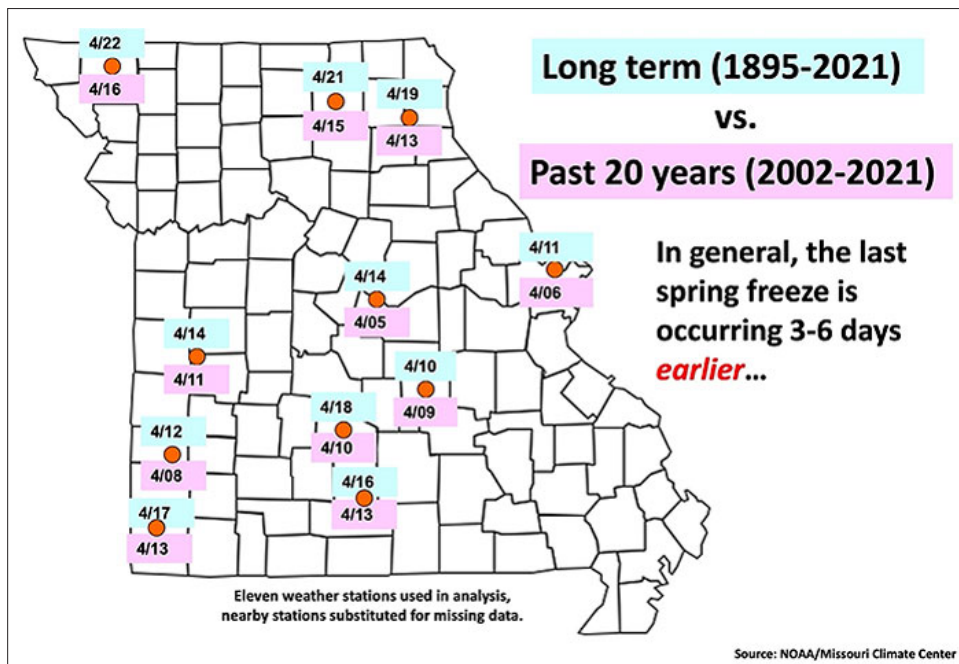


FIGURE 3 Median Date of Last Spring Freeze (≤ 32 Fahrenheit).

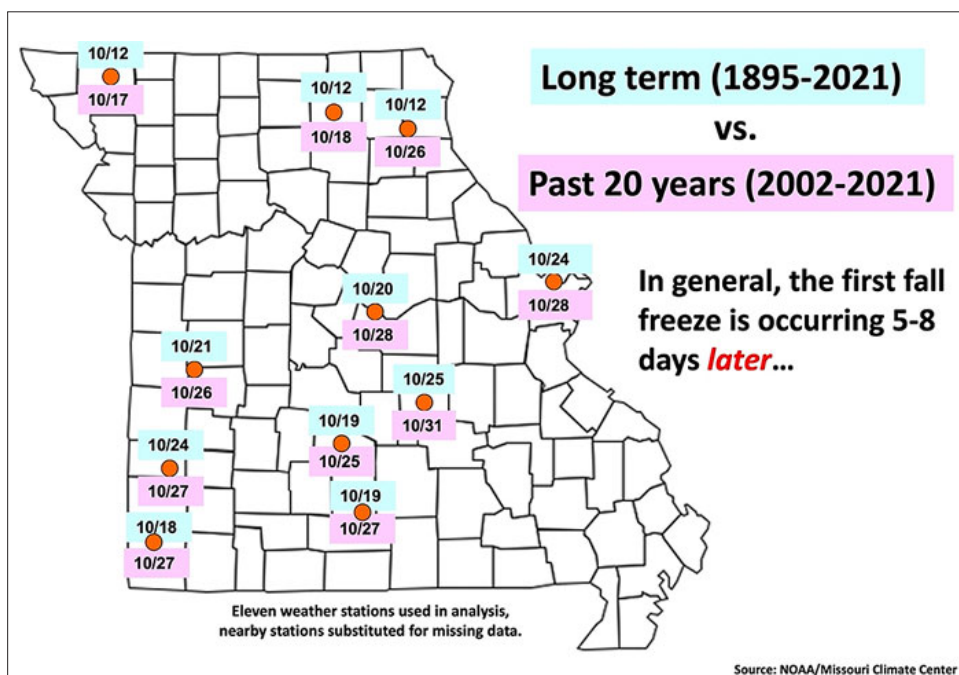


FIGURE 4 Median Date of First Fall Freeze (≤ 32 Fahrenheit).

