Livestock Fencing Systems For Pasture Management

Fences can significantly increase livestock grazing efficiency. The first step in planning livestock fencing is determining the purpose and goals of the fencing program. Proper fencing layout is a powerful management tool in efficient grazing systems. Livestock protection and confinement are not the only reasons to consider fencing. An effective rotational or other intensively managed grazing system can be an affordable way to provide forage to grazing livestock and reduce herd nutrition costs year round. Fencing needs vary depending on the type of grazing management system and livestock species, class, and age. Determine the operation size, number of animals, type of forage system, and number of paddocks needed before investing in fencing materials and supplies. Many effective fencing options are available to livestock producers. Whether used as permanent or temporary confinements, fences should be carefully planned and constructed for efficient use, long life, and low maintenance.

Farm Resources

Permanent Resources

Before planning the layout of a fencing system, evaluate the resources available (Fig. 1). Use the information to design a fencing layout that maximizes forage efficiency and provides proper rest periods for plant growth and recovery. Permanent resources, such as soil type, slope, and aspect, affect fencing layout plans. Pastures should have similar soil type, slope, and aspect to provide uniform forage production and grazing distribution.

Semipermanent Resources

Semipermanent resources include water and shade. Semipermanent resources are critical for livestock productivity but can be modified to accommodate the fencing layout.

Water – Fencing layout should be planned to allow livestock access to adequate water supplies. A continuous supply of clean water is essential for all livestock. Water is a critical nutrient required for a wide variety of body functions in cattle. Adequate, clean water is a key part of rotational grazing systems. Water quality and accessibility are important in maintaining adequate water intake. Refer to Mississippi State University Extension Service Publication 2490, Beef Cattle Water Requirements and Source Management, for detailed information on livestock water needs.

When possible, supply clean water in each paddock within a reasonable walking distance. Otherwise, incorporate into the fencing system a central water source accessible to and within 900 feet of each paddock. A central water source often produces muddy conditions where livestock congregate. Consider using pipes and portable containers to create mobile water systems and avoid mud. Any fencing design should allow for flexibility in water placement within paddocks to control animal distribution and avoid trampling around the water source. If a single water source is used in a particular paddock, make sure that that it can provide the volume of water needed during peak demand. When possible, fence off surface

MISSISSIPPI STATE UNIVERSITY™
EXTENSION SERVICE

water sources, such creeks and ponds, to prevent livestock from entering water bodies.

Shade –Shade is a major factor to consider when building fences. Shade does not decrease air temperature, but it does reduce animal exposure to the sun's radiant energy. Adequate shade can reduce respiration rate and body temperature in livestock during the hottest times of the day. Shade also alters the grazing habits of cattle. Cattle with access to shade have shown a 3 percent increase in feed efficiency and a 6 percent increase in weight gain during hot weather.

There are three types of shade: natural, permanent, and portable.

- Natural shade is often taken for granted where trees are plentiful. However, take care in situations where only a few trees are growing. High concentrations of livestock congregating near trees over extended periods of time can kill trees and leave pastures with limited shade. Establishment of natural shade requires long-term planning that includes protecting trees from livestock-induced damage, particularly during the first years of tree establishment.

- Permanent shade can be provided in the form of sheds or barns. These shades can be costly and are not flexible. Permanent shade structures can become muddy during wet periods and harbor disease-causing agents that can affect livestock production. For both natural shade and permanent shade structures, consider how shade location changes as sunlight direction changes throughout the day. Natural or permanent shades along east or west fence lines may provide shade to a particular paddock during only morning or afternoon hours.

- Portable shade structures made from galvanized pipe frames can be sturdy enough to withstand livestock activity. Shades can be moved with cattle as needed or moved to various locations within paddocks to avoid mud and manure buildup. Shades should be 7 to 14 feet tall depending on the species of livestock housed; beef cattle require shades at least 10 feet tall. Cover shade with shade cloth to allow adequate air movement. At minimum, 400-pound calves require 18 square feet of shade per head, and 800-pound stockers require 25 square feet of shade per head. Provide at least 80 percent of the minimum.

