COMPREHENSIVE RICE RESEARCH

ANNUAL REPORT
(January 1, 2011 - December 31, 2011)

PROJECT TITLE: Weed Control in Rice

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OBJECTIVES OF PROPOSED RESEARCH:

1. To test and screen herbicides for efficacy, safety and compatibility for tank mixtures or sequential treatments in order to develop, in integration with agronomic practices, weed control packages for the main rice production systems in California.

2. To continue searching and testing new compounds with potential for addressing critical weed control issues to establish their suitability and proper fit into the rice management systems of California. Encourage introduction of promising new chemicals to the California market.

3. To develop new alternatives to weed control through the exploration of agronomic and ecophysiological opportunities to minimize herbicide costs and environmental

impacts. To measure rice yield impact of specific weed species and develop a predictive approach.

4. To develop an understanding of herbicide resistance in weeds, provide diagnosis, test herbicides, and develop effective alternatives to manage this problem.

OBJECTIVE 1. *To test and screen herbicides for efficacy, safety and compatibility for tank mixtures or sequential treatments in order to develop, in integration with agronomic practices, weed control packages for the main rice production systems in California.*

Herbicide test plots were located at two different sites at the Rice Experiment Station (RES) in Butte County, and one off-station site in Glenn County. One of the RES sites has Londax (bensulfuron-methyl)-resistant smallflower umbrellasedge. The off-station site has resistant late watergrass ("mimic") as the main weed problem, and the stale seedbed field was planted June 10, while planting at the RES occurred May 18 and June 2. We continue to use the rice varieties M-205 and M-206 at the RES. This has led to reduced lodging of the rice which translates to greater reliability of the combine harvest yield.

In recognizing the need for developing herbicides to meet the cultural needs of growers throughout the state, our herbicide testing system was designed around the various types of irrigation schemes that growers use. These include: Continuous flood, pin-point flood, Leathers method and dry/drill seeding with establishment flush irrigation. Continuously flooded experiments have water applied and not drained throughout the duration of the season (fields are drained about one month prior to harvest). Pin-point experiments have flood water at the time of seeding then water is drained for foliar applications of herbicides at specific stages of rice growth. Two variations of the Leathers method were run this season. Both entail seeding into the water then dropping the water for establishment. One method leaves the water off the field until foliar herbicides can be applied, while the other method returns the water after the initial pegging of the seed followed immediately with water active herbicides. Dry seeded experiments were drilled into the soil followed by flushes of water to establish the rice; permanent flood was established with rice at the 3-4 leaf stage of growth. All foliar herbicide applications were made with a CO_2-pressurized (207 kPa) hand-held sprayer equipped with a ten-foot boom and 8003 nozzles, calibrated to apply 187 liters spray volume per hectare (20 gallons/acre). Applications with solid formulations were performed by evenly broadcasting the product over the plots. In this report we mention the herbicides by their brand name and the herbicide rates appear as amounts of active ingredient; a cross-reference between brands and active ingredients is presented in Table 1.

1.1. Continuous-flood system combinations

In the continuously flooded trial, good weed control can be achieved with early treatments and best results were obtained when herbicide programs provided at least 95% of broad-spectrum weed control during the first month after seeding enabling recovery of about 20% of potential yield losses. Figure 1 depicts the effects of competition by different weed infestation levels (weed cover) on rice yields for seasons 2007 through 2011. Yields are expressed as percent of the best yields attained in this system. Weed cover in herbicide-treated plots compared to the untreated checks relates to the weed control exerted (Figure 1). Therefore, strong reduction in relative weed cover (percent of field area covered by weed foliage) corresponds to a high level of weed control, and the greatest weed cover % in Figure 1 (and in Figures 2 and 3) generally correspond to untreated control plots. The first month after seeding corresponds to the "critical" period of weed control (30 days after seeding) for flooded rice in California (Gibson et al. 2002)[1]. Treatments that consisted of an early application followed by a late-season treatment (4 lsr to 1 tiller) generally were no better than the best early treatments; however they can be useful to prevent growth and seed production by late-emerging weeds and improve ease of harvest.

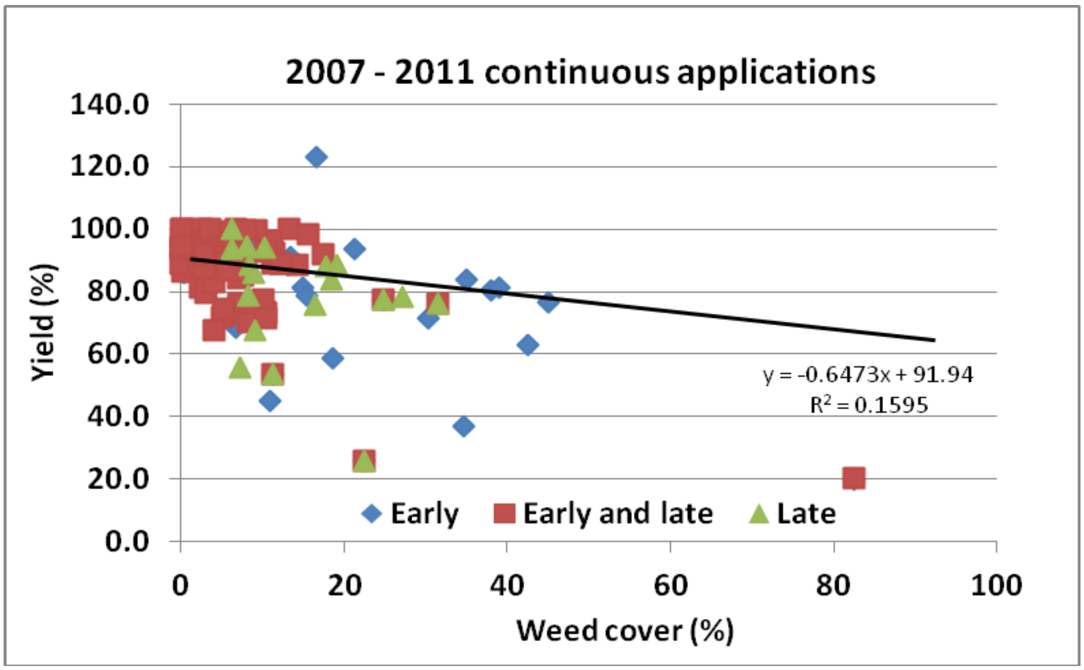

Figure 1. Weed competition in continuously flooded rice: Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation); evaluations of weed infestation were conducted 40 days after seeding rice. Data are combined for the 2007 through 2011 continuously flooded experiments at the RES. Early and late refer to applications made near the 3 lsr and 1-3 tillers of rice, respectively.

The low R^2 of the regression in this Figure 1 is, to a great extent, due to the slope of the line not being too steep and thus changes in weed cover were not associated with drastic changes in rice yields, which underscores the weed suppressive effect of the continuous presence of a 4-6 in deep flood in the field. In addition, herbicide treatments in this system provided very good control of watergrass and the remaining weed cover is represented by aquatic weeds (Table 2) that are not competing very strongly with rice. Other competitive grasses, such as sprangletop and barnyardgrass are normally not a

[1] Gibson, K.D., A.J. Fischer, T.C. Foin and J.E. Hill. 2002. Implications of delayed *Echinochloa* germination and duration of competition for integrated weed management in water-seeded rice. Weed Research 42:351-358.

problem in this system, since their emergence can be well suppressed by the continuous flooding. This all means that water-seeded and continuously flooded systems offer the best opportunities for choosing economic weed control programs if weed infestations are not excessive.

The continuous flood trials conducted at the Hamilton road site have herbicide-susceptible weed species. In most cases, the applications were sequential comprising an initial application of Cerano, Granite GR, Bolero Ultramax or V-10219 for watergrass and sedge control followed by an application of either Shark, propanil (Ultra Stam, Ultra Stam 4SC, Super Wham), Regiment, Sandea or Londax at various timings (Tables 2-3,) to control later-emerging broadleaves, sedges, watergrass plants or weed plants missed by the early treatment. Treatments discussed below are from individually leveed plots (Tables 2-3).

Several herbicide programs provided early and sustained weed control. They were: V-10219 at two rates(2923 g ai/ha and 4092 g ai/ha, both at 1-2 lsr) followed by Regiment (30g ai/ha + 0.125% v/v non-ionic surfactant [NIS] at 3-4 lsr), Granite GR (40 g ai/ha at the 2-3 leaf stage of rice), followed by Ultra Stam 4SC (6726 g ai/ha + 1.25% v/v crop oil concentrate [COC] applied at the 1-3 tiller stage of rice) and Bolero (3918g ai/ha at 1-2 lsr) followed by Regiment (22.4g ai/ha + 0.125% v/v NIS at 3-4 lsr) (Table 2). An additional early treatment combination with sustained weed control was Cerano (560 g ai/ha at DOS) followed by Shark and Londax (210 g ai/ha and 70 g ai/ha, respectively applied separately at 2 lsr) followed by Ultra Stam 4SC (4484 g ai/ha + 1.25% v/v COC applied at the 1-2 tiller stage of rice), although this is likely a very expensive combination (Table 3).

Testing of the new clomazone formulation Bombard, was continued this season. It is a prilled formulation, instead of an extruded, granule (Cerano). Efficacy on grasses appear to be the same as Cerano and yields of field rate treatments were not statistically different for the two formulations of clomazone (Table 4).

In a separate continuously flooded trial, we tested a new active ingredient (benzobicyclon) that Gowan Company is pursuing registration in California rice. We have been testing this compound for a couple years with good results. It is very effective on sedges and many broadleaf weeds with some activity on grasses. It is applied early to the water and has some residual activity. When GWN-9796 (300g ai/ha) was applied at 1 lsr and followed by Granite GR (40g ai/ha at 2-3 lsr) excellent weed control was achieved and the yield was not significantly different from either Cerano (673g ai/ha at DOS) followed by Granite GR (40g ai/ha at 2-3 lsr) or Cerano (673g ai/ha) and Sandea (52.5g ai/ha) applied 1 lsr (Table 5).

1.2. Herbicide combinations for the Pin-point system

Often, cold weather or windy conditions in spring, or the need to use foliarly applied herbicides, require early field drainage to favor rice establishment and foliage exposure to the spray. Prevailing weeds in this experiment were early and late watergrass, sprangletop, smallflower umbrellasedge, ducksalad and waterhyssop (Tables 6 & 7).

Two experiments utilized this method. DOW is looking at bringing a premix of Clincher and Granite (RebelEX) to the California market. We tested several rates and timings of this premix alongside comparable tank mix rates of the individual compounds. In addition, we tested the compatibility of the two compounds in tank mix utilizing different combinations of rates of each compound. Excellent broad-spectrum control and high yields were achieved when either RebelEX or the equivalent tank mix combination were applied at the recommended rates for timing at either 3-4 lsr or 5-6 lsr (Table 6). The tank mix trial shows that high rates of Granite SC are best especially in combination with the higher rates of Clincher for broad-spectrum efficacy on weed species and crop yield. Increased rates of Clincher also generally improve efficacy and grain yield. Low rates of Clincher reduced the efficacy of Granite on watergrass. (Table 7).