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Things to consider when selecting crop insurance

BY BEN BROWN
MU Extension

Farmers must finalize their crop insurance decisions for spring planted crops in Missouri by March 15. In 2021, over 9 million row crop planted acres in Missouri were covered by crop insurance policies overseen by the USDA Risk Management Agency. Most farmers purchase revenue protection insurance policies, followed by yield protection policies. Opportunities to increase risk protection within these crop insurance policies are presented below.

Prevent Plant Coverage

Crop insurance's prevented planting provisions provide protection to producers and landowners if they are prevented by extreme weather from planting the insured crop by the insurance policy final planting date or during the late planting period. Prevented planting payments are intended to cover costs accrued prior to planting.

Prevented planting coverage is part of revenue protection and yield protection plans but not of area-based plans. Coverage is calculated as a percent of the policy's insurance guarantee. Coverage factors for corn are 55 percent and 60 percent for soybeans, wheat, and grain sorghum. Example: a farmer buys a 75 percent revenue

protection policy on corn acres with \$800 of expected revenue. Should the farmer be prevented from planting the crop, a prevented planting payment of \$330 ($\$800 \times .75 \times .55 = \330) would be paid. For an additional premium cost, prevented planting coverage can be increased to 60 percent for corn and 65 percent for soybeans, wheat, and grain sorghum.

When considering the 5 percent prevented planting buy-up coverage, estimate pre-planting costs like land rent, fall fertilizer application, and herbicide burndown. If the default prevented planting coverage does not cover pre-planting costs, a risk adverse farmer might be enticed to purchase the 5 percent buy-up option.

High Coverage Policies

The 2014 Farm Bill introduced Supplemental Coverage Option (SCO). At its core, SCO adds additional area-based coverage above the underlying policy up to 86 percent, with certain restrictions. Example: an underlying Revenue Protection (RP) policy of 70 percent could buy a 16 percent band (86 percent - 70 percent) of SCO revenue protection. The policy holder would have individual revenue protection below 70 percent, area revenue coverage between 70 - 86 percent and no revenue protection between 86 percent and 100 percent.

Congress added an additional high coverage option in the 2018 Farm Bill titled Enhanced Coverage Option (ECO) allowing farmers and landowners to add a layer of area level insurance either between 86 percent - 95 percent or 90 percent - 95 percent. Producers using ECO are allowed to enroll in ARC.

Some key points to consider about SCO and ECO are:

High coverage policies provide more

protection for an operation by triggering at more shallow losses but come at a higher premium cost.

Government subsidies for SCO premiums are 65 percent; 51 percent for ECO yield policies; and 44 percent for ECO revenue policies.

SCO and ECO are both area-based coverage policies. It is possible for both to trigger payments for losses, only one, or neither.

SCO and ECO cannot be elected if the underlying crop insurance policy is margin



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Advancements in livestock technology

Consumer demand drives changes in industry, and the agricultural sector is no exception. Consumer demands for improved animal welfare have led to changes in the livestock sector, and various technologies have been developed and are in development to help this particular segment of the agricultural industry thrive.

According to the Animal AgTech Innovation Summit, various startups have developed technologies that can make the livestock industry more sustainable and efficient.



TREATMENT

The Israeli firm Armenta has developed a non-antibiotic treatment for bovine mastitis that utilizes acoustic pulse technology. The treatment has a 70 percent cure rate.

Another firm working to treat livestock is the United States-based General Probiotics. Animal AgTech reports that General Probiotics develops cellbots and antimicrobial probiotics that eliminate harmful pathogens in livestock. That can reduce dependency on antibiotics and make food production safer.

