COMPREHENSIVE RICE RESEARCH

ANNUAL REPORT
(January 1, 2010 - December 31, 2010)

PROJECT TITLE: Weed Control in Rice

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LEVEL OF 2010 FUNDING: **$**137,162.04

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 4, while planting at the RES occurred May 12 and June 3. 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 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. 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 to recover 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

2010. 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.

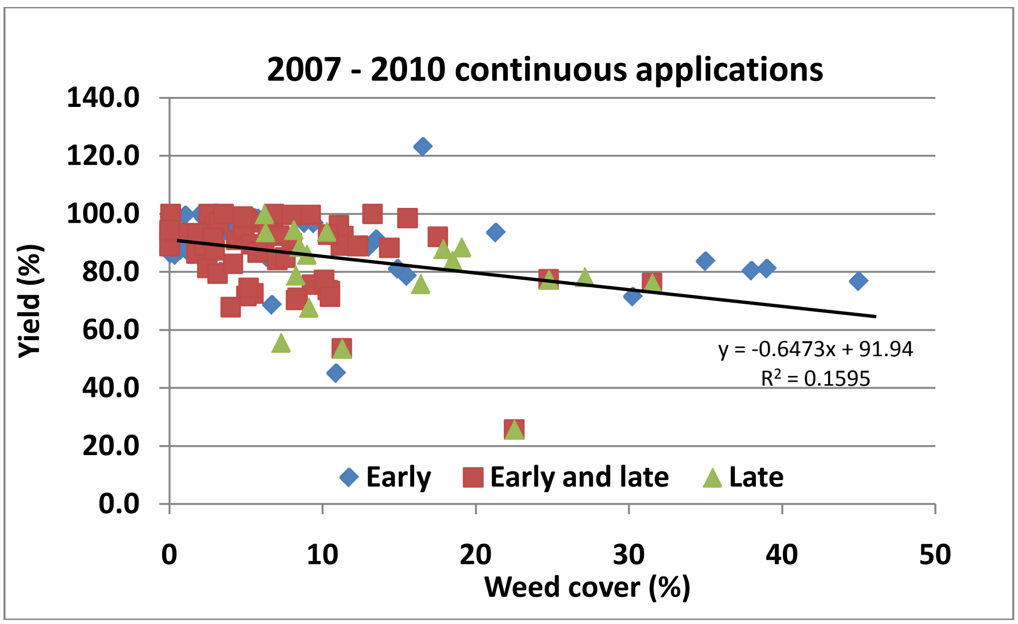

Figure 1. Weed competition in continuously flooded rice: Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation); evaluations of weed infestation were conducted 40 days after seeding rice. Data are combined for the 2007 through 2010 continuously 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

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[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, or Bolero Ultramax/Abolish for watergrass and sedge control followed by an application of either Shark, Londax, propanil (Ultra Stam, Ultra Stam 4SC, Super Wham, Rice Shot), Regiment, Sandea or Strada at various timings (Tables 2-4,) to control later-emerging broadleaves, sedges, watergrass plants or weed plants missed by the early treatment. Granite GR and Strada GR are recently available granular herbicides that were tested alongside other standard herbicides used by growers (Table 4). One additional continuously flooded trial was located in a field with ALS-resistant smallflower umbrellasedge (Table 5). Rice yields for most of the herbicide treatments were not statistically different. Treatments discussed below are from individually leveed plots (Tables 2-4).

A couple of herbicide programs provided early and sustained weed control. They were: Cerano (673 g ai/ha at DOS) followed by Granite GR [40 g ai/ha at the 2-3 leaf stage of rice (lsr)] and 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) (Table 2). An additional early treatment combination with sustained weed control was Cerano (673 g ai/ha at DOS) followed by Shark and Londax (224 g ai/ha and 70 g ai/ha, respectively applied separately at 2-4 lsr) followed by Ultra Stam 4SC (6726 g ai/ha + 1.25% v/v COC applied at the 1-3 tiller stage of rice), although this is likely a very expensive combination (Tables 3 and 5). Cerano (673 g ai/ha at DOS) generally provides good to excellent control of grasses. A follow up treatment of Sandea (35 g ai/ha at 2-3 lsr) added ricefield bulrush control and improved watergrass control (Table 2). Bolero Ultramax (4480 g ai/ha at 2lsr) followed by either Super Wham (6726 g ai/ha + 1.25% v/v COC) or Regiment (30 g ai/ha + 0.25% v/v NIS) applied at the 1-3 tiller stage of rice provided broad spectrum weed control. Shark (224 g ai/ha applied at 2-3 lsr) followed by Super Wham (6726 g ai/ha + 1.25% v/v COC applied at the 1-3 tiller stage of rice) had broad spectrum control as did Super Wham (6726 g ai/ha) plus Grandstand (420 g ai/ha) or 2,4-D (123 g ai/ha).

Some of the best yielding treatments in the continuously flooded system at Hamilton Rd (Table 2) icluded Cerano (12lb/a at DOS) followed by one of the propanil formulations (6726 g ai/ha + 1.25% v/v COC applied at the 1-3 tiller stage of rice). These treatments had good early control of watergrass and the later season application of propanil generally provided good control of sedge and broadleaf weeds. Other high yielding treatments included Cerano (673 g ai/ha at DOS) followed by Strada GR (74.5g ai/ha at 1-2 lsr) followed by Stam 80EDF (6726 g ai/ha + 1.25% v/v COC applied at the 1-3 tiller stage of rice), Abolish (4480 g ai/ha applied as a pre-flood surface treatment) followed by Super Wham (6726 g ai/ha applied at the 1-3 tiller stage of rice) and Cerano (673 g ai/ha at DOS) followed by Sandea (35 g ai/ha at 2-3 lsr). As noted above, Shark (8oz/a applied at 2-3 lsr) followed by Super Wham (6726 g ai/ha + 1.25% v/v COC applied at the 1-3 tiller stage of rice) provided good control of most weeds, but the late and incomplete watergrass control is probably associated to the significantly reduced yield for this treatment, since watergrass is the most competitive weed in this experiment. Other treatments with low yields were Super Wham (6726 g ai/ha) plus Grandstand (420 g ai/ha) applied at the 1 tiller stage of rice (in spite of good weed control values by 40 DAS, watergrass control in this treatment was probably a bit delayed) and Cerano applied alone (673 g ai/ha at DOS), since sedges and broadleaves were not controlled. The tank mix of Super Wham and Grandstand caused mild stunting of rice (Table 2).

In a separate continuously flooded trial, different formulations of Strada were tested for efficacy following treatment with Cerano (673 g ai/ha at DOS) (Table 4). Strada GR (granular) formulation is generally applied into the water at the 1 lsr. Compared to this, was the Strada CA (ex WG, wettable granule) formulation applied (spread) dry or as a spray over the surface of the plots. The three Strada treatments had similar weed control efficacy. The yield of the GR formulation was the highest followed by the foliar Strada CA spray application and by the dry Strada CA application. However, the differences were not statistically significant.

We also tested the new clomazone formulation Bombard, which is a prilled, instead of an extruded, granule (Cerano). Effects on rice and efficacy on grasses appear to be the same as with Cerano. Yields of field rate treatments were not statistically different for the two formulations of clomazone (Table 6).

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 (Table 7). Excellent overall treatments in this non-resistant site were Regiment plus Abolish (30 g ai/ha plus 3363 g ai/ha at the 3-4 lsr); a tank mix of Granite SC and Clincher (35 g ai/ha + 280 g ai/ha, respectively at the 3-4 lsr) followed by either Ultra Stam 4SC or Super Wham (6726 g ai/ha + 2.5% v/v COC at the 1-2 tiller stage of rice); Granite SC (35 g ai/ha + 2.5% v/v COC) applied alone at the 3-4 lsr; Regiment (30 g ai/ha + 0.125% v/v NIS) applied alone at 3-4 lsr or followed by Super Wham (6726 g ai/ha + 1.25% v/v COC) applied at the 1-2 tiller stage of rice (Table 7), although neither of these last two treatments can control sprangletop. Broad spectrum control was achieved with either of the different propanil formulations Ultra Stam 4SC (6726 g ai/ha + 1.25% v/v COC), Ultra Stam 80 EDF (4484 g ai/ha +1.25% v/v COC), Super Wham (6726 g ai/ha + 1.25% v/v COC), or Rice Shot (4484 g ai/ha + 1.25% v/v COC) applied at the 1 tiller stage of rice, although weed control was lower than achieved with earlier-applied treatments due to early weed emergence. Granite SC tank mixed with Ultra Stam 80 EDF (35 g ai/ha + 6726 g ai/ha + 2.5% v/v COC, 3-4 lsr) followed by Clincher (315 g ai/ha + 2.5% v/v COC, 1-2 tiller stage of rice) provided good general weed control. Clincher (315 g ai/ha at 3-4 lsr) followed by Ultra Stam 80EDF (6726 g ai/ha at 1-3 tiller) also provided good control and respectable yield, consistently with the good performance of this sequence over the years. The addition of Clincher (315 g ai/ha) to Super Wham (4484 g ai/ha) in tank mix applied at the 3-4 leaf stage of rice gave excellent watergrass control with activity on ricefield bulrush and sprangletop; however, occasional antagonistic effects on grass control has been observed with this mixture in the past. Treatments that did not include Clincher as an early application had little or no control of sprangletop.

