HEALTHY FOOD SYSTEMS | HEALTHY ENVIRONMENTS | HEALTHY COMMUNITIES | HEALTHY CALIFORNIANS

Rice Leaf

July 2022

UC CE University of California Agriculture and Natural Resources | Cooperative Extension Butte County

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Getting the most out of limited water

I have been asked over the past few weeks about what to do if you think you may not have enough water to take your crop through the season. Running out of water early in the season can greatly reduce yields and grain quality. Some practices to reduce water use are to use shorter duration varieties, plant later in the season and plant on heavy soils with low percolation potential; however, these decisions have already been made. Looking at the rest of the season, here are some thoughts on stretching out your water.

First, and perhaps most obvious, is not to spill water. I think most growers are already doing this. It is an excellent option, especially if you have good quality water. If irrigation water has a high EC, then salts could be a problem, especially in the bottom checks and in dead spots within the field.

Another way to stretch out limited irrigation water is not to drain at the end of the season but instead let your water subside. Growers often drain their water from the field about three weeks before the end of the season to prepare for harvest. At this time there can be 3 to 6 inches of water on the field which goes unused if it is drained. As a rule of thumb, evapo-transpiration (ET) losses at this time of year are about ¼ inch a day. However, I think in drought years when there is a lot of fallow ground and ground water pumping, water levels drop faster due to increased percolation (a lot of variability depending on water table and soil). Therefore, it may be safer to plan for about ½ inch loss a day. So, let's use an example of a farmer who typically pulls the boards at 25 days after heading and expects the surface water to be drained from the field by 28 days. If this farmer has 5 inches of water on the field, this water would last about 10 days. Therefore, irrigation water could be halted at 18 days after heading; and by 28 days, the field water would be similar as if they pulled the boards at 25 days. This would save one week of irrigation water.

Another potential way to save a water is to turn off water coming into the field during the growing season and allow the field to dry a bit. We have found that around PI having no flood water on the field for about 7 to 8 days does not negatively impact yields. In fact, I often see rice fields that are dry (even cracking) after propanil applications where growers have dried up their fields. This practice of letting the soil dry out during the season only saves water that would have been lost to percolation or seepage. So, if you have a field that is losing a lot of water in these ways, you can save water by letting the field dry down because these losses will be greatly reduced. The ET in these fields should stay about the same – at least you want them to. If rice leaves will start to curl from drought stress, yields will be affected. You have to be careful and consider a few things. First, keep an eye on how fast the soil is drying (fields dry out at varying rates), and remember it takes a while to reflood the whole field. Second, ideally this is not done during booting, as low night time temperatures during booting can cause blanking as flood water acts as a temperature buffer to these low temperatures

Article by Bruce Linquist, UCCE Specialist

Herbicide Susceptibility Survey of Watergrass in California Rice

Introduction

In California rice, herbicide resistance has been documented in Echinochloa spp. since the early 2000's. Recent reports of uncontrolled grasses, as well as possible new species or biotypes have precipitated renewed research on this genus. Sixty four watergrass samples were collected from a survey conducted in 2020, with grower and PCA-submitted samples from across the Sacramento Valley, as well as samples collected from University of California and Rice Experiment Station fields. Those samples were representative of all the watergrass species/biotypes: late watergrass, junglerice,

Methods

In August and September of 2020, 64 watergrass samples were collected from rice fields across the rice-growing region of California (Fig. 1). The samples were representative of the *Echinochloa* spp. present in California rice, but were likely resistant, as they were self-reported by growers and PCAs: late watergrass (*Echinochloa phyllopogon*), junglerice (*E. colona*), barnyardgrass (*E. crus-galli*), and a currently unknown new biotype which is being characterized in a complementary study (Table 1). The overall objective was to determine the distribution and status of resistance to currently-registered herbicides in these species (cyhalofop, propanil, bispyribac-sodium, penoxsulam, benzobicyclon+halosulfuron, clomazone, and thiobencarb). Two known susceptible controls of late watergrass (*E. phyllopogon*) were added to the screenings as controls.

