

# Large Farm Equipment Accident Prevention

Sammy Sadaka,  
Ph.D., P.E.  
Associate Professor -  
Extension Engineer

Donald M. Johnson,  
Ph.D.  
Professor - Agricultural  
Education, Communications  
and Technology

## Introduction

According to the Centers for Disease Control and Prevention, there were 58,385 adult farm-related job injuries in 2014. In other words, every day about 160 agricultural workers suffer a lost-worktime injury. Moreover, 5 percent of these injuries result in permanent impairment. Unfortunately, the Bureau of Labor Statistics reported in 2013 that 459 farmers and farm operators died from work-related injuries, leading to a fatality rate of 21.7 deaths per 100,000 workers, which is twice the rate for the next highest industry of mining. Injury and death rates in almost every survey published are higher for agricultural work from April to September, when most farm activities occur.

A selection of U.S. news over the past few months provides an overview of the on-farm hazards caused by farm equipment. On one occasion, a California farmer was killed when he was run over by a spray rig. A Michigan resident was killed when he was run over by a bulldozer. An Iowa farmer died after being hit by a hay bale as he was stacking large bales. A Wisconsin farmer was killed after being struck and pinned under his tractor. A Texas man was killed as he attempted to dislodge weeds from a shredder. In another fatal incident, a Pennsylvania farmer was killed when a front-end loader tipped on top of him while he was moving bales of hay down a steep hill.

Farm equipment is classified as **farmstead** equipment (stationary or immobile), **self-propelled** equipment and **towed** equipment. All equipment on the farm may present hazards to workers or bystanders. Farmstead equipment may pose significant safety hazards because of moving parts.

Self-propelled equipment has moving parts or may be towed and have moving parts. The mobility of moveable farm equipment adds another dimension to hazards faced by the operator or a bystander.

Farm equipment (both large and small) can be hazardous. It poses different hazards based on size and the nature of the mechanisms. The objective of this fact sheet is to identify hazards related to large farm equipment and to offer some tips farmers and operators might employ to prevent accidents while using this type of equipment.

**Always refer to the manufacturer's operating manual for specific operational and safety information.**

## Farm Equipment

Equipment commonly used on a farm generally fits in one of two categories: large farm equipment or small farm equipment. Most large farm equipment shares common hazards with smaller and hobby farm equipment. However, the greater physical size of large tractors and equipment presents unique hazards to operators, workers and others. These hazards include, but are not limited to, obstructed or partially obstructed sight lines, potentially higher noise levels, greater distances between operator and machinery and greater cognitive demands on the operator. For these and other reasons, operation of large equipment presents unique hazards.

## Large Farm Equipment Hazards

All farm equipment can maim or kill if not operated or used in a safe manner and treated with respect.

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To prevent accidents, farmers must recognize the hazards these machines present. Farmers should develop good safety habits to ensure no contact with hazardous components of operating machinery and should take appropriate actions to avoid accidental contact. Safety has these two components: (1) recognize the hazard and (2) take action to mitigate the risk. Therefore, experienced farmers need to instruct hired workers about the hazards of operating large equipment because they may be unaware of the dangers. A new worker may take the inconvenient route if he/she does not really see the danger or the benefit of acting safely. Training or instruction and maintaining signage and guards are important. Farmers-owners-operators should realize they have a responsibility to protect their workers. OSHA (Occupational Safety and Health Administration) is not regulating them, but they still have the responsibility nevertheless. Experienced farmers also need to remind workers to stay aware and to avoid unsafe actions by keeping a consistent culture of safety and setting consistent examples. Do not perform or tolerate shortcuts to get things done, even when operations are in crisis mode. The following hazard points are common on farm equipment.

### Pinch Points

Pinch points occur where two parts move together, with at least one part turning in a circle. Examples of pinch points include belt drives, chain drives, gear drives and feed rolls. Body parts can enter a pinch point directly or be drawn in by clothing or long hair caught in the drive components. Figure 1 shows pinch points and a pinch point warning sign. Contact with a pinch point may injure or sever fingers, hands or other body parts. These injuries happen very fast before the worker can withdraw from the mechanism.

