

Rice Leaf



University of California

Agriculture and Natural Resources

Cooperative Extension Butte County

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Summary of the 2024 variety trials

Bruce Linquist, UCCE Rice Specialist

In 2024 we had eight variety trial locations. Four locations were in what we refer to as warmer locations (north of hwy 20) and four in the cooler locations (south of hwy 20 and into the Sacramento Delta region). These trials are funded by the Rice Research Board and fulfill at least two purposes. First, they allow us to evaluate commercial varieties across the state in different environments. Second, we evaluate promising varieties being developed at the Rice Experiment Station to see how they respond across a wide range of environments. Below, I will briefly discuss what we found in terms of how the commercially available medium grains (M-105, M-206, M-209, M-210 and M-211) performed across locations. Details of these trials can be found in the UC Rice website under Reports and Publications, Agronomy Progress Reports (at <https://agronomy-rice.ucdavis.edu/sites/g/files/dgvnks11966/files/inline-files/340%202024%20APR%20rice.pdf>).

Overall, the number of days to heading in 2024 was shorter than normal. This can be attributed to a warm growing season (especially July) and later than normal planting dates. All of our trials in the Sacramento Valley were planted between May 13 and 25. Furthermore, across varieties and locations, yields were generally lower than we have seen in previous years. These lower yields were reflective of what was observed statewide.

In the warmer area north of hwy 20, all varieties perform well; however, M-211 tends to perform better followed by M-209. This is what we saw in 2024, as well as what has been observed historically. Average yields (cwt/ac) for the past 5 years are 90.9 (M-211), 89.4 (M-209), 88.9 (M-210), 87.0 (M-105), 85.7 (M-206). Importantly, as Dustin Harrell brought up in the recent winter grower meetings, while M-211 is higher yielding, its milling quality can be poor. This can result in M-211 head rice yields that are less than other varieties. To help prevent this, M211 needs to be harvested at grain moisture contents close to 20% and being sure not to drain the field too early.

In the southern cooler areas, M-209 does consistently poorly. M-105 usually has the highest yields. However, M-211 had the highest yields at two sites in 2024. One needs to be cautious here as 2024 was a warm year and cold nighttime temperatures during booting (which can cause blanking) was not a problem. The other consideration is that both M-211 and M-209 are longer duration varieties (heading 7-10 days later than M-105). This can be a problem, especially in late planted fields. The 5-year average yield for all the medium grain varieties in the southern area is between 89 and 90 cwt/ac, except for M-209 which is 86.2 cwt/ac.

Arthropods: the usual suspects

Luis Espino, UCCE Rice Farm Advisor

Time to round up the usual suspects! When talking about arthropod control in California, the usual suspects are rice seed midge, tadpole shrimp, and armyworms. I will focus on rice seed midge and tadpole shrimp in light of recent pyrethroid exceedances detected in the Sacramento Valley.

The challenge with both rice seed midge and tadpole shrimp is that they are a difficult pests to scout for and their injury can go undetected and can happen quickly. Unlike shrimp, midge does not muddy the water, so its presence can go unnoticed. Midge larvae construct small silken tubes that get covered in soil and are attached to the seed. These tubes are about the length of a seed and visible with the naked eye. In fields that take long to flood or where there is a delay in seeding, the tubes can be seen even before seeding. Midge larvae hide in the tubes and feed on the seed, hollowing it.

Usually, we suspect a field may have shrimp when the water is muddy (and there's no wind). However, small shrimp won't muddy water but can injure rice. Once you can see shrimp with the naked eye, they can cause damage. Shrimp grow very fast and they can go from "invisible" to large in just a couple of days. Shrimp will feed on the shoots of the seed as it germinates; they will not hollow the seed like midge does.

Late planted fields, or seeding during periods of high temperature, increases the risk of damage by both pests. Seeding in fields that have been flooded for 4 days or longer also increases the risk.