Variable Resources

Variable resources also play a major role in fencing decisions. A combination of cool- and warm-season grasses, along with compatible legumes, can provide a good forage supply throughout the grazing season.

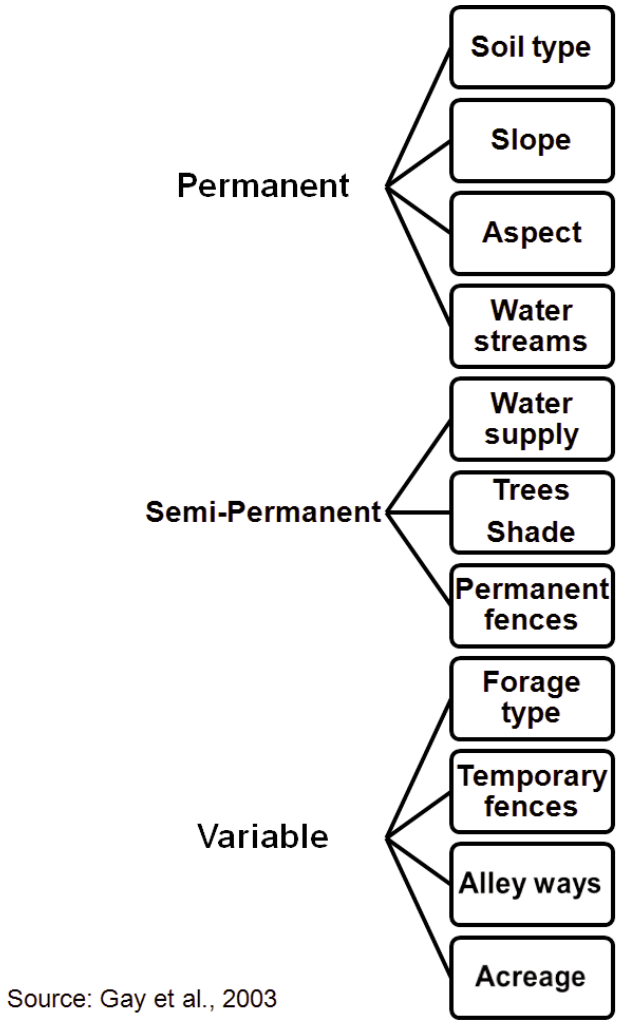

Figure 1. Farm resources to consider when planning fencing layout.

Use temporary fences to subdivide pastures by grazing method, such as creep grazing or leader-follower grazing, and to separate acreage designated for hay production. Temporary fences are often more economical than permanent fences when small paddocks are needed.

Locations of water, shade, and handling facilities are critical to fencing layout. Effective lane systems and gate placement make livestock movement to animal handling facilities and rotation to other pastures much easier. Be sure to place gates and passageways for livestock and equipment in the corner of each field closest to the central water source. Animals should follow through a gate and into a lane system instead of running inside the fence line when the first animal moves through the gate. When designing fencing layout, consider legal rights and responsibilities to avoid potential disputes with adjacent landowners. Remember: good fences make good neighbors.

Types of Fencing

There are two types of fencing systems: fixed or portable (flexible). Both systems have advantages and disadvantages (Table 1). Both types of fencing systems include a permanent boundary fence consisting of woven or barbed wire or electrified, high-tensile smooth wire to ensure that livestock are restrained on the ranch and excluded from areas such as roads and private property.

Fence Placement and Layout

Proper fencing is usually a major investment. Therefore, plan fencing layout carefully to save time and money. One of the benefits of a well-designed fencing system is that it can improve grazing efficiency. In continuous grazing, livestock tend to graze the most palatable plants first and leave mature plants until last. Forage selectivity by livestock often leads to concentrated and nonuniform manure distribution in the pasture.

