Following are impressions gathered by Linda Conway Duever ~

Observations from the Cogongrass Conference: Implications for Research, Management and Control

The conference proceedings include a detailed and heavily referenced review of cogongrass biology by Dr. Greg MacDonald (University of Florida), as well as lengthy abstracts for other talks, many including valuable tables, graphics, and weblinks. The following implications emerged from discussions or connections between ideas presented by different speakers:

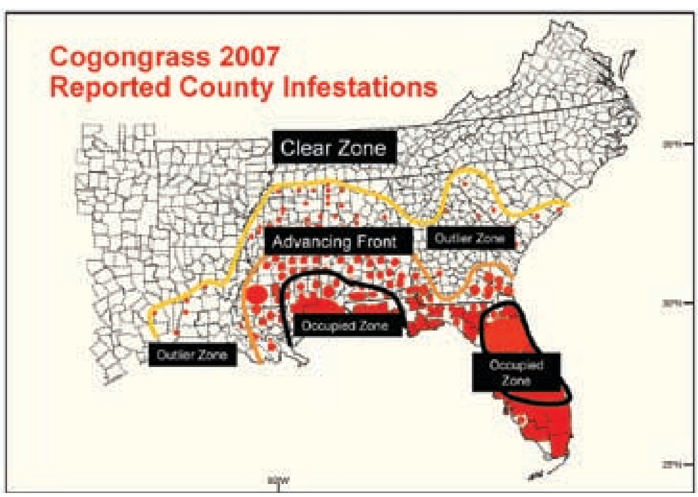
Averting an Out-Crossing-Generated Invasion Explosion in Florida

Whereas speakers talking about infestations in Alabama, Mississippi, and the western Florida panhandle described extensive reproduction from seed and stressed suppression of seedhead production as a control measure, little evidence of viable seed production was reported from Georgia or from most Florida populations. This has critical implications for geographic control strategy. Researchers suspect that many of the eastern infestations may still represent single clones. Therefore, since outcrossing has been reported to increase cogongrass seed production (Shilling et al. 1997), these stands may begin producing vastly greater quantities of viable seed if/when they come into contact with plants originating from other sources. If this hypothesis proves true, we are facing only a narrow window of opportunity to stop cogongrass from launching into an explosive seed-driven expansion on the eastern half of the Southeastern Coastal Plain.

Unfortunately, we don't know how real this threat is yet—and the most recent research (Capo-chichi et al. in press) is confounding previous hypotheses. That Auburn University study of southern Alabama populations found that cogongrass outliers showed increased genetic variation at increased distances from the Grand Bay point of introduction and that there was surprisingly great genetic variability within each infestation. The Auburn researchers are preparing a proposal for evaluating cogongrass seed production and viability across the southeast. If funded, that project should provide vital insight into the risk of cogongrass "blow-ups" from outcrossing.

It would nevertheless be prudent to take several immediate emergency actions: 1) stop the sale, distribution, and cultivation of "Red Baron" and other "Japanese bloodgrass" cultivars throughout the southeast; 2) identify and prioritize for control all eastern infestations that show evidence of producing viable seed; and 3) keep populations and patches separated by cogongrass-free control zones. All of these steps would help slow cogongrass invasion even if outcrossing does not turn out to be a critical factor.

My own idea for successfully containing seed-producing cogongrass in Florida—and ultimately controlling cogongrass invasion throughout the United States—is to rapidly develop and implement geographic cogongrass control strategies similar to the one prepared for Marion County (http://www.mcismc.org/) at both the local and regional levels. This strategy is based on Robin Lewis' "bull's eye" approach to preventing exotic invasion of restoration sites (Randall et al. 1997) and Steven Dewey's "Attack Your Weeds Like a Wildfire" guidelines (Carpenter and Murray 2000). Lewis speaks of treating critical areas vulnerable to invasion as the center of a bull's eye and maintaining concentric control buffers around them. Dewey explains that, in both fighting wildfires and controlling invasives, you must 1) build a fire line; 2) eliminate spot fires; 3) protect critical areas; and 4) control the main outbreak. I have