WELFARE

Faromatics, a firm based in Spain, has combined robotics, artificial intelligence and big data to improve animal welfare and farm productivity. One Faromatics product utilizes a robot suspended from a ceiling to monitor certain variables, including equipment function and health and welfare, that affect broiler chickens.

The American firm Swinotech utilizes voice recognition and computer vision technology in its SmartGuard product to prevent piglet deaths from crushing and starvation. The product also makes it possible to track and facilitate obstetrical assistance.

OPERATIONS

Based in Uganda, Jaguza Tech has developed a livestock management system that utilizes sensors, data science and machine learning to improve the efficiency, productivity and sustainability of modern farm operations. Farmers can utilize Jaguza to perform a host of functions, including monitoring their animals' health and identifying their livestock.

The Netherlands-based H2Oalert is a water control management system that checks the quality and quantity of cattle drinking water in real time. The management system also checks for pollution and malfunctions in the water supply.

Livestock technology continues to advance, and firms across the globe are developing new products and platforms to help livestock farmers make their operations more efficient, sustainable and productive.



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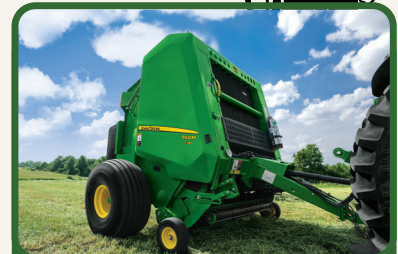
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New MU guide looks at silage

BY LINDA GEIST
MU Extension

COLUMBIA — University of Missouri Extension recently released an updated cost analyzer to help farmers estimate the break-even price to justify harvesting corn as silage rather than grain.

“Frequently, corn harvested for silage was planted for harvest as a grain crop,” says Joe Horner, an MU Extension agricultural business and policy specialist. Reasons for this change can include feed needs as well as drought and other events that result in poor grain yield.

Horner and MU Extension economist Ray Massey created the guide to help producers take the guesswork out of the decision to harvest corn as a grain or silage. Silage is the harvest of whole corn plants at 60–70 percent whole plant moisture.

The guide gives options for pricing silage in the field, delivered to storage and delivered to the feed bunk.

Nutrient considerations

Silage and other forage crops remove more nutrients — especially phosphorus and potassium — from the soil than grain crops. If the soil becomes low on nutrients, the producer incurs extra expense to replace them.

Planting corn for silage to deliberately remove nutrients also is an option in intensive manure-spreading areas and where the

potential for nutrient runoff exists.

General rules of thumb

Generally, the rule of thumb farmers use is that silage’s value per ton is 8–10 times the price of a bushel of corn. Massey says a factor of 8–9 is used to price silage in the field and a factor of 9–10 for pricing it in storage.

A higher factor is generally used for lower-priced corn and a lower factor for higher-priced corn. “This rule of thumb needs to be reconsidered given current corn and input prices,” says Massey. “Currently, silage priced in the field may be closer to seven times the price of a bushel of corn.”

Another consideration is the dry matter percentage of silage. Most often, price is determined on wet basis — as it stands in the field.

Other considerations

Producers should also consider costs of harvest, shrink, drying, transport and storage. Livestock producers should weigh costs against the cost of other feedstuffs.

Silage harvest requires specialized equipment, including a chopper and wagons.

Also, consider the removal of biomass for silage. The standing crop’s value increases because only the grain is removed rather than the entire plant.

See “Pricing Corn Silage” and the silage cost analyzer spreadsheet at extension.missouri.edu/g4591.