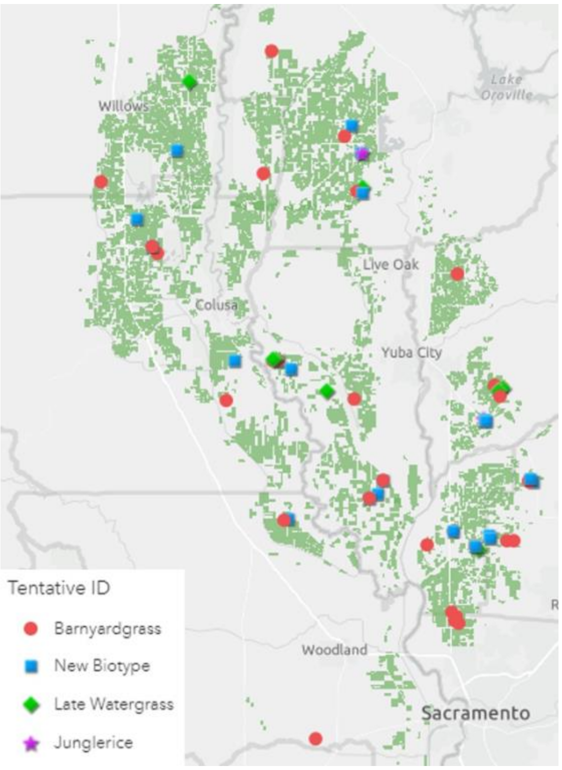


Figure 1. Distribution of *Echinochloa* spp. samples collected in August and September 2020 from California rice fields. ID = identification

Screenings took place at the Rice Experiment Station greenhouse in Biggs, CA, in the summer and fall of 2021. All formulations were tested at the 1.5 leaf stage of watergrass. Dormancy was broken for the watergrass by wet-chilling in the fridge for approximately two weeks before planting. Seeds were pre-germinated in the incubator. Pots were seeded and then thinned down to 4 plants per pot.

All foliar-applied formulations (cyhalofop, propanil, and bispyribac-sodium) were applied with the label-recommended surfactants. Applications for into-the-water herbicides (granular formulations of penoxsulam, benzobicyclon+halosulfuron, clomazone, and thiobencarb) were made onto the water surface of bins that were flooded to 10 cm above the soil surface of the pots (where the watergrass was planted). All liquid herbicide treatments were applied with a cabinet track sprayer with an 8001-EVS nozzle delivering 40 gallons of spray solution per acre (at a pressure of approximately 20 psi). A flood was applied at 10 cm above the soil surface 48 hrs after the foliar applications. All herbicides were applied at standard field rates for California rice, though not at the maximum label rate for all herbicides (Table 2).

At 14 days after treatment, the number of living plants per pot was counted, and fresh biomass was measured (per pot) by cutting plants at the soil surface and taking the weight (per pot). Dry biomass was measured after drying the fresh weight samples down to a constant weight. Samples were classified as resistant to an herbicide if the average percent (%) dry weight control was less than that of the susceptible controls.

Results

Out of the barnyardgrass samples (31), 23 were resistant to cyhalofop (CY), 3 were resistant to propanil (PR), and 26 were resistant to bispyribac-sodium (BS). Out of the late watergrass samples (9), there were 9 CY-resistant, 5 PR-resistant, and 9 BS-resistant. For the new unknown biotype samples (22), there were 17 CY-resistant, 3 PR-resistant, and 20 BS-resistant. For the granular formulations, barnyardgrass (31 samples) had 27 that were thiobencarb resistant (TH), 24 that were benzobicyclon+halosulfuron resistant (BH), 17 that were clomazone resistant (CL), and 26 that were penoxsulam resistant (PE). Out of the late watergrass samples (9), 9 were TH-resistant, 9 were BH-resistant, 6 were CL-resistant, and 9 were PE-resistant. For the new unknown biotype samples (22), there were 20 TH-resistant, 18 BH-resistant, 11 CL-resistant, and 20 PE-resistant.

The majority of the samples of all species are resistant to all of the tested herbicides, with only propanil and clomazone showing control of approximately 50% (or more) of the samples (Tables 3 and 4). Late watergrass is widely resistant to all of the herbicides tested, with only propanil showing some degree of control in roughly 50% of the samples. Surprisingly, 100% of samples tested were resistant to thiobencarb, benzobicyclon+halosulfuron, cyhalofop, bispyribac-sodium, and penoxsulam.