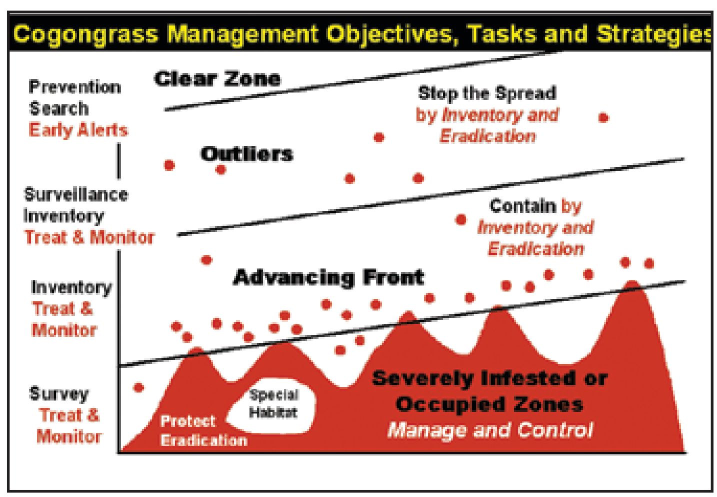


Figure 1. Zone of cogongrass spread and density in 2007. Figure 2. Invasion zones require specific objectives, tasks, and strategies to stop the spread and restore.
By James H. Miller, Ph.D., Research Ecologist Insect, Disease, and Invasive Plant Research, USDA Forest Service, Southern Research Station, Auburn, AL

added two concepts to this analogy: 5) prevent blow-ups; and 6) conduct mop-up operations. The logistic advantage of this control strategy is compelling even where genetic influences on seed production are not a concern.

Managing Cogongrass in Longleaf Pine Ecosystems

Shibu Jose gave a fascinating presentation, *What Research Has Found About Cogongrass Spread and Control in the Longleaf Pine Ecosystem.* He expanded upon implications from Carol Lippincott's 1997 dissertation, pointing out that cogongrass fires kill pines because they burn 15-20 percent hotter than other groundcover fires, not at the surface, but *4-6 feet above ground level*.

MacDonald explained that cogongrass is adapted to grow on soils like those of the longleaf pine ecosystem: low in pH, nitrogen, potassium, and organic matter. One of the most troubling things Jose told us was that cogongrass further lowers the pH in longleaf ecosystem soils and thereby causes nutrients to leach beyond the depth where they are accessible to wiregrass (*Aristida stricta*) and many of the ecosystem's other characteristic groundcover species.

The most intriguing part of Jose's talk was his report on mesocosm experiments aimed towards determining what characteristics of longleaf pine groundcover composition were most important in determining the community's resistance to cogongrass invasion.

> "Doing something to this plant only once just makes it mad." — Dave Moorhead

All of the longleaf community species mixtures he used slowed cogongrass invasion, but broomsedge (*Andropogon virginicus*) was the outstanding competitor. Jose told us that broomsedge can "go head-to-head with cogongrass" because it fights on the same turf, using "the same strategy that cogongrass uses in outcompeting other vegetation, but more effectively." He explained that the obvious weapons cogongrass uses (allelopathy, smothering thatch, super-flammability, root-piercing rhizome tips) are not the ultimate key to its success. The killer strategy is the way cogongrass sucks nitrogen and carbon deep into the ground and ties them up in a huge rhizome mass where other plants can't get at them. Broomsedge jumps in and aggressively installs a similar root mass at the same soil depth.

On the Thursday field trip, we saw closely related bushy bluestem (*A. glomeratus*) persisting in a massive old stand of cogongrass. My guess is that it might be a comparable competitor, especially on sites with relatively high soil moisture.

