COMPREHENSIVE RICE RESEARCH

ANNUAL REPORT
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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 sites has Londax (bensulfuron-methyl)-resistant smallflower umbrellasedge. The off-station site has resistant late watergrass 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 M-205 and M-206 at the two on station sites. 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, while pinpoint experiments have flood water at time of seeding then water 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 20 gallons of spray volume per 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. Weed cover is usually closely inversely associated with weed control. Therefore, low weed cover generally represents a high level of weed control. The first month after seeding corresponds to the “critical” period of weed control (30 days after seeding) for flooded rice in California. Treatments that consisted of an early application followed by a late-season treatment (4 lsr to 1 tiller) generally were no

better than early treatments; however they can be useful to prevent growth and seed production by late-emerging weeds and improve ease of harvest.
The low R^2 in this Figure 1 means that variations 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 that are not competing very strongly with rice. Other competitive grasses, such as sprangletop and barnyardgrass are normally not a 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.

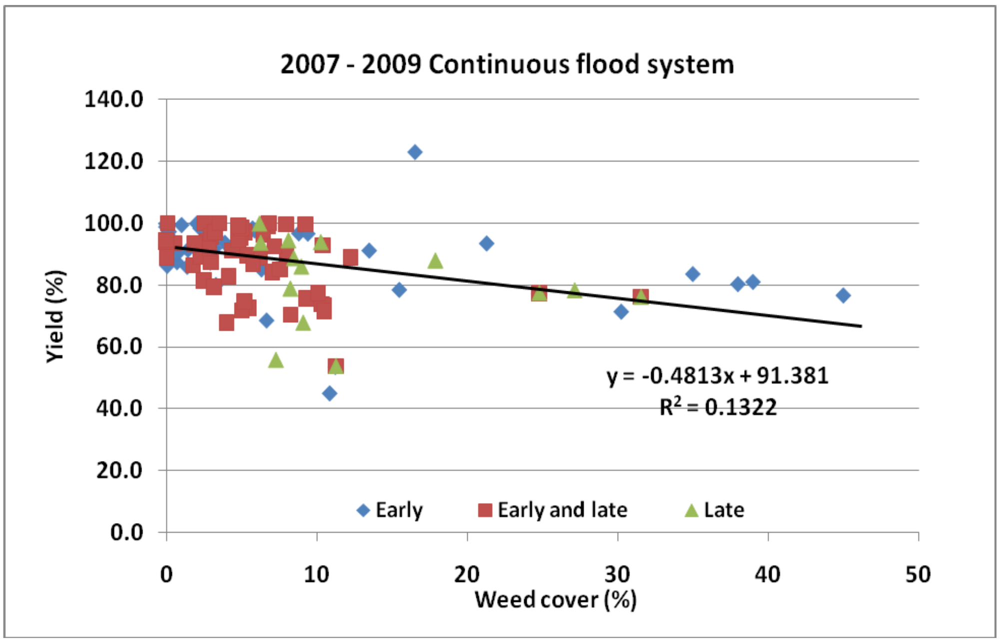

Figure 1. Weed competition in continuously flooded rice; evaluations of weed infestation were conducted 40 days after seeding rice. Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation). Data are combined for the 2007 through 2009 continuously flooded experiments at the RES.

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 control followed by an application of either Shark, Londax, propanil (Stam, Super Wham, Rice Shot) or Regiment at various timings (Tables 2-5,) to control broadleaves, sedges, and in some cases late-emerging watergrass plants or those 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. One additional continuously flooded trial was located in a field with ALS-resistant smallflower umbrellasedge (Table 6). Rice yields for most of the treatments were not statistically different. Treatments discussed below are from both individually leveed plots and plots located in a basin treated with one into-the-water herbicide followed by foliar applied herbicides.