Therefore, never reach into the area near a rotating part. Shields and guards may provide some protection, but workers should wear appropriate, close-fitting clothing, avoid wearing jewelry (especially chains hanging around the neck or wrist, rings, piercings or wrist watches), keep long hair put-up and never reach across a machine or equipment in operation. Pinch points may move so quickly that contacted clothing will draw a body part into the point before the worker can react. Be aware and take steps to protect yourself.

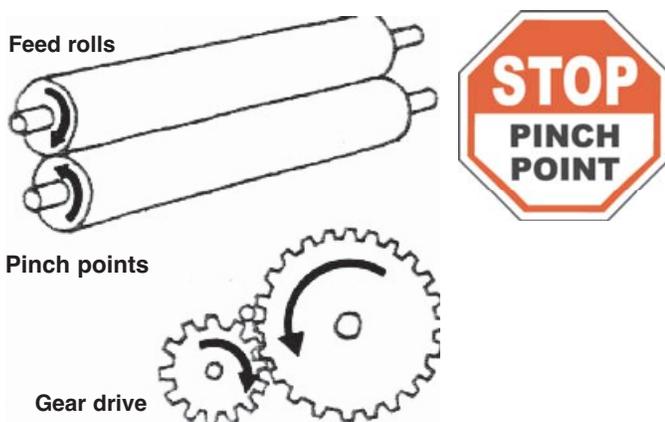


Figure 1. Examples of pinch points and a warning sign.

### Crush Points

Crush points are created when one object moves toward another stationary object or when two objects move toward each other (Figure 2). A good example is provided by the act of hitching an implement to the drawbar of a tractor. Jacked-up equipment, overhead garage doors and raised hydraulic components are other examples of potential crush points. Trees and tree limbs can also create a crushing injury. Equipment that is not properly blocked can create a potentially fatal crush injury as well. In one instance, a worker was pinned between a piece of equipment and a wall beam in a farm shop. Therefore, never enter the hitching area to place a pull pin until the tractor has stopped moving and the implement is secured and will not suddenly change positions. Be aware also of the possibility that after a piece of equipment is fully unhitched, it may shift or move and expose a worker to a potential crush injury. This is especially dangerous with three-point mounted equipment (towed implements, when stationary, are usually stable and have no forces on the hitch) or when the tractor and equipment are situated on sloping ground.

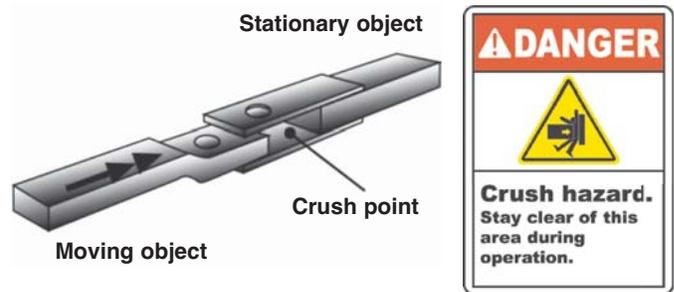


Figure 2. Example of a crush point and a crush point sign.

**Practice situational awareness at all times, identify potential hazards and take appropriate actions to prevent accidents.**

### Wrap-Up Points

Any rotating part or shaft is a potential wrap-up point and should be protected by a shield or guard (see Figure 3). Examples of wrap-up points include shaft ends that extend beyond bearings, fasteners on shafts such as couplers, U-joints and keys as well as irregularly shaped shafts. Even the smoothest-rotating shaft can grab and wrap if someone falls against it, creating friction between the shaft and an article of clothing. Power takeoff (PTO) shafts, if left exposed, could create wrap-up points that may quickly pull a worker into a machine or onto a shaft and a fatality or terrible injury can occur. Wrap-up points are most likely to wrap hair or clothing. Once the shaft catches the material, there is no escape. A 2-inch shaft rotating at 540 revolutions per minute can pull an article of clothing 12 inches before a worker can react (one-fifth of a second), and once caught there is no release.

Once again, shields and guards should always be properly replaced after removal for maintenance or repair. Avoid wearing loose clothing and keep long

hair tied back and covered when working around rotating machinery or parts. Never attempt to remove material wrapped around a rotating shaft or machine component while the shaft or component is rotating, even if the power has been shut off.



Figure 3. Properly guarded PTO driveline and wrap-up point sign.