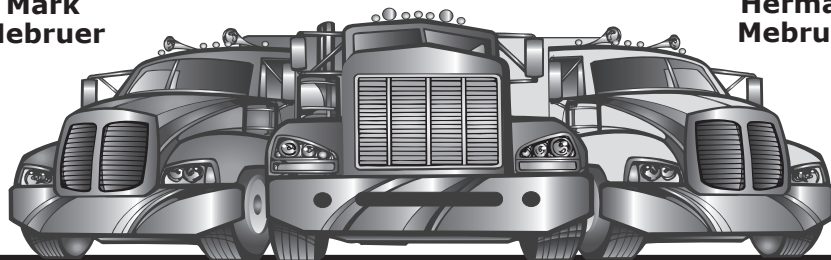
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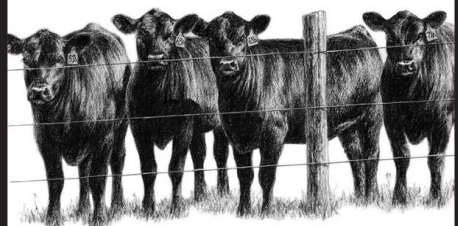
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MU Extension launches "Mizzou Crop & Pest News"

COLUMBIA — University of Missouri Extension has launched Mizzou Crop & Pest News, an electronic newsletter for agriculture professionals and extension specialists that provides information on current agronomic challenges.

Mizzou Crop & Pest News is an updated version of the Integrated Pest & Crop Management (IPCM) newsletter. The new format will provide readers with more concise information, including estimated read times and one-sentence summaries of articles, said Mandy Bish, MU Integrated Pest Management coordinator.

"The idea to launch Mizzou Crop & Pest News stemmed from a 2021 survey of over 500 Missouri professionals in row crop production," Bish said. "Respondents ranked electronic newsletters as a highly preferred source of information and indicated extension as the most trusted source."

Bish said the newsletter will include new topics as well as content that subscribers to

the IPCM newsletter have come to expect, such as state extension weed specialist Kevin Bradley's weed management articles.

"We believe that this newly formatted newsletter will prove to be a valuable source of information for producers and other agricultural professionals throughout Missouri," Bradley said.

"We have a series of 'Top Three' newsletters lined up for early March," Bish said, "and we plan to include info on crop insurance considerations, climate, mental health resources and more. These are topics that go hand in hand with crop production and pest management but have not traditionally been covered in the newsletter."

Following the "Top Three" series, the newsletter will be published as questions and needs arise throughout the season, she said.

To sign up for email notifications when new issues are published, visit ipm.missouri.edu/subscribe or email ipm@missouri.edu.

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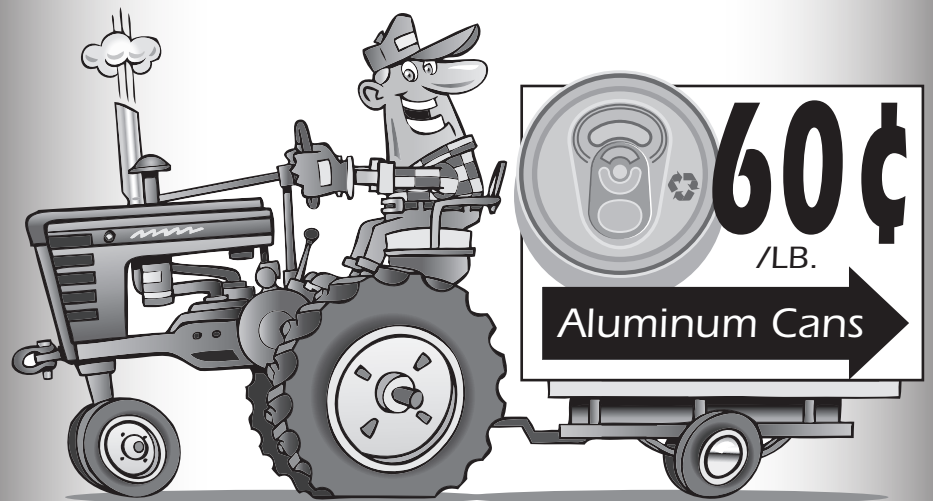
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Greenhouses effectively extend growing seasons

Modern, large-scale agriculture operations utilize various machines and technologies to provide products to consumers. Greenhouses are among the resources used to help plants thrive.