Upon hearing about broomsedge's competitiveness, Rod Grill raised the same question I did: Could we plant broomsedge barriers to enclose cogongrass stands and keep them from expanding? This might be a way to escape the "doughnut effect" when treating an established stand of cogongrass, which releases dormant rhizomes in an 8-10 foot band beyond the visible above-ground grass. If this zone were disked and planted in broomsedge before herbicide application, would that stop a new cogongrass stand from sprouting from those rhizomes? Could we plant broomsedge on sites where cogongrass has been recently treated? What do we know about its tolerance of glyphosate and imazapyr? Since broomsedge roots occupy a lower soil stratum than wiregrass or most wildflowers, it stands to reason that it could be seeded in a mix with those species. Since broomsedge is an early-succession species less flammable than wiregrass, rather than a pyrogenic climax species like cogongrass, it seems logical that time and fire would then permit wiregrass groundcover to reclaim the site.

There are questions about how easy/difficult broomsedge establishment would be in different situations, however. I have had some broomsedge (and a lot more *A. ternarius*) emerge from seeding a species mix on a red oak woods restoration site, but mixed results are reported from other seeding attempts. Since there is some anecdotal evidence that cogongrass may not grow well under southern red oak (*Quercus falcata*) (McKee 2007 personal communication), my *Andropogon* seeding experience may not be applicable to cogongrass-infested sites.

Addressing the Rhizome Mass

Several speakers pointed out that the luxuriant foliage we see above ground is only the tip of the cogongrass iceberg, since the rhizome mass below ground can be as large as 40 tons per hectare (Terry et al. 1997) and comprise over 60 percent of a stand's biomass. This disproportionate reservoir of belowground energy explains cogongrass' phenomenal ability to rapidly and repeatedly regenerate top growth after burning or cutting. Established stands simply don't have enough leaves to transport sufficient herbicide to kill all the roots at one time. This is why, as Dave Moorhead (Moorhead and Bargeron 2007) put it, "Doing something to this plant only once just makes it mad."

The take-home lesson reiterated by one speaker after another is that cogongrass must be attacked by a carefully integrated *sequence* of treatments that repeatedly remove carbohydrate-producing top growth and diminish the rhizome base. Various speakers described numerous ways of accomplishing this with herbicides, most involving spring and fall treatments with imazapyr and/or glyphosate. John Byrd (Byrd 2007) reviewed the effects of mechanical treatments and told us that rototilling cogongrass three times in a year will replace it with ordinary weeds and religiously mowing it short *at least weekly* for five or more years will achieve "positive control." Converting a cogongrass stand into a regularly tilled farm field will get rid of it. Dearl Sanders (Sanders 2007) told us that frequent plowing prevents cogongrass from invading sugarcane fields. Several speakers emphasized the importance of planting something else after treating cogongrass, reporting that drilled-in crimson clover, ryegrass, bahiagrass, bermuda, and soybeans have all worked well.

The bottom line is that successful, cost-effective cogongrass control demands commitment to timely retreatment and replanting. It also calls for longterm monitoring, since surviving rhizomes will sprout months or years after the last sign of green top growth. We know they can lay dormant this way for at least nine months (MacDonald 2007). How much longer?

Critical Needs for Regional Support

Over the course of the conference, the frontline cogongrass warriors identified several key areas where the troops on the ground need more support from Washington. Top-down action is needed to address these critical needs:

- More funding and training for southeastern Cooperative Weed Management Areas (CWMAs) and similar programs that are struggling to adapt advanced invasives control procedures to a new sociopolitical and ecological landscape while most of the money goes to well established western programs. We especially need more funding applicable to private lands because more of the southeastern landscape is privately owned.
- Appropriate refinement and effective enforcement of laws prohibiting site-to-site (not just state-to-state) movement of cogongrass by all mechanisms, including nursery stock, hay, bedding, mulch, pine straw, fill dirt, limerock and contaminated machinery.
- Regional and state-level cooperative agreements and pre-approved agreement documents between major agencies and landowners to facilitate sharing resources across property lines and to circumvent time-consuming red tape for local CWMAs.
- Downloadable documents and boilerplate covering questions that come up repeatedly across the region, especially Best Management Practices (BMPs) for various equipment cleaning and dirt moving procedures. Chuck Bargeron is doing a terrific job of sharing information regionally through http://www.cogongrass.org/. We need to route more funding and more information to this vital clearinghouse.

