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Flood Damage and Recovery Management for Forages

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Severe flooding of pastures can occur during any season. Flood damage to forages can be quite variable depending on several factors, such as time of year, temperature, soil texture, flood duration and water movement.

Flood events of one day or less usually have low impact on forage survival. However, if the field was ready for hay harvest, the topgrowth may be damaged or unsuitable for harvest after the flood recedes. Such fields should be checked for debris and silt cover before considering hay harvest.

Timing of flood occurrence relative to forage growth stage also has a large impact on forage survival. Forages that were actively growing when the flooding occurred will suffer more stand loss than those that were dormant. Damage is lower during cool air and water temperatures than during warm temperatures. Some references report survival of certain grasses after 60 days of submersion when water temperatures are 50°F or less, but those species can be killed within 24 hours when water temperatures are 86°F or higher.

Damage is less in areas of moving water compared to standing, stagnant water. Sedimentation on leaves and crowns in standing water increases injury. Damage from flooding is also reduced if the forage is not completely covered by water. Grasses with leaves extending above the water surface survive longer than those fully submerged. Obviously, damage increases with increasing time of submersion. In general, common bermudagrass, dallisgrass, and eastern gamagrass have high tolerance to flooding; hybrid bermudagrass, tall fescue, annual ryegrass, bahiagrass, and switchgrass have moderate tolerance; and small grains, orchardgrass, and most legumes have low tolerance to flooding.

Flood Recovery Checklist

Flood damage should be assessed as soon as possible after the water recedes. Weeds and vegetation may spring up quickly in warm weather following a flood, in some cases covering debris that could cause hazards later.

As soon as possible after water recedes, check fields for damage and debris including:

- gravel, rocks, sand and silt deposits
- ditches, ruts, eroded stream banks, scouring and holes
- logs, brush, trees and drift piles
- fence wire and fence posts
- metal, trash and building debris
- damaged equipment and farm implements

Assess silt, sand, gravel and debris deposits (Figures 1 and 2). Field grading and leveling may be required. Flood deposits often have low organic matter and poor soil structure or tilth, making forage growth very poor for extended periods. On deep sand, silt or gravel deposits, feeding hay over those areas may add nutrients and organic material needed to help reestablish forage cover.

Potential crusting after the field dries can also impede forage growth. Avoid moving equipment into fields while soils are still saturated and soft. Saturated fields are susceptible to rutting and compaction that will further reduce future field productivity.

Livestock fences are often destroyed or covered with drift material (Figure 3). One producer noted that broken barbed wire dragged across fields during flooding is one of the most significant hazards following a flood. It can be unnoticed in growing vegetation and can cause serious injury or equipment damage when mowing fields later.

Figure 1. Gravel deposited by 2011 flood of the Eleven Point River in Randolph County. The producer removed over 600 dump truck loads of gravel deposits from the field. *(Photo by Mike Andrews.)*

Figure 2. Logs and woody debris gathered from a pasture following a flood in Randolph County. *(Photo by Mike Andrews.)*

Assessing Flood Damage to Forages

Silt cover can ruin standing forage, making it unpalatable to livestock and unacceptable for hay harvest. Sediment can also increase plant disease potential. Flooded plants will have weakened root systems which reduce nutrient uptake. Rhizobia bacteria in legume nodules will be weakened and likely will cease nitrogen fixation for an extended period. Flood-damaged plants will appear yellowed and nitrogen deficient.

Figure 3. Livestock fence covered in drift material from flooding. *(Photo by Mike Andrews.)*

Check plant root condition by digging random plants across the flooded area. Look for creamy white roots and green and growing crown buds. Plants with watery, mushy, yellowish or dark-colored roots, with little or no active crown buds, will be the least likely to survive, even with good growing conditions. Flooded fields often become infested with "new" weeds due to seed deposited by flood water. Flooding that occurs during the growing season can reduce reseeding from desirable forages, which eliminates natural stand thickening from volunteer seed. Hay bales saturated by flood water will likely be ruined by mold and bacterial growth.

Damaged stands may recover or may need reseeding and renovation (Figure 4). A good damage assessment will help producers make that decision. A simple 5 × 5 wire frame grid (25 squares) made from concrete reinforcement wire or a cattle panel is a good tool for assessing forage damage. Drop the wire frame in random spots across the pasture and count the number of squares with live forage, the number of squares with bare ground or no forage and the number of squares with undesirable weeds. Try to take at least four frames, for a total of 100 squares to count. Count "1" for any square that contains all or

Figure 4. Bermudagrass stand in Miller County thinned by 6 weeks of flooding immediately followed by severe drought in 2015. *(Photo by Jennifer Caraway.)*

part of a plant. Add the number of squares for each of the four frames counted (100 total squares) to get a percent stand. For example, if a fescue pasture was being assessed for damage and fescue was counted in 10 squares in Frame 1, eight squares in Frame 2, 16 squares in Frame 3 and 20 squares in Frame 4, then the stand percent or "frequency rate" is 54 percent (10 + 8 + 16 + 20 = 54). If bare ground was counted as 4, 8, 10 and 3 squares for the four frames, then the bare soil "frequency" is 25 percent. Try to take counts (in multiples of four frames) in several areas of a field to get a good assessment.