The Leathers method is a variation of the pinpoint system where water is generally removed shortly after water seeding to improve rice seed establishment. We tested two variations of this method. The first is fairly typical, with flood water remaining off the field until the rice is pegged and has reached the 2-3 leaf stage. Foliar herbicides are applied near the end of this dry down period at which time the flood is re-established. This extended soil aerobic period encourages germination of many weed species that are not generally an issue in continuously flooded rice. The best treatments for broad-spectrum weed control and yield were: Super Wham (4484g ai/ha) tank mixed with Clincher (315g ai/ha + 2.5% v/v COC) applied 2-3 lsr, a tank mix of Clincher and Granite SC (280g ai/ha + 35g ai/ha respectively + 2.5% v/v COC, 2-3 lsr) followed by Super Wham (6726g ai/ha + 2.5% v/v COC, 1-2 lsr) and Regiment plus Abolish (30g ai/ha + 3363g ai/ha, 2-3 lsr). Several other treatments also had respectable yields (Table 8). The second Leathers method entails returning the flood water as soon as the seedling is pegged to the soil in order to apply water active herbicides that are generally applied during the early stages of rice growth. The best treatment for this system was Cerano and Granite GR (448g ai/ha + 40g ai/ha) applied shortly after re-flood. It provided complete weed control and the highest yield in the experiment. Another treatment was Cerano (448g ai/ha) applied early post re-flood followed by Super Wham (6726g ai/ha +1.25% v/v COC) applied 1 tiller stage of rice. Most other treatments in the trial had decent weed control and yields that were not statistically different from the top listed treatments (Table 9).

Weed infestations in our pin-point plots have a stronger impact on yields compared with the continuously flooded system (Figures 1 and 2), because of the temporary elimination of the weed suppressive effect of flooding and the consequent encouragement of vigorous grass growth. This promotes weed emergence and competition, thus the steeper negative slope of the weed cover-yield relationship illustrated in Figure 2.

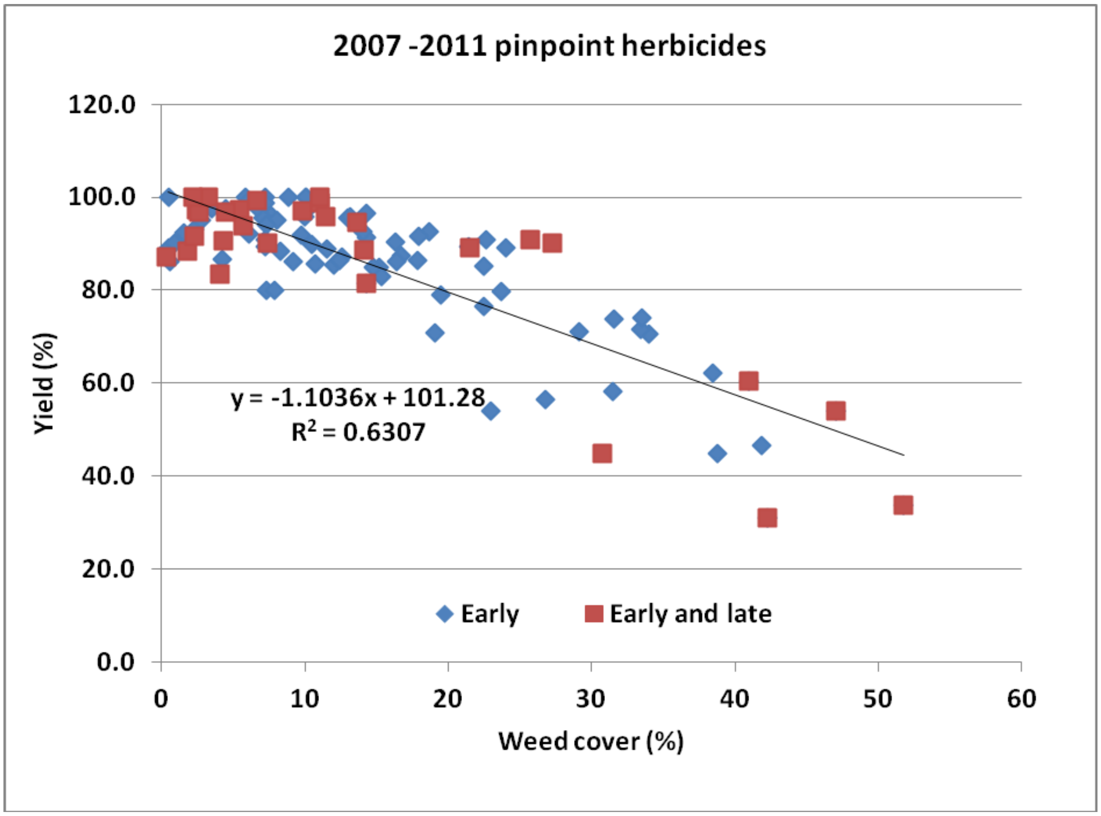

Figure 2. Weed competition in pin-point flooded rice: Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation); evaluations of weed infestation were conducted 40 days after seeding rice. Data are combined for the 2007 through 2011 pinpoint flooded experiments at the RES. Early and late refer to applications made near the 3 lsr and 1-3 tillers of rice, respectively.

1.3. Drill seeded system

This is the system that offers flexibility for herbicide use when proximity to sensitive crops imposes restrictions to aerial applications. Drill seeding favors weeds adapted to dryland seedbeds (sprangletop is typically problematic) but is unfavorable for the recruitment of aquatic species (ricefield bulrush, ducksalad, redstem). Thus drill seeding is useful for alternation with water seeded systems when the pressure of aquatic weeds becomes problematic.

Weed competition can cause significant yield loss under drill seeding, and early-applied treatments providing greater than 95 % weed control were necessary for optimum yields (Figure 3). As mentioned earlier, low weed cover is associated with high weed control in these experiments. Main weeds in the experiment were the *Echinochloa* complex and sprangletop (Table 10).

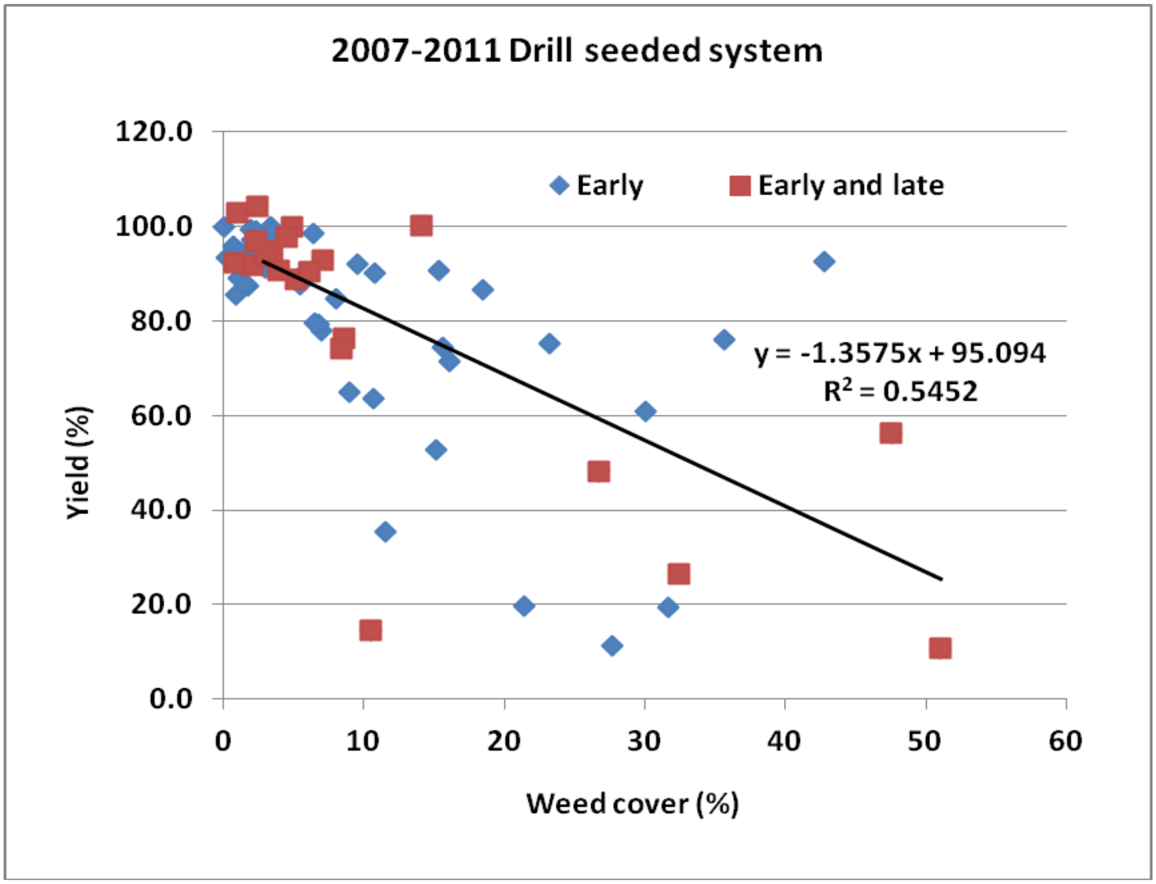

Figure 3. Weed competition in drill seeded rice; evaluations of weed infestation were conducted 40 days after seeding rice. Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation). Data are combined for the 2007 through 2011 drill seeded experiments at the RES. Early and late refer to applications made near the 3 lsr and 1-3 tillers of rice, respectively.

Prowl (pendimethalin) is a pre-emergence herbicide that can suppress weed emergence during the period after seeding rice until the permanent flood is imposed. It controls watergrass (including herbicide-resistant strains), barnyardgrass, sprangletop, and has some activity on smallflower umbrellasedge. Other good sprangletop herbicides for this system are Abolish, and Clincher.

Overall best weed control was achieved with a tank mix of Prowl H_2O plus Super Wham plus Clincher (1120 g ai/ha plus 4484 g ai/ha plus 280 g ai/ha, respectively with 1.25% v/v COC) applied at the 2-3 lsr (Table 10). A second good treatment was Prowl H_2O (1120 g ai/ha, delayed pre-emergent [DPRE]) followed by Super Wham (4480 g ai/ha + 1.25% v/v COC, 3-4 lsr).

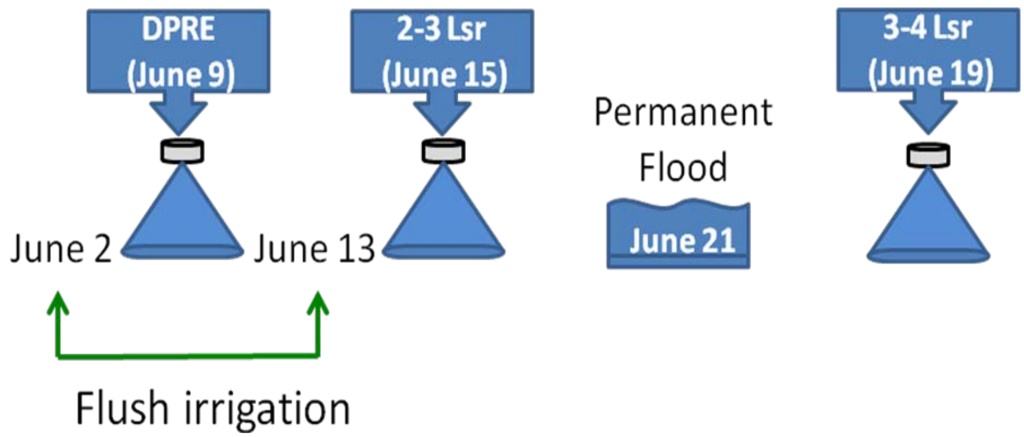

Figure 4. Possible pre-flood timings for herbicide applications in drill-seeded rice. Dates correspond to applications in 2011 following the June 2 seeding of 'M-206' rice (DPRE = delayed premergence; lsr = leaf stage of rice).