### Pull-In Points

Some implement components function by pulling materials into the implement (Figure 4). Examples include hay rakes, hay balers and cotton picker feed rolls. These components usually operate at high speed, and a worker or a worker's body part can be pulled into the machine system before the he/she can react and let go. Even if the reaction is quick, the powered implement or component cannot be overcome by human strength. Pull-in accidents often happen when attempting to unclog or feed material by hand into a machine while it is operating.



Figure 4. A pull-in hazard resulting from feeding materials into a machine by hand and a nip points sign.

Always stop the machine, switch the power off and wait until all moving parts have completely stopped before attempting to unplug a feed roll or chute. Alert any other workers that the machine should not be restarted during the unclogging action. While lockout tagout procedures may not be practical in on-farm situations, the risk exists (a worker in a vulnerable safety position relative to a dangerous piece of

equipment gets injured because someone else restarts the machine before everyone is clear), and steps should be taken to mitigate or reduce the likelihood of a mishap, serious injury or fatality. Never attempt to remove plant or foreign material from a feed roll or other component that is actively pulling material or objects into the implement.

### Shear and Cutting Points

Shear points may involve two parts moving next to each other, sometimes in opposite directions, and provide a shearing effect, that is cutting like scissors. Shear points may also consist of a moving part in close contact with a stationary part (Figure 5), such as between the rotating auger and stationary housing of a grain or feed auger. The shear point is created when the moving object has enough force to cut relatively soft material. All guards, such as the inlet guard on an auger, should be kept in place to prevent accidental contact and injury.



Figure 5. Mechanical guard at inlet of portable grain auger.

Cutting devices are extensively used on harvesting equipment where the active parts may rotate or reciprocate. Sickle bars, found on combine grain platforms, some mowers and forage harvesters, forage cutters and disk blades used on some mower-conditioners, are examples of items that are intended to cut. Because these devices must contact the crop in order to work, they are difficult to protect with safety guards. To make matters worse, cutting devices are in rapid motion, so they are not easily seen and are sometimes overlooked. Workers should remain alert and use special care when using these devices. Always disengage power to cutting devices before inspecting, clearing or servicing. Familiarity with the implement might prevent disasters. Therefore, think about the point where the shear or cut could occur and take precautions.

### Burn Points

Burn points can include hydraulic lines, fluids and drive casings, exhaust pipes, mufflers and manifolds, engine blocks and components, radiators, coolant fluids, hoses, bearings and casings, turbochargers and molten metal from welding and cutting. Tractor, combine and other implement engines are also potential burn hazards. Overheated bearings can sometimes become so hot they will turn red from heat and can cause plant or other flammable debris to ignite. Fire needs three building blocks to burn: combustible material, air and something hot enough to ignite the material.

Burns can occur to virtually any part of the body and, in some cases, internally as well. When hot or irritant gases or liquids are accidentally inhaled or ingested, internal organs (lungs, trachea, esophagus, stomach, bronchial tubes, nasopharynx and membranes) may be damaged. Some gases or fluids may be poisonous when ingested or inhaled. If smoke appears from behind a hatch, guard or inspection shield, care should be exercised before opening the hatch or guard. A fire might suddenly flash or increase in size when exposed to the open air.

Be careful when making decisions as to when to refuel, perform maintenance, etc. Keep implements and machines as free as possible from accumulations of debris and clean them often. Keep appropriate fire extinguishers close at hand and available on the machine. Use extreme caution when approaching any implement or engine.

### Freewheeling Parts

Parts that continue to move or rotate after power to the equipment is disconnected are said to be “freewheeling.” Those unfamiliar with machines or implements with freewheeling parts may misinterpret the fact that the power source has been shut off and assume the implement is safe to approach or begin to perform maintenance. The freewheeling parts must “wind down” due to inertia because they have no braking system to be applied. Such implements operate with a large amount of “rotational energy.” The heavier the freewheeling part, the longer it will take for inertia to slow and stop the movement of the part, and the greater the potential harm to anyone who gets caught up in it.

Examples of implements that make use of rotational energy and have freewheeling parts include hay balers (flywheels), forage harvester cutter heads, feed grinder hammer mills, some rotary mower blades and blower fans. These examples illustrate the point that no implement should be approached until all parts have stopped moving, no matter how slowly the parts may be moving. When freewheeling parts are moving, even slowly, they may still have enough rotational energy to do serious damage to anyone or anything that interferes with the rotation. Injury occurs when an impatient worker reaches in to unclog or service the equipment before the freewheeling part stops moving. Make sure to leave all guards and shields in their proper location and be patient enough to wait for all parts to stop movement, even if it takes more than a couple of minutes.

