

How Grasses Promote Frequent Fires in Southeastern Pine Savanna Ecosystems¹

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This publication is designed to provide ecologists, land managers, and the public with information on how the grass-fire feedback loop helps maintain these pine savannas, illustrating the mechanisms of the feedback loop and underscoring the importance of maintaining diverse perennial grasses to support frequent fire regimes and sustain healthy southeastern pine savannas.

Southeastern pine savannas are one of the most species-rich ecosystems in North America. Pine savannas have an open canopy of widely spaced pine trees, including longleaf (*Pinus palustris*) and slash (*P. elliottii*) pines and a grass-dominated, biodiverse understory (Figure 1). Many plant and animal species in these ecosystems are found nowhere else in the world (Sorrie and Weakley 2001; Noss et al. 2015). Once abundant throughout the southeastern United States, pine savannas have declined from over 92 million acres in pre-settlement times to approximately 3 million acres today because of past fire suppression and commercial development (van Lear et al. 2005). Historically, fires ignited by lightning and Native Americans burned large areas, resulting in an average fire frequency of one to three years in flat coastal areas (Frost 1998). Lightning fires burned the largest areas in the late dry season, just before the summer rainy season (Slocum et al. 2003; Platt et al. 2015), while fires lit by Native Americans tended to burn in the winter months (Fowler and Konopik 2007). After nearly a century of fire suppression and land conversion, southeastern pine savannas today depend on prescribed fire for restoring and maintaining critical habitat for plant and animal species.

Long-lived perennial grasses are considered foundational species in healthy old-growth savannas (Ellison 2005). Perennial grasses provide important functions, such as foraging and nesting habitats for wildlife and pathways for nutrient cycling and storage (Tucker et al. 2004; West et al. 2004). Because they dry quickly and regrow quickly



Figure 1. Pine savanna structure showing widely spaced longleaf pine trees with a diverse, grass-dominated understory, including flowering wiregrass.

Credit: R. M. Crandall, UF/IFAS.

(Figure 2), perennial grasses can burn frequently. This results in a positive feedback between the grasses and fire: fire burns the grass, which benefits from the increased sunlight and grows back quickly, providing fuel again for the fire, and the cycle repeats. Grass-fire feedbacks benefit the long-term health and persistence of pine savanna ecosystems.

Wiregrass (*Aristida stricta* and *A. beyrichiana*), a dominant perennial bunchgrass found only in the coastal plain of the southeastern United States, is considered a pivotal species in grass-fire feedbacks (Clewett 1989; Fill et al. 2016). Other perennial grasses that easily burn, such as little bluestem (*Schizachyrium scoparium*), cutthroat grass (*Coleataenia abscissa*), and pineywoods dropseed (*Sporobolus junceus*), also help maintain this feedback. As one of the more well-studied species, wiregrass is a good example of how savanna grasses promote and benefit from fire.