One of the first management considerations in designing grazing systems is selection and installation of the proper fencing system. Give priority to well built perimeter fences and fences along roads or other areas from which livestock must be excluded, such as cropland. An effective fencing layout for rotational stocking includes a combination of permanent and temporary fences (Fig. 2). The combination will provide both perimeter security and flexibility for adjusting paddock size with livestock daily nutritional needs and forage availability.

The ideal number of fenced paddocks depends on forage species and productivity, performance goals, grazing pressure, rate of plant recovery, economic capability, and livestock characteristics, such as herd size, animal weights, and production levels. Size paddocks to provide consistent days of grazing. A 30- to 50-day rotation is very common and requires about 10 paddocks if cattle are moved at least once a week. During the spring, when forages grow rapidly and may grow to excess, a quick rotation of about 20 days may be needed to keep plants in a vegetative stage. A faster rotation means larger paddock areas are grazed for shorter periods of time with shorter intervals between grazing. Four paddocks in a 20-day rotation means moving animals every 5 days. On the other hand, a 45-day rotation, appropriate during slow winter growth or drought conditions, means longer periods between grazing, a restricted forage diet, and longer periods spent in each paddock. It may be necessary to divide the ranch up into as many as 20 paddocks. With this number of paddocks, gates can be opened or animals moved more often during a quick rotation, temporary electric fencing can further split paddocks during a slow rotation, or paddocks can be cut out of the rotation to produce hay.

To develop proper paddock layout and to estimate how much fencing will be necessary, consult aerial photos available through the National Resource Conservation Service (NRCS) or Farm Service Agency (FSA). A soil survey will also aid in dividing the paddocks for similar production capabilities. Plan for straight fences; they are more economical and easier to layout and construct.

The shape of the fenced pasture makes a big difference in the length of fence needed to enclose the pasture. Paddocks should be fairly square, minimizing soil variation and following landscape changes. A perfect square is not always possible, as access to water, shade, livestock handling facilities, and the natural lay of the land must be considered. Square paddocks usually require the minimum amount of fencing and reduce distance to water sources. Rectangular paddocks should be no more than four times as long as they are wide. Pie-shaped fencing designs with a central water source can lead to mud holes where livestock congregate at water sources. Also, following land contours is much more difficult with pie shapes. Paddocks can be subdivided with temporary fences to change grazing periods and to adjust for seasonal changes in forage availability.

Calculate the length of fencing needed for different fencing layouts. This exercise will help identify the most efficient layout and estimate the amount of supplies necessary. Information on determining the number of paddocks and temporary fences can be found in Pasture Management and Grazing Guide for Livestock Producers (Mississippi State University Extension Service Publication P2459).

Table 1. Comparison of livestock fencing systems.

Fencing Systems	Advantages	Disadvantages
Fixed	Minimum daily labor Low maintenance Low cost per acre on large installations	High cost per acre on small installations Limited management flexibility
Flexible	High management flexibility Low cost per acre on small installations	More labor High maintenance