### Thrown Objects

Rapidly moving parts of farm machinery may contact and forcefully throw foreign material – small rocks, dried plant stems, wire or even broken machine parts. Rotary mowers and flail choppers can throw small stones and other debris great distances with excessive force. Combine straw choppers and hammer mills can also throw kernels and other crop materials. When any of these materials become airborne due to the force of the operating machine, they may cause injury to operators or bystanders. If the thrown object

strikes an individual, a severe injury or even a fatality may occur. Both machine operators and others in the area should be careful to avoid these hazards. Don't operate these machines around children or pets.

### Breakthrough and Equipment Fall

Large heavy farm equipment may be moved from worksite to worksite using farm roads or county and state roads. During the move between worksites, the equipment will cross culverts, small bridges over ditches, canals and other means of crossing obstacles. Some old bridges are made of wood and have been in service for some time. This presents two hazards actually: breakthrough and equipment falls.

Breakthrough occurs when the weight of an individual piece or the combined weight of the material crossing the bridge exceeds the ability of the bridge to support the weight, and the bridge fails. Equipment fall may occur when the width of the wheels on the equipment is almost equal or exceeds the width of the bridge. A driver may try to cross a bridge or culvert that is not quite wide enough to provide support for the full width of the implement tire. This will cause a significant amount of the equipment weight to be without support or a large amount of weight supported by a small area of the bridge, resulting in possible bridge failure and equipment falling into the ditch or canal. Therefore, equipment drivers should be aware of the overall weight and width of all equipment as well as the maximum allowable weight and width of the bridge to be crossed. Slowing the speed of travel would be advised to allow observation and reaction to implement breakthrough and to lessen injury. Previously, workers have fallen from tall combines, grain buggy platforms and other elevated work positions, and they should therefore be aware of these hazards.

### Stored Energy Sources

Springs (Figure 6) used in the operation of many farm implements store energy when compressed or extended (stretched). Springs may be used to keep belts tight, and large and heavy springs may be used on large farm equipment as a form of shock absorber or to assist in lifting a heavy section of a piece of equipment. At one time, heavy springs were used on certain land plane blades to allow the blade to “trip” or ride over obstacles, such as ground level tree stumps on recently cleared land.



Figure 6. Spring samples.

It is important not to view a spring as just an inanimate object and disregard the danger it can represent. A compressed or stretched spring when released and returning to its resting state can release an immense amount of energy, quickly moving a large object or letting an object fall from above. Should a spring break, the released energy may send pieces of debris flying or let something move that was held in place by the spring. Always treat springs and the

energy they may hold with respect. Consequently, know whether and in what situations a spring will compress or release, what direction the spring will move and what effect the movement of the spring will have on a piece of equipment or a component of the equipment. When a spring with stored tension or compression forces is in a stationary position, a worker could be lulled into thinking there is no danger. A similar situation can occur when cleaning up a fallen tree, where some limbs may be bent and under spring compression that could unexpectedly be released and injure the worker who saws the limb in two.

## Hydraulic Systems

Hydraulic systems assist in the performance of many functions on large farm implements. Hydraulics are used to power hydraulic motors and hydraulic cylinders. Hydraulic systems (Figure 7) provide power to hydraulic rams or cylinders that raise and lower combine headers and wing gangs on disks and field cultivators and raise and lower implements for transport and field work. The use of hydraulics makes steering and braking of large tractors and combines easier. To perform these tasks, a great deal of stored energy in the form of hydraulic pressure must be available.



Figure 7. A hydraulic cylinder.

Because it is under enormous pressure, hydraulic fluid becomes very hot and can cause a burn hazard or, due to the immense pressure, a small leak can be an injection risk. Servicing a hydraulic system should be a job for an experienced technician. In any case, hands should never be used to find a hydraulic fluid leak. A leak may be so small it cannot be seen but could inject

hydraulic fluid under the skin if the hand or arm comes in contact. Medical attention should be sought immediately if hydraulic fluid is injected into the body, since infection or gangrene may result. Always wear long sleeves, heavy gloves, eye protection and use something like heavy cardboard to search for leaks. Hydraulic cylinders holding equipment in a raised position should be lowered upon completion of the work or before working under the raised equipment. Someone could inadvertently actuate the control or a leak could allow the pressure to be released. Avoid the possibility that children could get hurt by raised equipment by lowering the equipment when work stops. Do not allow children to play on parked equipment.