Literature Cited

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The following notes were taken by Justin F. Jones of The Nature Conservancy in Milton, Florida, jjones@tnc.org

A few messages on cogongrass control were repeated throughout the conference. These include:

- Cogongrass control is best achieved through a multifaceted approach including herbicides, mechanical treatment, and the introduction of desirable, competitive plant species.
- Use glyphosate, imazapyr, or a mixture of both, depending on surrounding vegetation.
- Fall applications are necessary, spring applications are good insurance.
- Plan on three years of herbicide application for effective control.
- Mowing or burning and then treatment of new growth can reduce the amount of herbicide required.
- Application of glyphosate is effective for seed prevention.

A note from Jim Miller:

Most short and long distance spread can be attributed to the movement of seed and rhizomes on contaminated equipment, fill dirt, hay, and possibly pine straw. Equipment used for forestry and right-of-way management have been the culprits and must be cleaned before moving when working in or near cogongrass infestations.

Contaminated recreational off-road vehicles and food plot cultivators from Florida, southern Alabama and Mississippi have been shown to introduce cogongrass onto distant hunting lands. Special programs to educate hunters are underway on private lands and in Georgia and need wider adoption.

Wilson Faircloth, USDA Agricultural Research Service

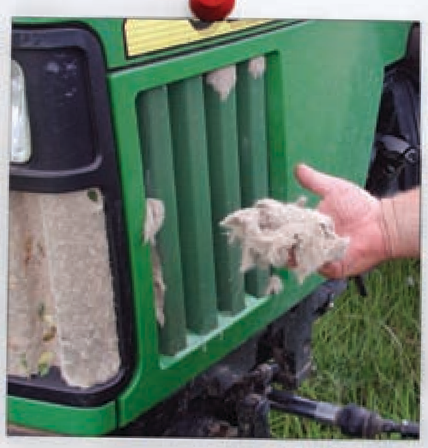
Managing Cogongrass on Rights-of-Way

- Apply a mixture of glyphosate (≥ 3 lb ai/acre) and imazapyr (0.38lb ai/acre) in the fall. Follow with a treatment of glyphosate on the new growth in the spring.
- Repeat applications for three years.
- Apply at least 15 gal/acre herbicide solution to ensure adequate coverage
- Mechanical treatments such as discing improve cogongrass control when used in combination with herbicides.
- Revegetation with a desirable grass such as bermuda- or bahiagrass should occur immediately after herbicide treatments. In fall/winter, use of clovers or annual ryegrass can offer suppression and serve as a bridge to rehabilitation with more desirable species.
- An accurate, up-to-date survey and proper training of row employees/managers can do more for prevention and containment than any herbicide program.

David J. Moorhead, University of Georgia

Cogongrass Distribution and Spread Prevention

- Seeds and rhizomes can hitch-hike on equipment and in mulch and fill.
- Equipment sanitation is necessary, including cleaning radiators, screens and any equipment parts that collect seed or come into contact with the soil and rhizomes.
- Inspect sources of off-site material for invasive species.
- Establish a central staging area where equipment and off-site material can be inspected and monitored for invasives.
- Utilize databases such as the Early Detection and Distribution Mapping System (EDDMapS) to record/share infestation and treatment data.



WILSON H. FAIRCLOTH, USDA/ARS

Gregory E. MacDonald, University of Florida, IFAS

Cogongrass: The Plant's Biology, Distribution, and Impacts in the Southeastern US

Reproduction

- Spreads both clonally through rhizomes and by seed.
- Produces extensive rhizomes (can comprise over 60% of total plant biomass, fresh weights as high as 40 tons per hectare).
- Most rhizomes are found 6-10 inches below ground, but can be found as deep as 4 feet.
- Rhizomes are allelopathic, and also interfere with the growth of other plants by penetrating roots, bulbs and tubers.
- Not self-compatible, and must out-cross to produce viable seed (populations originating from rhizomes only spread clonally until they reach close proximity to a genetically different population).
- Produces over 3000 seeds per plant.
- Flowering generally occurs in the late winter/early spring, but disturbance can stimulate flowering year-round.
- Seeds are wind disseminated, and though they can travel long distances, generally move ~15 m.
- There is a rapid decline in seed viability over time, and a complete loss of viability after one year.
- Seed is able to invade and grow in established native plant communities. Seed establishment is facilitated by tillage and burning.