1.4. Stale seedbed

The stale seedbed has proven to be a very useful tool for controlling multiple-herbicide-resistant late watergrass ('mimic') in areas of heavy infestation by this weed. The success of this technique depends on achieving maximum weed emergence by the time the non-selective herbicide (glyphosate in this case) is applied. This year's experiment was flushed with irrigation and flooded multiple times in order to get maximum weed emergence of both aerobic and anaerobic weed species prior to planting. Glyphosate was applied to control all weeds present. The field was flooded and seeded to 120lb of M-206 on June 22. Flood water was lowered July 18 for follow up herbicide applications made on July 18. The glyphosate treatments were very effective for control of watergrass and provided good smallflower control, which was not yet fully emerged (Table 11). Follow-up herbicides were needed to control weeds that germinated after the glyphosate treatment. Yield for glyphosate alone was statistically better than untreated and all treatments with follow-up herbicides were statistically similar in yield and greater than glyphosate alone.

1.5. Variety tolerance to recently registered herbicides

There are several recently available herbicides in California that appear to impact rice significantly during the critical establishment period when the well developed canopy of an actively growing crop is crucial for suppressing early weed growth. Cerano has been noted to reduce stand and cause bleaching of rice plants. Granite GR tends to stunt root development and causes shorter stature and darker green plant growth. Granite SC tends to cause the darker green color of rice foliage and may cause some stunting. Regiment has been noted to cause some stunting of rice and occasionally yellowing of the foliage. Testing of Cerano, Granite GR, Granite SC and Regiment across six predominant varieties of rice grown in California (Calmochi 101, L-206, M-202, M-205, M-206 and S-102) was warranted to determine if these herbicides may impact rice growth and yield in the absence of weed interference. All varieties were planted at a density of 168kg/ha

(150lb/a) viable seed on June 20 in 2009, June 30 in 2010 and June 14 in 2011. The trials were run with 5 replications. Prior to seeding, the field was subjected to the stale seedbed treatment including a glyphosate application in order to control weed interference. This allowed to adequately compare herbicide impact on rice by eliminating the interfering effects of weed competition upon rice. A mid-season blanket propanil treatment was needed to keep the plots weed free season-long.

Granite GR and Cerano were tested in a split-plot continuously flooded trial where the six rice varieties were planted in 10 x 20 ft plots within a leveed treatment basin. Cerano treatments were applied at the recommended field rate (673g ai/ha) and at twice this rate (1,344g ai/ha); applications were made into the water of a continuously flooded culture at the 1 leaf stage of rice. Similarly, Granite GR was applied at the recommended (40g ai/ha) and at double (80g ai/ha) the field rate at the 2-3 leaf stage of rice.

Granite SC and Regiment were tested as foliar applications in a split-plot pin-point flooded trial where all varieties were planted in 10 x 20 ft plots. Water was drained briefly to spray the herbicides. Granite SC treatments were the recommended field rate of 35g ai/ha and double rate of 70g ai/ha, both applied at the 3-4 leaf stage of rice. Regiment was applied at 30g ai/ha and 60g ai/ha. Applications were at the 4 leaf stage of rice.

In the continuous trial there appeared to be no impact on eventual yield. Granite GR tended to reduce plant height especially at the 2X rate, except for L-206. Both Cerano and Granite GR reduced vegetative weight of Calmochi-101 and S-102, while only the high rates of these compounds impacted the medium grain varieties and no apparent effect on L-206. There was a marked reduction in number of plants per square foot for most varieties at the high rates of both herbicides. Heading was delayed by Granite GR especially when it was applied at 2X.

In the pinpoint trial there was no strong evidence for yield reduction by either Granite SC or Regiment at either rate. Vegetative weight was slightly reduced in a couple varieties by the high rate of Regiment. No strong evidence that either herbicide impacted plant height or plants per square foot. Regiment may have delayed heading in a couple varieties when applied at 2X.

Further analysis remains to be done to compile the results of the three years that this experiment was conducted.

1.6. Granite SC and Clincher tank mix interaction study

This study was undertaken due to numerous occasions in the past where it was noted that weed control with this combination treatment was not consistent with what would generally be expected. It was surmised that there may be some level of antagonism when these two herbicides are mixed. There is now a formulated product available for use in rice in the southeastern US (RebelEX) and may become available in California in the near future.

An experiment was set up with 10 x 20 ft plots in a randomized complete block design with 4 replications. The trial was water seeded June 2nd with 120lb M-206 seed. Water was drained June 13th in preparation for foliar applications of treatments on June 25th (20 days after seeding). Applications were made with 2.5% volume to volume crop oil concentrate and spray volume of 187 liters/ha. Rice was at the 3 leaf stage, watergrass was 3 leaf stage, while ricefield bulrush was 2-4 leaf, smallflower was 3 leaf and ducksalad was 1 tiller. Flood water was re-established June 27th. Visual evaluations of weed control were made on July 16th and August 1 with harvest October 12th.

When Clincher and Granite SC were mixed, the best weed control and best yield was obtained with full field rates of both herbicides (Table 7). When a low rate of Clincher is added to any concentration of Granite SC, there is a reduction in watergrass control. When both herbicides are used in mixture, this antagonism is partially overcome by using the highest rates of Clincher and Granite. Antagonism on Clincher by other herbicides can be minimized if Clincher is applied 5 days before or 7 days later than the other herbicide (DOW Agrosciences, personal communication).

OBJECTIVE 2. *To continue searching and testing new compounds with potential for addressing critical weed control issues to establish their suitability and proper fit into the rice management systems of California. Encourage introduction of promising new chemicals to the California market.*

Bombard

Bombard is a new formulation of clomazone. It has the same percent active ingredient as Cerano and will be applied at identical rates. The formulation is a prilled granule instead of an extruded granule like Cerano. Weed suppressive activity and yield appear to be similar to Cerano applied at label rates (Table 4). The best results were obtained when the commercial rate of clomazone was applied at the day of seeding or one-leaf stage of the watergrass. The doubled commercial rate provided greater watergrass control, but caused severe phytotoxicity that resulted in lower yields.

RebelEX

RebelEX is a new pre-mix formulation of cyhalofop and penoxsulam (active ingredients in Clincher and Granite SC). The mixture contains 21.06% cyhalofop and 2.95% penoxsulam. This pre-mix formulation has already been available in the southeast US. Excellent broad-spectrum control and high yields were achieved when either RebelEX or the equivalent tank mix combinations were applied at the recommended rates for timing at either 3-4 lsr or 5-6 lsr (Table 6). Advantages to the pre-mix are reduced worker exposure and less chance of a tank mix mistake.

V-10219

Valent has been researching the potential for a combination granule of thiobencarb and imazosulfuron (V-10219) to be used in California rice production. It will apparently be named League MVP. It has delivered excellent broad-spectrum control with excellent yields over several years of testing (Table 2).

Unnamed compound

Gowan Company has been researching the potential for benzobicyclon (GWN-9796) to be used in California rice production. It has been used in Japanese rice production for a number of years. It is a different mode of action than the other available herbicides in California. It is efficacious on bulrush, smallflower umbrellasedge, ducksalad and monochoria. In addition, it also has some activity on sprangletop and watergrass (Table 5). Although it has good residual activity it will not be a standalone chemical and therefore will need to be backed up by other herbicide options in a program. Gowan is working on a granular formulation for the California market. They will also be looking at the potential for combination granules utilizing other herbicides currently available in California.

OBJECTIVE 3. *To develop new alternatives to weed control through the exploration of agronomic and ecophysiological opportunities to minimize herbicide costs and environmental impacts. To measure rice yield impact of specific weed species and develop a predictive approach.*

3.1. Herbicide resistant weed management systems in rice using alternative stand establishment techniques:

The one grower which cooperated for several years implementing the stale seedbed continues to use the procedure to reduce the weed seedbank of resistant late watergrass ("mimic") in specific fields. The neighbor who followed the progress for a couple years before trying it himself last season has used it again this year on a larger scale. Both appear to be happy with the method in light of the difficulty to control the resistant late watergrass with conventionally available herbicides.

3.2. Predicting weed emergence to optimize timing of herbicide applications to control herbicide-resistant weeds using a stale seedbed technique.

a) Using threshold models to describe germination and emergence of herbicide-resistant and -susceptible *E. phyllopogon* across temperature, moisture and oxygen gradients

Echinochloa phyllopogon (late watergrass) has evolved resistance to most available herbicides in California (this is the "mimic" biotype of late watergrass), thus severely limiting chemical control options and presenting a need for alternative control measures, such as the stale seedbed technique, which entails recruiting weeds through early irrigation events and treating them prior to planting with alternating broad-spectrum herbicides (like glyphosate) for which resistance does not exist in these weeds. Controlling the cohort of weeds that would otherwise emerge with the crop, followed by rice seeding with no soil disturbance, would ensure that rice emerges with a minimum of (herbicide-resistant) weeds. This approach will function optimally if the timing and rate of weed seedling emergence under varying temperatures and irrigation regimes can be accurately predicted, so that a timely application of the herbicide can be done on fully emerged weeds with minimum delay in planting rice. The length of time a seedbed has to be irrigated to promote the pre-plant weed emergence is usually a source of uncertainty for growers. To optimize the functioning of this technique by predicting field-level seedling emergence, and identify differences between herbicide-resistant (R) and –susceptible (S) *E. phyllopogon* populations, we applied population based threshold models that could define and test the temperature, moisture and oxygen conditions for achieving the highest rates of germination and emergence in non-dormant seed. All R and S populations germinated at increasing rates between 9.5 and 31 C, (Figure 5) and had base water potentials below -1.0 MPa. However, emergence in field soils was reduced by moisture stress (Figure 6), especially in the soils with R seed, and R populations were particularly susceptible to post-imbibition drying. We combined thermal and hydro time for germination with thermal time for early growth to predict time to field emergence in two fully hydrated aerobic soils and two soils subjected to intermittent moisture stress. The hydrotime requirement for germination was incorporated into this approach by separately modeling germination for distinct seed fractions as they crossed their water potential threshold and accumulated hydrotime; in this way the model defined the relative size and numbers of the emergence flushes that constitute final recruitment. Since there was no dose response to oxygen in germination (Figure 7), we suggest reductions in emergence in flooded soils (Figure 8) may be due to hypoxia-driven reductions in early growth. Given the absence of negative effects of hypoxia on germination, to optimize *E. phyllopogon* emergence in field soils, we recommend flooding fields for up to about 60 thermal units after the field is first irrigated in spring to promote >95% watergrass germination, and then drain fields to enable adequate weed emergence growth. Glyphosate should be sprayed onto emerged weeds by about 120 thermal units after the initial irrigation (Figure 6). If water is first applied on April 15, this corresponds to about 10 days of flooding and, as temperatures rise, another 7 days until glyphosate application; while starting on May 15, would require 7 days of flooding followed by another 5 days until glyphosate application.