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.

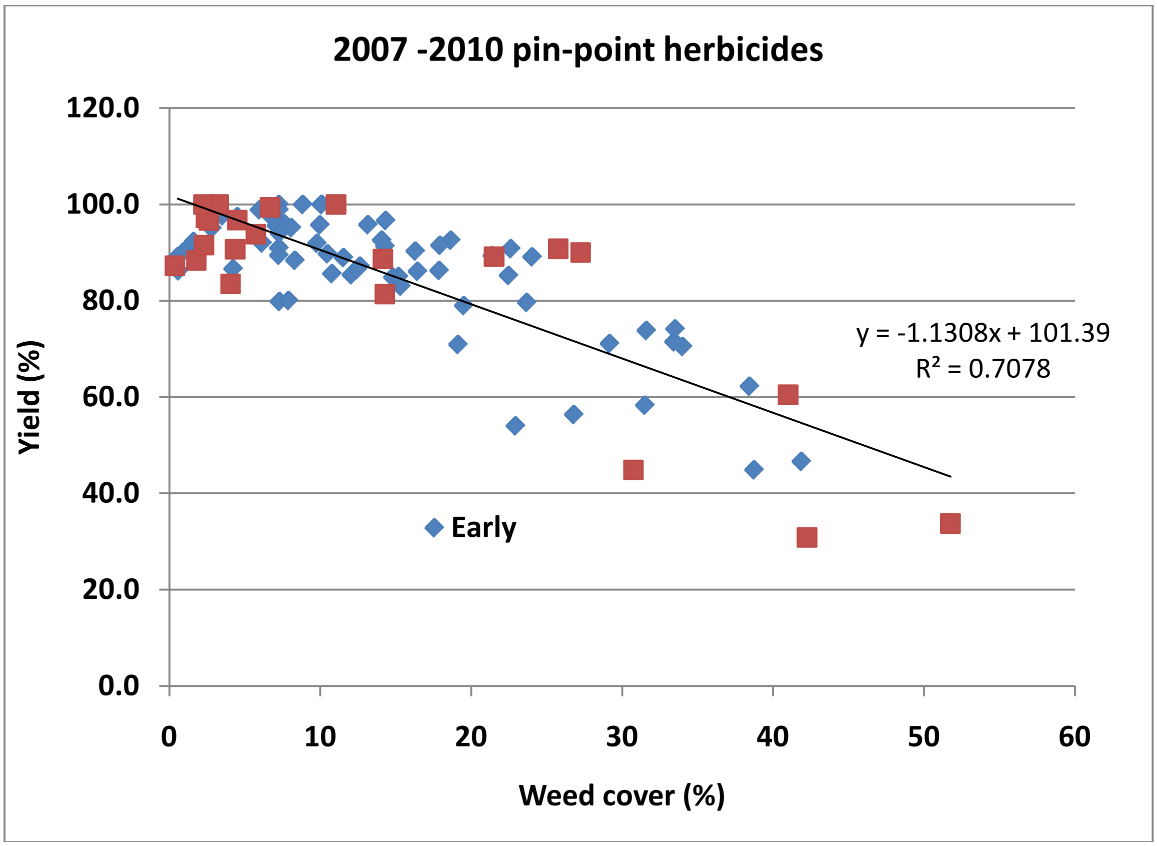

Figure 2. Weed competition in pin-point flooded rice: Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation); evaluations of weed infestation were conducted 40 days after seeding rice. Data are combined for the 2007 through 2010 pinpoint 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 9).

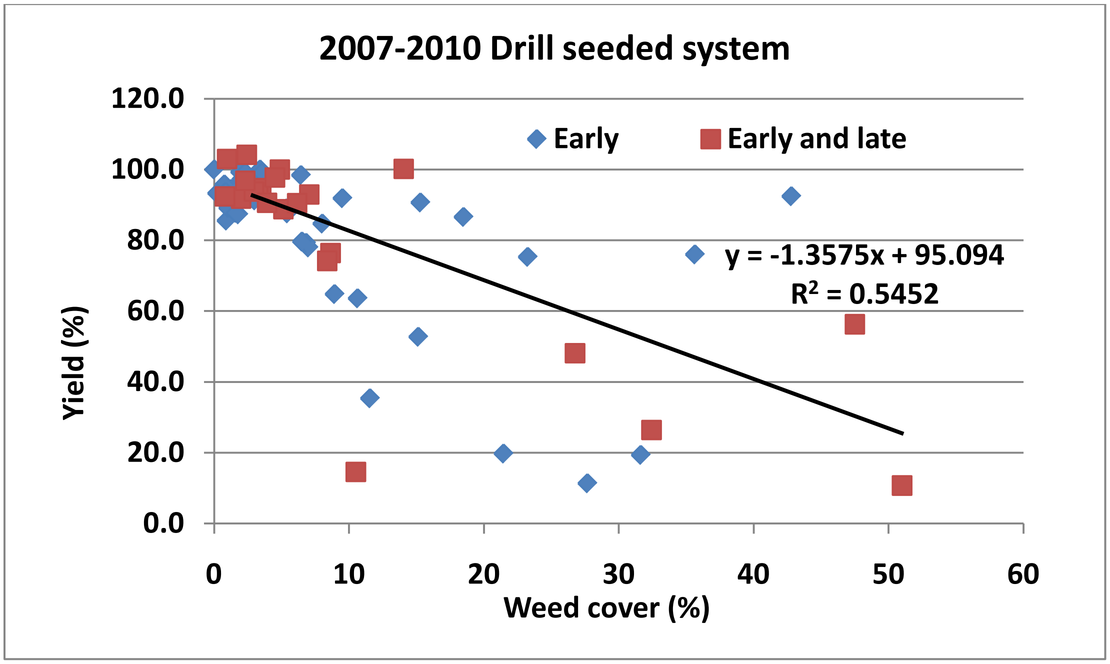

Figure 3. Weed competition in drill seeded rice; evaluations of weed infestation were conducted 40 days after seeding rice. Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation). Data are combined for the 2007 through 2010 drill seeded experiments 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 Granite SC plus Prowl H_2O plus Clincher (35 g ai/ha plus 1120 g ai/ha plus 315 g ai/ha, respectively with 2.5% v/v COC) applied at the 2-3 lsr (Table 9). This is the second year that this three way tank mix has had the best broad spectrum weed control. Other good treatments were: a three way mix of Prowl H_2O, Super Wham and Clincher (1120 g ai/ha + 4484 g ai/ha + 280 g ai/ha, respectively with 1.25% v/v COC, applied at the 2-3 lsr after the final irrigation flush); Regiment plus Abolish (25 g ai/ha + 3360 g ai/ha, 2-3 lsr) followed by Super Wham plus Clincher (6726 g ai/ha + 315 g ai/ha, post permanent flood); Granite SC (35 g ai/ha + 2.5% v/v COC, applied at 2-3 lsr) followed by Clincher (315 g ai/ha + 2.5% v/v/COC, post permanent flood); Granite SC tank mixed with Clincher (35 g ai/ha + 315 g ai/ha, respectively with 2.5% v/v COC) at 2-3lsr followed by Super Wham (6726 g ai/ha + 1.25% v/v COC) post permanent flood; Clincher (280 g ai/ha + 2.5% COC, 2-3 lsr) followed by Super Wham (4484 g ai/ha + 1.25% COC; after final flush). All of the above mentioned treatments were not statistically different from each other for yield.

Prowl H_2O (1120 g ai/ha) applied alone at either delayed pre-emergent (DPRE) or 2-3 lsr provides about 50% watergrass control by 40 days after seeding and is thus an excellent partner for tank mix or early follow-up foliar applications. A successful program in this system should aim at good weed control prior permanent flood and then at maintaining consistent flooding thereafter (Figure 4).

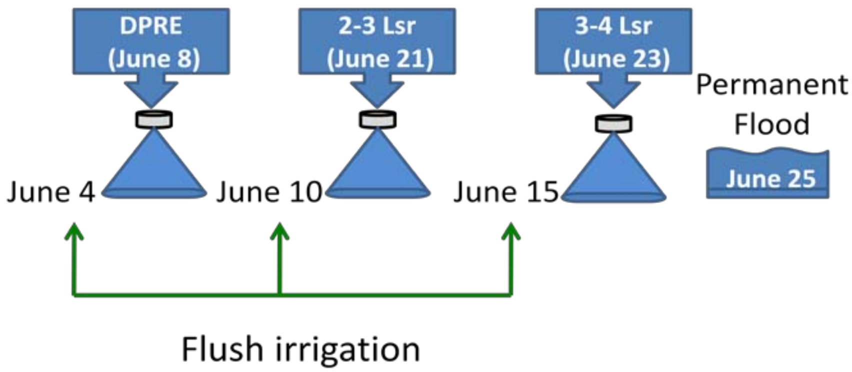

Figure 4. Possible pre-flood timings for herbicide applications in drill-seeded rice. Dates correspond to applications in 2010 following the June 2 seeding of 'M-206' rice (DPRE = delayed premergence; lsr = leaf stage of rice).

