Project Title: Cover Crops for Italian Ryegrass Management in Corn

PI: Luis De Avila

Department: Plant and Soil Sciences

Project Summary (Issue/Response)

Italian ryegrass is one of the most problematic weeds affecting Mississippi corn production. Widespread resistance to multiple herbicide modes of action has reduced the effectiveness of traditional chemical control programs, increased production costs, and increased the risk of yield loss due to poor early-season weed control. Because Italian ryegrass is a winter annual with most emergence occurring in the fall, management strategies that begin only in the spring are often insufficient. Effective control requires a multi-season, integrated approach that reduces fall emergence, limits overwinter survival, and depletes the soil seedbank.

This project addresses these challenges by evaluating the role of winter cover crops and fall-applied residual herbicides as integrated tools for Italian ryegrass management in Mississippi corn systems. The overall goal is to identify cover crop species and mixtures that suppress Italian ryegrass while remaining compatible with corn production, and to determine which residual herbicides can be safely used in cover crop systems without compromising cover crop establishment.

Research activities were organized around three objectives: (1) identifying effective cover crop species and mixtures for Italian ryegrass suppression, (2) evaluating the selectivity of fall-applied residual herbicides on winter cover crops, and (3) assessing the combined effects of cover crops and residual herbicides on Italian ryegrass control and corn yield. Field experiments were established in fall 2025 at the MAFES Brown Loam Branch Experiment Station, while greenhouse studies were conducted at the MSU North Farm to evaluate herbicide selectivity under controlled conditions.

During the 2025 funding cycle, major emphasis was placed on establishing field experiments and completing greenhouse trials related to herbicide selectivity. Cover crops were successfully established in naturally infested fields, baseline soil seedbank assessments were conducted, and ryegrass emergence was monitored. Greenhouse experiments evaluating six commonly used residual herbicides across eight cover crop species were completed and provided clear differentiation among herbicides in terms of cover crop tolerance.
The results generated during this reporting period provide critical guidance for integrating cover crops with residual herbicides, laying the foundation for effective Italian ryegrass suppression while protecting corn productivity. This work directly supports Mississippi corn growers by identifying practical, science-based strategies to manage herbicide-resistant ryegrass and improve long-term weed control sustainability.

Project Results/Outcomes

Significant progress was made toward all project objectives during the 2025 funding cycle. Field and greenhouse experiments were successfully established, and key datasets were generated to guide integrated Italian ryegrass management strategies.

Objective 1: Cover Crop Establishment and Early Suppression
Cover crops were planted in November 2025 in a naturally infested field at the MAFES Brown Loam Branch Experiment Station in Raymond, Mississippi. Treatments included cereal rye, black oat, barley, oilseed radish, rapeseed, and mixtures of these species with nitrogen-fixing cover crops such as crimson clover, Persian clover, and hairy vetch. A no-cover-crop treatment served as a control.
Soil samples were collected prior to planting to establish baseline Italian ryegrass seedbank density. Emergence of Italian ryegrass was monitored at multiple time points after planting, and cover crop establishment was evaluated through stand counts. These early observations confirmed the successful establishment of all cover crop treatments and provided the first indication of ryegrass suppression relative to the untreated control. The seedbank assessment protocol was initiated in the greenhouse to quantify viable ryegrass seed density and to track seedbank depletion over time.

Objective 2: Herbicide Selectivity on Cover Crops
Greenhouse experiments evaluating the selectivity of fall-applied residual herbicides on winter cover crops were completed during this reporting period. Six herbicides commonly used for Italian ryegrass control—pyroxasulfone, pyroxasulfone-based mixtures, S-metolachlor, S-metolachlor + metribuzin, and clomazone—were evaluated across eight cover crop species.
Results showed clear differences in herbicide selectivity. Pyroxasulfone applied alone was the most selective herbicide, causing less than 25% biomass reduction in cereal rye, barley, and hairy vetch, and moderate injury to Persian clover. Pyroxasulfone-based mixtures also showed acceptable selectivity for cereal rye and barley. In contrast, clomazone and S-metolachlor + metribuzin caused severe injury across most cover crop species and were identified as incompatible with many cover crop systems.

Project Results

These findings provide critical guidance for growers and consultants regarding which residual herbicides can be integrated with cover crops without compromising cover crop performance. The greenhouse results were consistent across experimental runs and showed strong agreement between visual injury ratings and biomass measurements.

Objective 3: Integrated Field Systems

Field experiments evaluating the combined effects of cover crops and residual herbicides were established at the Brown Loam Branch Experiment Station. Cover crops were planted and residual herbicides were applied at planting. Italian ryegrass emergence and cover crop injury were evaluated throughout establishment.

Soil samples were collected to assess the Italian ryegrass seedbank using standardized greenhouse emergence methods. These experiments are ongoing and will continue into the 2026 growing season to evaluate ryegrass suppression following cover crop termination and to assess impacts on corn yield.

Overall, the project is on schedule. Objective 2 has been completed, and objectives 1 and 3 are progressing as planned. Data generated during the 2025 funding cycle provide a strong foundation for identifying effective cover crop–herbicide combinations for managing Italian ryegrass in Mississippi corn systems.

Project Impacts/Benefits

This project delivers direct and practical benefits to Mississippi corn producers facing increasing pressure from herbicide-resistant Italian ryegrass. By identifying cover crop species and herbicide programs that are compatible with corn production, the research provides growers with tools to improve weed control while reducing reliance on increasingly limited postemergence herbicide options.