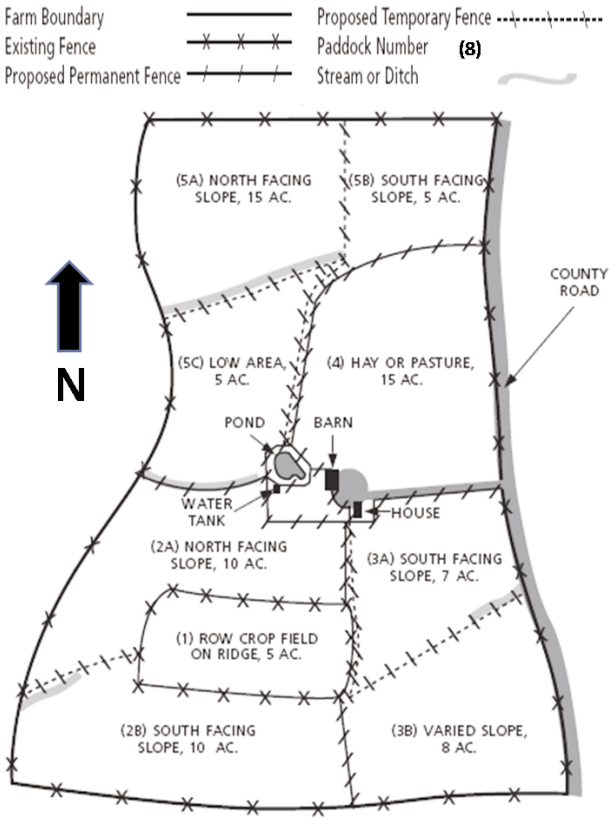

Figure 2. Subdivision of 80 acres pasture into eight paddocks using permanent and temporary fences. Source: Gay et al., 2003. Virginia Coop. Ext. Serv. P442-130.

Types of Wire

Three main types of wire are used in permanent livestock fencing: barbed wire, woven wire, and high-tensile wire.

- Barbed wire fences contain strands of horizontal wires twisted together with barbs spaced every 4 to 5 inches.

- Woven wire fences are smooth horizontal and vertical wires made of mild steel. Many producers use them, but they typically are more expensive and may be less effective than high-tensile electric fences.

- High-tensile wire is used for both nonelectric and electric fencing. It is lighter than mild steel and has greater elastic capacity. High-tensile wire costing about the same amount as mild steel is two and a half times stronger than mild steel. For example, when a corner post or H brace moves ½ inch, a mild steel wire such as barbed wire loses over 20 percent of its original strain, but high-tensile wire loses only about 10 percent.

High-tensile fences can be electric or nonelectric. High-tensile, nonelectric fences are desirable because they can withstand livestock contact and low temperatures without losing elasticity. The wire used in this type of fencing is usually 11- to 14-gauge wire with a tensile strength of 170,000 to 200,000 pounds per square inch and a breaking strength of 1,800 pounds.

High-tensile electric fences, on the other hand, combine the strength of the high-tensile fence with an electrical component. The electrical component is used to provide an electrical shock to any animal that touches the wire. One disadvantage of electric fences is that animals must be trained to stay away from the electric wire. With effective electric fencing, this training can be accomplished within a few days. Depending on animal size, 12 ½ gauge high-tensile electric wires (180,000 to 20,000 psi strength) with a galvanized coating Class 3 are commonly used for permanent fences. Each high-tensile fence wire should have one in-line tightener for every ¼ mile of straight run to adjust tension. Usually two "hot" wires are used to restrain livestock in lanes and paddocks, but the wire number and spacing depend on the type of livestock being constrained (Table 2). A two-wire fence, with one wire charged and one grounded, may be needed for better livestock control in areas with shallow, rocky soils. If the fixed area is larger than necessary to maintain animals for a specific number of days, subdivide it into paddocks with portable fences that can be moved to maintain grazing efficiency. Fixed fences at both ends will provide the necessary electrical charge to supply the portable fence.

Table 2. Electric fencing wire spacing for effective cattle containment.

Livestock	Number of wires	Wiring spacing above ground (inches)
Cows	1[1]	26 - 32
Cows and calves	2	18 – 24 / 24 – 36
Hard-to-hold cattle	3	11 – 18 / 23 – 30[2] / 34 – 44

[1] A 1-wire fence is usually located 2/3 animal shoulder height of a mature cow.

[2] Wire could be grounded under extremely dry conditions or soil types with low conductivity (sandy or gravelly soils), allowing animals to touch a hot wire and a ground wire.

Source: Pfost, 2000. Missouri Coop. Ext. Serv. Pub. EQ279.