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 30. Flood water was lowered July 22 for follow up herbicide applications made on July 23. The glyphosate treatments wiped out the watergrass and provided good smallflower control, which was not yet fully emerged. But bulrush germinated and established after the glyphosate treatment when sufficiently aquatic conditions prevailed after the permanent flood was imposed (Table 10). Follow-up herbicides were needed to control bulrush and improve control of the smallflower that germinated after the glyphosate treatment. Yields were generally low due to the late planting.

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 and June 30 in 2010. The trials were run with 5 replications. Prior to seeding, the field was subjected to the stale seedbed treatment in order to control weed intererence using glyphosate. 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 the 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.

All the varieties responded similarly to the herbicides (no herbicide by variety interaction) in both systems and years. No herbicide injury, stand loss, delay in heading, nor yield reductions were observed for both herbicides and rates tested in the pin-point system (Table 11). Effects in the continuously flooded system were variable with year and herbicide. However, it can be concluded that injury to rice can occur with Cerano and Granite applied into the water when rates are doubled, as it would occur in areas of application band overlap (Table 12). In 2009, the double rate of Cerano caused severe stand reduction, growth inhibition, stunting and heading delay, which significantly reduced yield. In 2010, injury and stand reduction were also observed, but the crop recovered and yields were not affected. Stand reduction with Cerano was also observed with the commercial rate in 2009. Granite stunted rice with both rates in 2010 and lowered the stand in 2009. These effects did not affect yields. Given the variation in effects observed across years, we will conduct the experiments again and seek a timelier seeding.

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 4th with 120lb M-206 seed. Water was drained June 16th in preparation for foliar applications of treatments on June 24th (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 2 leaf. Weed coverage at treatment was 24% watergrass, 2% sprangletop and 9% sedges. Flood water was re-established June 26th. Visual evaluations of weed control were made on July 20th and harvest was October 13th.

When Clincher and Granite SC were mixed, the best weed control and best yield was obtained with full field rates of both herbicides (Table 8). When a low rate of Clincher is added to any concentration of Granite SC, there is a reduction in sprangletop and watergrass control. When both herbicides are used in mixture, this antagonism is partially overcome by using the highest rates of Clincher and Granite. The antagonism with Clincher/Granite mixtures was further corroborated with a Colby (1967) analysis[2]. Given the broad spectrum control achieved by the mixtures, yields were not impacted by antagonism in weed control. However the Colby analysis suggests that greater and more economical weed control would be achieved if both herbicides had been used in sequence rather than in mixture. 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.*

Prowl H_2O (pendimethalin)

Prowl H_2O is a selective herbicide for controlling annual grass (watergrass, barnyardgrass, sprangletop) and certain broadleaf weeds (smallflower umbrellasedge) as they germinate and emerge. As a meristematic inhibitor, it interferes with the plant's cellular division and early growth. Prowl H_2O has substituted Prowl EC on the supplemental label for drilled and dry seeded rice in California. Prowl H_2O is a recently released water based capsule suspension (CS) formulation. Wet/dry cycles cause the capsule wall to rupture and release the pendimethalin. Prowl H_2O needs to be applied to moist soil without any standing water. Flooding causes the chemical to degrade and

[2] Colby, S.R. 1967. Calculating Synergistic and Antagonistic Responses of Herbicide Combinations. Weeds 15:20-22.

loose efficacy; also volatility losses are more rapid when this herbicide is applied to wet soil surfaces. Prowl H_2O was tested in a drill seeded rice culture at the RES (Table 9). Prowl H_2O applied alone (1120 g ai/ha) as delayed pre-emergent (DPRE) provided 49% watergrass/barnyardgrass control by 40 DAS, but this dropped to 25% by 60 DAS, while sprangletop control at this later observation was 75%. Watergrass control was greatly improved when Prowl H_2O DPRE was followed by Super Wham (4484 g ai/ha) at the 3-4 lsr. Although Prowl H_2O does not have post-emergence activity, when it was applied at the 2-3 lsr provided this season similar control to the DPRE application, suggesting the small emerged plants were taken it up via roots. However, best performance with this compound is obtained when applied prior to weed emergence. When weeds were already emerging at the time of application, a tank mixture of Prowl H_2O, Clincher (315 g ai/ha) and Super Wham (4480 g ai/ha) improved control and yield (Table 9). The combination of Granite SC, Prowl H20, and Clincher (35, 1120 and 315 g ai/ha, respectively) applied at the 2-3 leaf stage of rice provided outstanding grass control, although yields were no better than other less elaborate treatments.

Strada CA (orthosulfamuron, water-dispersible granule)

Orthosulfamuron is an ALS inhibitor for broad-spectrum activity on susceptible watergrass and smallflower umbrellasedge, and other sedges and broadleaf weeds. It has shown very little phytotoxicity to rice at all stages of growth. We have been testing a CA (wettable granule) formulation for pinpoint applications and a GR (granule for spreading) for into the water treatments in continuously flooded rice culture. Both formulations appear to be very safe on rice (Tables 2 and 4). Londax-resistant smallflower umbrellasedge is usually resistant to this herbicide.

This experiment was conducted to assess if the CA formulation could replace the GR formulation in order to reduce costs. Strada CA was tested as a dry application or as a foliar spray application dribbled over the flooded plots timed and compared to the Strada GR formulation. All treatments followed a standard treatment of Cerano (Table 4). Overall, weed control and yield were best with the GR formulation although the yield was not statistically superior. The CA formulation is unlikely to get labeling for either of the above mentioned application methods, and continue to be available for use as a foliar spray. Strada CA was also applied at the 5-6 lsr timing in tank mix with Ultra Stam. This treatment had less control of weeds and lower yield than the above mentioned treatments; Strada needs to be applied early onto smaller weeds for effectiveness.

Strada GR (granular formulation)

Strada GR was tested in a continuously flooded experiment (Table 2). Excellent weed control was achieved when Cerano (473 g ai/ha, DOS) was followed by an early application of Strada GR (74.5 g ai/ha, 1-3 leaf sedge) which could then be followed by Stam (6726 g ai/ha, 1 Till). These treatments provided better weed control than Cerano (673 g ai/ha, DOS) followed by Stam (6726 g ai/ha) although yields were statistically similar.

Granite GR (penoxsulam, granular formulation) alone and in combinations

Granite GR is also an ALS inhibiting, post-flood, post-emergence herbicide for selective control of susceptible watergrass/barnyardgrass (not active on sprangletop), broadleaf and sedge weeds. The granular formulation, Granite GR, was first available commercially during the 2005 season. This product was applied into the water at 40 g ai/ha 14 days after seeding. It was tested in combination with a follow-up application of Ultra Stam 4 SC (6726 g ai/ha, 1 Tiller) and as a follow-up to Cerano (673 g ai/ha, DOS). Both of these treatments had excellent broad-spectrum (watergrass, smallflower umbrellasedge, ricefield bulrush, and ducksalad/monochoria) weed control. However, yield tended to be lower (although not statistically different) than other treatments that provided less weed control ((Table 2). The cool season may have impacted yield of these treatments more than has been noted in the past.

Granite SC (penoxsulam, suspension concentrate formulation) alone and in combinations

Granite SC is a fluid formulation of penoxsulam for foliar application. It has been labeled for California since 2006. It was tested mixed with 2.5% crop oil concentrate in a pin-point flood trial where flood water was dropped for an application at the 3-4 lsr (Table 7). All treatments that included Granite SC had excellent weed control and were among the highest yielding.

Ultra Stam 4SC (propanil)

Ultra Stam 4SC is a liquid suspension of propanil that is owned by UPI (United Phosphorus Inc.) and was available in 2008 in limited supply as Stam 4SC. It was tested in both our continuously flooded experiment and in the pin-point system. In the continuously flooded experiment, Ultra Stam 4SC was applied alone following Cerano for direct comparison with Cerano followed by Super Wham (Table 2). Weed control and yield were better this year with Ultra Stam 4SC than with Super Wham. Ultra Stam 4SC was also tested in tank mix with Londax with similar results, but with better ricefield bulrush control by 40 DAS. In the pin-point trial, (Table 7) Ultra Stam 4SC performed similar to other propanil formulations.

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 6). The best results were obtained when the commercial rate of clomazone was applied at the one-leaf stage of the watergrass, rather than at the day of seeding (DOS) rice.