This season, the best treatments for both weed control and yield were: Cerano (673 g ai/ha, DOS) fb. V-10142 (336 g ai/ha) plus Wham (4484 g ai/ ha) at the 4-5 leaf stage of rice; V-10219 (2800 + 120 g ai/ha, 2 lsr); Cerano (673 g ai/ha, DOS) fb. Stam 4SC (6726 g ai/ha, 1-3 Till): V-10219 (4681 g ai/ha, 2 lsr); Abolish (4480 g ai/ha, as a pre-flood application on soil surface, PFS) fb. Super Wham (6726 g ai/ha, 1-3 Till); Regiment (37 g ai/ha, 1-3 Till). Treatment with Super Wham (6726 g ai/ha, 1-3 Till) alone resulted in very clean plots by the end of the critical period of weed control and excellent yields. Granite GR (40 g ai/ha, 2-3 lsr) fb. Super Wham (6726 g ai/ha, 1-3 Till) had the best overall weed control (Table 1). Other good treatments were: Bolero Ultramax (4480 g ai/ha, 1-2 lsr) fb. Super Wham (6726 g ai/ha, 1-3 Till); Bolero Ultramax (4480 g ai/ha, 1-2 lsr) fb. V-10142 (168 g ai/ha) plus Regiment (22.4 g ai/ha) at 1-3 Till (Table 1). Treatments in other continuously flooded trials at the RES that provided good weed control and yields were: Cerano (673 g ai/ha, DOS) fb. Shark H_2O (224 g ai/ha, 2-4 lsr); Cerano (673 g ai/ha, DOS) fb. Shark H_2O (224 g ai/ha) plus Londax (70 g ai/ha) applied at 2-4 lsr; Shark H_2O (224 g ai/ha) plus Bolero (4484 g ai/ha) applied at 2-4 lsr; Cerano (448 g ai/ha, DOS) fb. Strada GR (73.5 g ai/ha) plus Stam (6726 g ai/ha) applied 5-6 lsr; Cerano (448 g ai/ha, DOS) fb. Strada GR (73.5 g ai/ha) plus Stam (6726 g ai/ha) plus Siapton (321 g ai/ha) applied 5-6 lsr; Cerano (448 g ai/ha, DOS) fb. Stam (6726 g ai/ha, 5-6 lsr.). The following treatments were not statistically different: Cerano (560 g ai/ha, DOS) fb. Super Wham or Rice Shot (6726 g ai/ha) plus Unison (122 g ai/ha), 1-3 Till.; Cerano (560 g ai/ha, DOS) fb. Super Wham or Rice Shot (6726 g ai/ha) plus Granite SC (35 g ai/ha), 1-3 Till.; Cerano (560 g ai/ha, DOS) fb. Super Wham or Rice Shot (6726 g ai/ha) 1-3 Till. (Tables 2- 6).

1.2. Pin-point system combinations

In the pinpoint system, weed infestations in our have a stronger impact on yields compared with the continuously flooded system, because of the temporary elimination of flooding. This promotes emergence of competitive weeds and eliminates temporarily the weed suppressive effect of flood; thus the steeper slope of the significant weed cover-yield relationship illustrated in Figure 2. The same comments made earlier regarding the continuously flooded system apply here as well.