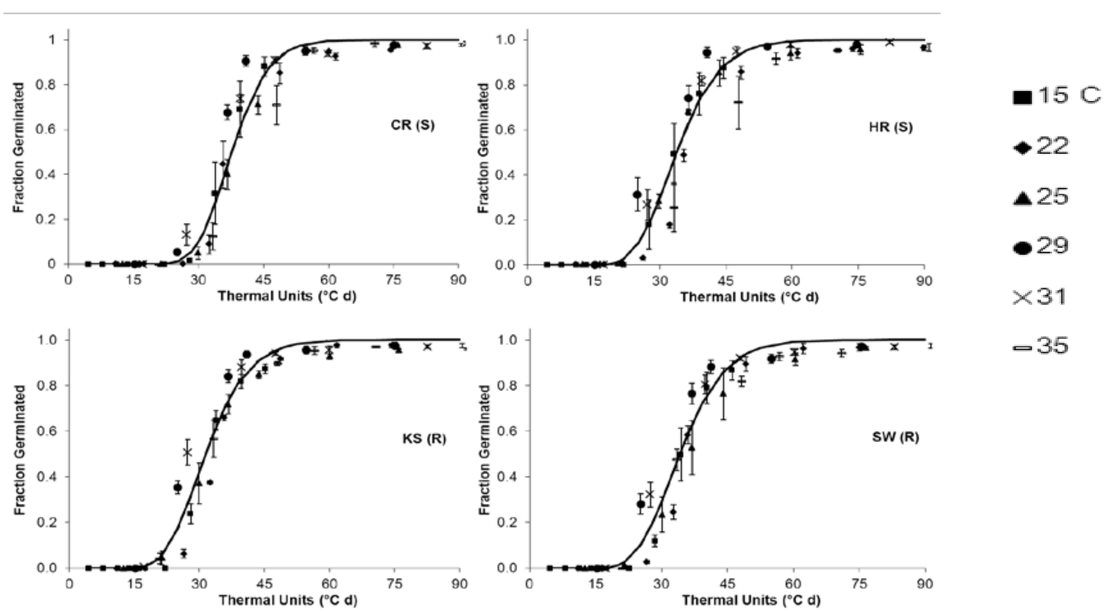

Figure 5. Germination of four *E. phyllopogon* populations across six constant temperature regimes at 0 MPa and 21% oxygen. Cumulative observed (symbols) and predicted (line) germination plotted over thermal units calculated for each population according to the equation: $G = [\log t_g – (\log \theta_T(50) - \log(T-$

$T_b))/\sigma_{\theta T(50)}]$. Bars represent standard errors based on three replicates of ~55 seeds. Models were fit by replicate with average RMSE ±SE values of 0.067 ±0.010 for CR, 0.065 ±0.012 for HR, 0.063 ±0.002 for KS and 0.065 ±0.009 for SW.

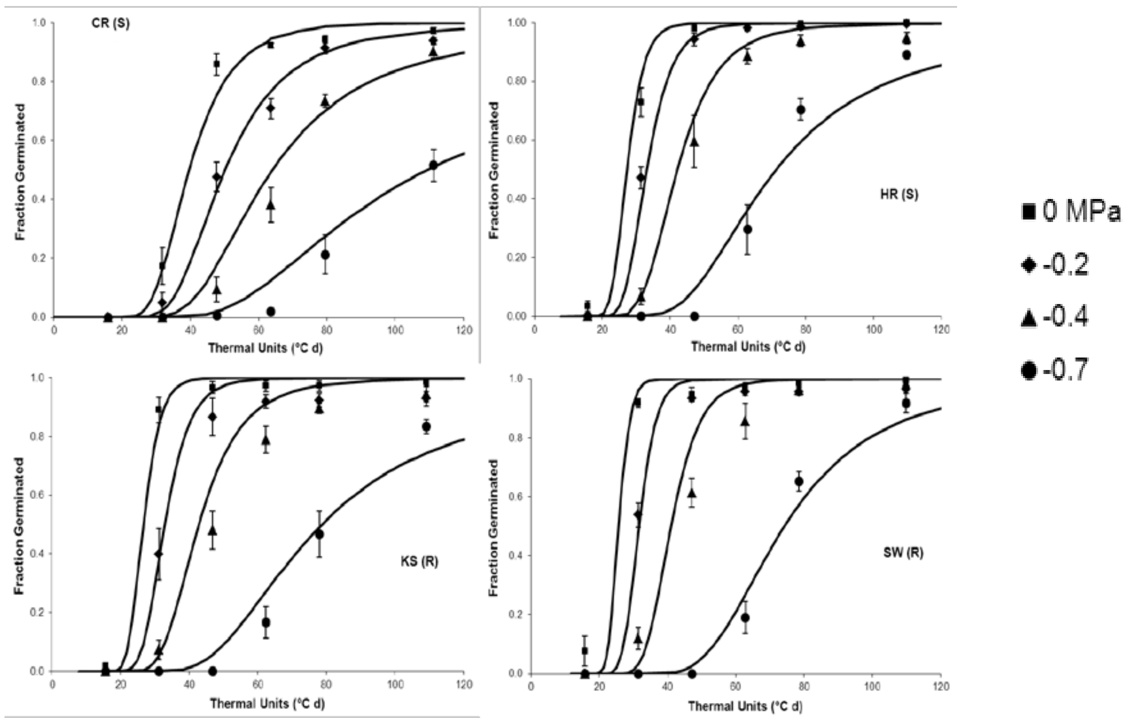

Figure 6. Germination of four *E. phyllopogon* populations across four constant moisture regimes at 24 C and 21% oxygen. Observed germination time courses (symbols), and predicted germination (lines) according to a hydrotime model using the equation: $probit(g) = [\Psi - \theta_H/t_g(\Psi) - \Psi_b]/\sigma_{\Psi b}$. Bars represent standard errors based on 6 replicates of 35 seeds. Models were fit by replicate with average RMSE ±SE values of 0.077 ±0.008 for CR, 0.052 ±0.003 for HR, 0.075 ±0.005 for KS and 0.056 ±0.004 for SW.

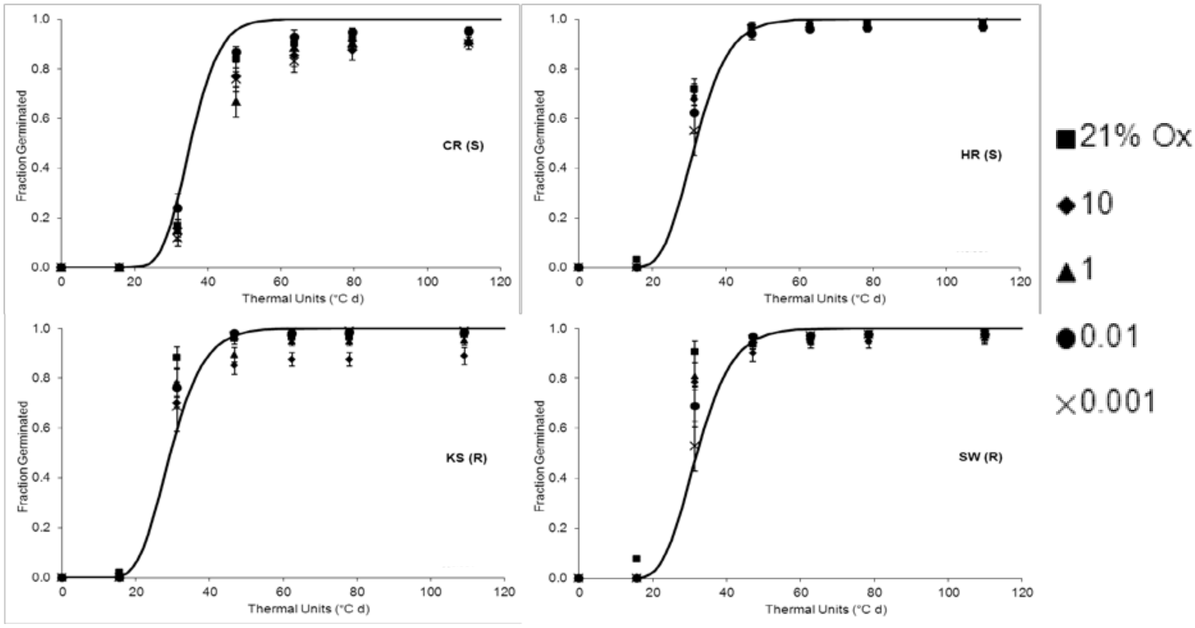

Figure 7. Germination of four *E. phyllopogon* populations across five constant oxygen regimes at 24 C and 0 MPa. Observed germination time courses (symbols), and predicted germination (lines) according to a thermal model using the equation $G = [\log t_g – (\log \theta_T(50) - \log(T - T_b))/\sigma_{\theta T(50)}]$. Bars represent standard errors based on 6 replicates of 35 seeds. Average final G across treatments was 94, 98, 96 and 98% ($LSD_{0.05}$ =2) for populations CR, HR, KS and SW, respectively.