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:

We implemented the stale seedbed concept to control severe infestations of herbicide-resistant late watergrass ("mimic") in a cooperating grower's farm in Glenn County. This work was part of a larger endeavor initiated back in 2009 in a collaborative effort with Dr. Bruce Lindquist and the rice Farm Advisors where certain alternative stand establishment techniques developed over a five-year period at the Rice Experiment Station were implemented in grower fields around the valley. The field was spring tilled then flushed on May 5th and treated with glyphosate on May 25th. Although the field has been known to have heavy infestations of resistant late watergrass, no watergrass germinated during the stale seedbed treatment in the peculiar cool spring conditions of this year. The field was flooded on June 2nd and seeded with 180lb of 'M-104' on June 5th. Two top dress applications of ammonium sulfate were made during the season. Granite SC was applied at 35 g ai/ha for control of later emerging weeds. Since there was not a stand of watergrass this season, the individual herbicide test plots were abandoned prior to harvest.

The field that had been used for stale seedbed experiments during the past two years (see 2008 and 2009 Reports) was reverted back to a conventional system this season. Weed pressure appeared to be lower where stale seedbed treatments had been implemented for one or two seasons before. Quadrat sampling (weed counts within 1 square foot) show a dramatic reduction of watergrass emergence when one year of stale seedbed had been implemented. Even lower weed emergence was observed when two consecutive years of this technique had been implemented compared to an adjoining conventional field. Average watergrass plants from the conventionally farmed area was 11, while there were 3 from the single year of stale seedbed and only 1 from the area where stale seedbed was implemented for two consecutive seasons.

A neighboring grower decided to try the stale seedbed on a couple of his fields where herbicide-resistant late watergrass has been a problem in the past. He flooded his fields on May 16th for the stale seedbed weed establishment. A good stand of watergrass emerged onto which glyphosate was applied June 8th; the field was flooded and subsequently seeded on June 12th. The insecticide Warrior was applied on June 15th and a tank mix of Super Wham and Grandstand (6qt/a + 4oz/a, respectively) was sprayed on July 7th for late-emerging weeds. Harvest was conducted in October 26th with average paddy yield of 81 cwt (14%). The grower will consider using the stale seedbed establishment technique in the future for reducing heavy late watergrass seedbanks.

3.2. Predicting germination of *Echinochloa phyllopogon* biotypes across environmental gradients using population based threshold models

Echinochloa phyllopogon (late watergrass, also known as "mimic") has evolved resistance to almost all available grass herbicides in California. Post-emergence chemical control options have thus become increasingly limited and there is a pressing need to identify and refine alternative control methods. One such method is the stale seedbed approach, which entails recruiting weeds prior to planting and treating them with broad-spectrum herbicides to which they have not evolved, nor are likely to evolve, resistance.

Accurate predictions of weed seed germination can help optimize field level implementation of the stale seedbed technique by fine-tuning the timing of water application, water removal and herbicide application. Dry-stored and stratified seeds of two herbicide-resistant and two -susceptible biotypes of *E. phyllopogon* were subjected to eight temperature, four moisture, and six oxygen levels in a controlled laboratory setting. Interactive effects of moisture and oxygen levels were also examined. Germination was counted daily and simple population-based threshold models were used to derive germination rates, thresholds and patterns in terms of accrued heat, moisture and oxygen. Stratification reduced minimum oxygen requirements and hydrothermal time to germination, and allowed for germination to proceed under drier conditions. Among dry-stored seed, resistant biotypes tended to germinate under lower temperatures, in drier conditions and at lower oxygen levels than susceptible biotypes, but stratification reduced these differences.

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 four 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.

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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 <u>Continuous Flooded</u> 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. Cerano applied early is a very good grass herbicide and good broad-spectrum weed control was achieved when this herbicide was followed by propanil (Super Wham, Ultra Stam 80EDF, Ultra Stam 4SC or Ultra Stam 4SC tank mixed with Londax), Strada GR, Sandea, Granite GR or Stada GR followed by Ultra Stam 80EDF. Granite GR followed by Ultra Stam 4SC provided excellent broad-spectrum control of rice weeds. Some stunting and dark green color of rice could be noticed after the Granite GR treatment, and the Granite GR treatments had lower yield than would be expected given the level of weed control observed. Other treatments that worked well in this systemwere: Abolish followed by Super Wham or Bolero Ultramax followed by Super Wham or Regiment.

The <u>Pinpoint System</u> 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. Some of the best broad-spectrum treatments were: Regiment followed by Super Wham, Clincher tank mixed with Granite SC followed-up by propanil (Ultra Stam 4SC or Super Wham), Granite SC alone or tank mixed with Ultra Stam 80EDF then followed by Clincher, Regiment tank mixed with Abolish, Regiment alone, or Clincher followed by Ultra Stam 80EDF.

Our <u>Drill-Seeded rice</u> was flushed with water three times for establishment (June 4, June 10, and June 15), then a final permanent flood (3-4 inches deep) was imposed when rice was at the 5 leaf stage of growth (June 25). 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 excellent weed control and good yield were: Clincher followed by Super Wham, a tank mix of Prowl H_2O plus Granite SC plus Clincher, Granite SC followed by Clincher, a tank mix of Prowl H_2O, Super Wham and Clincher, Granite SC plus Clincher followed by Super Wham or Regiment plus Abolish followed by Super Wham.

The variety tolerance of rice to recently available herbicides that appear to impact rice growth was tested in 2009 and 2010 to assess if those effects translate into yield reduction. Thus Granite GR and Cerano were tested as into-the water granular applications in a continuously flooded system and Granite SC and Regiment were tested as foliar sprays in a pin-point experiment. All the varieties responded similarly to the herbicides (no herbicide by variety interaction) in both systems and years. No herbicide effects on rice were in the pin-point system. However, it can be concluded that injury to rice and stand reduction can occur with Cerano and Granite applied into the water when rates are doubled. In 2009, the double rate of Cerano significantly reduced yield. Although in certain cases the double rate of Granite could stunt rice and lower its stand, these effects did not affect yields.

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 were implemented by a cooperating grower and by one neighboring grower. This was in collaboration with Dr. Bruce Lindquist. One spring tilled stale seedbed technique was implemented with water-seeded rice for the second year on 10 acres 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. Neither portion of the field had germination of late watergrass during the stale seedbed treatment. A neighboring grower tried the spring tilled stale seedbed treatment on a couple fields infested with resistant late watergrass. He controlled the watergrass using the stale seedbed approach with glyphosate and had excellent yields. He will consider utilizing the technique in the future where heavy watergrass seedbanks exist. The field where we had stale seedbed treatments during the prior two seasons was reverted back to conventional rice. Early season counts of grasses showed dramatic reduction of the seedbank over just one year of implementation and even greater reduction when two consecutive years of this technique were implemented.

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

Table 2. Continuous flood trial at Hamilton Road.

Treatment	Rate (g ai/ha)	Timing[3]	Application date 1st	Application date 2nd	Application date 3rd	Phytotoxicity[1] 1st 7 DAT % Stunting	% Stand	% Injury	1st 14 DAT % Stunting	% Stand	% Injury	2nd 7 DAT % Stunting	% Stand	% Injury	2nd 14 DAT % Stunting	% Stand	% Injury	3rd 7 DAT % Stunting	% Stand	% Injury	3rd 14 DAT % Stunting	% Stand	% Injury
Untreated[4]	---	---																					
Cerano	673	DOS	4-Jun			NA	NA	NA	0	1	13												
Cerano fb. Superwham + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 1-3 Til	4-Jun	7-Jul		NA	NA	NA	0	0	20	4	1	3	1	2	0						
Cerano fb. Ultra Stam 4 SC + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 1-3 Til	4-Jun	7-Jul		NA	NA	NA	0	0	8	0	0	0	0	0	0						
Cerano fb. Ultra Stam 4 SC + Londax + COC	673 fb. 6726 + 67 + 1.25% v/v	DOS fb. 1-3 Til	4-Jun	7-Jul		NA	NA	NA	0	0	19	1	0	1	1	1	0						
Cerano fb. Ultra Stam 80 EDF + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 1 Til	4-Jun	7-Jul		NA	NA	NA	0	0	8	2	1	0	1	1	0						
Cerano fb. Granite GR	673 fb. 40	DOS fb. 2-3 lsr	4-Jun	16-Jun		NA	NA	NA	0	0	18	0	8	10	3	7	8						
Cerano fb. Sandea	673 fb. 35	DOS fb. 2-3 lsr	4-Jun	16-Jun		NA	NA	NA	3	0	8	0	1	5	4	5	6						
Sandea	35	2-3 lsr	16-Jun			0	0	1	1	2	3												
Cerano fb. Strada GR	673 fb. 74.5	DOS fb. 1-2 lsr	4-Jun	11-Jun		NA	NA	NA	0	1	6												
Cerano fb. Strada GR fb. Ultra Stam 80 EDF + COC	673 fb. 74.5 fb. 6726 + 1.25% v/v	DOS fb. 1-2 lsr fb. 1-3 Til	4-Jun	11-Jun	7-Jul	NA	NA	NA	4	4	11	3	4	11	3	5	11	0	1	0	1	1	0
Untreated																							
Granite GR fb. Ultra Stam 4 SC + COC	40 fb. 6726 + 2.5% v/v	2-3 lsr fb. 1-3Til	16-Jun	7-Jul		0	3	3	3	7	4	34	5	11	11	5	2						
Shark H_2O fb. SuperWham + COC	224 fb. 6726 + 1.25% v/v	2-3 lsr fb. 1-3 Til	16-Jun	7-Jul		0	0	4	0	2	4	1	1	0	0	0	0						
Abolish fb. SuperWham + COC	4480 fb. 6726 + 1.25% v/v	PFS bf. 1-3 til	2-Jun	7-Jul								1	1	0	2	1	0						
Bolero Ultramax fb. Superwham + COC	4480 fb. 6726 + 1.25% v/v	1-2 lsr fb. 1-3 Til	11-Jun	7-Jul		0	0	0	1	0	1	4	3	5	1	4	0						
Bolero Ultramax fb. Regiment + NIS	4480 fb. 30 + 0.125% v/v	1-2 lsr fb. 1-3 Til	11-Jun	7-Jul		1	0	0	0	1	1	13	7	1	5	5	0						
SuperWham + COC	6726 + 1.25% v/v	1-3 Til	7-Jul			0	1	0	1	3	0												
Superwham + Grandstand + COC	6726 + 420 + 1.25% v/v	1-3 Til	7-Jul			1	1	0	0	2	0												
Superwham + 2,4-D + COC	6726 + 123 + 1.25% v/v	1-3 Til	7-Jul			5	1	1	1	1	0												
LSD (P=0.05)																							