Post Placement

Setting posts correctly is one of the most important factors in fence strength. The first consideration is setting the post at the correct depth. The proper depth depends on the diameter of the post and soil type. Generally, in medium to heavy clay soils, a post should be placed at a depth equal to ten times its diameter. In sandier soils, the depth should be fifteen times the diameter. These depths ensure that the post would break before it would uproot. If posts are too short or it is impossible to dig a deep enough hole, a "foot" may be used to anchor the post. A foot can be constructed from a 1-foot piece of four by four nailed or wired to the bottom of the post to form a "T". The "T" helps hold the post in the ground. A foot may also be necessary if there are dips or angles greater than 10 o in the fence line. Post spacing varies with the fence type (i.e., electric versus conventional) and the contour of the land. On a flat piece of ground with 2- or 3-wire electric fencing, posts can be spaced over 1000 feet apart as long as T-posts or hardwood posts are placed every 40 to 50 feet. Where the land has dips and angles, place posts at the top and bottom of the dip to make sure the fence follows the contour of the land.

Electric Fencing

Electric fencing is the fastest and most economical way to contain livestock. Electric fencing is more cost effective, easier to install and repair, and requires fewer posts in the fence than barbed wire fencing. Electric fence can be installed using polywire, polytape, or high-tensile wire. Use at least three strands of electric wire on perimeter fences and two strands on cross fences. Solid corner posts and gate posts are very important. High-tensile fencing tends to place more pressure on the posts. Be sure that H braces are sturdy.

Wire

Several types of wire are appropriate for portable electric fencing. The most commonly used materials for portable fencing are polywire and polytape. They can be maintained by using a reel with step-in plastic posts. These fence wires are commonly fabricated of polyethylene and stainless steel, but other products containing fiberglass and aluminum or thin copper conductors are available. Poly fences require no tools for setup, minimal bracing, and very light duty line posts. One potential problem with poly fences is that internal resistance of the filaments used as conductors limit the distance at which they can be powered.

Polywire has the appearance of heavy cord or plastic polyethylene baler twine laced with several strands of stainless steel wire (three, six, or nine). Polywire with six or nine strands is commonly used for longer runs without an excessive drop in voltage. Due to high resistance, the six-strand wire can effectively transmit charges for distances of up ½ mile; a distance of 2,000 feet is common. Nine-strand wire can transmit charges for ¾ to 1 mile. Polywire may last up to 10 years with proper use and maintenance.

Polytape is available in options similar to polywire, and it should be purchased on the basis of the number of filaments and quality of the plastic weave in the tape. A good polytape contains at least six wire filaments. Polytape is more visible than polywire and tends to flutter in the wind, making it easier for animals to see and avoid it. The life span for polytape is approximately 5 to 7 years due to wear by wind friction on post clips and insulators.

Reels

Reels are an essential part of dispensing and retrieving poly portable fences. Get one with a good locking system, adequate holding capacity, high speed gearing, and a good manufacturer's warranty. The best locking system is a cog-and-lock lever system, which prevents the accidental loosening of fence. Reel capacities range from 300 to 1,320 feet of fencing. Polywire capacities may range from 660 to 2,640 feet or even greater. If fences are to be relocated often, then a geared reel is helpful. Most reels work in a 1:1 retrieval ratio, but a geared reel can retrieve tape or polywire at a ratio of 3:1. A geared reel is typically more expensive; however, time savings will justify the purchase.

Most reels are durable, but they are plastic. Therefore, a good warranty is advisable. Most warranties range from zero to five years for replacing plastic parts. Check with the dealer or manufacturer about terms and conditions.

Posts

Common wood posts and steel posts are used with insulators for permanent electric fences. Plastic and fiberglass posts are the most common line posts used with electric fences. Fiberglass posts come in different diameter sizes, including 3⁄8", 1⁄2", 5⁄8" and larger, and are used without insulators. Drought or freezing conditions may compact the ground, which can limit the efficiency of posts. Certain types of imported posts, such as well-cured hedge (osage orange, red cedar, and black locust) can be used without insulators if high soil moisture levels do not reduce guard voltage. Different models of step-in posts are also available; choose one with a step large enough to accommodate a person's foot completely so the post can be driven or pushed into the ground easily. The post should be rigid enough to withstand windstorms but flexible enough to bend under excessive pressure. Be sure posts have the appropriate spike diameter. For high-tensile fences, use corner wood posts that are 8 feet tall, 5 to 6 inches across, and have adequate H-bracing.