The new biotype is best controlled with clomazone (50% of samples) or propanil (76% of samples), while a smaller proportion of samples were controlled by the other herbicides tested. Barnyardgrass is best controlled by propanil (90% of samples), and clomazone (45% of samples).

Although the new biotype shows widespread resistance, its impact on yields is likely explained by more than just herbicide resistance and is likely due to its competitive ability as well.

Conclusions

The implications of this study reflect anecdotal evidence relayed by growers. *Echinochloa* spp. are becoming increasingly difficult to manage using our currently registered herbicides. For growers, this means it is increasingly difficult to plan an effective program that both controls grasses and prevents further selection for resistance. Aside from rotations with the above-utilized herbicides, some other alternative management strategies include: deep water, utilizing a stale seedbed, and rotating to a dry-seeded or drill-seeded system.

Deep Water:

Maintaining a deep flood (of at least 4–6 inches) can suppress some grass emergence. Deeper water will provide more suppression. Deep water also improves herbicide efficacy for granular herbicide applications, and the deep water may also improve efficacy of pre-emergent herbicides. Keeping the water on the field as long as possible will improve control. Watergrass typically emerges in the first 30 days after water is put on the field, so longer flood duration is better.

Stale Seedbed:

A stale seedbed has been shown to provide good control of watergrass in heavily infested fields. To implement a stale seedbed, prepare the field as normal (in spring). The field can be tilled or untilled. If untilled, please keep in mind that watergrass seeds typically only emerge from the top 6 cm (3–4 inches) of soil.

Once the seedbed is prepared, flood the field until water is 3 to 4 inches deep, then turn off water and let it sink into the soil. This will increase watergrass germination. Roughly 1 to 2 weeks later, spray a nonselective herbicide (make sure the field is fully drained to ensure coverage). Tillage can also be utilized in place of an herbicide, but avoid deep tillage, as it will bring up additional grass seeds. Timing of the herbicide application or tillage will depend on temperature. Warmer temperatures cause faster emergence of grass. Two weeks should be more than enough time to bring up most of the grass population that will be germinable (able-to-germinate), regardless of temperature.

If not planting rice, this process (flushing/flooding, followed by tillage or herbicide application) can be repeated multiple times throughout the season. If planting rice, flood up the field after the application of the nonselective herbicide (follow label for instructions on flood timing).

Rotation to Drill- or Dry-Seeded System:

Drill-seeding or dry-seeding rice allows for the use of pendimethalin, which is a different mode of action from all other currently-registered rice herbicides. Depending on the actual product used, pendimethalin may be best used in a drill-seeded system, due to the possible injury to emerging rice plants. Or it can be used in a dry-seeded system, where seed is flown on instead of drilled. For more information on application methodology, refer to the product herbicide label.

Article by Whitney Brim De-Forest, UCCE Farm Advisor, Taiyu Guan, Assistant Specialist, and Troy Clark, Rice Junio Specialist.

Table 1. Watergrass (*Echinochloa* spp.) samples were collected across the California rice-growing region in 2020. The samples were sorted by the seed description and preliminarily identified to species/biotype. No. = Number

Description	Identification	No. of Samples	Percentage (%)
Small seeds, long awns	New biotype (*Echinochloa* spp.)	22	34.4
Extra small seeds, no awns	Junglerice (*E. colona*)	2	3.1
Small seeds, variable awns	Barnyardgrass (*E. crus-galli*)	31	48.4
Large seeds, no awns	Late watergrass (*E. phyllopogon*)	9	14.1

Table 2. Herbicides and rates utilized for the 2021 watergrass screening. Rates are in grams of active ingredient (a.i.) per hectare and are standard field rates for California rice growers with susceptible *Echinochloa* spp. biotypes.

Active Ingredient	Rate
clomazone	673 g/ha-1
thiobencarb	3918 g/ha-1
benzobicyclon+halosulfuron	306 g/ha-1
penoxsulam	40 g/ha-1
cyhalofop	263 g/ha-1
bispyribac-sodium	32 g/ha-1
propanil	6726 g/ha-1

Table 3. Percent of samples resistant (R) to foliar-applied herbicides (cyhalofop, propanil, and bispyribac-sodium), by species or biotype, in comparison to two susceptible late watergrass (Echinochloa phyllopogon) populations.