Treatment	Weed Control[2] 24-Jun ECHPH	24-Jun SCPMU	14-Jul ECHPH	14-Jul SCPMU	14-Jul HETLI	14-Jul MOOVA	14-Jul BAORO	3-Aug ECHPH	3-Aug SCPMU	3-Aug HETLI	3-Aug MOOVA	Yield (lb/A) 13-Oct
Untreated[4]	4	4	6	5	8	4	5	34	3	5	2	2529
Cerano	43	0	83	0	15	0	0	87	0	19	42	7333
Cerano fb. Superwham + COC	0	0	73	0	15	65	0	74	57	45	52	8679
Cerano fb. Ultra Stam 4 SC + COC	38	0	100	0	15	50	0	99	91	59	77	9826
Cerano fb. Ultra Stam 4 SC + Londax + COC	46	0	93	75	15	0	0	98	100	75	83	9682
Cerano fb. Ultra Stam 80 EDF + COC	43	0	77	25	15	0	0	93	63	47	0	9051
Cerano fb. Granite GR	50	27	100	95	95	100	100	99	100	100	100	8432
Cerano fb. Sandea	43	19	100	100	15	50	0	99	100	47	100	8826
Sandea	43	52	67	100	0	25	50	85	100	40	100	7970
Cerano fb. Strada GR	36	20	62	50	75	0	0	94	80	100	0	8708
Cerano fb. Strada GR fb. Ultra Stam 80 EDF + COC	43	13	73	0	75	25	0	96	82	100	0	9075
Untreated	4	5	8	4	6	5	5	30	2	6	3	2025
Granite GR fb. Ultra Stam 4 SC + COC	43	27	100	100	100	100	100	99	100	100	100	8739
Shark H_2O fb. SuperWham + COC	21	52	67	100	33	100	75	78	90	93	100	6989
Abolish fb. SuperWham + COC	43	0	100	25	15	0	100	94	100	85	0	9439
Bolero Ultramax fb. Superwham + COC	43	0	100	75	15	0	75	97	92	58	0	8748
Bolero Ultramax fb. Regiment + NIS	43	0	80	75	15	5	100	100	75	97	0	8755
SuperWham + COC	NA	NA	25	50	11	0	25	75	100	66	69	8705
Superwham + Grandstand + COC	NA	NA	25	75	15	25	50	70	100	92	75	7460
Superwham + 2,4-D + COC	NA	NA	62	65	15	0	0	82	100	70	88	8252
LSD (P=0.05)												871

[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. Abolish applied June 2 to dry soil prior to flood
2. Trial seeded June 4, 2010 with 120 lbs per acre of M206
3. Trial managed as a permanent flood with flood water at 4-5 inches.
4. No weeds were visible when Cerano was applied on day of seeding June 4.
   Watergrass was 1-2 leaf on June 11.
   Watergrass was 1-2 leaf, ricefield bulrush was 1-2 leaf, smallflower was 1-2 leaf and ducksalad was 2 leaf on June 16.
   Watergrass was 3 tiller, ricefield bulrush was 3 tiller,smallflower was 8-10", ducksalad was flowering on July 7.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on June 2: Air temperature 81^o F, wind 2-5 MPH from the Southeast.
   Weather conditions on June 4: Air temperature 75^o F, wind 2-4 MPH from the Southeast.
   Weather conditions on June 11: Air temperature 64^o F, wind 5-6 MPH from the North.
   Weather conditions on June 16: Air temperature 68^o F, wind 8-10 MPH from the Northwest.
   Weather conditions on July 7: Air temperature 78^o F, wind 1-2 MPH from the south.

Table 3. FMC - HR

Treatment	Rate	Timing[3]	Date			Phytotoxicity[1] 1st						Phytotoxicity[1] 2nd						Phytotoxicity[1] 3rd						Weed Control[2]								Yield (lb/A)
						% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	SCPMU	ECHPH	SCPMU	HETLI	ECHPH	SCPMU	HETLI	
	(g ai/ha)		1st	2nd	3rd	7 DAT			14 DAT			7 DAT			14 DAT			7 DAT			14 DAT			24-Jun		14-Jul			3-Aug			13-Oct
Untreated[4]	--	--																						14	19	30	2	30	42	3	9	2595
Cerano fb. Shark H_2O 40 DF + Londax fb. Ultra Stam 4 SC + COC	673 fb. 224 + 70 fb. 6726 + 1.25% v/v	DOS fb. 2-4 lsr fb. 30 DAS	4-Jun	16-Jun	28-Jun	NA	NA	NA	23	5	35	5	6	8	8	8	11	9	8	7	7	6	5	49	56	99	100	100	100	100	100	8277
Cerano fb. Shark H_2O 40 DF + Londax fb. Ultra Stam 4 SC + COC	673 fb. 196 + 70 fb. 6726 + 1.25% v/v	DOS fb. 2-4 lsr fb. 23 DAS	4-Jun	16-Jun	24-Jun	NA	NA	NA	41	5	51	4	4	8	5	9	5	9	8	5	4	8	4	49	56	99	100	97	99	100	75	7855
LSD (P=0.05)																																2782

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 4, 2010 with 120 lbs per acre of M206
2. Trial managed as a continuous flood with 4-5 inches.
3. No weeds visible on June 4.
   Watergrass was 2-3 leaf, bulrush and ducksalad sprouted on June 16.
   Watergrass was 4 leaf, ricefield bulrush was 4-5 leaf, ducksalad was 1 tiller, redstem 2 leaf, waterhyssop was 1 tiller on June 24.
   Watergrass was 5-6 leaf, ricefield bulrush was 5-6 leaf, ducksalad was 1-2 tiller, redstem 4-5 leaf, waterhyssop was 1-2 tiller on June 28.
4. Weather conditions on June 4: Air temperature 75^o F, wind 2-4 MPH from the Southeast.
   Weather conditions on June 16: Air temperature 68^o F, wind 8-10 MPH from the northwest.
   Weather conditions on June 24: Air temperature 64^o F, wind 1-2 MPH from the southeast.
   Weather conditions on June 28: Air temperature 84^o F, wind 2-4 MPH from the southwest.