Unfortunately, we do not have traditional thresholds for these pests. It is difficult to count



Rice seed midge hollows the seed. Notice the larvae and frass next to the hole.

midge or shrimp in the field. Instead, we rely on the number of healthy seedlings per square foot. Remember that at a seeding rate of 180 lbs/a you are broadcasting about 60 seeds per square foot. The optimum number of plants per square foot to maximize yields is 25, but rice is able to compensate as stand decreases. Many other factors will affect stand, so you want to be as close to the 25 as possible.

I use a small aquarium net to scoop seeds/seedlings and shrimp during windy days when the water is muddy. Inspect the seeds/seedlings and determine if they have been injured. If the number of seedlings per square foot is less than 25 and either midge or shrimp are present, an insecticide is needed. Rice is susceptible to both pests during the period of germination, but once the root is anchored in the soil and you have a well-developed spike, seedlings are less susceptible to damage. If you "leather" your field (drain very soon after seeding), then midge or shrimp won't be an issue and no insecticide treatment will be needed.

Chlorine seed treatments

Sarah Marsh Janish, Rice Farm Advisor

In the last month, I've had more frequent calls about how to cut costs, with several people mentioning cutting their chlorine seed soak treatment in an attempt to bring down their input costs. This seed soak is used to eliminate bakanae spores from rice seed and is one of the most effective methods to prevent widespread bakanae infestations in rice fields.

As we get ready to plant for the 2025 season, it's important to talk about why the chlorine (sodium hypochlorite) seed soak solution is vital to reducing the amount of fungal inoculum available to infest rice fields.

What is bakanae?

Bakanae is a disease that is caused by the fungus *Fusarium fujikuroi*, which causes overproduction of the plant hormone gibberellin and the mycotoxin fusaric acid. In normal quantities, gibberellin stimulates cell elongation and regulation of plant stature; however, the excess production of the hormone results in a plant that is overly elongated, spindly, and chlorotic. As the plants mature, the crown of the plant will rot, and most plants will die prior to producing a panicle. If a panicle is produced, the kernels will not fill.

Bakanae was first discovered in California in 1999. Since then, it has spread across the state's rice-growing areas. Initially, the disease posed a significant threat to the rice industry, leading to reduced yields in heavily affected fields. However, after the introduction of sodium hypochlorite as a seed treatment, the disease became less of a concern, with losses occurring only rarely. In recent years, though, its significance has increased again due to a decrease in the use of chlorine seed treatment.



A rice plant affected by bakanae. Photo by Sarah Marsh Janish Janish

How does bakanae spread?

At field maturity, the pathogen will produce pink sporulation on dying tillers, which can infest seeds of nearby plants and fields during harvest. Bakanae is usually classified as a seed-borne disease, meaning that the spread of the disease occurs primarily via seed and seed coats. In basmati fields in India, survival of *Fusarium fujikuroi* in field soil was detected several months post-harvest ([An et al, 2024](#)); however, infested soil is not considered a major source of bakanae inoculum.

There is evidence that the pathogen can be hosted by several different grass species besides rice, including some species of watergrass. However, it is not known if this occurs in California ([Hsuan et al, 2011](#)).

What is the best way to prevent bakanae?

Using a chlorine solution as a seed treatment is the most effective method for eliminating bakanae spores from the seed. A chlorine solution is a mixture of chlorine, typically in the form of sodium hypochlorite (often referred to as bleach), dissolved in water. Seed treatment with a registered sodium hypochlorite product is effective at reducing the incidence of this disease and may be performed at either 3,000 or 1,500 parts per million (ppm) available chlorine.

To prepare the chlorine solution, use only registered sodium hypochlorite products and follow the instructions on the label. Products have different concentrations of sodium hypochlorite and therefore the amount of product needed to reach the right chlorine concentration varies. An example of registered products as of the writing of this Fact Sheet is shown in Table 1.

Seed should be sown within 12 to 24 hours of draining. When seed is held for longer, temperature in the holding tank increases and any surviving bakanae spores will germinate and produce more spores, resulting in seed that is infested even though it was treated.

How expensive is the chlorine treatment?

According to the [2021 UC Rice Production Cost Study](#), the total pre-plant costs for seed delivery to field (in a conventional, water-seeded system) approximate \$62 per acre; however, that price includes the cost of the seed, the delivery, and the aerial application: all practices that would be performed in a regular water-seeding practice, and therefore should not be considered as additional costs. The study estimates that the chlorine seed soak treatment costs approximately \$4 per acre. The cost studies are an approximation of costs, and your numbers may vary, but the chlorine solution cost is a very small part of the overall seed delivery expense.