Flood damage to perennial pastures can be separated into three classes:

Fully functional = stand frequency greater than 70 percent

Fully functional pastures should recover quickly with weed control, proper soil fertility and deferred grazing or harvest once satisfactory growing conditions return. Complete recovery in these pastures may require 1 to 2 months of uninterrupted growth.

Moderately damaged = stand frequency between 40 and 70 percent

Pastures with this level of damage should fully recover with weed control, proper soil fertility and deferred grazing or harvest. Tillers and volunteer seed from some species will aid in stand recovery. Some overseeding may be necessary if flooding prevented seed production of the existing forage. Complete recovery in these pastures may require 2 to 3 months or more of uninterrupted growth.

Severely damaged = stand frequency less than 40 percent.

Severely damaged stands will require patience for adequate recovery. These could fully recover with weed control, proper soil fertility and deferred grazing or harvest, but it may take a year or longer for full recovery. Tillers and volunteer seed from some species will aid in stand recovery if seed was produced prior to flooding. Pastures in this category should be the first considered for total reseeding or stand renovation if a forage species change would help with developing a balanced seasonal forage system.

(Rating system adapted from Redfearn, 2011, *Assessing Drought Damage in Perennial Grass Pastures*, PSS-2593, Oklahoma State University.)

Case Histories

Arkansas – 2015

Flooding occurred along the Arkansas and Red Rivers in central and southwest Arkansas during the spring and winter of 2015. The primary perennial forage species in these areas was bermudagrass, so most assessment of flood damage is for that species with few or no observations for fescue, clover or ryegrass. Several county agents reported good survival and recovery of bermudagrass following 30 and 40 days of submergence, especially in areas where flood water was moving. The winter flood was of shorter duration and occurred in December when most forages were dormant, resulting in less stand damage to fields. Most of the 2015 flooding occurred in spring before seed-set of annual ryegrass or fescue, which reduced volunteer stands of those forages in the fall.

Johnson County – 2015

Repeated flooding in the same growing season has a strong negative impact on forage survival. Bermudagrass in hayfields outside the Arkansas River levee in Johnson County went underwater for 4 weeks in late April and early May. The grass regrew and began to fill in after the water receded. Before the stand fully recovered, a second flood occurred, covering the field for 4 weeks in June. The second flood severely weakened the stand, reducing the stand to about one good sprig per 10 square feet. The stand was further stressed later that summer by an infestation of armyworms. In the summer of 2016, the stand was about 50 percent with a lot of weeds and nutsedge.

Miller County

In May and June of 2015, the Red River flooded 1,500 acres of Two Rivers Plantation for a little over 2 months. Within 2 to 3 weeks after water subsided, the landowner started seeing bermudagrass recovering.

In September 2015, forage brassica was planted on some of the flooded acreage for an emergency fall grazing crop. Ironically, in October 2015, the area went into a severe drought, with the entire area of southwest Arkansas, northwest Louisiana and northeast Texas being under a burn ban. Some rain occurred in late October, and the brassica began germinating. Heavy rains fell again starting in late

Figure 5. Sand deposit across a bermudagrass pasture in Miller County from the 2015 Red River flood. The bermudagrass eventually grew across the sand deposit. *(Photo by Jennifer Caraway.)*

Figure 6. Bermudagrass stand damage from 30 days of backwater flooding of the Fourche Lafave River in Perry County in 2015. *(Photo by John Jennings.)*

October into December, causing the Red River to flood 400 acres again in December, including the brassica site.

Flooding continued into January 2016 and again in March 2016. The brassica did not survive the repeated flooding. The landowner reported later in May 2016 that other than the sand piles left from the flood, there appeared to be no long-term bermudagrass stand loss. The bermudagrass grew back even in the sand piles (Figure 5).

Faulkner County

Bermudagrass in Toad Suck Park near Conway was growing and was being mowed in less than 2 weeks after a 4-week flood event in April-May, 2015, where flood water was constantly flowing. Bermudagrass in pastures near Wooster was flooded for 4 weeks by Cadron Creek and appeared to fully recover after flood water receded.

Perry County

Bermudagrass was slow to recover in a Perry County pasture covered for 30 days by backwater flooding from the Fourche Lafave River (Figure 6). In this case, the flood water was not flowing. Knotroot foxtail was also observed to recover well in that field.