## Collisions

Collisions occur when a moving object strikes a stationary object or another moving object. Often these objects may involve farm implements, vehicles or a person. An excellent field of vision and an alert operator following safety precautions are ways to reduce collisions on the farm. Well-identified irrigation risers, support wires and established entry and exit roads into and out of equipment lots and fields may also help in reducing the chance of an on-farm collision.

Off-farm collisions may be reduced by having all equipment identified with a slow-moving vehicle sign, reflective tape and flashing warning lights (Figure 8). Lead and trailing vehicles with flashers and slow-moving or wide-load signs may also be helpful. Automobile drivers may not realize how quickly their rate of approach to a farm implement or tractor will occur. It is desirable to have some flashers to engage the attention of approaching vehicle drivers when implements are being moved, especially on paved roads. According to a University of Iowa study, enhanced lights and safety markings have the potential to reduce on-highway tractor accidents by up to 60 percent.

## Tractor Roll-Over

Tractors are major sources of on-farm injury and fatalities. Please review *Tractor Safety Tips for Arkansas Producers* (<https://www.uaex.edu/publications/pdf/FSA-1026.pdf>).

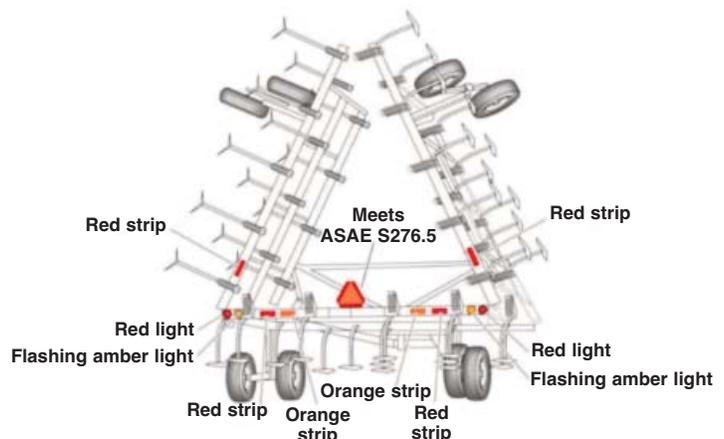
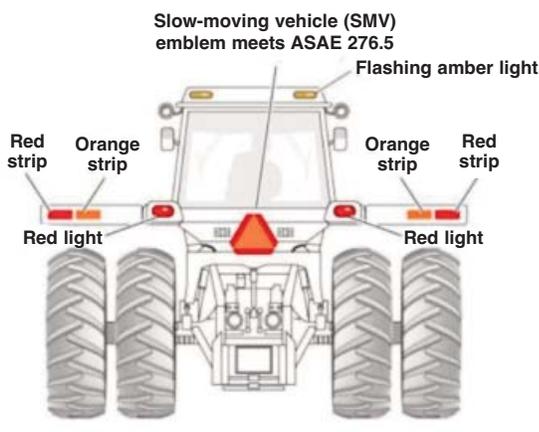


Figure 8. Tractor and implement properly illuminated and marked for highway travel.

## Asphyxiation

Although asphyxiation hazards (see Asphyxiation Hazard Sign in Figure 9) may not have been encountered often with farm implements in the open air, it could be induced by a wrap-up accident pulling the victim into a bind so tight as to prevent breathing. Farm shop and equipment storage buildings are not the ideal places to run tractors or other equipment engines, due to the potential accumulation of fossil fuel combustion byproducts such as carbon dioxide and other gases. Even if the shop or storage is well vented, it could still be a very dangerous practice to operate internal combustion engines in an enclosed area. Carbon monoxide is a byproduct of some combustion engines. Carbon monoxide is a colorless, odorless and tasteless gas that may cause unconsciousness before its presence is detected.