What are the options for organic, drilled, or dry-seeded rice growers?

Currently, no effective seed treatments against bakanae exist for organic, dry, or drill seeded rice. Given that most of the acreage in California is conventionally grown and water seeded, wide adoption of the chlorine seed treatment can reduce the areawide bakanae inoculum and reduce the overall risk of infection and contamination of seed for organic, drilled, and dry-seeded rice.

For further information about bakanae in rice, refer to the [UC Rice bakanae fact sheet](#).

Table 1. Example of products registered for bakanae seed treatment and dilution rates.

Product	Sodium hypochlorite concentration (%)	Dilution to reach 3,000 ppm chlorine solution	Dilution to reach 1,500 ppm chlorine solution
Clorox Germicidal Bleach	8.25	4 gal/96 gal of water	2 gal/98 gal of water
Aqua Chlor	12.5	2.5 gal/100 gal of water	1.3 gal/100 gal of water
Sunny Sol Sodium Hypochlorite 12.5%	12.5	2.64 gal/110 gal of water	1.32 gal/110 gal of water
Multi-Chlor	15.5	2 gal/100 gal of water	1 gal/100 gal of water

Late season control options for watergrass

Whitney Brim-DeForest, UCCE Rice Farm Advisor; Taiyu Guan, Assistant Specialist, UCCE

Watergrass (*Echinochloa* spp.) is the most competitive weed complex in California rice production. These plants can emerge under both continuously flooded and flushed conditions, often resulting in significant yield losses—up to 100% in dry- or drill-seeded systems, and about 50% in water-seeded systems, when no herbicides are used. Watergrass was also one of the first weed groups to develop herbicide resistance in the early 2000s. This resistance is metabolic, meaning the plants break down or "consume" the herbicide before it can take effect.

Currently, four primary watergrass species are found in California rice fields: barnyardgrass (*Echinochloa crus-galli*), early watergrass (*E. oryzoides*), late watergrass (*E. phyllospadix*), and coast cockspur (*E. walteri*). Coast cockspur (fig. 1) is a relatively new addition, first identified in California rice fields in 2017. It is a robust species with thick stems and can grow over 6 feet tall if left unmanaged. All four species exhibit some degree of herbicide resistance, and resistant biotypes have been documented throughout all counties of the Sacramento Valley.

Over the past few years, we've faced growing challenges in managing watergrass, leading many growers to rely on double applications of propanil. However, this approach is contributing to the development of propanil-resistant biotypes, threatening the long-term effectiveness of this product for grass control. To slow the development of resistance and preserve propanil's utility, we recommend the following strategies:

- Rotate herbicide modes of action — avoid using propanil as a clean-up spray year after year.
- Use tank mixes — combine propanil with other herbicides for clean-up applications rather than using it alone.



Fig. 1. Coast cockspur has a large panicle with long, purple awns.

Our team has been actively researching tank mix alternatives to double propanil applications over the past few seasons, and we'll continue this work into 2025. Our goal is to support growers and Pest Control Advisors with practical, sustainable options for effective watergrass control.

Alternatives to the Double-Propanil Application (2024)

In 2024, we conducted watergrass field trials at five locations in Butte County (2), Yuba County (1) and Sutter County (2). Watergrass populations were high in all fields except the one at the Rice Experiment Station, which was applied as a control to confirm phytotoxicity. All varieties were Calrose medium-grain. The herbicides tested were Stam 80DF® (propanil), Abolish® (thiobencarb), Shark H2O® (carfentrazone), Loyant® (florpyrauxifen-benzyl), Clincher CA® (cyhalofop-butyl), Regiment® (bispuryribac-sodium), and Cliffhanger® (benzobicyclon) (Table 1). Applications were made at 35-40 DAS, at 20 gallons per acre spray volume.

Table 1. Treatments applied in 2024 field testing (applied at 35-40 days after seeding for watergrass control).