	Samples (%)		
Identification	**cyhalofop (R)**	**propanil (R)**	**bispyribac-sodium (R)**
Barnyardgrass (*E. crus-galli*)	74	10	84
Junglerice (*E. colona*)	0	50	50
Late Watergrass (*E. phyllopogon*)	100	56	100
New Biotype (*Echinochloa* spp.)	77	14	91
Total	77	19	88

Table 4. Percent of samples resistant (R) to granular formulated herbicides (thiobencarb, benzobicyclon+halosulfuron, clomazone, and penoxsulam), by species or biotype, in comparison to two susceptible late watergrass (Echinochloa phyllopogon) populations.

	Samples (%)			
Identification	**thiobencarb (R)**	**benzobicyclon+ halosulfuron (R)**	**clomazone (R)**	**penoxsulam (R)**
Barnyardgrass (*E. crus-galli*)	87	77	55	84
Junglerice (*E. colona*)	0	50	0	50
Late Watergrass (*E. phyllopogon*)	100	100	67	100
New Biotype (*Echinochloa* spp.)	91	82	50	91
Total	88	81	53	88

Germination of Stored Rice Seed

The drought has significantly reduced the acreage of rice planted in California, including rice seed fields. This means that next year the industry may face a reduction in the supply of fresh seed, that is, seed that was planted and harvested in 2022 and that would be offered to growers in 2023.

Typically, rice seed producers only sell seed produced the previous year, and anything left over is sent to the mill. Storing rice seed for a year is infrequent and usually limited to research material, which is often put in cold storage to extend viability for years, and specialty varieties. However, because of the reduction in planted acres, some of the unused 2021 seed will be stored through 2022 to be used in 2023 to make up for the reduction in seed field acres.

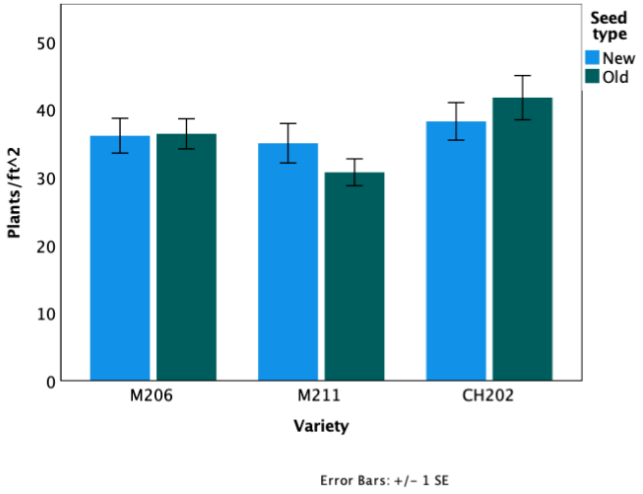
Storing rice seed under ambient conditions can result in significant decreases in germination. Unfortunately, there is not a lot of data about the effect of seed storage under California conditions on seed germination. To help the industry have a better understanding of what happens to stored seed, we established a field trial this year at the Rice Experiment Station (RES) in Biggs to compare the germination and establishment of seed produced in 2020 and stored through 2021 with seed produced in 2021:

Variety - age	Year Produced	General storage conditions
M-206 - old	2020	Shop building, ambient temperature
M-206 - new	2021	Bin, ambient temperature
M-211 - old	2020	Shop building, ambient temperature
M-211 - new	2021	Bin, ambient temperature
CH-202 - old	2020	Bin, ambient temperature
CH-202 - new	2021	Bin, ambient temperature