North Arkansas

Tall fescue is the dominant forage across northwest Arkansas and south Missouri. The region is characterized by steep topography where flash flooding may occur but is normally less than 1 day in duration. Water is often moving rapidly with great force during flash flooding, so the damage to pastures is more often caused by scouring, erosion and destruction of fences than from prolonged submergence of the forage.

Flash flooding occurred two to three times along several drainages in southwest Missouri into northwest Arkansas in spring/summer of 2015 where flood water rose to levels higher than locals could remember. The main damage was severe scouring of pastures and deep gravel deposits. Large round hay bales stored in low-lying areas floated away, and many farm implements such as balers, rakes and tractors were damaged or lost. Fences were destroyed and debris was ensnared in the wire, creating hazards for man, livestock and wildlife. Most fescue stands recovered, but weed problems increased from seed deposited by the flood. Many fields became infested with johnsongrass and other species. Logs and other debris littered many fields and had to be cleared to regain use of the field.

In northeast Arkansas, the terrain transitions from the steep Ozarks into the flatter Delta. Flood waters from the high elevations quickly fill the Black River and other drainages. Damage along the Ozark rivers is primarily flash flooding, causing scouring/erosion. But flood waters slow substantially after reaching the Delta, so flood water remains for a much longer time, causing long-term submersion stand damage to forages.

In 2017 in Randolph County, the Black River caused extensive flood damage. Backwater covered some fields for 6 to 8 weeks, causing forage stand loss. Several small grain pastures flooded for less than 1 week were a complete loss. Wheat was at the early heading stage ready for silage harvest, and oats were approaching 12 to 18 inches tall. Flooded fescue and bermudagrass fields started recovery within 2 weeks where the flood receded except where the topsoil was scoured away. In those cases, forage recovery may take over a year. Gravel deposits in fields along the Eleven Point River were over 6 feet deep in some cases. One Randolph County producer noted that he maintains a 40- to 50-foot timbered strip along creeks and rivers to help reduce flood damage, erosion and damage to the stream bank.

Arkansas – 2019

The Arkansas River reached record flood levels in May and June of 2019. The river reached a record crest in early June and flooded over 76,000 acres of hay and pasture land. The river receded after 24 days, and then flooded again in late June. Three fields were selected to assess damage and recovery of forages after both flooding events. Vegetation coverage rate was estimated at 2% per day based on drone images taken on 4 different dates after water recession at the 3 locations. This recovery rate suggests that producers should have a good visual assessment of the extent of natural recovery or damage within a month after flood water recession. Forage species were annual ryegrass, common bermudagrass, hybrid bermudagrass, bahiagrass, and johnsongrass. Common bermudagrass showed green leaf tips four days after the water receded (24 days of flooding) and appeared to be fully recovered by late summer. Two fields of hybrid bermudagrass (Tifton 44 and Midland 99) showed some green leaf tip four days after the water receded, but suffered severe damage after the fields flooded a second time in late June. Both fields were overtaken by weedy annual grasses by late summer and were converted to other crops the following year. Bahiagrass was severely damaged by the flood and live plants were found in the field only above the high-water line. Johnsongrass appeared to greenup quickly after the initial flood, but died out after the second flood event in late June. Annual ryegrass did not survive the initial 24 day flood event. Eastern gamagrass was noted to survive well along field ditches following both flooding events.

Dealing With Saltwater Intrusion in Pastures and Hayfields

Flooding in coastal areas or water from saline wells can cause salt buildup in soils, which reduces forage growth. The capacity of forage plants to grow satisfactorily in salty conditions depends on several interrelated factors, including the plant's physiological condition, growth stage and rooting habits. All soil contains some water-soluble salts. Plants absorb essential plant nutrients in the form of soluble salts, but excessive accumulation of soluble salts, called soil salinity, suppresses plant growth. When soil salinity exceeds a plant's tolerance, growth declines. Reduced growth caused by salinity is a progressive condition that increases as the salinity rises above a plant's tolerance threshold.

Symptoms of salt injury in plants resemble drought. Salt injury and drought are characterized by water stress (wilting) and reduced growth. As salt concentration rises, water becomes increasingly difficult for the plant to absorb. A plant can actually die from water stress (i.e., lack of available water) in a moist soil if the salt concentration becomes high enough. Severe injury caused by prolonged exposure or high salinity results in stunted plants and tissue death.

Forage crops grown vary in their tolerance to salty conditions. Salt-tolerant plants (plants less affected by salinity) are better able to adjust internally to the effects of high salt concentrations than salt-sensitive plants. Salt-tolerant plants are more able to absorb water from saline soils. Salt-sensitive plants have a limited ability to adjust and are injured at relatively low salt concentrations.