Table 4. Isagro Continuous

Treatment	Rate (g ai/ha)	Timing[3]	Date 1st	Date 2nd	Date 3rd
Untreated[4]					
Cerano fb. Strada CA (dry) fb. Ultra Stam + COC	448 fb. 73.5 fb. 5605 + 1.25% v/v	DOS fb. 1 lsr(dry) fb. 5-6lsr	4-Jun	11-Jun	24-Jun
Cerano fb. Strada CA (spray) fb. Ultra Stam + COC	448 fb. 73.5 fb. 5605 + 1.25% v/v	DOS fb. 1 lsr(spray) fb. 5-6lsr	4-Jun	11-Jun	24-Jun
Cerano fb. Strada GR fb. Ultra Stam + COC	448 fb. 74.5 fb. 5605 + 1.25% v/v	DOS fb. 1 lsr fb. 5-6lsr	4-Jun	11-Jun	24-Jun
Cerano fb. Strada CA + Ultra Stam + COC	448 fb. 73.5 + 5605 + 1.25% v/v	DOS fb. 5-6 lsr	4-Jun	24-Jun	
Cerano fb. Ultra Stam + COC	448 fb. 5605 + 1.25% v/v	DOS fb. 5-6 lsr	4-Jun	24-Jun	
LSD (P=0.05)					

Phytotoxicity[1]

Treatment	1st 7 DAT % Stunt	1st 7 DAT % Stand	1st 7 DAT % Injury	1st 14 DAT % Stunt	1st 14 DAT % Stand	1st 14 DAT % Injury	2nd 7 DAT % Stunt	2nd 7 DAT % Stand	2nd 7 DAT % Injury	2nd 14 DAT % Stunt	2nd 14 DAT % Stand	2nd 14 DAT % Injury	3rd 7 DAT % Stunt	3rd 7 DAT % Stand	3rd 7 DAT % Injury	3rd 14 DAT % Stunt	3rd 14 DAT % Stand	3rd 14 DAT % Injury
Untreated[4]																		
Cerano fb. Strada CA (dry) fb. Ultra Stam + COC	NA	NA	50	6	3	22	6	3	22	4	7	3	4	0	1	3	1	1
Cerano fb. Strada CA (spray) fb. Ultra Stam + COC	NA	NA	50	19	6	6	19	6	6	4	10	4	5	1	1	3	3	1
Cerano fb. Strada GR fb. Ultra Stam + COC	NA	NA	50	15	5	9	15	5	9	10	9	4	5	1	1	4	2	1
Cerano fb. Strada CA + Ultra Stam + COC	NA	NA	50	4	3	14	4	0	1	3	1	1						
Cerano fb. Ultra Stam + COC	NA	NA	50	5	4	13	5	1	1	3	3	1						
LSD (P=0.05)																		

Weed Control[2]

Treatment	24-Jun ECHPH	24-Jun SCPMU	24-Jun CYPDI	24-Jun HETLI	24-Jun BAORO	14-Jul ECHPH	14-Jul SCPMU	14-Jul HETLI	14-Jul MOOVA	3-Aug ECHPH	3-Aug SCPMU	3-Aug HETLI	3-Aug MOOVA	Yield (lb/A) 13-Oct
Untreated[4]	13	4	5	14	6	8	5	5	5	16	5	5	3	1699
Cerano fb. Strada CA (dry) fb. Ultra Stam + COC	23	0	33	87	73	70	65	75	25	78	92	95	0	8442
Cerano fb. Strada CA (spray) fb. Ultra Stam + COC	58	6	68	90	69	77	55	75	25	81	93	85	0	8697
Cerano fb. Strada GR fb. Ultra Stam + COC	68	0	6	89	90	70	75	100	0	73	88	80	0	8902
Cerano fb. Strada CA + Ultra Stam + COC	53	0	55	2	24	32	0	0	0	56	80	20	0	7560
Cerano fb. Ultra Stam + COC	63	0	26	6	51	37	5	0	0	77	78	30	0	8278
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] 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 4, 2010 with 120 lbs per acre of M206
2. Trial managed as a continuous flood.
3. No weeds visible on June 4.
   Watergrass was 1-2 leaf on June 11.
   Watergrass was 4 leaf, ricefield bulrush was 4-5 leaf, ducksalad was 1 tiller, redstem 2 leaf, waterhyssop was 1 tiller on June 24.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 4: Air temperature 75^{o} F, wind 2-4 MPH from the Souyheast.
   Weather conditions on June 11: Air temperature 64^{o} F, wind 5-6 MPH from the north.
   Weather conditions on June 24: Air temperature 64^{o} F, wind 1-2 MPH from the southeast.

Table 5. FMC - J-9

						Phytotoxicity[1]															Weed Control[2]												
						1st						2nd			3rd																		
Treatment	Rate	Timing[3]	Date			% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	ECHPH	SCPMU	HETLI	BAORO	ECHPH	SCPMU	HETLI	MOOVA	AMMCO	BAORO	Yield (lb/A)
	(g ai/ha)		1st	2nd	3rd	7 DAT			14 DAT			14 DAT			7 DAT			14 DAT			10-Jun		30-Jun				19-Jul						30-Sep
Untreated[4]	--	--																			14	19	9	14	2	4	15	20	2	2	3	1	6328
Cerano fb. Shark H_2O 40 DF + Londax fb. Ultra Stam 4 SC + COC	673 fb. 224 + 70 fb. 6726 + 1.25% v/v	DOS fb. 2-4 lsr fb. 30 DAS	21-May	7-Jun	21-Jun	NA	NA	NA	0	6	0	1	5	2	0	1	3	0	0	1	49	56	88	98	94	100	94	94	100	100	100	100	9805
Cerano fb. Shark H_2O 40 DF + Londax fb. Ultra Stam 4 SC + COC	673 fb. 196 + 70 fb. 6726 + 1.25% v/v	DOS fb. 2-4 lsr fb. 23 DAS	21-May	7-Jun	14-Jun	NA	NA	NA	0	0	0	2	6	3	2	6	3	3	7	5	49	56	88	97	75	100	92	85	75	100	83	50	9834
LSD (P=0.05)																																	1186

[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 May 21, 2010 with 120 lbs per acre of M205
2. Trial managed as a continuous flood with 4-5 inches.
3. No weeds visible on May 21.

Watergrass was 2 leaf, ricefield bulrush was 2-3 leaf, smallflower was 1-2 leaf and ducksalad was 2 leaf on June 7.
Watergrass was 2-4 leaf, ricefield bulrush was 2-4 leaf, smallflower was 1-2 leaf and ducksalad was 2 leaf on June 14.
Watergrass was 3-5 leaf, ricefield bulrush was 4 leaf, smallflower was 3 leaf and ducksalad was 1 tiller on June 21.

4. Weather conditions on May 21: Air temperature 82^{o} F, wind 2-4 MPH from the West.

Weather conditions on June 7: Air temperature 84o F, wind 1-2 MPH from the west.
Weather conditions on June 14: Air temperature 91o F, wind 1-3 MPH from the southwest.
Weather conditions on June 21: Air temperature 82o F, wind 1-3 MPH from the west.

Table 6. Cheminova Cont. flood

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st: % Stand	% Stunting	% Injury	% Stand	% Stunting	% Injury	ECHPH	SCPMU	HETLI	ECHPH	SCPMU	HETLI	MOOVA	BAORO	ECHPH	SCPMU	HETLI	MOOVA	Yield (lb/A)
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			24-Jun			13-Jul					3-Aug				13-Oct
Untreated[4]	--	--									11	19	18	23	4	11	2	5	29	2	10	2	2247
Bombard fb. Grandstand + COC	336 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	4-Jun	12-Jul	NA	NA	NA	3	3	11	57	68	28	42	0	0	0	0	0	92	83	83	5942
Bombard fb. Grandstand + COC	448 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	4-Jun	12-Jul	NA	NA	NA	2	9	23	69	59	56	59	0	14	38	0	48	58	91	53	6998
Bombard fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	4-Jun	12-Jul	NA	NA	NA	3	10	26	55	52	71	73	0	15	0	0	68	88	93	100	7889
Bombard fb. Grandstand + COC	1345 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	4-Jun	12-Jul	NA	NA	NA	19	7	69	92	67	46	97	0	60	75	0	98	33	81	100	8619
Bombard fb. Grandstand + COC	336 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	11-Jun	12-Jul	9	7	30	4	8	4	57	81	48	63	0	0	42	0	28	88	86	100	6871
Bombard fb. Grandstand + COC	448 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	11-Jun	12-Jul	7	8	46	3	10	11	91	82	75	82	0	7	50	0	76	63	80	100	8191
Bombard fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	11-Jun	12-Jul	10	6	44	9	30	23	89	79	89	94	0	0	50	0	95	67	81	75	8661
Bombard fb. Grandstand + COC	1345 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	11-Jun	12-Jul	18	12	61	13	95	25	69	82	45	97	0	0	75	0	100	67	70	100	6785
Cerano fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	Post flood/Preplant fb. 1 Til	4-Jun	12-Jul	NA	NA	NA	2	14	38	80	71	58	60	0	6	17	0	51	88	90	95	7085
Cerano fb. Grandstand + COC	673 fb. 420 + 0.5% v/v	< 1 lsg fb. 1 Til	11-Jun	12-Jul	12	5	53	14	45	56	94	84	86	95	0	20	50	0	96	63	73	88	8330
LSD (P=0.05)																							1670

[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 4, 2010 with 120 lbs per acre of M206
2. Trial managed as a continuous flood with 4-5 inches.
3. No weeds visible on June 4.
   Watergrass was 1-2 leaf on June 11.
   Watergrass was 2-3 tillers, ducksaladflowering, bulrush 1 tiller, monochoria 2-3 stems, waterhyssop flowering on July 12.
4. Weather conditions on June 4: Air temperature 75^o F, wind 2-4 MPH from the Southeast.
   Weather conditions on June 11: Air temperature 64^o F, wind 5-6 MPH from the north.
   Weather conditions on July 12: Air temperature 83^o F, wind 2-3 MPH from the south.