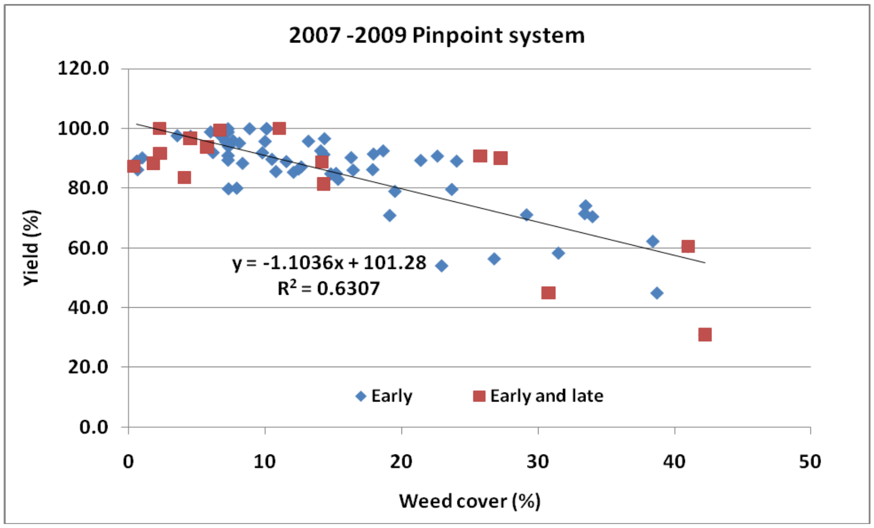

Figure 2. Weed competition in pinpoint flooded rice; evaluations of weed infestation were conducted 40 days after seeding rice. Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation). Data are combined for the 2007 through 2009 pinpoint flooded experiments at the RES.

As mentioned before, weed cover represents the level of weed infestation and low weed cover results from good weed control. Good yields (80% of potential or greater) were largely associated with good weed control (> 90%) achieved during the first critical month of weed competition (Figure 2). Split early and late applications gave similar results as early-only weed control when weed control was (> 90%), but such double treatments can be useful to suppress the ability of late emerging weeds to produce seed and re-infest the seedbank; on resistant sites, the control of late weed seed production is an essential component for managing herbicide resistance. Late-only application treatments have largely been dropped from our trials due to the lower yields inherently associated with them.

In the water seeded pin-point flood trial with herbicide susceptible weeds conducted at the RES, plots were drained two days prior to initial application on June 16, then kept drained until June 20 when a quick flush was applied and then re-flooded two days after late pinpoint applications on June 24. Follow-up applications of foliar herbicides require lowering of water to achieve 70% weed exposure for effective coverage of weed foliage.

Main weeds this year were late watergrass, sprangletop, smallflower umbrellasedge and ducksalad. Weed interference is often more intense in a system where water is drained for even a brief period, which encourages germination and growth of certain species. Smallflower umbrellasedge and sprangletop are usually typical weed problems in this system. Control of watergrass, sprangletop and smallflower umbrellasedge were the main determinants of final yield.
Most of the treatments tested had statistically similar yields (Table 7). The following treatment combinations provided best weed control and yield: Granite SC (35 g ai/ha) tank mixed with Clincher (280 g ai/ha) applied at the 2-4 lsr followed by Stam 4SC or Super Wham (6726 g ai/ha, 1-2 Till); Stam (4484 g ai/ha, 3-4 lsr; Regiment (30 g ai/ha, 3-4 lsr); Granite SC (35g ai/ha, 3-4 lsr); Granite SC (35g ai/ha) plus Stam (6726 g ai/ha) applied at 3-

4 lsr followed by Clincher (315 g ai/ha, 1-2 Till); Regiment (30 g ai/ha, 3-4 lsr) fb. Super Wham (6726 g ai/ha, 1-2 Till.); Super Wham (4484 g ai/ha) plus Clincher (315 g ai/ha), 3-4 lsr; Stam 4 SC (3363 g ai/ha, 3-4 lsr); Prowl H2O (1120 g ai/ha) plus Stam (3363 g ai/ha), 3-4 lsr). In a second pinpoint trial a new formulation of Clincher (Clincher EZ) was tested alongside treatments utilizing the standard Clincher formulation (Table 8). Weed control and yields were not significantly different between these comparisons. A third pinpoint trial compared combinations of herbicides with either Super Wham or Rice Shot (Table 9). Yields from these treatments were not statistically different. Rice Shot did show slightly higher rice injury than Super Wham.

1.3. Drill seeded system

Weed competition can cause significant yield loss in the drill seeded experiment, and early treatments generally providing greater than 95 percent weed control were necessary for optimum yields (Figure 3). As mentioned earlier, low weed cover is associated with high weed control.