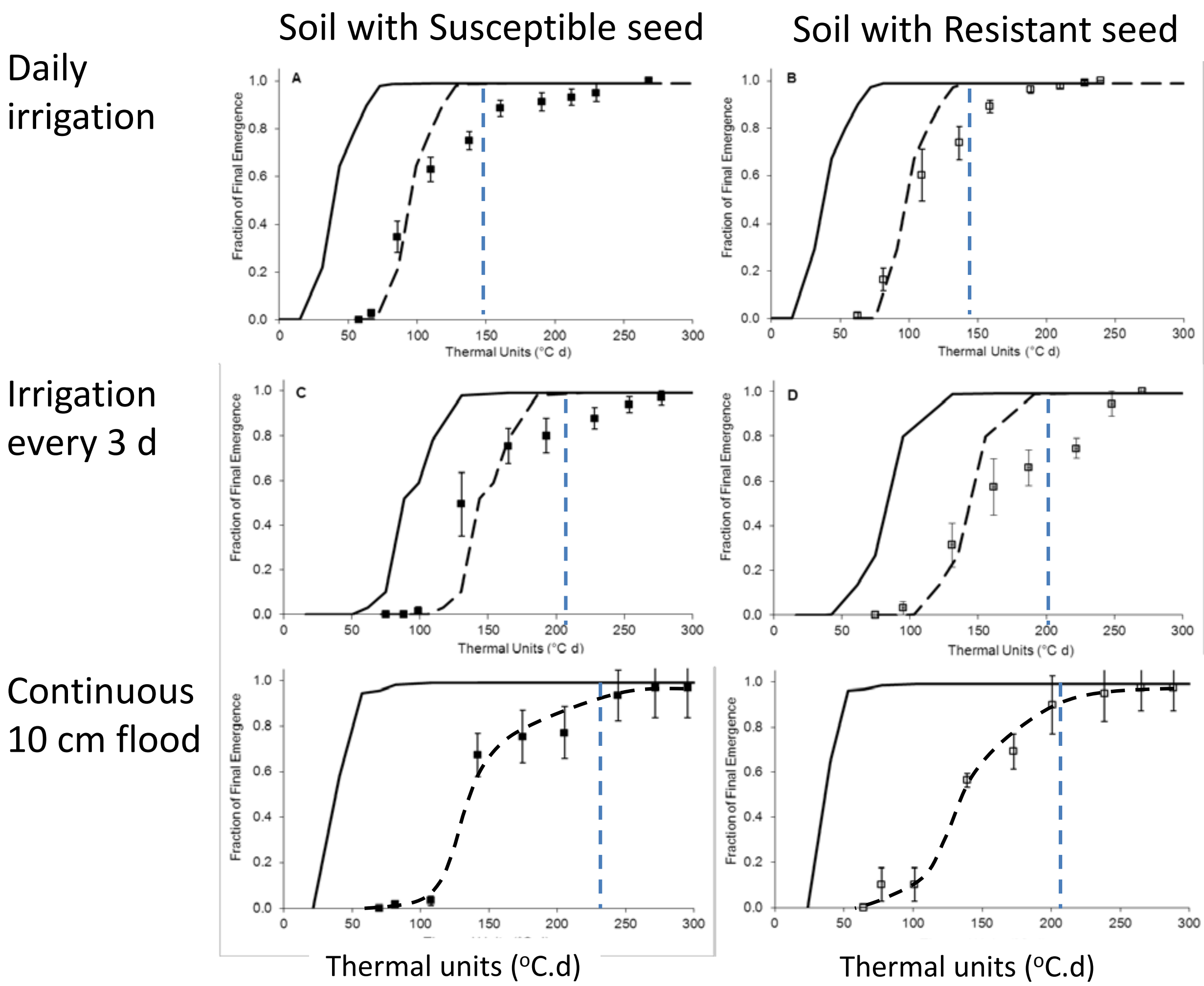

Figure 8. Predicted germination and emergence in field soils using a thermal time model modulated by moisture accumulation in distinct fractions of the population, as determined by their individual ψ_b. Thick solid lines represent the sum of germination predictions for distinct fractions for a soil with predominantly herbicide-susceptible (S) late watergrass seed and another with predominantly herbicide-resistant (R) seed. Soils were either under daily irrigation to maintain constant near saturation moisture, intermittent moisture or continuously flooded. Predicted germination of each fraction λ of the population that had completed accrual of θ_H based on its particular ψ_b, was calculated by applying the equation: $G\lambda = \{[\log t - (\log \theta_T(50) - \log(T-T_b))] / \sigma_{\theta T}\} * \lambda$. Predicted total germination was calculated as $\Sigma\, G\lambda$. ψ_b for distinct fractions were determined with the equation $\Psi_b(\lambda) = probit(\lambda)\sigma_{\psi b+}\, \Psi_b(50)$. Symbols represent observed emergence and dashed lines represent predicted emergence. Observed emergence is expressed as a fraction of mean final observed emergence within each treatment. Dashed lines were obtained, according to equation 10, by adding the average number of thermal units for growth to 3 cm to predicted thermal units to germination for any given fraction of seed. Symbols represent observed averages ±SE, based on five replicates per treatment. Vertical dashed lines represent the approximate time in thermal units (degree-days, ^oC.d) to full weed emergence.

b) Modeling Germination and Emergence of Smallflower Umbrella Sedge (Cyperus difformis L.) Resistant and Susceptible to ALS-Inhibiting Herbicides

Cyperus difformis L. (smallflower umbrella sedge) is the most common weed found in rice fields, capable of causing yield losses of up to 50% in dense infestations. Due to the increased infestation of herbicide-resistant accessions, innovative management tools are needed to develop adequate options for C. difformis control. In California, alternative rice establishment systems such as the stale-seedbed method have been developed to address the increasing issue of herbicide resistance. This technique consists of herbicide applications anterior to rice sowing, although delays due to time needed for weeds to germinate and emerge prior to such herbicide applications are a main concern in such systems. Knowledge of the temporal pattern of germination will contribute to optimize the timing of control measures, thus maximizing efficacy.

The effects of constant temperature and water stress on germination (coleoptile extension) were investigated in seeds of two herbicide (ALS-inhibiting)-resistant (R) and three herbicide-susceptible (S) Cyperus difformis L. accessions in order to develop thermal- and hydro-time germination-response models capable of predicting its germination across different temperature (T) values. No germination was recorded at 13.25 C, and the rate of germination increased linearly from 16 to 33.7 C, indicating that the optimum temperature for germination is above the latter. Base temperatures were estimated through iteration for maximum fit and ranged from 16.5 to 19.8 C, with no clear pattern between R and S accessions. R seeds tended to have a lower germination synchronicity across water potentials, faster germination, and an apparently greater ability to germinate in cold temperatures. Base water potential for seed germination varied significantly across different temperatures and among accessions, and ranged from -0.24 to -1.13 MPa. R accessions, moreover, showed lower (more negative) base water potential values, indicating greater capacity to germinate in dryer conditions.

Field soil germination indicated significantly different thermal times to emergence across three water regimes (e.g. daily water, flooded and saturated), with daily flush emergence occurring faster than other treatments. Nonetheless, total seedling density under daily water treatments scored below other water regimes, and was inconsistent across soils. Irrigation performed every 3 days did not produce moisture conditions suitable for seedling emergence.

Our research suggests that in order to optimize springtime seedling emergence for this species, soil moisture should be kept around field capacity, since germination rates are significantly slowed at reduced water potentials. Results also enable for improvements in the stale-seedbed method by allowing for earlier irrigation due to the greater ability of R accessions in withstanding cold temperatures, as well as decreasing the time necessary for smallflower umbrella sedge emergence due to the more rapidly germination of R in comparison to S accessions. Moreover, R accessions had significantly lower base potential values, which could contribute to intermittent irrigation systems aiming at encouraging this weed’s emergence.

OBJECTIVE 4. *To develop an understanding of herbicide resistance in weeds, provide diagnosis, test herbicides, and develop effective alternatives to manage this problem.*

4.1. Diagnostic and detection of herbicide resistance.

We continue to screen potentially resistant grass samples (late watergrass, early watergrass and barnyardgrass) submitted by growers and PCAs against known susceptible and resistant lines. Testing this past season included Cerano, Regiment, Clincher, Bolero, Ordram, Granite and propanil applied at the standard field rate and ½ the standard rate. During the past five seasons, we have reported results of testing by including a picture showing the individual treatment effects on their watergrass sample compared with the known susceptible and resistant lines. The percent control (i.e. control referred as percent of the mean of untreated plants for the same biotype) and standard error was labeled below each treatment. Response from growers and PCA's on this mode of reporting results continues to be positive. They comment that they like seeing the effect on the grass along with the level of control by the different herbicides. Various resistance patterns were observed in all submitted samples, which included barnyardgrass, early, and late watergrass accessions. A number of grass samples have been submitted for testing this season. Additionally, a number of smallflower umbrellasedge and bulrush samples have been submitted for herbicide resistance testing.

PUBLICATIONS OR REPORTS

Osuna, M.D., M. Okada, R. Ahmad, A. J. Fischer, and M. Jasieniuk. 2011. Genetic diversity and spread of thiobencarb resistant early watergrass (Echinochloa oryzoides) in CaliforniaWeed Science 2011 59:195-201

Yasuor, H., M. Milan, J.W. Eckert, and A.J. Fischer. 2011. Quinclorac Resistance: a concerted hormonal and enzymatic effort in Echinochloa phyllopogon.Pest Management Science (wileyonlinelibrary.com; DOI 10.1002/ps.2230)

Zhou, W., H. Yasuor, A.J. Fischer, V. Tolstikov. 2011. Trace metabolic profiling and pathway analysis of clomazone using liquid chromatography coupled with triple Quadruple-Linear Ion Trap Mass Spectrometry in Predictive Multiple Reaction Monitoring Mode. LGCC Noth America 29 (9)8p (www.chromatographyonline.com).

Yasuor, H., M. Milan, J.W. Eckert, and A.J. Fischer. 2011. Quinclorac Resistance: a concerted hormonal and enzymatic effort in Echinochloa phyllopogon.Pest Management Science (wileyonlinelibrary.com; DOI 10.1002/ps.2230)

Hanson, B.D., A. J. Fischer, A. McHughen, M. Jasieniuk, A.Shrestha, and A. J. Jhala. 2011. Herbicide-Resistant Weeds and Crops. In Hanson et al. Principles of Weed Science - 4th edition. California Weed Science society (In Press).

Fischer, A.J. 2011. Mechanisms and mitigation of herbicide resistance [in Spanish]. Pages 97-107 In J. R. Arévalo et al. Plantas Invasoras, Resistencias a Herbicidas y Detección de Malas Hierbas. XIII Congress of the Spanish Weed Science society [Congreso Nacional de Malherbología] 22, 23, and 24 November, San Cristóbal de La Laguna, Canary Islands, Spain.

CONCISE GENERAL SUMMARY OF RELEVANT RESULTS OF THIS YEAR'S RESEARCH

Our field and lab program seeks to assist California rice growers in their critical weed control issues of preventing and managing herbicide-resistant weeds, achieve economic and timely broad-spectrum control and comply with personal and environmental safety requirements. Thus we test in the field at the RES, and in a cooperator's field heavily infested with *mimic* (multiple-herbicide-resistant late watergrass biotypes), herbicides, their mixtures and sequential combinations for the rice growing systems that currently prevail in California. Experiments at the RES were conducted with rice 'M-206'. Advantages of the Continuous Flooded rice system, provided a uniform 4-inch water depth can be maintained, include the elimination of sprangletop as a problem and the suppression of watergrass by the deep flood. We had early and late watergrass infestations, but also ricefield bulrush, smallflower umbrellasedge and the complex of ducksalad/monochoria were present. Granular formulations applied early into-the-water are excellent non-drift tools for this system. Programs that worked well were Granite GR followed by propanil, V-10219 (thiobencarb + imazosulfuron) followed by Regiment, Bolero Ultramax followed by Regiment, Cerano followed by Granite GR, Cerano plus Sandea, Cerano followed by Shark and Londax followed by propanil, and GWN-9796 (benzobicyclon) followed by Granite GR.

The Pinpoint System is used in California when rice requires early draining for establishment or when early (2-4 leaf stage) weed exposure to foliar herbicides is needed. However, this exposure of the soil surface to air also favors the establishment of weeds like sprangletop, barnyardgrass and smallflower. For this reason, it is important that fields be rapidly re-flooded beginning 48 hours after application. Follow-up applications can be made at the 1-2 tiller stage after water is lowered (draining not needed) to expose 70% of weed foliage to the spray. This season we concentrated our effort on tank mix combinations of Granite SC and Clincher due to the upcoming release of a pre-mix from DOW. In addition we had two Leathers method trials, one of which had an extended drain for rice establishment. Near the end of the drain, foliar herbicides were applied. Best programs for this system were propanil plus Clincher, Clincher plus Granite SC followed by propanil, and Regiment plus Abolish. A second concept on the Leathers method is to drain shortly after seeding then returning flood as soon as the seed begins to peg. This timing allows use of water active herbicides soon after the water is returned. Good programs in this scenario are Cerano plus Granite GR and Cerano followed by propanil.

Our Drill-Seeded rice was flushed with water two times for establishment prior to final permanent flood (3-4 inches deep) when rice was at the 5 leaf stage of growth (June 21). Significant yield losses were associated with infestations by the main weeds in this system (watergrass and sprangletop). There were no stand alone treatments that provided sufficient weed control and good yield in the drill seeded trial this season. Several combinations that did provide good weed control and yield were: Prowl H_2O plus Super Wham plus Clincher, and Prowl H_2O followed by Super Wham.

The stale seedbed concept has proven to be a very useful tool for controlling multiple-herbicide-resistant late watergrass ('mimic') in areas of heavy infestation by this weed. This entails water flushes of a prepared seedbed in order to encourage weed seed to germinate. This is followed up by a dry down and an application of a total herbicide like glyphosate. The field is then flooded and seeded. Follow up herbicides are generally required to control any weeds that germinate after the permanent flood is established.

There are three rather new herbicides that are either on the market or destined to be available soon. They include Bombard from Cheminova, which is a new formulation of clomazone the same active as Cerano; RebelEX from DOW, which is a pre-mix of penoxsulam and cyhalofop (active ingredients in Granite SC and Clincher); V-10219 (League MVP) from Valent is a combination granule of thiobencarb and imazosulfuron; and GWN-9796 from Gowan, which is benzobicyclon, but does not have a final formulation or trade name as yet.