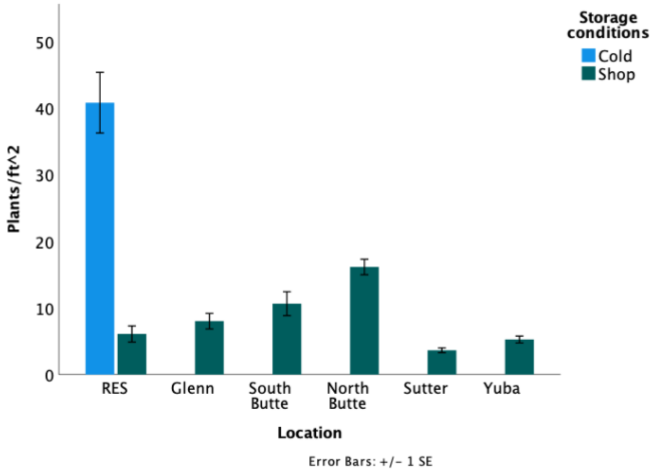
We also collected data from our variety trials and a breeder seed field where variety S-202 was planted with seed produced in 2020. See the table below for details of how that seed was stored.

Variety - age	Year Produced	General storage conditions
S-202 - old	2020	Shop building, ambient temperature
S-202 - cold	2020	Cold storage

In the RES trial, there were no stand differences between the seed produced in 2021 (new) and seed that was produced in 2020 and stored through 2021 (old).



For variety S-202, the stand was good for seed that was put in cold storage through 2021 but poor for seed that was just stored through 2021 in a shop at ambient temperature.



Many factors can affect the germination of stored seed. For example, seed that is stored at high temperature and moisture content is known to reduce germination. There might also be an effect of the variety, with some varieties being able to keep their germination potential than others.

We have sent samples of the seeds used to obtain the information above to a CDFA approved lab to conduct a germination test. Most likely, the germination test results will mirror field observations. We will update the industry once we have that information and provide some guidelines as to how to adjust seeding rates if seed with low germination is used.

Article by Luis Espino, UCCE Rice Farm Advisor, and Timothy Blank, California Crop Improvement Association.

Challenges and Opportunities for US Organic Rice

The USDA’s Organic Research and Extension Institute is funding a three-year project to study the challenges and opportunities of organic rice production in the US. The study will focus on the production and marketing of organic rice in California, Texas, and Arkansas.

Currently, US consumer demand for organic rice exceeds domestic supply, leading to significant import competition. The project’s goal is to facilitate the growth of organic rice production in the US and foster the growth of domestic markets. To achieve this, focus groups with growers and consumers will be conducted.

In California, UCCE would like to invite organic growers to participate in a meeting to develop a “representative organic farm” model. This information will be used to:

- Assist growers make sound financial decisions and identify production opportunities
- Assist financial institutions asses the viability of organic rice farms
- Develop better crop insurance policies
- Help policymakers to develop policies that favor the US organic rice market

The meeting will be conducted in mid-August. Invitations will be made soon, but if you are interested in participating contact Luis Espino at laespino@ucanr.edu or 530-635-6234.

Don't Forget the Rice Field Day!

Wednesday August 31, 2022

Rice Experiment Station

955 Butte City Highway, Biggs, CA

The annual Rice Field Day will be Wednesday, August 31, 2022, at the Rice Experiment Station (RES), Biggs, California. We cordially invite you and your associates to join us for this event. The purpose of the Rice Field Day is to give rice growers and others an opportunity to observe and discuss research in progress at RES. Rice Field Day is sponsored by the California Cooperative Rice Research Foundation (CCRRF) and University of California. We also seek and receive support from many agricultural businesses and are planning a rice equipment vendor display. Following is a brief outline of the Rice Field Day program.

7:30—8:30 a.m. **REGISTRATION**

- Posters and demonstrations

8:30 - 9:15 a.m. **GENERAL SESSION**

- CCRRF Annual Membership Meeting
- Rice Research Trust Report
- California Rice Industry Award

9:30 - Noon **FIELD TOURS OF RICE RESEARCH**

- Variety Development
- Disease and Insect Management
- Agronomy and Fertility
- Weeds Management
- ROXY Rice Production System

Noon **LUNCHEON CONCLUDES PROGRAM**

The program will begin at 8:30 a.m. with a General Session that serves as the Annual CCRRF Membership Meeting. Posters and demonstrations will be in place during registration until after lunch. Field tours of research will emphasize progress in rice variety improvement, disease, insect, and weed control. The program will conclude at noon with a lunch that includes rice.

We hope to see you August 31st. The RES is located at 955 Butte City Highway (Hwy. 162), approximately two and one half miles west of Highway 99 north of Biggs, California.