Insulators

High quality insulators are important in corners and ends of permanent electric fences. UV-stabilized, high-density polyethylene or polypropylene insulators are recommended for use on wood or steel posts of permanent electric fences. Porcelain insulators can work if they are high quality. However, they are less desirable because they can crack under high strain, allowing in moisture that could create an electric short. With double-hole insulators, make sure that the two wires cross one another to load the insulator under compression. Loading the double-hole insulator under tension can split it in half.

Energizers

Using an adequate energizer, or charger, for electric fencing is very important. If electricity is not available, battery or solar energizers can be used. The first step is to choose low impedance, high-voltage charger. There are several excellent ones on the market that include solar, battery, or household hook-up. It is important to have a charger that can deliver an adequate electrical shock under unfavorable conditions such as dry ground or excess vegetation touching the wire. Plants and poor insulators can bleed off electricity from an electric fence. Proper grounding of an electric fencing system is a must. Drive at least three 6-foot ground rods into the ground at 10-foot intervals. Alternating hot and ground wires on the fence structure can be effective in cattle restraint. Start with the top wire electrified.

Some chargers are rated in miles of fence or in acres. The longer the fence, the more powerful the energizer must be to send an effective charge throughout its length. Make sure that the charger has indicators showing correct operation, input voltage, high/low switch or separate output terminals for dry or normal conditions, and a light that indicates when the fence is charged. Battery-powered units should also have a half-power option. Select a charger that is approved by Underwriters Laboratories or the U.S. Bureau of Standards, and do not use homemade chargers. Chargers are usually powered by a 6- or 12-volt AC battery, by solar panels, or by main lines using 120 or 240 volt AC power. Main lines usually deliver a good shock under the favorable conditions described previously. Main-type chargers should be placed in dry areas with easy access for inspection but protected from access by animals and small children. When selecting a solar panel, make sure it that can provide at least 10 watts of solar panels per joule of output and the panel is oriented to receive the maximum amount of sunlight.

It is important to select a charger with output characteristics that match the length of fence to be energized. The charger should also meet the expected operating conditions, such as moisture levels in the air and soil, degree of contact with vegetation, wire size, total length of the wire, and length of the hair or wool on animals being fenced. The guard voltage, or voltage present at any point on the fence where an animal may contact it, can range from 2,000 to 4,000 volts. Usually 2,000 volts is sufficient for cattle under normal conditions, and 4,000 volts can be used under extremely dry conditions or for well-insulated animals such as sheep. Also check the ground line voltage with a voltmeter to ensure proper charge flow. It is wise to buy a charger with excess capacity to allow for future expansion. Another option is to buy one or more chargers and divide the fence into perimeters, but never connect two chargers to one perimeter.

Grounding

The size of the energizer, the grounding material itself, soil type, and soil moisture can all play a role in designing an effective grounding system. Inadequate grounding is one of the most common failures in properly constructed, insulated, and electrified fencing systems. Poor grounding causes weak shocks. In an electric fencing system, the electricity must complete a full circle back to the charger through the ground. It is important to install several ground rods -- at least three that are 6 to 8 feet long and attached with good ground clamps. Copper or galvanized rods are the most commonly used metals.

Use the same type of metal throughout the system. Each metal has a different ability to conduct electricity and a different rate of expansion or contraction in response to power surges and temperature changes. In addition, when a steel wire is hooked to a copper wire, the metal corrodes, causing poor contact and weakening shock power. The corrosion limits the amount of electricity that is able to flow through the system, and the electricity that does flow seeks an alternate route back to the energizer, creating a stray voltage risk.