Habitat

- Infests diverse habitats.
- Adapted to poor soils and drought conditions, and appears to grow best in soils with acidic pH, low fertility and low organic matter.
- Extremely efficient in nutrient uptake, and is a better competitor for phosphorus than native pine-savanna species.
- Best adapted to full sun, but can thrive under moderate shade and survive as an understory species.
- Thrives in fired-based ecosystems.
- Fires from cogongrass are hot and intense (15 to 20% hotter than fires in pine systems in the Southern U.S.) allowing little above-ground vegetation to survive. This limits natural secondary succession and causes mortality of normally fire tolerant species, such as long-leaf pine.
- Serrated margins of cogongrass leaves accumulate silicates, which deters grazing.

James H. Miller, U.S. Forest Service

What Research has Found about Establishing Loblolly Pine in Cogongrass Infestations

- Study showed that burning cogongrass, followed by discing the next day then split treatments of imazapyr at 44 and 90 days after burning, provided greater than 90% control.
- Also effective to replace 2nd imazapyr application with a 2nd discing.
- Both imazapyr and glyphosate are most effective when applied September through November or December in South Florida.
- Imazapyr has been shown to be a more effective active ingredient than glyphosate, but a mixture of imazapyr and glyphosate is more cost-effective than either herbicide alone.

Shibu Jose, University of Florida

What Research has Found about Cogongrass Spread and Control in the Longleaf Pine Ecosystem

- There does not appear to be a significant relationship between the rate of cogongrass spread and native plant species richness, functional richness, or cover of the invaded community.
- The presence of broomsedge (*Andropogon virginicus*), a particularly competitive native species, substantially reduced cogongrass establishment and spread.
- Wiregrass (*Aristida beyrichiana*), partridge pea (*Chamaecrista fasciculata*), narrowleaf silkgrass (*Pityopsis gramnifolia*), and gallberry (*Ilex glabra*) were not effective in resisting cogongrass invasion.
- Cogongrass can significantly reduce native understory species cover in longleaf pine forests.
- Fire can more than double the rate of spread of cogongrass if control measures are not used.
- Cogongrass infestation can increase fire related mortality of longleaf pine seedlings and saplings.
- Revegetation with a desirable grass such as bermuda- or bahiagrass should occur immediately after herbicide treatments. In fall/winter, use of clovers or annual ryegrass can offer suppression and serve as a bridge to rehabilitation with more desirable species.
- An accurate, up-to-date survey and proper training of row employees/managers can do more for prevention and containment than any herbicide program.

John D. Byrd, Mississippi State University

What Works on Cogongrass and What Does Not:
A Summary of Nearly 10 Years of Cogongrass Research in Mississippi

- Studies found both glyphosate (2% mixture of Roundup Pro 4L) and imazapyr (0.375 lb ai/acre) consistently control cogongrass.
- Both herbicides achieved control levels of 80% or greater when repeatedly applied in the fall (last week of September) or in both the spring (last week of April or first week of May) and the fall, over three growing seasons.
- Rope-wick applicators proved less effective in controlling cogongrass than conventional hydraulic nozzles, but were effective in selectively applying herbicides to avoid harming longleaf pine.
- The surfactant Dyne A Pak, when added to imazapyr at 1% spray volume, enhanced cogongrass control compared to a nonionic surfactant.
- When applied during dormant growth stage, glyphosate and imazapyr reduced the number of viable seeds produced.
- Foliage removal by mowing or burning prior to application of glyphosate or imazapyr resulted in improved visual control and reduced rhizome biomass (rhizome biomass was not significantly altered by burning and application of glyphosate).
- Rotary tillage prior to herbicide application reduced stem weights 74-92% and rhizome biomass 88-98% after two years. Discing prior to herbicide application reduced stem weights 61-80% and rhizome biomass 47-80% after two years.
- Use a combination of tactics to control cogongrass: herbicide, mechanical, burning and, if possible, plant competitive plant species.