Greenhouses are not a new phenomenon, even if today's incarnations have technological upgrades over their ancestors. The first attempts to grow plants in greenhouse-like structures likely date back to ancient Egypt, but there are writings from the Romans as early as 14 BCE explaining greenhouse operations. The Roman emperor Tiberius wanted to eat cucumbers all year long. Roman winters would not allow for cucumbers to thrive when temperatures dropped below freezing. Rolling cucumber growing carts into sheds only did so much. Someone came up with the concept of making sheds with sheets of efenite, a transparent rock, to let the sun in and help keep cucumbers growing indoors warm. The idea took off from there.

Greenhouses are comprised of walls and roofing materials primarily made of a transparent material. The interior of a greenhouse exposed to sunlight becomes significantly warmer than the external temperature, helping to protect plants inside from extreme conditions and enabling plants to thrive even when weather conditions are not optimal. Through the years, greenhouses also may have incorporated some form of additional heating.

Keeping plants thriving for commercial production now gets additional help from computers, as

relying on sunlight alone may result in fluctuations in optimal conditions. Modern, smart greenhouses, according to the cultivation technology company Growlink, employ smart technology for heating, cooling and lighting. This tech is connected to a computer to optimize plant growth conditions. Computers can adjust conditions accordingly for the particular plant being produced, such as for tropical fruits that require more moisture and heat.

Anyone who desires a greenhouse for personal plant growth can build one in his or her backyard with various plans available for free or purchase. Companies also sell prefabricated greenhouse kits that can be erected with relative ease.

Handy homeowners also can construct basic greenhouses with materials found at many home improvement retailers. A wood frame greenhouse can be built in any size and covered with plastic sheeting. One can purchase a prefabricated greenhouse door or simply use a sheet of weighted plastic that can be tied out of the way for the door. To allow for ventilation in hot weather, a wood-frame vent that can be propped open can be incorporated into the roof rafter design.

Those who want a more permanent structure may want to look into using greenhouse plastic paneling in lieu of plastic sheeting. Either way, home greenhouses can be as elaborate or as simple as individuals desire.

Greenhouses are effective ways to extend growing seasons for both commercial and home gardeners.





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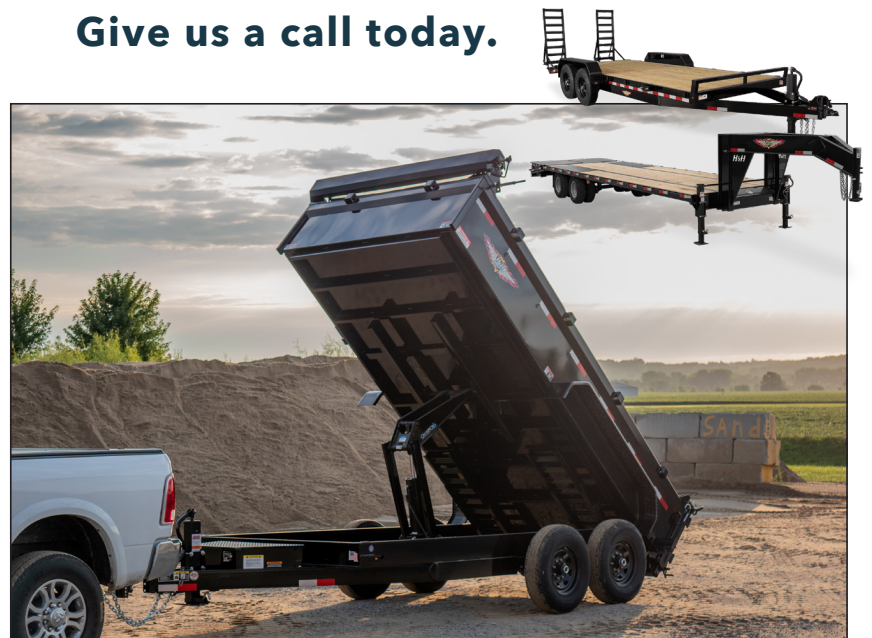
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BY LINDA GEIST
University Extension

A recent report through the Transforming Drainage project shows that drainage water recycling systems can improve corn yields and the environment, says University of Missouri Extension agronomist Kelly Nelson.