Gates

Gates may be purchased or custom designed. Several manufacturers sell plans for gates, people passages, and cattle guards. Electrical charge at gates can be passed through underground wiring or overhead wiring high enough to clear animals and equipment. If placing the wire underground, pass the wire through plastic pipe to decrease the possibility of creating a short circuit. Gate placement is especially important under rotational grazing, because animals will be moved frequently, but it is important in all grazing systems so that animals can be moved to handling facilities for health treatments or other management practices as needed. A gate should be in a comer of the paddock to allow easy animal movement down the alley way.

Different tasks can be achieved with all the available livestock fencing technologies. Electric fencing makes subdivision relatively fast and inexpensive. However, the effectiveness of these fences relies on proper construction and the ability to carry the charge. The success of electric fencing can also be dependent on the cattle. Well-behaved livestock that are regularly handled and familiar with electric fencing will treat a single "hot" wire with at least as much respect as they would a barbed wire fence. Livestock, especially calves, can be quickly and easily trained to electric fences with a temporary wire in the pasture. Once livestock are shocked a few times, they should respect electric fences.

Summary

In addition to keeping livestock out of the neighboring pastures and off the major highways, fencing is a key component of good grazing management. Fencing allows control over both the movement of livestock and the productivity, quality, and utilization of forage crops. Low-cost, semi-permanent and temporary electric fencing systems make controlling and efficiently using pasture resources easier than ever. Well-designed fencing, water, and shade systems can make a big difference in animal comfort and productivity as well as labor efficiency. These systems should be functional the arrival of livestock and must be monitored and maintained throughout the year.

References

Buschermohle, M.J., J.B. Wills, W.W. Gill, C.D. Lane. 2001. Planning and building fences on the farm. Tennessee Coop. Ext. Serv. Pub. PB-1541.

Electric fencing for the serious grazer. 2005. USDA Natural Resources Conservation Service. Columbia, MO. Online: http://www.mo.nrcs.usda.gov/news/news/MO%20NRCS%20Electric%20Fencing_low.pdf

Gay, S.W., S.R. Smith, and G.E. Groover. 2003. Planning fencing systems for controlled grazing. Virginia Coop. Ext. Serv. Pub. 442-130.

Gay, S.W. and R.D Heidel, R.D. 2003. Fencing materials for livestock systems. Virginia Coop. Ext. Serv. Pub. 442-131.

Gay, S.W. and R.D Heidel, R.D. 2004. Constructing high-tensile fences. Virginia Coop. Ext. Serv. Pub. 442-132.

Marsh, L. 2001. Pumping water from remote locations for livestock watering. Virginia Coop. Ext. Serv. Pub. 442-775.

Meyer, R. and T. Olsen. 2005. Estimated costs for livestock fencing. Iowa Coop. Ext. Serv. Pub. B-175.

Pfost, D., J. Gerrish, M. Davis, and M. 2000. Managed grazing systems and fencing for distribution of beef manure. Missouri Coop. Ext. Serv. Pub. EQ-379.

Phillips, R.E. 1993. Constructing wire fences. Missouri Coop. Ext. Serv. Pub. G-1192.

Turner, L.W., C.W. Absher, and J.K. Evans. 1997. Planning fencing systems for intensive grazing management. Kentucky Coop. Ext. Serv. Pub. ID-74.

Worley, J.W. and G. Heusner. 2000. Fences for Horses. Georgia Coop. Ext. Serv. Bull. 1192.

By **Dr. Rocky Lemus**, Assistant Extension Professor, Plant and Soil Sciences; **Jimmy Parish**, Forage Variety Testing Manager, Plant and Soil Sciences; and **Dr. Jane Parish**, Associate Extension and Research Professor, Animal and Dairy Science.

Publication 2538
Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. Dr. Melissa Mixon, Interim Director (POD 06-09)

MISSISSIPPI STATE UNIVERSITY
EXTENSION SERVICE
MSUcares.com