Treatment	
1	Untreated Control
2	Stam 80DF (7 lb/A) + COC (1.25%)
3	Stam 80DF (3.75 lb/A) + COC (1.25%) fb Stam 80DF (3.75 lb/A) + COC (1.25%) (1 week later)
4	Stam 80DF (7 lb/A) + Abolish (2 pt/A)
5	Stam 80DF (7 lb/A) + Shark H2O (4 oz/A)
6	Stam 80DF (7 lb/A) + Loyant (1.33 pt/A) + MSO (0.5 pt/A)
7	Stam 80DF (7 lb/A) + Clincher (15 fl oz/A) + COC (1.25%)
8	Regiment (0.8 oz/A) + UAN (2%) + Dyneamic (5 fl oz/A)
9	Regiment (0.8 oz/A) + UAN (2%) + Dyneamic (5 fl oz/A) fb Stam 80DF (3.75 lb/A) + COC (1.25%) (1 week later)
10	Regiment (0.8 oz/A) + Loyant (1.33 pt/A) + UAN (2%) + Dyneamic (5 fl oz/A)
11	Regiment (0.8 oz/A) + Clincher (15 fl oz/A) + UAN (2%) + Dyneamic (5 fl oz/A)
12	Regiment (0.8 oz/A) + Abolish (2 pt/A)
13	Stam 80DF (7 lb/A) + Cliffhanger (10.3 oz/A) + COC (1.25%)
14	Regiment (0.8 oz/A) + UAN (2%) + Dyneamic (5 fl oz/A) + Cliffhanger (10.3 oz/A)
15	Clincher (15 fl oz/A) + Loyant (1.33 pt/A) + COC (2.5%)
16	Clincher (15 fl oz/A) + Abolish (2 pt/A)

Results (2024)

Results (averaged across the 5 locations) indicate that Regiment® followed by Stam® (9), and Stam + Clincher® (7) are good candidates for watergrass control. Those 2 treatments showed great watergrass control and high yields (Figure 2). Additionally, only mild phytotoxicity was observed throughout the duration of the trial for these treatments. Treatments that are not quite as good in grass control but good in a rotation include Stam® + Shark® (5), Stam® + Abolish® (4). These treatments resulted in less effective watergrass control compared to treatments 9 and 7, but yields were similar. In these treatments, Stam® can be substituted with SuperWham®.

Recommendations:

To effectively manage tough watergrass, growers should use integrated weed management where possible. This includes:

- Using combinations of chemicals (granular) and tank-mixes (foliar)
- Rotating chemistries at the beginning of the season
- Rotating clean-up herbicides
- Crop rotation or fallow

- Winter flooding to maximize seed predation and decomposition over the winter
- Resistance testing through the UC Rice Weed Science Program

Herbicide recommendations include (at the beginning of the season):

- Zembu® (pyraclonil) if other granular options are ineffective, to give other chemistries a break. Zembu® suppresses grass (does not control) but will help prevent the selection of resistance as it is a new mode of action for watergrass.
- Cerano® followed by Butte® or Cliffhanger®, applied one week apart, is effective even on tough grass. In red soils, this may be a phytotoxic combination, and rates may need to be reduced.
- Implement a stale seedbed approach by applying glyphosate or Suppress® (capric/caprylic acid) pre-plant as a rotational tool. Please check in with Farm Advisors for guidance on timing.
- Pendimethalin (Harbinger®, Prowl H2O®, and others) to rotate MOA in a drill- or dry-seeded system (please follow the label for each product's timings and rates).

Foliar options (best grass control) (see above tables for rates and adjuvants used):

- Regiment followed by Stam®/SuperWham® (may cause injury on certain specialty varieties). Tested at 1 week apart, other spacings may be better, we will be evaluating in 2025.
- SuperWham®/Stam® + Clincher (not as good in 2023)
- Abolish® + SuperWham®/Stam® (not as good in 2024)

Foliar options (good grass control) (see above tables for rates and adjuvants used):

- SuperWham®/Stam® + Loyant
- SuperWham®/Stam® + Shark H2O® (some phyto)
- Regiment® + Clincher®

Not all of these treatments will work on all watergrass biotypes and fields. However, trying a new combination, even on one or two fields or one or two individual checks, will help growers and PCA's to evaluate the efficacy of these treatments and prevent selection for propanil resistance on your farm or ranch.