The variety tolerance to recently registered herbicides trial has been run for three consecutive years. The water active herbicides Cerano and Granite GR tend to have a greater impact on rice than the foliar applied herbicides Granite SC and Regiment

Testing of Granite SC and Clincher interactions in tank mix combination provided evidence of antagonism on watergrass and sprangletop control when these two herbicides were mixed. Antagonism was partially overcome by using the highest rates of Clincher and Granite. Given the broad-spectrum control achieved by the mixtures, yields were not impacted by antagonism in weed control.

Certain alternative stand establishment techniques developed over the past five years at the Rice Experiment Station are being utilized by a cooperating grower and by one neighboring grower. These growers are located in Glenn County where resistant late watergrass '*mimic*' is dominant. This technique uses glyphosate to eliminate weeds germinated with early irrigation prior to flooding and seeding rice. This technique has been very successful in reducing or eliminating watergrass and sprangletop competition during the growing season. We hope that several years of implementation of this technique will significantly reduce the seedbank in the soil such that the fields can be transitioned back to a more conventional production system with high yields.

Research continues on germination modeling of significant weed species in rice. This will benefit growers in determining the optimum conditions and timing for weed control in stale seedbed rice systems.

Table 1. Herbicides used and their active ingredient

Brand name	Active ingredient
Abolish	thiobencarb
Bolero Ultramax	thiobencarb
Cerano	clomazone
Bombard	clomazone
Clincher	cyhalofop
Granite SC	penoxsulam
Granite GR	penoxsulam
Grandstand	triclopyr
Strada CA	orthosulfamuron
Strada GR	orthosulfamuron
Londax	bensulfuron methyl
Prowl H_2O	pendimethalin
Regiment	bispyribac-sodium
Shark H_2O	carfentrazone
Ultra Stam 80 DF	propanil
Super Wham	propanil
Whip 360	fenoxaprop-p-ethyl
Ricestar HT	fenoxaprop-p-ethyl
Roundup	glyphosate
MCPA	dimethylamine salt of 2-methyl-4-chlorophenoxyacetic acid
Ultra Stam 4SC	propanil
Halomax 75	halosulfuron-methyl
RiceShot	propanil
Sandea	halosulfuron-methyl
Rebel EX	penoxsulam + cyhalofop
V-10219 (League MVP)	thiobencarb + imazosulfuron
GWN-9796	benzobicyclon

Table 2. Continuous flood trial H.R.

Treatment	Rate (g ai/ha)	Timing[3]	Application date 1st	Application date 2nd	Phytotoxicity[1] 1st 7 DAT % Stunting	1st 7 DAT % Stand	1st 7 DAT % Injury	1st 14 DAT % Stunting	1st 14 DAT % Stand	1st 14 DAT % Injury	2nd 7 DAT % Stunting	2nd 7 DAT % Stand	2nd 7 DAT % Injury	2nd 14 DAT % Stunting	2nd 14 DAT % Stand	2nd 14 DAT % Injury
Untreated[4]	---	---														
Cerano	673	DOS	2-Jun		NA	NA	NA	6	1	4						
Cerano fb. Sandea	673 fb. 35	DOS fb. 2-3 lsr	2-Jun	15-Jun	NA	NA	NA	3	4	21	1	0	5	3	0	1
Granite GR fb. Ultra Stam 4 SC + COC	40 fb. 6726 + 2.5% v/v	2-3 lsr fb. 1-3Til	15-Jun	30-Jun	1	0	3	0	0	8						
Shark H_2O fb. SuperWham + COC	224 fb. 6726 + 1.25% v/v	2-3 lsr fb. 1-3 Til	15-Jun	30-Jun	0	0	4	0	0	0						
Superwham + Grandstand + COC	6726 + 420 + 1.25% v/v	1-3 Til	30-Jun													
Bolero Ultramax fb. Superwham + COC	3918 fb. 6726 + 1.25% v/v	1-2 lsr fb. 1-3 Til	13-Jun	30-Jun	0	1	3	0	0	0						
Bolero Ultramax fb. Regiment + NIS	3918 fb. 30 + 0.125% v/v	1-2 lsr fb. 1-3 Til	13-Jun	30-Jun	6	1	0	1	6	0						
V-10219[5] fb. Regiment + UAN + NIS	2923 fb. 22.4 + 2.0% + 1.0% v/v	1-2 lsr fb. 3-4 lsr	13-Jun	20-Jun	3	0	3	3	9	3	0	6	0	0	6	0
V-10219 fb. Regiment + UAN + NIS	3508 fb. 22.4 + 2.0% + 1.0% v/v	1-2 lsr fb. 3-4 lsr	13-Jun	20-Jun	3	0	3	0	10	0	3	5	3	3	4	0
V-10219 fb. Regiment + UAN + NIS	4092 fb. 22.4 + 2.0% + 1.0% v/v	1-2 lsr fb. 3-4 lsr	13-Jun	20-Jun	6	0	4	1	8	0	1	3	3	0	3	0
Cerano fb. Stam + Londax + COC	280 fb. 6726 + 67 + 1.25% v/v	DOS fb. 4-5 lsr	2-Jun	24-Jun	NA	NA	NA	1	3	69	0	4	3	0	1	0
Bolero Ultramax fb. Regiment + UAN + NIS	3918 fb. 22.4 + 2.0% + 1.0% v/v	1-2 lsr fb. 3-4 lsr	13-Jun	20-Jun	3	0	4	4	4	1	3	4	1	0	0	0
LSD (P=0.05)																

Treatment	Weed Control[2] 22-Jun ECHPH	22-Jun SCPMU	22-Jun CYPDI	22-Jun HETLI	12-Jul ECHPH	12-Jul SCPMU	12-Jul CYPDI	12-Jul HETLI	12-Jul MOOVA	1-Aug ECHPH	1-Aug LEEFA	1-Aug SCPMU	1-Aug CYPDI	1-Aug HETLI	Plant meas. Yield (lb/A) 18-Oct	Plant meas. Lodging 18-Oct
Untreated[4]	25	5	5	19	46	3	5	24	13	10	1	2	2	2	1835	83
Cerano	82	0	0	68	86	0	0	1	0	99	100	0	0	0	5779	64
Cerano fb. Sandea	85	76	100	87	100	85	100	85	83	81	100	100	42	0	8691	63
Granite GR fb. Ultra Stam 4 SC + COC	52	61	67	49	98	100	100	100	100	100	0	100	100	100	9011	50
Shark H_2O fb. SuperWham + COC	22	100	100	86	70	100	100	96	97	0	0	83	100	67	8423	73
Superwham + Grandstand + COC	NA	NA	NA	NA	82	95	100	44	32	16	75	100	92	0	8371	0
Bolero Ultramax fb. Superwham + COC	59	100	100	59	92	95	100	64	46	43	100	75	100	13	8351	43
Bolero Ultramax fb. Regiment + NIS	44	89	100	85	96	100	100	57	0	40	100	83	100	100	8754	24
V-10219[5] fb. Regiment + UAN + NIS	89	59	100	86	100	100	100	100	95	100	100	100	75	100	9157	30
V-10219 fb. Regiment + UAN + NIS	87	95	100	99	99	100	100	98	95	100	100	100	100	88	8309	64
V-10219 fb. Regiment + UAN + NIS	63	95	75	94	99	100	100	98	100	100	100	100	100	100	9062	39
Cerano fb. Stam + Londax + COC	96	91	90	100	97	100	100	100	100	100	100	100	100	100	7798	88
Bolero Ultramax fb. Regiment + UAN + NIS	55	64	100	76	96	95	75	68	87	95	100	8	100	100	8786	40
LSD (P=0.05)															1239	45

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead); MOOVA (Monochoria)

[3] PFS (pre-flood surface), PPI (pre-plant incorporated), fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species

[5] V-10219 consists of 10% thiobencarb + 0.46% imazosulfuron

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a permanent flood with flood water at 3-4 inches.
3. No weeds were visible when Cerano was applied on day of seeding June 2.
   Watergrass was 1-2 leaf, bulrush and ducksalad were 2" tall and smallflower was 1" tall on June 13.
   Watergrass was 3 leaf, ricefield bulrush was 2-3 leaf, smallflower was 1-2 leaf and ducksalad was 3 leaf on June 15.
   Watergrass was 3-4 leaf, ricefield bulrush was 2-3 leaf, smallflower was 2-3 leaf, ducksalad was 2-3 leaf on June 20.
   Watergrass was 1 tiller, ricefield bulrush was 4 leaf, smallflower was 3", ducksalad was 3 leaf , waterhyssop was 4 leaf on June 24.
   Watergrass was 3 tiller, ricefield bulrush was 4-5 leaf, smallflower was 3", ducksalad was tillered , waterhyssop was tillering on June 30.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on June 2: Air temperature 57° F, wind 2-3 MPH from the southeast.
   Weather conditions on June 13: Air temperature 75° F, wind 1 MPH from the southeast.
   Weather conditions on June 15: Air temperature 80° F, wind 9-10 MPH from the northwest.
   Weather conditions on June 20: Air temperature 77° F, wind 4-5 MPH from the northwest.
   Weather conditions on June 24: Air temperature 82° F, wind 1-2 MPH from the southeast.
   Weather conditions on June 30: Air temperature 72° F, wind 3-4 MPH from the southwest.

Table 3. FMC continuous flood - HR

Treatment	Rate (g ai/ha)	Timing[3]	Date 1st	Date 2nd	Date 3rd	Phytotoxicity[1] 1st 7 DAT % Stunting	1st 7 DAT % Stand	1st 7 DAT % Injury	1st 14 DAT % Stunting	1st 14 DAT % Stand	1st 14 DAT % Injury	2nd 7 DAT % Stunting	2nd 7 DAT % Stand	2nd 7 DAT % Injury	2nd 14 DAT % Stunting	2nd 14 DAT % Stand	2nd 14 DAT % Injury	3rd 7 DAT % Stunting	3rd 7 DAT % Stand	3rd 7 DAT % Injury	3rd 14 DAT % Stunting	3rd 14 DAT % Stand	3rd 14 DAT % Injury	Weed Control[2] 22-Jun ECHPH	22-Jun SCPMU	22-Jun CYPDI	22-Jun HETLI	12-Jul ECHPH	12-Jul SCPMU	12-Jul HETLI	12-Jul BAORO	1-Aug ECHPH	1-Aug SCPMU	1-Aug CYPDI	1-Aug HETLI	Plant meas. Yield (lb/A) 17-Oct	Lodging 17-Oct
Untreated[4]	--	--																						8	2	6	20	23	1	19	2	24	1	1	2	3378	88
Cerano fb. Shark H_2O + Londax fb. Stam 4 SC + COC	560 fb. 210 + 70 fb. 4484 + 1.25% v/v	DOS fb. 2 lsr fb. 1-2 Til	2-Jun	14-Jun	30-Jun				0	1	14	1	4	4	0	1	3							70	88	100	100	98	100	100	100	100	100	100	100	9162	83
Cerano fb. Shark H_2O + Londax fb. Shark H_2O + NIS	560 fb. 210 + 70 fb. 112 + 0.25% v/v	DOS fb. 2 lsr fb. 1-2 Til	2-Jun	14-Jun	24-Jun				5	6	14	14	4	4	0	9	3	0	10	7	0	8	0	69	100	100	100	100	100	100	100	97	100	100	100	8889	60
Cerano fb. Shark H_2O fb. Shark H_2O + NIS	560 fb. 210 fb. 112 + 0.25% v/v	DOS fb. 2 lsr fb. 1-2 Til	2-Jun	14-Jun	24-Jun				11	9	5	1	5	5	0	3	6	0	5	9	0	1	0	84	75	100	100	98	100	100	100	100	100	75	100	7293	89
Cerano fb. Shark H_2O 40 DF + Londax fb. Stam 4 SC + COC	673 fb. 196 + 70 fb. 6726 + 1.25% v/v	DOS fb. 2 lsr fb. 23 DAS	2-Jun	14-Jun	30-Jun				0	0	10	15	4	6	0	0	5							81	75	100	100	95	100	100	100	100	100	100	100	8489	65
Cerano fb. Stam 4 SC + COC	560 fb. 4484 + 1.25% v/v	DOS fb. Prior to reflood	2-Jun	30-Jun					0	0	1													63	0	50	62	95	0	40	0	100	0	0	38	8420	13
LSD (P=0.05)																																				1691	37.0