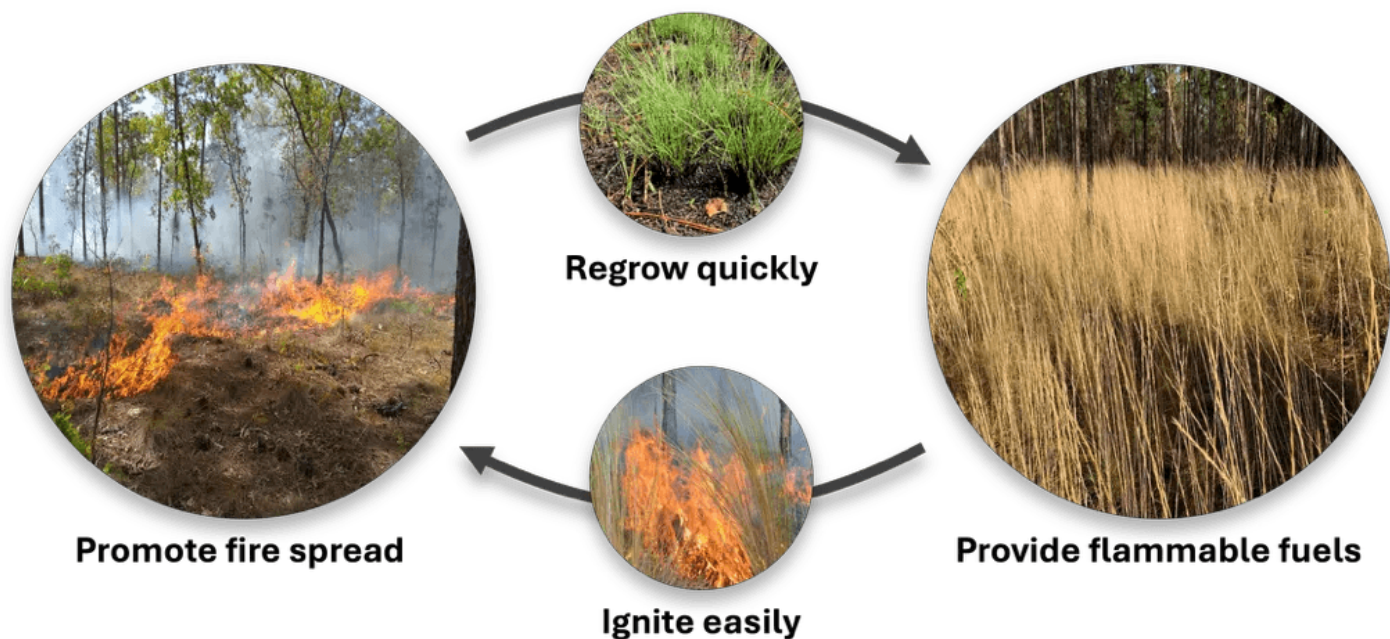


Figure 2. The grass-fire feedback cycle in southeastern pine savannas: grasses provide flammable fuel for fires, fires promote grass growth and reduce woody plant competition, and healthy grasses provide more fuel for future fires, creating a self-sustaining cycle.
Credit: R. M. Crandall, UF/IFAS.

Plant Structure

Wiregrass is recognized as two species, *Aristida stricta* (northern wiregrass) and *A. beyrichiana* (southern wiregrass), that grow from North Carolina south to the Florida Peninsula and westward to coastal Mississippi (Cerro-Tlatilpa et al. 2011; Weakley et al. 2024). As a C4 bunchgrass, it is well-adapted to warm, arid, and high-light environments. Growing in tufted clumps, its tillers, or new shoots, are densely packed at the base but spread outward in a fountain-like manner, especially in recently burned areas (Figure 3). New tillers grow from axillary buds at the base of old tillers, mainly along the outer edge of the plant (Fill et al. 2025), while tillers on the inside eventually die. This growth pattern eventually results in a “donut” shaped structure in older plants (Laucevicius et al. 2021; Fill et al. 2025).

Plant Flammability

The structure of wiregrass directly affects fire behavior, specifically flame length and fire duration. With thin, wiry leaves and an accumulation of leaf and needle litter that collects within these clumps, wiregrass is essentially tinder. Greater amounts of wiregrass result in greater flame length, which can promote more rapid fire spread by preheating fuels along the fire front. As fire spreads, plants preheat rapidly, allowing wiregrass to ignite quickly even under very moist conditions (Wade 2013). Plants burn readily under a wide range of weather conditions and can catch fire within hours after a summer rain, burning with as much as 80% fuel moisture (Wade 2013; Fill et al. 2016). Both the density of tillers in wiregrass plants and the accumulation of litter increase the duration of flaming and smoldering (Fill et al. 2016). Even with a greater density of tillers, however, wiregrass plants flame and smolder for less than five minutes (Fill et al. 2016).

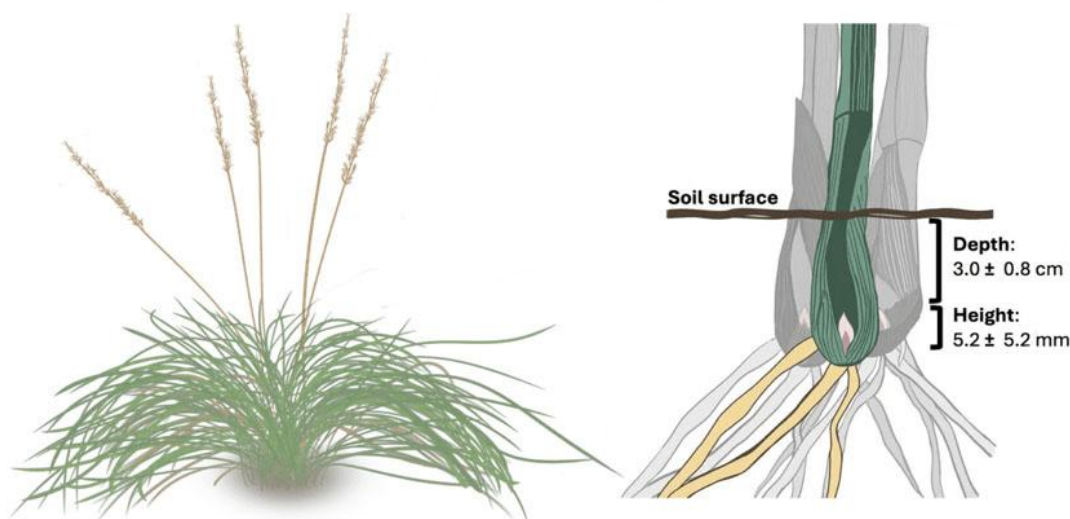


Figure 3. Wiregrass plant structure and growth pattern. Left, fountain-like form of wiregrass with tillers packed at the base and spreading outward, connecting one plant to another and helping the fire spread. Right, new tillers form from axillary buds at the base of existing tillers, allowing the plant to expand and regrow after fires. Wiregrass buds are approximately 5.2 mm tall and about 3 cm under the ground (Fill et al. 2025).