A significant impact of this work is the identification of residual herbicides that can be safely integrated into cover crop systems. The results clearly demonstrate that not all residual herbicides are compatible with cover crops, and that herbicide selection is critical to maintaining cover crop establishment and function. This information reduces the risk of costly stand failures and helps growers avoid management decisions that could compromise both weed control and soil conservation goals.

The project also supports long-term Italian ryegrass management by targeting the soil seedbank. Because Italian ryegrass seed longevity is relatively short, consistent suppression over multiple seasons can substantially reduce future infestations. Integrating cover crops with fall residual herbicides accelerates seedbank depletion, reducing weed pressure and improving early-season corn establishment.

From an economic standpoint, improved ryegrass suppression reduces the need for repeated spring herbicide applications and minimizes yield losses caused by early-season competition. This leads to more predictable weed control costs and improved return on investment for corn producers.

Beyond weed control, the project promotes soil health benefits associated with cover crop adoption, including residue cover, erosion reduction, and improved nutrient management. By providing science-based recommendations tailored to Mississippi conditions, this research helps growers implement sustainable, economically viable weed management systems that protect corn yield and long-term field productivity.

Project Deliverables

· Field research trials established at the MAFES Brown Loam Branch Experiment Station

· Greenhouse experiments completed evaluating cover crop tolerance to residual herbicides

· An abstract was submitted, and the data will be presented at the Southern Weed Science Society Annual Meeting, to be held in Nashville in March 2026.

Additional Questions

1. What value does this research give the grower? Describe any financial decision-making tools your project provides.

This research provides growers with clear guidance on which cover crops and residual herbicides can be used together to suppress Italian ryegrass without compromising cover crop establishment or corn yield. It supports informed decision-making, reduces trial-and-error costs, and improves the long-term effectiveness of weed management.

2. List other sources of funding you have acquired over the past 2 calendar years.

Mississippi Corn Promotion Board (current funding cycles)
Mississippi Soybean Promotion Board (Three projects)

Graphics

A greenhouse experiment was conducted to evaluate the tolerance of winter cover crop species to commonly used residual herbicides for Italian ryegrass management. Cover crops were treated with pre-emergence herbicides, including clomazone, pyroxasulfone, and S-metolachlor-based programs, and responses were assessed through visual injury ratings and shoot dry weight at 28 days after treatment (DAT). The results below describe cover crop injury and biomass reduction in response to these herbicide treatments.

Biomass reduction closely matched visual injury ratings 28 DAT, confirming consistency between visual and quantitative assessments. Among the winter cover crop species evaluated, cereal rye, barley, and hairy vetch exhibited the lowest biomass reduction and injury under pyroxasulfone-containing herbicide treatments (Figure 1a and 1b). Oilseed radish was the only cover crop to present tolerance to S-metolachlor, with biomass reduction above 20% (Figure 1a).
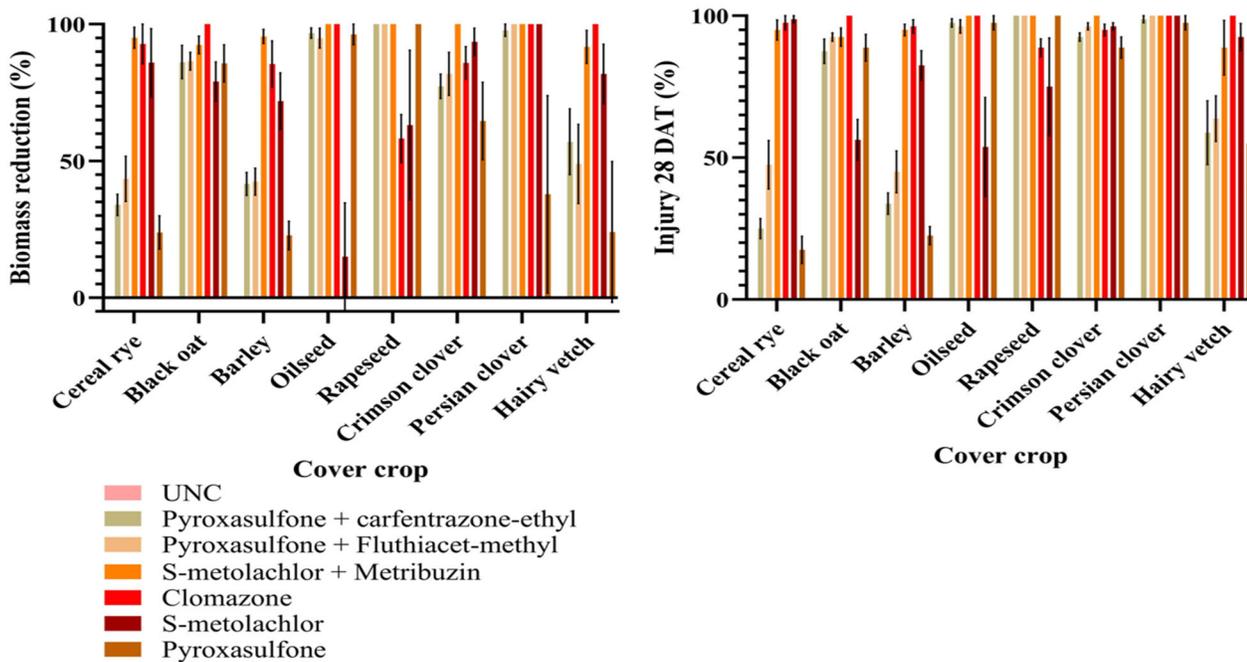

Figure 1. (a) Percentage reduction in shoot dry weight, (b) injury 28 days after residual herbicide application. Error bars represent standard error. UNC = untreated control.