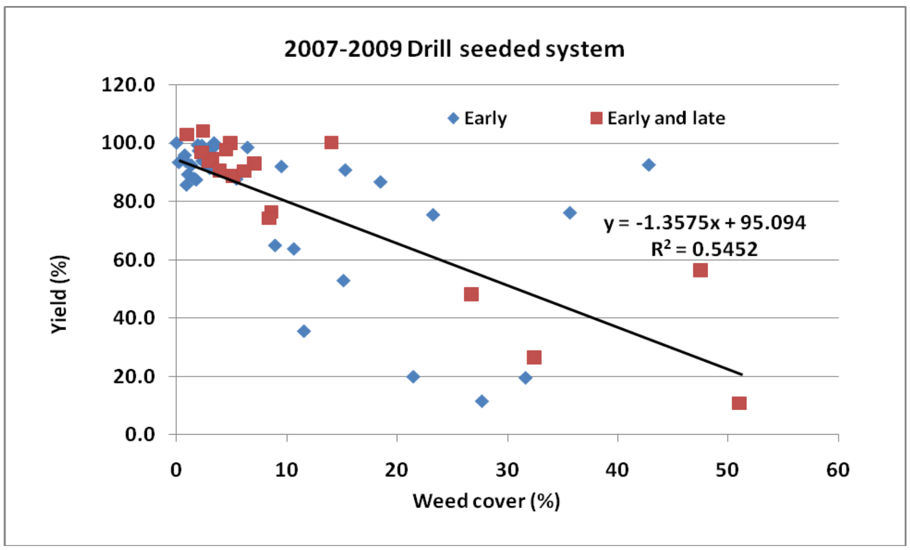

Figure 3. Weed competition in drill seeded rice; evaluations of weed infestation were conducted 40 days after seeding rice. Rice yields (percent of the maximum yield) as affected by weed cover (a measure of the intensity of weed infestation). Data are combined for the 2007 through 2009 drill seeded experiments at the RES.

In 2008, several treatments whose low yields were not consistent with the weed control level achieved suggested these treatments were injurious to rice. This was the case of Prowl H_2O (1120 g ai/ha; DPRE or at the 2-3 lsr) Abolish (4484 g ai/ha; DPRE) and the mixture of Super Wham plus Whip (4484 + 32 g ai/ha respectively) at the 3-4 lsr. Stand reduction was observed in those treatments. Several of these treatments were retained in the 2009 trial with different results. The two Prowl treatments applied alone, did not appear to be detrimental to rice. The Super Wham plus Whip treatment also did not show phytotoxicity that was noted in 2008, had good weed control and the best yield of the trial. The Abolish DPRE treatment has shown phytotoxicity in the past and was dropped from this trial in 2009 (Table 10). Rice seed was drilled into dry ground, then flush-irrigated for establishment. Additional flush irrigations were applied to insure good crop establishment. Standing water inhibits establishment of the rice that is drilled into the soil. The main weeds in this system are generally watergrass, ricefield bulrush, smallflower umbrellasedge and sprangletop, however, this season this experiment was dominated by watergrass and sprangletop.

Herbicide timing included delayed pre-emergent (DPRE) applications after the first irrigation flush, applications at the 2-3 lsr, 3-4 lsr and post permanent flood (PPF) applications (Table 10). Early control of watergrass and sprangletop that lasted through the season generally led to the highest yields in this trial. Good treatments were; Granite SC tank mixed with Prowl H2O and Clincher (35 g ai/ha plus 1120 g ai/ha, plus 315 g ai/ha respectively, 2-3 lsr); Super Wham plus Whip (4484 plus 32 g ai/ha respectively, 3-4 lsr); Clincher (280 g ai/ha, 2-3 lsr) fb. Super Wham (4484 g ai/ha, 3-4 lsr); Granite SC plus Clincher (35 plus 280 g ai/ha respectively, 2-3 lsr) fb. Super Wham (6726 g ai/ha, PPF); Regiment plus Abolish (25 plus 3360 g ai/ha respectively, 2-3 lsr) fb. Super Wham plus Clincher (6726 plus 315 g ai/ha respectively, PPF); Granite SC (35 g ai/ha, 2-3 lsr) fb. Clincher (315 g ai/ha, PPF); Prowl H_2O (1120 g ai/ha, DPRE) fb. Super Wham (4480 g ai/ha, 3-4 lsr); tank mix of Prowl, Super Wham and Clincher (1120, 4484 and 280 g ai/ha respectively, 2-3 lsr).