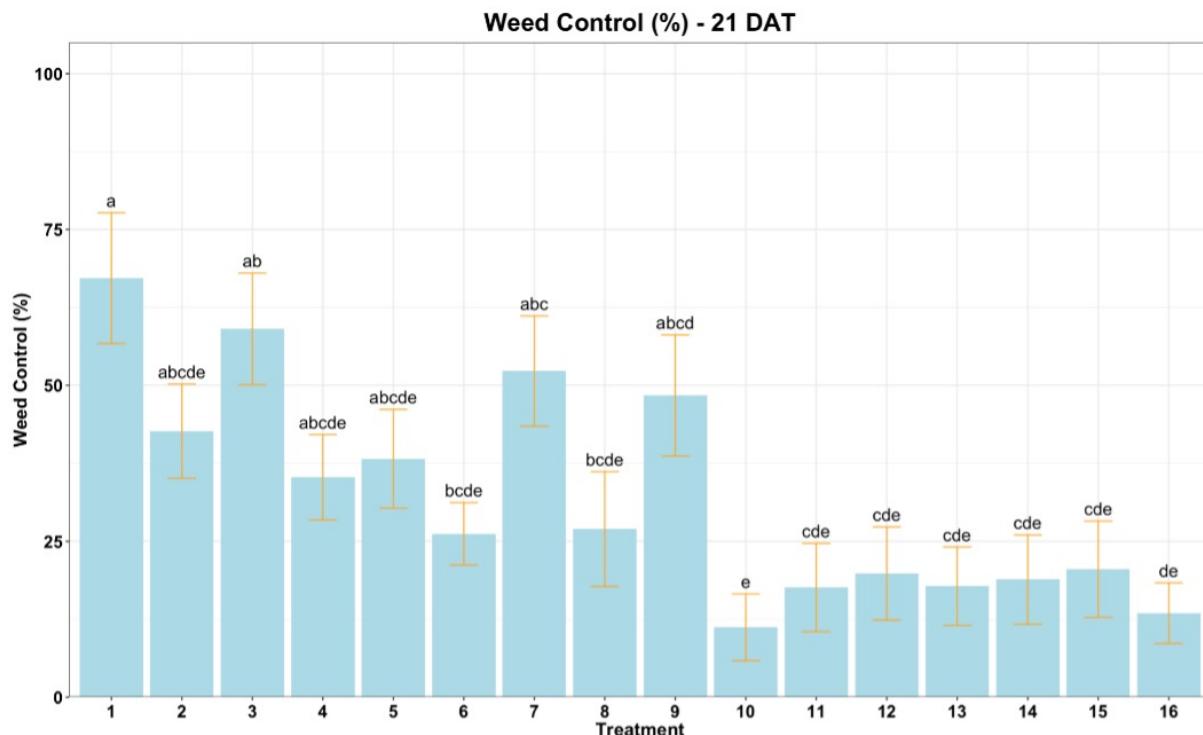


Fig. 2. Percent watergrass control (%) (Treatments 2-16) compared to the untreated control (Treatment 1) in 2024 (21 Days After Application). Treatment 1 (Untreated) is the percent watergrass cover per plot, not the percent control. Averages are across 4 sites (Rice Experiment Station was not included due to low watergrass populations).



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Emergency Commodity Assistance Program: long and medium grain rice qualify for relief

Domena A. Agyeman, UCCE Ag and Natural Resources Advisor

On March 18, 2025, the United States Department of Agriculture Farm Service Agency (USDA-FSA) announced that it will provide \$10 billion in direct payments to eligible agricultural producers of qualifying commodities. Passed under the [American Relief Act of 2025](#), the economic relief will be delivered through the Emergency Commodity Assistance Program (ECAP) to help eligible producers offset the effects of increased input costs and depressed commodity prices from the 2024 crop year.