Nearly two-thirds of the site-years evaluated in the study saw an increase in yield compared to free drainage, with an overall average yield increase of 19 bushels per acre. The study looked at data from seven sites in the Midwest. These included silt loam fields in Shelby and Knox counties in Missouri, which are part of MU's Lee Greenley Jr. Memorial Research Center, as well as two sites in Minnesota and three sites in Ohio.

Researchers found that drainage recycling systems reduced yield variability by 28 percent over 53 site-years of work. This increases the resilience of the crop system and improves food security, Nelson says.

A combination of drainage and subirrigation also protects the environment by keeping nutrients such as nitrogen and phosphorus from entering downstream waterways, he says. That nutrient-rich water is recycled through irrigation.

Closed-loop drainage control systems capture and store surface and subsurface drainage water in a reservoir and then reuse that water as supplemental irrigation. Water level control structures—boxes with slides or gates that are buried in the ground—are spaced through water management zones based on the field's slope. Flow is adjusted to retain or drain water based on precipitation and the growth stage of the crop.

Researchers also found that corn yields gain most in the second half of vegetative development (9-leaf and greater) to early grain filling (blister stage). They found no yield difference between free drainage and drainage water recycling before the V9 stage or after R2.

Yields increased most in dry years when corn was most vulnerable to water stress and lower yields. Drainage water recycling likely improves corn yield in years when precipitation is below the critical threshold of 5 inches during the V9-R2 period and during extreme temperatures.

Soil characteristics play a major role in yield benefits of drainage water recycling, Nelson says. Deep soils with high water-holding capacity are less likely to be affected by short, dry periods during critical crop growth stages and may benefit less from irrigation. Soils that hold less water include shallow soils and sandy or clayey soils.

Because soil plays such an important role, Nelson recommends the Subirrigation Site Suitability Tool at transformingdrainage.org/tools/subirrigation-suitability-tool to help with initial planning.

The report was written by collaborators from MU, Minnesota Department of Agriculture, Purdue University, University of Wisconsin-Green Bay, USDA Agricultural Research Service (ARS) and the agricultural biotechnology company Benson Hill. Nelson, Lori Abendroth of the USDA-ARS

in Columbia and doctoral student Rebecca Willison worked on the research for the publication.

The report, "Corn Yield Response to Drainage Water Recycling Using Subirrigation," is available for download at bit.ly/3sPU8MH.

Learn more about the Transforming Drainage project at www.transformingdrainage.org.

During a recent field day at MU Greenley Research Center, extension agronomist Kelly Nelson presents results from a new report showing that drainage water recycling systems can improve corn yields and protect the environment.



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How agricultural technology can help improve sustainability

Sustainable agriculture is an approach to farming that will allow modern farmers to meet the needs of a growing population while enhancing environmental quality. That can benefit both current and future generations, and technology will play a vital role in realizing the goals of sustainable agriculture.

According to the National Sustainable Agriculture Coalition, sustainable agriculture is designed to meet the needs of the present without compromising future generations' ability to meet their own needs. That's a worthy goal, especially in the face of a growing global population that the United Nations estimates will increase by two billion persons by 2050.

There are numerous benefits to utilizing sustainable agriculture technology, which can be especially advantageous to modern farmers.

EFFICIENT LAND MANAGEMENT

Modeling technologies can be utilized to make more efficient use of land. According to Sustainable Brands, a global community of brand innovators, modeling technologies can be employed in a host of ways, including to identify tillage practices and the status of tile drainage. Certain agricultural technologies have been designed to predict the performance of cropland, which can allow farmers to more effectively and efficiently use their land. Farmers also can employ modeling technologies to determine soil health and water needs and usage, which can benefit the land and ensure resources aren't wasted. Utilization of such technologies ensures farmers can meet the needs of modern consumers without affecting future farmers' ability to do the same.

REDUCE RUNOFF

The United States Environmental Protection Agency notes that runoff poses a significant threat to the environment. When runoff occurs, fertilizer, bacteria and other pollutants find their way into streams, rivers, lakes, and the ocean. Sustainable Brands notes that nanotechnology is an efficient way to deliver nutrients to crops that can improve both the efficacy of the nutrients and reduce runoff.