Credit: R. M. Crandall, UF/IFAS.

Post-Fire Regrowth

Wiregrass survives fire and regrows rapidly thanks to its underground bud bank. The bud bank is a collection of dormant buds located approximately 3 cm (just over an inch) below the soil surface (Fill et al. 2025). These buried buds can survive and grow into new tillers even after experiencing surface fire temperatures as high as 800 to 1000°C (Parrott 1967). Small plants may be more vulnerable to fire-induced mortality, particularly after extended fire-free periods (Fill et al. 2021).

After fires, in any season, wiregrass regrows tillers immediately. The plant can recover its pre-fire aboveground biomass (plant material) in fewer than 6 months (Figure 4). In some parts of its range, wiregrass may continue growing roots underground throughout the entire year (Satereson and Vitousek 1984). This remarkable ability to regrow quickly after fire is one of the key features that make wiregrass so important for fueling the next fire, maintaining the grass-fire feedback cycle.

Fire Exclusion

Human activity has historically shifted fire regimes toward less frequent fires or to total fire suppression in southeastern pine savanna systems. When fires are prevented or suppressed for long periods, the ecosystem changes dramatically. Without fire, a denser midstory develops as trees and shrubs grow taller and larger, with increased shading and litter (Hiers et al. 2009). Although it is true that, in the short term, wiregrass biomass tends

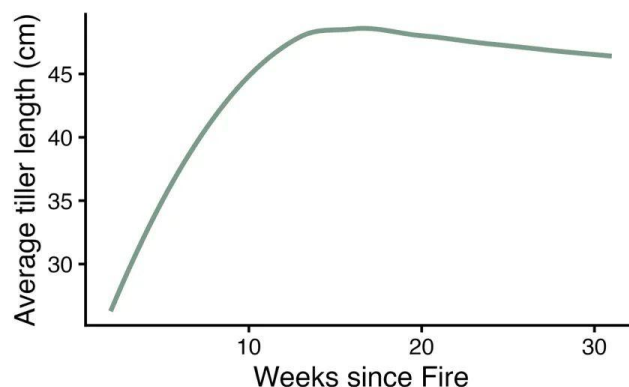


Figure 4. Wiregrass biomass recovery following fire over a 32-week period. Rapid regrowth begins immediately after fire, with growth leveling off at approximately 12 weeks post-fire.

Credit: J. M. Fill and R. M. Crandall, UF/IFAS.

to increase with time since the last fire in (Parrott 1967), the long-term effects of fire exclusion are harmful to fire-adapted wiregrass. As the canopy closes during long periods of fire exclusion, the size and number of wiregrass individuals eventually decline (Fill et al. 2021). However, wiregrass can persist under a range of fire regimes, even surviving over 50 years of fire exclusion (Fill et al. 2021; Fill and Crandall 2024). The ability of these remnant populations to survive makes wiregrass an important feature of ecosystem resistance and resilience to changing conditions. These surviving plants can help restore the ecosystem when fire is eventually reintroduced.

Managing for Feedbacks

Grass-fire feedbacks vary across southeastern pine savanna landscapes. Pine savannas support diverse plant communities that vary along soil and elevation gradients. Communities within short distances of each other can have very different species composition, ranging from prairies with short periods of standing water co-dominated by sedges and grasses to upland sandhills with very deep sands and higher grass cover (Slocum et al. 2003; Orzell and Bridges 2006). High and dry pine savannas tend to burn more completely, supporting more frequent fire intervals, than wetter areas that burn in a patchier manner (Slocum et al. 2003). Fire frequency also depends on the seasonality of weather conditions that promote dry fuel conditions. Grass fuels are more likely to be dry towards the end of the dry season than during the wet season, when fuel moisture content is likely to be patchy because rain falls in different areas of the landscape at different times (Slocum et al. 2003). Longer fire return intervals tend to allow shrubs to grow taller and denser, thereby shading out grasses and reducing the likelihood that grass-fire feedbacks will be maintained (Simha and Wright 2025).

Conclusion

In the past decade, southeastern pine savannas have gained scientific recognition as old-growth ecosystems whose persistence depends on fire (Platt 1999; Noss et al. 2015; Fill et al. 2015; Pau et al. 2023). These old-growth ecosystems require regular burning to maintain their structure and biodiversity. Wiregrass is a key example of how perennial grasses can survive and promote frequent fire regimes that benefit the health of southeastern pine savannas (Fill and Crandall 2024). Its ability to burn readily and regrow quickly creates a self-sustaining cycle that maintains these valuable habitats. Many other bunchgrasses in the ecosystem, such as bluestems (*Schizachyrium scoparium* and *Anatherum* spp.) and dropseeds (*Sporobolus* spp.), are also flammable and influence fire behavior and vegetation-fire feedbacks. Maintaining a diversity of perennial bunchgrasses is key to supporting healthy pine savanna ecosystems under frequent fire regimes.

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