ECAP will offer direct payments for 22 eligible commodities using a flat per-acre payment rate. Long grain and medium grain rice are among the eligible commodities at a rate of \$76.94 per acre (Fig.1).

To be eligible, producers must be actively engaged in farming, have an interest in input expenses for a covered commodity, have reported eligible planted and prevent plant acres to FSA for the 2024 crop year via an [FSA-578, Report of Acreage form](#), and, if

Eligible commodities and ECAP payment rates (\$/acre)

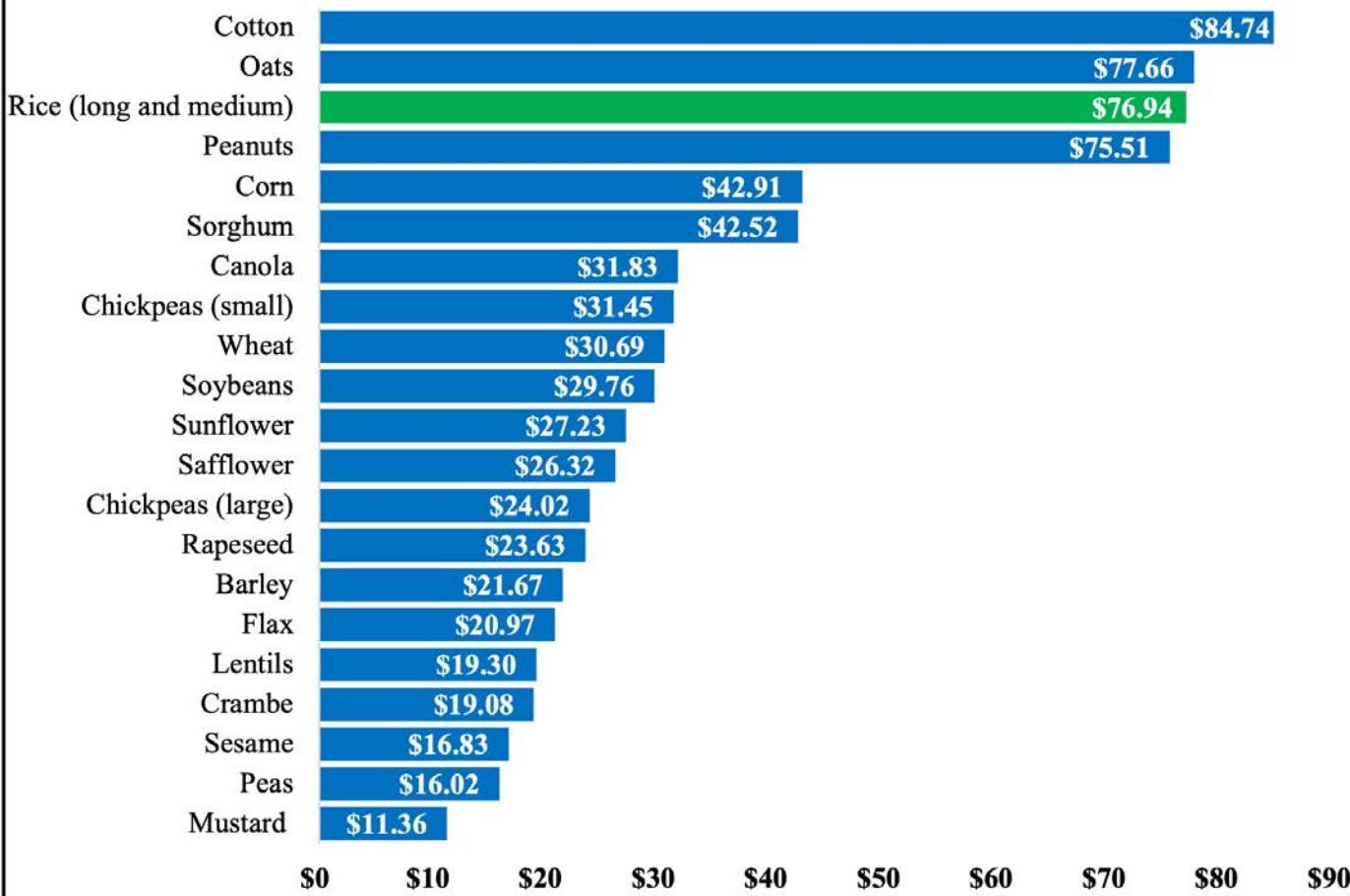


Fig.1 Eligible commodities and ECAP payment rates. Note: Initial payments will be 85% of the payment rate.

applicable, have filed a [CCC-576 Notice of Loss of form](#) for prevent plant acres for the 2024 crop year.