PROTECT CROPS

Sustainable Brands notes that agricultural biologicals are inputs derived from natural materials that have low toxicity. That low toxicity reduces their environmental impact. Agricultural biologicals utilize the properties of such things as bacteria, fungi and even insects to support healthy crops, potentially improving yield without adversely affecting the environment.

Sustainable agriculture technologies can help modern farmers and their successors meet the needs of a rapidly growing global population.



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Legumes improve pastures, grazing, profits

BY PATRICK DAVIS
University Extension

Add legumes to grazing pastures to improve cattle performance and forage production, says University of Missouri Extension Regional Livestock Field Specialist Patrick Davis.

Frost-seed clovers and lespedeza now. They grow well with cool season grasses in Missouri and improve spring and summer pastures.

“Proper establishment is important to incorporation and persistence of these legumes,” says Davis. He urges producers to work with their local MU Extension agronomist when seeding legumes. MU Extension guide sheet G4652 extension.missouri.edu/p/g4652 also offers guidelines.

Clovers and lespedeza can be seeded by drill or broadcast, says Davis. He prefers drilling because it improves seed-to-soil contact for better establishment.

“If you broadcast seed, use cattle hoof action as well as the freezing and thawing process to work the seed into the soil,” says Davis.

“Legumes improve year-round cattle grazing opportunities when added to cool season grass pastures,” says Davis. Clovers enhance grazing in the spring while lespedeza improves grazing during late spring and summer.



mixed grass stand or slowly adapt cattle to very thick stands of clover to reduce bloat. Another way to reduce cattle bloat is to provide supplemental proxalene or bloat blocks to cattle, says Davis.

Lespedeza is a non-bloating legume that improves grazing in summer months, says Davis. Lespedeza is a drought-tolerant, warm season legume that provides summer grazing in cool season mixed pastures.

Do not overfertilize pastures with lespedeza, says Davis. Most fertilizer applications containing more than 30 pounds of nitrogen per acre will reduce stands of lespedeza. Lespedeza is an annual but will come back each year if it reseeds.

Clovers and lespedeza also help to reduce fescue toxicosis in cattle by diluting fescue pastures, says Davis. Adding legumes results in better quality forages, improved cattle production and higher profits.

To learn more about fescue toxicosis in cattle, see “Tall Fescue Toxicosis” at <https://extension.missouri.edu/publications/g4669>.

For more information, contact your local MU Extension agronomy or livestock field specialist. Find more resources on improving grasslands at <https://extension.missouri.edu/programs/nrcs-mu-grasslands-project>.

Proper grazing management of legumes improves persistence and cattle performance, says Davis. He recommends rotational grazing to prevent overgrazing.

The proper grazing height and rest period help to maintain white clover in cool season pastures, says Davis. Graze pastures to 4-inch stubble height and then rest pastures three to four weeks to maintain mixtures of white clover, fescue, and orchardgrass.

“The best time to graze red clover is when about half the plants are blooming,” says Davis. “At this point, the forage will yield a feeding value similar to alfalfa.”

Cattle bloat is a concern when grazing high-protein, highly digestible legumes. Incorporate white clover in a

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Pasture and cattle management strategies for a successful summer grazing season

BY PATRICK DAVIS

University Extension

Proper management of cool season pastures and incorporation of summer annuals is key to a successful summer cattle grazing season. Efficient year-round cattle grazing is important for optimum cattle operation profitability.

Strive to keep cool season pastures vegetative. During the grazing season, cool season grass heights should range between 4 to 8 inches. During the summer months, cool season forages will sometimes exceed this range or seed heads will start to develop. Forage in this growth stage is low quality and will not provide optimum cattle grazing intake and performance. Davis urges cattle producers to clip or mow pastures that are too tall or if seed heads are emerging to reset the pastures which allows for high quality cool season forage regrowth.