While beyond the scope of this publication, silos and manure pits are common on-farm asphyxiation hazards. Grain bin hazards to workers involving entrapment and asphyxiation are also critical farm safety issues. Sources of safety information about these two asphyxiation hazards are included in the references at the end of this publication.

## General Tips to Prevent Accidents

Operating farm equipment presents a serious threat to life and limb. Operators need to be able to recognize machine hazards and take the appropriate steps to protect themselves and others. The following are some tips that could help you avoid and prevent large farm equipment accidents.



Figure 9. Asphyxiation hazard sign.

- Be aware of hazards.
- Think about actions and their consequences before you take them.
- Never reach into any moving part of an operating machine.
- Never attempt to unclog or feed material into an operating machine.
- Disconnect power, shut off the engine, take the key and be patient until all parts have stopped before servicing equipment.
- Place all guards and shields in their locations and properly maintain them.
- Read the warning signs fixed to farm equipment.
- Keep the helper away from the tractor until the tractor is backed into position when hitching equipment. Always move the tractor forward to make necessary positioning adjustments.
- Keep bystanders far from areas where thrown objects could hit them.
- Keep children and bystanders away from operating machines.
- Do not try to remove twine, wire, weeds or any other object that is partially wrapped around a shaft before it completely stops.
- Never work under raised equipment unless it is securely blocked.

Considering that farming is a dangerous occupation, we should not allow children to operate farm equipment, tractors, pickups, etc., due to the dangers they pose. Children are at a special risk because of height and strength limitations, inexperience and inability to recognize dangers and make good decisions about safety. Although there is a tradition for this, farmers should be encouraged to rethink their practices.

**Never attempt to do any kind of work on farm equipment while the power is engaged or components are in motion.**

## Resources for More Information

- Mechanical hazards: Freewheeling parts. (2013). Farm and Ranch eXtension in Safety and Health (FReSH) Community of Practice. Retrieved from <http://articles.extension.org/pages/64419/mechanical-hazards:-freewheeling-parts>
- Pinch Points: Safety Training. Environmental Health and Safety, Middle Georgia State University. [https://www.mga.edu/risk-management/docs/environmental-services/safety-manual/machines/info/Pinch\\_Points.pdf](https://www.mga.edu/risk-management/docs/environmental-services/safety-manual/machines/info/Pinch_Points.pdf)
- Physical Hazards of Machinery and Equipment. Weill Cornell Medicine. [http://weill.cornell.edu/ehs/static\\_local/pdfs/PhysHaz.pdf](http://weill.cornell.edu/ehs/static_local/pdfs/PhysHaz.pdf)
- Occupational Health and Safety Guidelines for Farming Operations in Ontario. [http://www.labour.gov.on.ca/english/hs/pubs/farming/gl\\_equipment.php](http://www.labour.gov.on.ca/english/hs/pubs/farming/gl_equipment.php)
- Johnson, S. B., and D. L. Cyr. Fire Safety on the Farm. University of Maine. <http://nasdonline.org/1024/d000821/fire-safety-on-the-farm.html>
- Health and Safety Training Manual. Oregon State University. <http://agsci.oregonstate.edu/research/section-4-%E2%80%93-agricultural-safety-rules/chapter-1-%E2%80%93-farm-machinery-and-equipment>
- Confined Space Manure Storage Hazards. Penn State University. [http://extension.psu.edu/business/ag-safety/confined-spaces/manure/manure-pit-safety-fact-sheets/e-51/pdf\\_factsheet](http://extension.psu.edu/business/ag-safety/confined-spaces/manure/manure-pit-safety-fact-sheets/e-51/pdf_factsheet)
- Silo Gases: The Hidden Danger. Penn State University. [http://extension.psu.edu/business/ag-safety/confined-spaces/silo-safety/e16/pdf\\_factsheet](http://extension.psu.edu/business/ag-safety/confined-spaces/silo-safety/e16/pdf_factsheet)
- <https://www.uaex.edu/publications/pdf/FSA-1026.pdf>
- <https://www.uaex.edu/publications/pdf/FSA-1079.pdf>

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SAMMY SADAKA, Ph.D., P.E., is an associate professor - Extension engineer with the University of Arkansas System Division of Agriculture in Little Rock. DONALD M. JOHNSON, Ph.D., is a professor in the Agricultural Education, Communications and Technology Department with the University of Arkansas System Division of Agriculture in Fayetteville.

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