This could provide relief for some rice growers as the FSA's 2024 acreage report (dated January 2, 2025) shows 417,313 acres of medium- and long-grain rice were reported as prevented acres (Fig. 2). Arkansas led with 186,695 acres, followed by California (92,429 acres), and Texas (74,030 acres) (Fig. 3). For acres reported as prevent plant, ECAP will provide economic support for 50 percent of the reported acres.

The initial round of payments will be based on an 85 percent payment rate, delivering \$65.40 per acre rice (0.85×76.94). This is to ensure that total program payments do not exceed available funding. If funds remain after the initial payment round, FSA may distribute a second payment covering up to the remaining 15%. Growers can estimate their ECAP payment using this [calculator](#).

The application period opened on March 19, 2025, and will remain open until August 15, 2025. Eligible producers must submit the required application forms and have other required documentation for the 2024 crop year on file with their local FSA office. Visit the [ECAP information page](#) for complete eligibility details and application process.

SAVE THE DATE

- No-Till field day - June 10, 2025
- Rice Production Workshop - July 23-24, 2025

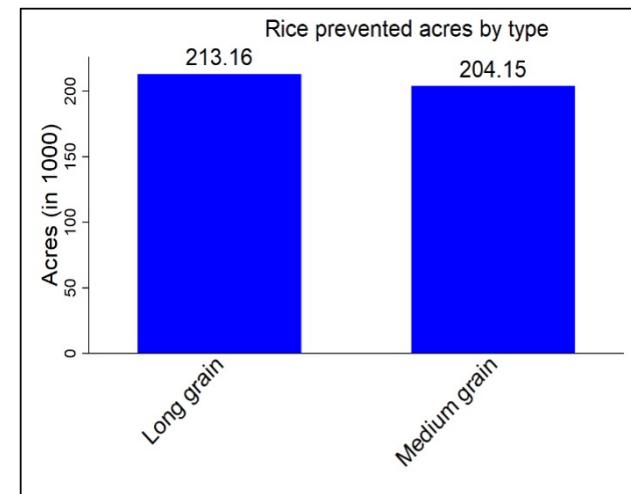


Fig.2 Rice prevent plant acres by type. Medium grain includes temperate japonica from California. Source: USDA-FSA crop acreage data, 2024.

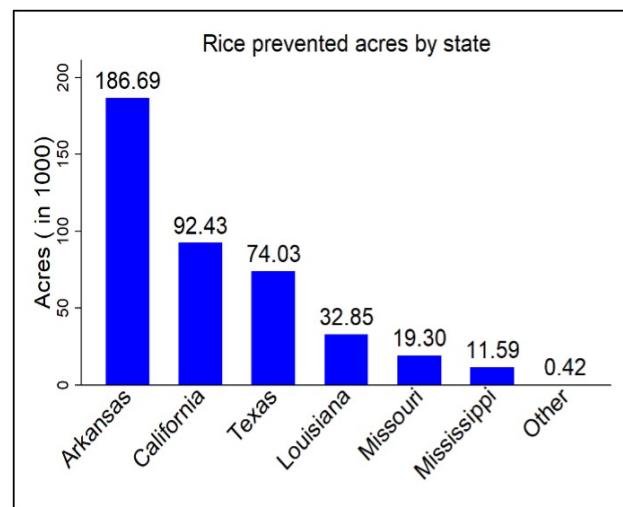


Fig.3. Rice (long and medium) prevent plant acres by state. California includes temperate japonicaSource: USDA-FSA crop acreage data, 2024.

- Weedy Rice Workshop - August 5, 2025
- Rice Field Day - August 27, 2025, Rice Experiment Station, Biggs

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