[1] % Stand (Percent stand reduction), % Stunting (Percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad)
LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead)

[3] fb. (followed by), PFS (pre-flood surface), PWE (pre-weed emergence), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species, DAS = days after Shark application

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a continuous flood with 3-4 inches.
3. No weeds visible on June 2.
   Watergrass was 2 leaf, ducksalad and bulrush 2" tall, smallflower 1" tall on June 14.
   Watergrass was 1 tiller, ricefield bulrush was 4-5 leaf, ducksalad was 1 tiller, waterhyssop was 4 leaf on June 24.
   Watergrass was 3 tiller, ricefield bulrush was 4 leaf, ducksalad was 1-2 tiller, waterhyssop was 1-2 tiller on June 30.
4. Weather conditions on June 2: Air temperature 75° F, wind 1-2 MPH from the Southeast.
   Weather conditions on June 14: Air temperature 75° F, wind 1 MPH from the southeast.
   Weather conditions on June 24: Air temperature 82° F, wind 1-2 MPH from the southeast.
   Weather conditions on June 30: Air temperature 72° F, wind 2-4 MPH from the southwest.

Table 4. Cheminova Continuous flood-H.R.

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st						Weed Control[2]										Yield (lb/A)
					% Stand	% Stunting	% Injury	% Stand	% Stunting	% Injury	ECHPH	SCPMU	HETLI	ECHPH	HETLI	ECHPH	SCPMU	CYPDI	HETLI	MOOVA	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			22-Jun			12-Jul		1-Aug					13-Oct
Untreated[4]	--	--									25	7	26	25	29	13	2	2	2	2	5059
Bombard fb. Grandstand + COC	336 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	3-Jun	30-Jun	0	0	3	0	1	1	60	0	55	86	0	74	50	0	0	25	6654
Bombard fb. Grandstand + COC	448 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	3-Jun	30-Jun	0	0	5	0	0	4	53	28	64	94	7	84	33	0	0	75	7596
Bombard fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	3-Jun	30-Jun	0	0	11	0	0	4	40	0	66	99	0	90	0	0	0	100	6396
Bombard fb. Grandstand + COC	1345 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	3-Jun	30-Jun	13	1	21	6	3	44	82	25	98	100	60	96	0	0	0	100	5304
Bombard fb. Grandstand + COC	336 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	13-Jun	30-Jun	6	4	39	0	16	38	42	50	0	82	0	63	0	0	0	10	6862
Bombard fb. Grandstand + COC	448 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	13-Jun	30-Jun	14	5	39	0	18	31	21	50	60	81	15	61	50	38	0	75	6853
Bombard fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	13-Jun	30-Jun	4	3	59	0	3	31	71	53	66	97	0	83	42	13	0	94	6806
Bombard fb. Grandstand + COC	1345 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	13-Jun	30-Jun	13	5	86	0	16	35	100	0	52	100	0	95	0	0	0	100	5045
Cerano fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	3-Jun	30-Jun	0	0	5	1	3	10	69	50	85	100	6	91	0	0	0	100	6787
Cerano fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	13-Jun	30-Jun	9	5	56	0	10	33	44	13	35	91	0	79	0	0	0	92	7072
LSD (P=0.05)																					1465

[1] % Stand (Percent stand reduction), % Stunting (Percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad) LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead)

[3] fb. (followed by), PFS (pre-flood surface), PWE (pre-weed emergence), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 3, 2011 with 120 lbs per acre of M206
2. Trial managed as a continuous flood with 3-4 inches.
3. No weeds visible on June 3.
   Watergrass was 2 leaf, ducksalad and bulrush 2" tall, smallflower 1" tall on June 13.
   Watergrass was 2-3 tillers, ducksalad tillered, bulrush 4 leaf, waterhyssop tillering on July 30.
4. Weather conditions on June 3: Air temperature 58° F, wind 1-2 MPH from the Southeast.
   Weather conditions on June 13: Air temperature 89° F, wind 3-4 MPH from the west.
   Weather conditions on June 30: Air temperature 86° F, wind 2 MPH from the southwest.

Table 5. Gowan/SDS Biotech Cont. flood - H.R.

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st % Stand	Phytotoxicity[1] 1st % Stunting	Phytotoxicity[1] 1st % Injury	Phytotoxicity[1] 1st % Stand	Phytotoxicity[1] 1st % Stunting	Phytotoxicity[1] 1st % Injury	Phytotoxicity[1] 2nd % Stand	Phytotoxicity[1] 2nd % Stunting	Phytotoxicity[1] 2nd % Injury	Phytotoxicity[1] 2nd % Stand	Phytotoxicity[1] 2nd % Stunting	Phytotoxicity[1] 2nd % Injury	Weed Control2 ECHPH	Weed Control2 SCPMU	Weed Control2 CYPDI	Weed Control2 HETLI	Weed Control2 MOOVA	Weed Control2 ECHPH	Weed Control2 SCPMU	Weed Control2 CYPDI	Weed Control2 HETLI	Weed Control2 MOOVA	Plant meas. Yield (lb/A)	Plant meas. Lodging
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			12-Jul					1-Aug					17-Oct	17-Oct
Untreated[4]	--	--															38	2	1	25	6	31	1	1	2	2	3275	84
GWN-9796	300	1 lsr	13-Jun		0	54	38	0	1	13							60	100	100	100	100	40	100	100	100	100	5188	20
GWN-9796 + Sandea	300 + 52.5	1 lsr	13-Jun		0	50	45	0	10	15							85	100	100	100	100	78	100	100	100	100	6394	81
Cerano fb. Stam + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 5-6 lsr	NA	24-Jun							0	0	2	0	0	0	77	100	100	35	80	67	75	50	0	17	6860	36
GWN-9796 fb. Granite GR	300 fb. 40	1 lsr fb. 2-3 lsr	13-Jun	15-Jun	0	70	13	0	6	9	1	10	8	10	10	11	100	100	100	100	100	100	100	100	100	100	8160	45
Cerano + Sandea	673 + 52.5	1 lsr	13-Jun		0	39	43	0	1	10							98	100	100	67	88	90	100	100	75	100	8179	26
Cerano fb. Granite GR	673 fb. 40	1 lsr fb. 2-3 lsr	13-Jun	15-Jun	0	50	40	0	5	14	0	0	25	1	3	23	97	100	100	100	100	100	100	100	100	100	8830	21
LSD (P=0.05)																											1905	46

[1] % Stand (Percent stand reduction), % Stunting (Percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad) LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead)

[3] fb. (followed by), PFS (pre-flood surface), PWE (pre-weed emergence), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a continuous flood with 3-4 inches.
3. Watergrass was 1-2 leaf, ricefield bulrush was 2 " tall, and ducksalad was 2 " tall on June 13.
   Watergrass was 3-4 leaf, ricefield bulrush was 2-3 leaf,smallflower was 1-2 leaf on June 11.
4. Applications made with 10 foot boom with nozzles removed.
5. Weather conditions on June 13: Air temperature 75° F, wind 1 MPH from the South southeast.
   Weather conditions on June 4: Air temperature 75° F, wind 4-6 MPH from the Southeast.
   Weather conditions on June 11: Air temperature 74° F, wind 3-6 MPH from the northwest.

Table 6. Rebel EX pinpoint - H.R.

				Phytotoxicity[1]						% Weed Control[2]										Plant meas.	
Treatement	Rate	Timing[3]	Date	% Stand	% Stunting	% Injury	% Stand	% Stunting	% Injury	ECHPH	LEEFA	SCPMU	HETLI	BAORO	ECHPH	LEEFA	SCPMU	CYPDI	HETLI	Yield (lb/A)	Lodging
	(g ai/ha)			7 DAT			14 DAT			12-Jul					1-Aug					12-Oct	12-Oct
Untreated[4]	---	---								12	10	4	16	7	11	6	1	9	7	6123	25
Clincher CA + Granite SC + COC	280 + 35 + 2.5% v/v	3-4 lsr	20-Jun	0	0	5	0	5	0	96	95	83	100	86	100	83	100	97	98	9336	0
Rebel EX + COC	250 + 35 + 2.5% v/v	3-4 lsr	20-Jun	0	1	5	0	5	0	95	86	92	98	72	90	73	100	88	100	9090	0
Rebel EX + COC	280 + 39 + 2.5% v/v	3-4 lsr	20-Jun	0	1	5	0	8	0	98	98	92	99	82	100	80	100	100	98	9183	0
Rebel EX + COC	310 + 43.8 + 2.5% v/v	3-4 lsr	20-Jun	0	0	4	0	4	0	100	95	100	98	80	88	83	100	98	100	9179	0
Clincher CA + Granite SC + COC	315 + 35 + 2.5% v/v	5-6 lsr	24-Jun	1	3	0	1	0	0	100	100	100	70	66	100	100	100	87	88	9455	0
Rebel EX + COC	250 + 35 + 2.5% v/v	5-6 lsr	24-Jun	0	5	1	0	1	0	100	95	100	99	83	90	93	100	98	75	9291	0
Rebel EX + COC	280 + 39 + 2.5% v/v	5-6 lsr	24-Jun	13	4	0	4	4	0	100	100	92	99	73	90	100	100	88	100	9515	0
Rebel EX + COC	310 + 43.8 + 2.5% v/v	5-6 lsr	24-Jun	6	4	1	0	3	0	98	98	92	100	83	92	100	100	88	100	9544	0
Rebel EX + Grandstand + COC	280 + 39 + 105 + 2.5% v/v	5-6 lsr	24-Jun	0	1	0	0	1	0	100	96	92	99	76	100	95	75	86	97	9247	0
Rebel EX + Ultra Stam + COC	280 + 39 + 5381 + 2.5% v/v	5-6 lsr	24-Jun	3	3	0	3	0	3	98	100	100	78	71	72	90	100	98	88	9183	0
LSD (P=0.05)																				1017	17

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead); MOOVA (Monochoria)

[3] fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice), DPRE (pre emergent), EPE (early post emergent), PPF (post permanent flood).

[4] Control weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a pinpoint flood. Water drained June 13 and reflood on June 22.
   Water drained June 24 for 70% exposure of weeds, reflood June 26.
3. Watergrass was 3-4 leaf, ricefield bulrush was 2-3 leaf, smallflower 2 leaf, ducksalad was 2 leaf on June 20.
   Watergrass was 1 tiller, ricefield bulrush was 4 leaf, smallflower was 3", ducksalad was 3 leaf, waterhyssop was 4 leaf on June 24.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June20: Air temperature 77° F, wind 4-5 MPH from the northwest.
   Weather conditions on June24: Air temperature 82° F, wind 1-2 MPH from the southeast.

Table 7. Granite/Clincher tankmix interaction H.R.