Seed summer annuals now to strengthen the summer grazing rotation. Crabgrass, pearl millet, and sudangrass are summer annuals that can be seeded now and grazed in the summer months to fill in the cool season grass slump. Cattle producers are urged to checkout MU Extension Guide Sheet G4661 as well as visit

with your local MU Extension agronomy field specialist to discuss proper seeding and establishment of these summer annuals.

Begin grazing crabgrass at 8 to 10 inches and don't graze lower than 3 inches. Crabgrass can typically be grazed approximately 30 to 45 days after planting.

Begin grazing sudangrass at a height of greater than 24 inches to prevent prussic acid poisoning in cattle. Since pearl millet does not cause prussic acid poisoning in cattle, begin grazing it at a height range between 18 to 30 inches. Do not graze either of these forages below 10 inches. Both of these forages can typically be grazed 45 to 60 days after planting.

Nitrate toxicity can be an issue with sudangrass and pearl millet during summer drought. Contact your local MU Extension livestock specialist for cattle and forage management strategies to reduce potential nitrate toxicity issues.

For more info or questions on how to manage your forage program for a successful summer cattle grazing season contact your local MU Extension Agronomy and Livestock Field Specialists.



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Plan now for antibiotic changes on the horizon

In 2023, antibiotics that are currently available over the counter will require a veterinarian's prescription.

BY LINDA GEIST
University Extension

COLUMBIA, Mo. – While 2023 might seem a long way off, it's not too early for livestock producers think about how recent Food and Drug Administration guidance might affect their operations, says University of Missouri Extension veterinarian Craig Payne.

On June 11, the FDA's Center for Veterinary Medicine published Guidance for Industry No. 263 (GFI #263) in the Federal Register. The document outlines a strategy and timeline for bringing all medically important antibiotics that are currently available over the counter under veterinary oversight. This will affect several antibiotics familiar to livestock producers.

If you have a valid veterinarian-client-patient relationship (VCPR), the impact will be minimal because a veterinarian will be able to issue a prescription

for these antibiotics, says Payne. If you don't have a VCPR, now is the time to find a veterinarian willing to work with you to ensure future access to antibiotics.

Under a VCPR, a veterinarian must have sufficient knowledge of your operation to make medical judgments, he says. It also means you agree to follow the veterinarian's instructions.

In 2017, many antibiotics used in the feed or drinking water of livestock moved from over-the-counter status to requiring a Veterinary Feed Directive or prescription. However, a small percentage remained available OTC in other forms, such as injectables, intramammary tubes and boluses, Payne says.

GFI #263 specifically addresses this small percentage. The FDA expects the labels of these remaining OTC antibiotics to display the following language by June 11, 2023: "Caution: federal law restricts this drug to use by or on the order of a licensed veterinarian."

"This will end over-the-counter sales of antibiotics, and livestock owners will need a prescription from a veterinarian in the future if they want access to antibiotics," Payne says.

He emphasizes that antibiotics won't necessarily have to be purchased through a veterinarian, but a prescription will be required.

GFI #263 is available at www.fda.gov/media/130610/download.

EXAMPLES OF AFFECTED PRODUCTS:

Cephapirin, cephapirin benzathine

- Intramammary tubes: ToDAY and ToMORROW

Gentamicin

- Injectables: Garasol, Gentamicin Piglet Injection

Lincomycin

- Injectables: Lincomix 100, Lincomix 300, LincoMed 100, LincoMed 300

Oxytetracycline

- Injectables: Liquamycin LA-200, Noromycin 300 LA, Bio-Mycin 200, Agrimycin 200, etc.

- Boluses: Terramycin Scours Tablets, OXY 500 Calf Boluses

Penicillin G procaine, penicillin G benzathine

- Injectables: Penicillin Injectable, Dura-Pen, Pro-Pen-G, Combi-Pen 48, etc.

- Intramammary tubes: Masti-Clear, Go-dry, Albadry Plus

Sulfadimethoxine, sulfamethazine

- Injectables: Di-Methox 40 percent, SulfMed 40 percent

- Boluses: Albon, Sustain III Cattle & Calf Boluses, Supra Sulfa III Cattle & Calf Boluses

Tylosin

- Injectables: Tylan 50, Tylan 200

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