Bermudagrass is generally considered to have a high salt tolerance. Some research indicates that bermudagrass can tolerate salt concentrations up to 5,000 parts per million (ppm) for extended periods. Most of the resource information on bermudagrass pastures and hayfields indicates these areas should recover well from saltwater intrusion over time.

Rainfall is a major player in reducing salinity because it leaches the soil. In fact, five inches of rainfall will remove about 50 percent of the soil salts. Other perennial forage species such as bahiagrass and carpetgrass aren't as salt tolerant, but in relative terms, they are still considered to be salt tolerant. Most cool-season forage species such as ryegrass, wheat and barley are considered to be moderately tolerant to salty conditions. Most clover species, including white, red, arrowleaf and crimson, are considered to be salt sensitive.

Soil salinity is a big concern when attempting to plant winter annuals such as ryegrass into areas that have received some level of saltwater intrusion. Ryegrass planting normally occurs during September and October. In general, well-established plants will usually be more tolerant of salty conditions than young plants. A literature review makes it obvious that ryegrass seedlings are much more susceptible to salt injury than are mature plants. In 2005, the Louisiana State University AgCenter established the salinity threshold value of 1,800 ppm for seeding ryegrass.

Determining Soil Salt Levels

Salt accumulation will likely not be uniform across a field. "Hot" spots will be in the least well-drained areas of the fields. Soil samples can be collected from those areas to compare with samples from the overall field. Take samples from the top 3 inches of soil. Producers can check with their local extension agent if they have questions about how to perform this procedure or about any associated costs for salt analysis.

Producers also can perform a simple experiment (bioassay) on their own with a small amount of soil from affected areas before planting large acreages of forage crops, especially ryegrass and clovers. The bioassay can help predict potential crop injury. A bioassay does not measure the amount of salt residue present in the soil, but it may indicate whether enough salt residue is present to injure seedlings.

To begin the bioassay procedure, take soil samples in the top 3 inches from several locations in the field suspected of having high salt content. Mix the soil samples together in a clean plastic pail. You will need about a quart of soil for the bioassay. If possible, also take separate samples from fields that did not receive any saltwater intrusion. These samples can be labeled as "check" samples.

Plastic bottles are appropriate containers in which a bioassay can be conducted. Punch holes in the bottom of the containers to allow water drainage. Sprinkle a small amount of seed (about a teaspoon) in each container of soil and cover the seed with about ½ inch of soil. Wet the soil with water, but do not saturate it.

Place the containers in a warm location (70 to 75 degrees) where they can receive ample sunlight. Keep the soil in the containers moist. Within 7 to 10 days, injury symptoms should become apparent. Possible symptoms include no germination, partial germination, slowed emergence or seedlings appearing to be dried out.

It is a good idea to compare the germination and growth of the seedlings in the salt-affected containers to those in the "check" containers. Although this is not a precise experiment, it should provide an idea of how various forage species may germinate and grow in areas affected by saltwater intrusion.

Saltwater Damage – Louisiana

Hurricanes Katrina and Rita struck the state of Louisiana on August 29 and September 24, 2005, respectively. Both storms caused extensive flooding along the coastal parishes of Louisiana. Concerns about the amount of saltwater intrusion into pastures and hayfields were raised by producers in the affected areas. Six sites in Vermilion parish and two sites in Calcasieu parish were chosen to assess the salinity problem in forage crops. Cores were taken from the top 3 inches of the soil profile in mid-October. Initial salt levels ranged from 2,210 to 7,780 parts per million (ppm) (Figure 7). The sites were sampled 2 months later, and salt levels had declined by about 50 percent. Most producers who planted ryegrass that fall obtained excellent stands (Figure 8).

Figure 7. Pasture in Vermilion Parish, Louisiana, about 3 weeks after flooding from Hurricane Rita. The salt content in the soil was 2,600 ppm. *(Photo by Ed Twidwell, LSU AgCenter.)*

Figure 8. An excellent ryegrass stand in Vermilion Parish, Louisiana, was obtained after planting in late October, 2005, into a field that was flooded in late September during Hurricane Rita. *(Photo by Ed Twidwell, LSU AgCenter.)*

Saltwater intrusion had a minimal effect on bermudagrass, which is the major perennial summer forage grown in the coastal parishes. In fact, many producers reported flood waters caused a significant reduction in weed populations in their bermudagrass pastures and hayfields in the year following the hurricanes. The major weed species that were negatively impacted were smutgrass, crabgrass and vaseygrass. Numerous species of broadleaf weeds were also killed. These weed species were apparently more sensitive to the salt content present in the flood waters than was the bermudagrass.

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