Treatement	Rate	Timing[3]	Date	Phytotoxicity[1] % Stand	% Stunting	% Injury	% Stand	% Stunting	% Injury	% Weed Control[2] ECHPH	LEEFA	HETLI	ECHPH	LEEFA	CYPDI	HETLI	Yield (lb/A)
	(g ai/ha)			7 DAT			14 DAT			9-Jul			1-Aug				12-Oct
Untreated[4]	---	---								7	4	15	7	4	2	7	5978
Granite SC + COC	9 + 2.5% v/v	3-4 lsr	25-Jun	3	4	0	0	3	0	73	33	78	72	28	26	0	8298
Granite SC + COC	18 + 2.5% v/v	3-4 lsr	25-Jun	3	3	0	0	4	0	94	46	98	93	33	89	100	9179
Granite SC + COC	36 + 2.5% v/v	3-4 lsr	25-Jun	3	4	0	0	0	0	96	59	100	100	38	100	100	9420
Clincher + COC	79 + 2.5% v/v	3-4 lsr	25-Jun	0	3	0	0	0	0	65	74	0	76	85	0	0	8148
Clincher + COC	158 + 2.5% v/v	3-4 lsr	25-Jun	0	1	0	0	0	0	88	83	0	87	87	0	0	7663
Clincher + COC	316 + 2.5% v/v	3-4 lsr	25-Jun	1	3	0	0	0	0	96	100	30	100	92	0	0	8323
Granite SC + Clincher + COC	9 + 79 + 2.5% v/v	3-4 lsr	25-Jun	0	3	0	0	8	0	75	82	97	72	79	1	97	8806
Granite SC + Clincher + COC	9 + 158 + 2.5% v/v	3-4 lsr	25-Jun	1	3	0	0	1	0	71	92	98	78	100	0	61	8886
Granite SC + Clincher + COC	9 + 316 + 2.5% v/v	3-4 lsr	25-Jun	0	3	0	0	4	0	92	98	72	97	100	0	0	8877
Granite SC + Clincher + COC	18 + 79 + 2.5% v/v	3-4 lsr	25-Jun	1	14	0	0	0	0	74	54	45	82	89	27	75	8606
Granite SC + Clincher + COC	18 + 158 + 2.5% v/v	3-4 lsr	25-Jun	1	0	0	0	1	0	96	93	100	95	95	63	100	9399
Granite SC + Clincher + COC	18 + 316 + 2.5% v/v	3-4 lsr	25-Jun	0	3	0	0	5	1	91	93	100	91	98	0	100	9010
Granite SC + Clincher + COC	36 + 79 + 2.5% v/v	3-4 lsr	25-Jun	0	1	0	0	4	0	98	83	100	100	69	66	100	9411
Granite SC + Clincher + COC	36 + 158 + 2.5% v/v	3-4 lsr	25-Jun	3	4	0	0	3	0	96	100	100	100	87	71	100	9678
Granite SC + Clincher + COC	36 + 316 + 2.5% v/v	3-4 lsr	25-Jun	0	1	0	0	9	0	93	100	100	99	100	71	100	9674
LSD (P=0.05)																	797

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead); MOOVA (Monochoria)

[3] fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice), DPRE (pre emergent), EPE (early post emergent), PPF (post permanent flood).

[4] Control weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a pinpoint flood. Water drained June 13 and reflood on June 27.
3. Watergrass was 3 leaf, ricefield bulrush was 2-4 leaf, smallflower 3 leaf, ducksalad was 1 tiller on June 24.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June24: Air temperature 69° F, wind 2-3 MPH from the southeast.

Table 8. Leathers Trial H.R.

					Phytotoxicity[1]						Weed Control[2]								
					1st														
Treatment	Rate	Timing[3]	Date 1st	Date 2nd	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	LEEFA	SCPMU	HETLI	ECHPH	LEEFA	CYPDI	HETLI	Yield (lb/A)
	(g ai/ha)				7 DAT			14 DAT			12-Jul				1-Aug				12-Oct
Untreated[4]											9	12	5	9	8	9	2	6	7303
Clincher + Granite SC + COC fb. SuperWham + COC	280 + 35 + 2.5% v/v fb. 6726 + 2.5% v/v	2-3 lsr fb. 1-2 Til	17-Jun	30-Jun	0	1	0	3	9	3	66	83	100	73	94	82	33	83	9297
Super Wham + COC	6726 + 1.25% v/v	1 Til	30-Jun								70	52	90	0	63	18	0	3	8159
Granite SC + COC	35 + 2.5% v/v	2-3 lsr	17-Jun		0	4	1	0	5	1	80	5	90	100	100	4	25	100	8904
Clincher + COC	315 + 2.5% v/v	2-3 lsr	17-Jun		0	3	0	0	1	0	83	100	15	15	88	94	0	0	9126
Clincher + COC fb. Ultra Stam 80 EDF + COC	315 + 2.5% v/v fb. 6726 + 2.5% v/v	2-3 lsr fb. 1-2 Til	17-Jun	30-Jun	0	0	1	0	0	0	70	100	95	0	83	100	0	9	9048
Super Wham + Clincher + COC	4484 + 315 + 2.5% v/v	2-3 lsr	17-Jun		1	1	1	0	3	0	68	96	79	78	95	90	75	68	9557
Regiment + NIS fb. Super Wham + COC	30 + .125% v/v fb. 6726 + 1.25% v/v	2-3 lsr fb. 1-2 Til	17-Jun	30-Jun	5	8	0	6	6	8	73	61	65	63	89	23	0	55	8620
Regiment + Abolish	30 + 3363	2-3 lsr	17-Jun		1	4	0	3	4	0	65	66	80	33	69	59	0	28	9260
LSD (P=0.05)																			803

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead), MOOVA (Monochoria)

[3] PFS (pre-flood surface), PPI (pre-plant incorporated), fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a Leathers method with flood water drained June 10, reflood June 20.
3. Watergrass was 2-3 leaf, sprangletop was 1-2 leaf, smallflower was sprouted on June 17.
   Watergrass was 2-3 tiller, ricefield bulrush was 4 leaf, smallflower was 3 leaf, ducksalad was tillering, waterhyssop was tillering on June 30.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 17: Air temperature 73° F, wind 2-3 MPH from the northeast.
   Weather conditions on June 30: Air temperature 72° F, wind 3-4 MPH from the southwest.

Table 9. Wilbur-Ellis Leathers trial at HR

Treatment	Rate	Timing[3]	Application date		Phytotoxicity[1] 1st						Weed Control[2]												Plant meas.	
					% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	LEEFA	SCPMU	HETLI	ECHPH	LEEFA	SCPMU	HETLI	ECHPH	SCPMU	HETLI	MOOVA	Yield (lb/A)	Lodging
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			22-Jun				12-Jul				1-Aug				13-Oct	13-Oct
Untreated[4]	---	---									14	4	5	8	30	3	5	12	23	1	1	1	4395	52
Cerano fb. Superwham + COC	673 fb. 6726 + 1.25% v/v +/- 210	Post re-flood fb. 1Til	13-Jun	30-Jun	0	0	8	0	6	4	40	92	65	69	87	75	100	60	91	50	0	100	7902	15
Cerano fb. Superwham + COC	448 fb. 6726 + 1.25% v/v +/- 210	Post re-flood fb. 1Til	13-Jun	30-Jun	0	0	4	0	6	3	64	73	56	35	80	58	65	42	82	50	0	75	8037	13
Cerano fb. Superwham + COC	336 fb. 6726 + 1.25% v/v +/- 210	Post re-flood fb. 1Til	13-Jun	30-Jun	0	0	4	0	4	4	55	83	73	30	78	75	70	53	86	50	0	13	7807	19
Cerano + Strada	448 + 74.5	Post re-flood	13-Jun		0	3	6	0	5	6	79	100	75	78	60	75	40	85	31	75	38	38	7127	25
Cerano + Strada	560 + 74.5	Post re-flood	13-Jun		0	1	24	0	5	4	75	67	70	78	72	71	90	98	52	75	25	63	7009	43
Cerano + Granite	448 + 40	Post re-flood	13-Jun		1	3	10	1	1	8	95	100	100	95	98	100	100	100	100	100	100	100	8144	45
LSD (P=0.05)																							1389	42

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead); MOOVA (Monochoria)

[3] PFS (pre-flood surface), PPI (pre-plant incorporated), fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice).

[4] Untreated weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 120 lbs per acre of M206
2. Trial managed as a delyed Leathers. Water drained June 7 and reflood on June 10.
3. Watergrass was 1-2 leaf, sprangletop was 1 leaf, ricefield bulrush and smallflower were sprouted on June 13.
   Watergrass was 3 tiller, bulrush was 4 leaf, smallflower was 3 leaf, ducksalad was tillered, waterhyssop was tillered on June 30.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 13: Air temperature 89° F, wind 1-2 MPH from the southwest.
   Weather conditions on June 30: Air temperature 86° F, wind 1-2 MPH from the southwest.

Table 10. Drill seeded trial H.R.

					Phytotoxicity[1]												Weed Control[2]											
					1st						2nd																	
Treatment	**Rate**	**Timing[3]**	**Date**		% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	ECHPH	LEEFA	ECHPH	LEFFA	CYPDI	HETLI	ECHPH	ECHOR	LEFFA	CYPDI	HETLI	Yield (lb/A)
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			22-Jun		12-Jul				1-Aug					12-Oct
Untreated[4]	---	---															16	3	11	19	10	4	3	15	11	2	1	5493
Prowl H2O	1120	DPRE	9-Jun														12	21	24	63	30	90	0	2	80	0	100	6723
Prowl H2O fb. Super Wham + COC	1120 fb. 4480 + 1.25 % v/v	DPRE fb. 3-4 lsr	9-Jun	19-Jun							0	4	0	0	6	0	80	100	100	43	55	0	83	100	39	0	50	8147
Prowl H2O	1120	2-3 lsr (AFF)	15-Jun		0	0	0	0	0	0							0	58	38	51	80	75	0	0	67	50	100	6445
Prowl H2O + Super Wham + Clincher + COC	1120 + 4484 + 280 + 1.25 % v/v	2-3 lsr (AFF)	15-Jun		3	5	70	4	4	0							96	100	100	82	55	15	95	98	74	13	0	9032
LSD (P=0.05)																												1591

[1] % Stand (percent stand reduction), % Stunting (percent stunting of rice), % Injury (percent injury to rice)

[2] ECHPH (Late watergrass), SCPMU (Rice field bulrush), CYPDI (Small flower Umbrellaplant), HETLI (Duck salad), LEFFA (Sprangletop), BAORO (Waterhyssop), AMMCO (Redstem), SAGMO (California arrowhead)

[3] fb. (followed by), lsr (leaf stage of rice), Til (tillers of rice), DPRE (pre emergent), EPE (early post emergent), AFF (after final flush), PPF (post permanent flood).

[4] Untreated weed control values represent % cover by the respective weed species

Trial Information

1. Trial seeded June 2, 2011 with 100 lbs per acre of M206
2. Trial managed as a drill seeded with initial flush on June 2, additional flushes on June 13, with final flood on June 21.
3. Watergrass was 1 leaf on June 9.
   Watergrass was 2-3 leaf, sprangletop was 1 leaf on June 15.
   Watergrass was 3-4 leaf, and smallflower was 2 leaf on June 19.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 9: Air temperature 77° F, wind 4-5 MPH from the southwest.
   Weather conditions on June 15: Air temperature 80° F, wind 8-10 MPH from the northwest.
   Weather conditions on June 19: Air temperature 92° F, wind 0-1 MPH from the northwest.