Table 7. Pinpoint Trial at Hamilton Road

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st % Stunting	1st % Stand	1st % Injury	1st % Stunting	1st % Stand	1st % Injury	2nd % Stunting	2nd % Stand	2nd % Injury	2nd % Stunting	2nd % Stand	2nd % Injury	Weed Control[2] ECHPH	SCPMU	HETLI	BAORO	ECHPH	LEEFA	SCPMU	CYPDI	HETLI	Yield (lb/A)
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			14-Jul				3-Aug					13-Oct
Untreated[4]																	21	3	25	2	45	2	2	3	6	2337
Clincher + Granite SC + COC fb. Ultra Stam 4 SC + COC	280 + 35 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	23-Jun	7-Jul	0	1	3	0	0	0	0	3	1	0	0	0	98	95	96	69	98	100	50	71	95	6731
Clincher + Granite SC + COC fb. SuperWham + COC	280 + 35 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	23-Jun	7-Jul	0	0	0	0	0	0	0	3	3	0	1	1	97	87	96	69	98	75	63	92	100	6695
Ultra Stam 4SC + COC	6726 + 1.25% v/v	1 Til	7-Jul		0	5	2	0	0	1							85	33	71	25	71	17	75	100	0	4862
Super Wham + COC	6726 + 1.25% v/v	1 Til	7-Jul		0	4	2	0	0	1							84	79	65	0	68	0	75	92	0	5159
Ultra Stam 80 EDF + COC	4484 + 1.25% v/v	1 Til	7-Jul		0	6	1	0	2	0							74	70	69	0	56	0	88	75	0	4837
Rice Shot + COC	4484 + 1.25% v/v	1 Til	7-Jul		0	7	2	1	4	0							81	63	54	10	56	0	63	65	0	4715
Granite SC + COC	35 + 2.5% v/v	3-4 lsr	23-Jun		0	1	0	0	0	0							94	100	97	63	96	0	63	60	92	6583
Granite SC + Ultra Stam 80 EDF + COC fb. Clincher + COC	35 + 6726 + 2.5% v/v fb. 315 + 2.5% v/v	3-4 lsr fb. 1-2 Til	23-Jun	7-Jul	0	0	1	0	0	0	0	4	0	0	0	0	98	75	90	69	98	88	75	67	70	6280
Untreated																	29	3	24	2	44	1	2	2	4	2063
Clincher + COC	315 + 2.5% v/v	3-4 lsr	23-Jun		0	1	0	0	0	0							95	0	0	0	98	100	38	0	0	5113
Clincher + COC fb. Ultra Stam 80 EDF + COC	315 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	23-Jun	7-Jul	0	1	0	0	1	0	0	4	1	0	0	1	99	0	37	0	99	88	50	42	0	6174
Super Wham + Clincher + COC	4484 + 315 + 2.5% v/v	3-4 lsr	23-Jun		0	1	11	0	3	0							96	63	26	13	98	50	75	25	0	5904
Regiment + NIS	30 + 0.125% v/v	3-4 lsr	23-Jun		0	0	6	0	4	0							97	63	95	50	98	0	88	63	74	6000
Regiment + NIS fb. Super Wham + COC	30 + .125% v/v fb. 6726 + 1.25% v/v	3-4 lsr fb. 1-2 Til	23-Jun	7-Jul	0	4	6	0	3	0	0	6	2	0	0	0	97	100	96	33	98	0	50	78	83	6925
Abolish	3363	3-4 lsr	23-Jun		0	0	0	0	0	0							42	0	0	44	9	0	75	0	0	3230
Regiment + Abolish	30 + 3363	3-4 lsr	23-Jun		0	3	4	0	4	0							100	100	95	81	99	13	38	67	88	6392
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 4, 2010 with 120 lbs per acre of M206
2. Trial managed as a pinpoint flood with flood water drained June 16, reflood June 26.
3. Watergrass was 3 leaf, bulrush was 1-2 leaf, ducksalad was 1-2 leaf, smallflower was 1-2 leaf on June 23.
   Watergrass was 2-3 tiller, ricefield bulrush was 1 tiller, smallflower was 3-4" monochoria 2-3 stems and ducksalad was flowering on July 6.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on June 23: Air temperature 84^{o} F, wind 0-1 MPH from the northwest.
   Weather conditions on July 6: Air temperature 80^{o} F, wind 1-3 MPH from the south southwest.

Table 8. Granite/Clincher tankmix interaction

				Phytotoxicity[1]						% Weed Control[2]														
Treatement	Rate	Timing[3]	Date	% Stand	% Stunting	% Injury	% Stand	% Stunting	% Injury	ECHPH	SCPMU	CYPDI	HETLI	BAORO	ECHPH	LEEFA	SCPMU	HETLI	ECHPH	LEEFA	SCPMU	CYPDI	HETLI	Yield (lb/A)
	(g ai/ha)			7 DAT			14 DAT			14-Jul					20-Jul				3-Aug					13-Oct
Untreated[4]	---	---								18	4	4	6	3	24	2	3	9	10	2	2	3	2	1859
Granite SC + COC	9 + 2.5% v/v	3-4 lsr	24-Jun	2	1	0	1	0	0	77	75	85	73	30	85	25	40	84	72	0	42	38	54	5847
Granite SC + COC	18 + 2.5% v/v	3-4 lsr	24-Jun	1	1	0	0	1	0	83	84	84	79	4	92	13	70	87	76	0	50	77	42	6123
Granite SC + COC	36 + 2.5% v/v	3-4 lsr	24-Jun	1	2	0	0	2	0	89	85	78	87	40	97	0	63	89	89	0	33	71	42	6314
Clincher + COC	79 + 2.5% v/v	3-4 lsr	24-Jun	1	0	0	1	0	0	52	10	0	0	0	83	63	0	0	62	63	0	0	0	3927
Clincher + COC	158 + 2.5% v/v	3-4 lsr	24-Jun	1	0	0	0	0	0	84	5	0	0	0	95	63	0	0	82	100	0	0	0	4798
Clincher + COC	316 + 2.5% v/v	3-4 lsr	24-Jun	1	0	0	2	0	0	95	0	11	0	0	96	75	0	0	90	100	0	0	0	4497
Granite SC + Clincher + COC	9 + 79 + 2.5% v/v	3-4 lsr	24-Jun	1	2	0	0	1	0	62	45	60	42	3	52	50	25	63	55	75	38	40	33	4456
Granite SC + Clincher + COC	9 + 158 + 2.5% v/v	3-4 lsr	24-Jun	1	1	0	1	1	0	62	84	75	73	0	71	75	58	82	63	100	29	38	38	5360
Granite SC + Clincher + COC	9 + 316 + 2.5% v/v	3-4 lsr	24-Jun	1	2	0	0	1	0	58	53	58	61	10	66	0	0	69	62	100	29	13	54	5024
Granite SC + Clincher + COC	18 + 79 + 2.5% v/v	3-4 lsr	24-Jun	1	2	0	0	0	0	67	55	55	70	3	64	63	25	81	46	50	25	52	46	5058
Granite SC + Clincher + COC	18 + 158 + 2.5% v/v	3-4 lsr	24-Jun	0	1	0	0	2	0	87	94	94	78	10	90	63	45	89	75	50	50	67	50	6083
Granite SC + Clincher + COC	18 + 316 + 2.5% v/v	3-4 lsr	24-Jun	1	2	0	1	0	0	90	79	88	82	0	87	38	58	89	73	75	75	63	54	6570
Granite SC + Clincher + COC	36 + 79 + 2.5% v/v	3-4 lsr	24-Jun	1	1	0	1	1	0	94	88	88	81	45	98	38	63	94	65	0	58	40	33	5704
Granite SC + Clincher + COC	36 + 158 + 2.5% v/v	3-4 lsr	24-Jun	2	2	0	0	1	0	95	90	90	84	9	96	63	45	95	88	63	75	75	54	6429
Granite SC + Clincher + COC	36 + 316 + 2.5% v/v	3-4 lsr	24-Jun	1	1	0	0	1	0	98	90	90	84	46	97	75	75	95	90	88	63	83	46	6825
LSD (P=0.05)																								1311

[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 4, 2010 with 120 lbs per acre of M206
2. Trial managed as a pinpoint flood. Water drained June 16 and reflood on June 26.
3. Watergrass was 3 leaf, ricefield bulrush was 2-4 leaf, smallflower 3 leaf, ducksalad was 2 leaf on June 24.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June24: Air temperature 82^{o} F, wind 2-3 MPH from the southwest.

Table 9. Drill seeded trial

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1]												Weed Control[2]												Yield (lb/A)
					1st						2nd																		
					% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	ECHPH	SCPMU	CYPDI	ECHPH	SCPMU	CYPDI	ECHPH	ECHOR	LEFFA	SCPMU	HETLI	MOOVA	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			24-Jun			14-Jul			3-Aug						13-Oct
Untreated[4]	---	---															9	3	4	30	3	3	6	6	5	4	2	2	1224
Prowl H2O	1120	DPRE	8-Jun		0	0	0	0	0	0							30	0	0	49	44	65	25	45	75	69	63	75	7494
Prowl H2O fb. Super Wham + COC	1120 fb. 4480 + 1.25 % v/v	DPRE fb. 3-4 lsr	8-Jun	23-Jun	0	0	0	0	0	0	0	1	0	0	1	0	14	0	0	86	63	85	41	95	90	50	63	50	7441
Prowl H2O	1120	2-3 lsr (AFF)	21-Jun		0	0	0	0	0	1							NA	NA	NA	51	35	44	32	43	35	56	88	88	6563
Prowl H2O + Super Wham + Clincher + COC	1120 + 4484 + 280 + 1.25 % v/v	2-3 lsr (AFF)	21-Jun		0	1	0	0	1	0							NA	NA	NA	96	65	92	76	100	100	56	88	88	7958
Regiment + Abolish fb. Super Wham + Clincher + COC	25 + 3360 fb. 6726 + 315 + 1.25 % v/v	2-3 lsr fb. PPF	21-Jun	1-Jul	0	0	0	0	0	4	0	0	5	1	0	4	NA	NA	NA	96	65	60	100	100	60	44	88	38	7723
Super Wham + Whip + COC	4484 + 32 + 1.25 % v/v	3-4 lsr	23-Jun		0	0	1	0	0	1							NA	NA	NA	58	63	88	27	91	20	56	25	38	7130
Clincher + COC fb. Superwham + COC	280 + 2.5% v/v fb. 4480 + 1.25% v/v	2-3 lsr fb. 3-4 lsr (AFF)	21-Jun	23-Jun	0	1	0	0	0	0	0	1	0	0	0	0	NA	NA	NA	96	58	65	95	100	95	56	63	25	8415
Granite SC + COC fb. Clincher + COC	35 + 2.5% fb. 315 + 2.5% v/v	2-3 lsr fb. PPF	21-Jun	1-Jul	0	0	0	0	0	0	0	0	0	5	0	1	NA	NA	NA	94	85	85	100	100	30	50	75	38	7974
Granite SC + Prowl H2O + Clincher + COC	35 + 1120 + 315 + 2.5 % v/v	2-3 lsr	21-Jun		0	0	0	0	3	0							NA	NA	NA	98	77	100	95	100	100	69	75	75	8137
Granite SC + Clincher + COC fb. Super Wham + COC	35 + 280 + 2.5% v/v fb. 6726 + 1.25 % v/v	2-3 lsr fb. PPF	21-Jun	1-Jul	0	0	0	0	3	3	0	0	3	2	2	3	NA	NA	NA	96	56	67	90	96	95	50	50	13	7778
KSU 12800	327	DPRE	8-Jun		0	0	0	0	0	0							28	83	88	27	100	100	17	55	55	50	63	75	6672
KSU 12800	654	DPRE	8-Jun		0	0	0	0	0	0							29	50	75	32	100	100	0	50	80	81	100	88	6704
LSD (P=0.05)																													951

[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 3, 2010 with 100 lbs per acre of M206
2. Trial managed as a drill seeded with initial flush on June 4, additional flushes on June 10, June 15 with final flood on June 25.
3. No weeds present on June 8.
   Watergrass was 2-3 leaf, bullrush, smallflower sprouted on June 21.
   Watergrass was 3 leaf, and smallflower was 2 leaf on June 23.
   Watergrass was 1-2 tiller, sprangletop was tillering, smallflower was 2-3", ducksalad 2 leaf on July 1.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 8: Air temperature 77^{o} F, wind 1-3 MPH from the south.
   Weather conditions on June 21: Air temperature 70^{o} F, wind 2-3 MPH from the northwest.
   Weather conditions on June 23: Air temperature 92^{o} F, wind 0-1 MPH from the northwest.
   Weather conditions on July 1: Air temperature 88^{o} F, wind 1-2 MPH from the southwest.

Table 10. Stale seedbed - H.R.

						Phytotoxicity[1]					
						2nd	Weed Control[2]				
Treatment	Rate		Timing[3]	Date		% Stunting	ECHPH	ECHPH	SCPMU	CYPDI	Yield/Acre (14%)
	(g ai/ha)	Prod./a				7 DAT	21-Jul	9-Aug			17-Nov
Untreated[4]							30	30	3	3	1224
Roundup + UAN	2% v/v + 2% v/v	1.2lb a.e. + 2% v/v	After flush	25-Jun			93	86	0	65	3020
Roundup + UAN	2% v/v + 2% v/v	1.2lb a.e. + 2% v/v	After flush	25-Jun			93	86	0	65	3538
Roundup + UAN fb. Super Wham + COC	2% v/v + 2% v/v fb. 4484 + 1.25% v/v	1.2lb a.e. + 2% v/v fb. 4qt + 1.25% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		90	92	100	100	4207
Roundup + UAN fb. Granite SC + COC	2% v/v + 2% UAN fb. 35 + 2.5% v/v	1.2lb a.e. + 2% v/v fb. 2oz + 2.5% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		87	99	100	79	4681
Roundup + UAN fb. Granite SC + Clincher + COC	2% v/v + 2% UAN fb. 35 + 315 + 2.5% v/v	1.2lb a.e. + 2% v/v fb. 2oz + 15oz + 2.5% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		92	99	100	71	4325
Roundup + UAN fb. Regiment + NIS + UAN	2% v/v + 2% v/v fb. 44.5 + 0.25% v/v + 2.0% v/v	1.2lb a.e. + 2% v/v fb. 0.79oz + 0.25% v/v + 2.0% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		91	97	100	73	4571
Roundup + UAN fb. Regiment + Abolish	2% v/v + 2% v/v fb. 30 + 3363	1.2lb a.e. + 2% v/v fb. 0.79oz + 1.5qt	After flush fb. 3-4lsr	25-Jun	23-Jul		89	96	60	10	4797
Roundup + UAN fb. Rice Shot + COC	2% v/v + 2% v/v fb. 4484 + 1.25% v/v	1.2lb a.e. + 2% v/v fb. 4qt + 1.25% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		94	92	100	100	4447
Roundup + UAN fb. Ultra Stam 4SC+ COC	2% v/v + 2% v/v fb. 4484 + 1.25% v/v	1.2lb a.e. + 2% v/v fb. 4qt + 1.25% v/v	After flush fb. 3-4lsr	25-Jun	23-Jul		92	93	100	100	4544
LSD (P=0.05)											723

[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), PFS (pre-flood surface), PPI (pre-plant incorporated).

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

Trial Information

1. Trial timeline

Spring tilled and rolled

June 4 Flush field.

June 10 flush field

June 2 field flooded

June 15 Flush field

June 18 Flood field

June 21 drain field

June 25 apply glyphosate treatments

June 28 flood field

June 30 seed field with 120lb M206

July 22 drop water for applications

July 23 apply follow up herbicide treatments

2. Trial managed as a stale seedbed with pinpoint drain for foliar herbicide applications.

3. Spray applications made with 20 gallons/acre using 8003 nozzles.

4. Weather conditions on June 25: Air temperature 72° F, wind 2-5 MPH from the south southwest.

Weather conditions on July 23: Air temperature 80° F, wind 0-2 MPH from the south southwest.

Table 11. Pinpoint flood variety tolerance trial

	Rate (g ai/ha)	Yield 2009	Yield 2010	Fresh wt 2009	Fresh wt 2010	Height 2009	Height 2010	Plants/sqft 2009	Plants/sqft 2010	% Heading 2009	% Heading 2010
		Percent of untreated and weed-free control									
GRANITE	35	94	128	106	128	100	104	105	118	93	98
	70	93	128	104	120	100	104	101	117	103	104
REGIMENT	30	96	119	108	107	101	104	104	93	97	101
	60	96	114	110	108	100	103	97	96	97	97

Table 12. Continuously flooded variety tolerance trial

	Rate (g ai/ha)	Yield 2009	Yield 2010	Fresh wt 2009	Fresh wt 2010	Height 2009	Height 2010	Plants/sqft 2009	Plants/sqft 2010	% Heading 2009	% Heading 2010
		Percent of untreated and weed-free control									
CERANO	673	109a	96	82a	101a	101a	102	68b	105a	115a	87
	1344	67b	97	37b	66b	89b	103	19c	61b	65b	94
GRANITE	40	100	102	96	68b	101	103a	86ab	96	109	91
	80	99	99	89	72b	99	94b	77b	107	110	103