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 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 10). Prowl H_2O applied alone (1120 g ai/ha) as delayed pre-emergent (DPRE) has in the past provided 46% watergrass/barnyardgrass control and 33% sprangletop control at 40 DAS, however, this treatment did not control watergrass, but provided 57% control of sprangletop in 2009. Watergrass control was greatly improved when Prowl H2O DPRE was followed by Super Wham (4484 g ai/ha) at 3-4 lsr. Since it does not have post-emergence activity, Prowl (1120 g ai/ha) applied alone at the 2-3 lsr provided poor control of watergrass/barnyardgrass and no control of sprangletop. In both DPRE and 2-3 lsr there were emerged watergrass/barnyardgrass plants that are not expected to be controlled foliarly by this herbicide, therefore, weed control ratings reflect the ability of the herbicide to control non-emerged weeds; 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 10). 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. Prowl generally works better in dry/drill seeded and aerobic conditions than in water saturated soils where it gets rapidly broken down. Thus in water seeded, pin-point rice, Prowl works better when fields are drained and re-flood is slow or delayed (Table 7).

Strada WG (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 WG (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. Londax-resistant smallflower umbrellasedge is usually resistant to this herbicide.

Strada WG was tested as pinpoint applications in a basin that had been previously treated with Cerano at the day of seeding. Strada WG was applied at the 2-4 lsr timing or at the 5-6 lsr timing (Table 4). All treatments in this trial had excellent weed control and good yields. No statistical differences were noted in yield. Applications of Strada in combination with propanil following Cerano provided excellent grass and ricefield bulrush control.

Strada GR (granular formulation)

Strada GR was tested in a continuously flooded experiment (Table 2). Excellent weed control was achieved when Cerano (448 g ai/ha, DOS) was followed by an early application of Strada GR (74.5 g ai/ha, 1-3 leaf sedge) which was then followed by Stam (6726 g ai/ha, 1 Till). This treatment provided better weed control than Cerano (448 g ai/ha, DOS) followed by Stam (6726 g ai/ha) alone 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 in California rice. 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 Stam 4 SC (Table 2). This treatment provided excellent broad-spectrum (watergrass, smallflower umbrellasedge, ricefield bulrush,and ducksalad/monochoria) weed control. Rice plants at the 3 leaf stage exhibited noticeable root stunting by Granite at the suggested field rate. This effect was short lived and the plants recovered.

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

Granite SC is a fluid formulation of penoxsulam for foliar application. It has been labeled for California since 2006. It was tested in three pinpoint flood trials with flood water dropped for an application at the 3-4 lsr (Tables 5,7 & 8). High yielding treatments that included Granite SC were: Clincher tank mixed with Granite SC (280 g ai/ha and 35 g ai/ha respectively, 3-4 lsr) fb. either Stam 4SC (6726 g ai/ha, 1-2 Till or. Super Wham (6726 g ai/ha, 1-2 Till) (Table 7). Also, Granite SC plus Clincher (35 plus 315 g ai/ha respectively, 3-4 lsr) and Granite SC plus Clincher EZ (35 plus 315 g ai/ha respectively, 3-4 lsr were very good broad-spectrum treatments (Table 7). Granite SC will not control sprangletop, therefore, Clincher is generally needed for control of this weed. Granite SC was also included in tank mix combinations with Rice Shot and Super Wham applied at the 5 leaf stage of rice (Table 6). All treatments in this trial had good weed suppression and statistically similar yields.

V-10142 (75% imazosulfuron water dispersible granule)

V-10142 75 WDG is a Valent Corporation dispersible granule. Valent is pursuing registration of this formulation in California. It is intended as a tank mix partner for follow-up spray treatments after an into-the-water herbicide (Table 2). Cerano (336 g ai/ha, DOS) was followed by V-10142 75 WDG (wettable-dispersible granule formulation) (336 g ai/ha) plus Wham (propanil 4484 g ai/ha) at the 4-5 lsr. A second combination of V-10142 75 WDG (168 g ai/ha) plus Regiment (22.4 g ai/ha) was applied at 5 lsr following Bolero Ultramax (3923 g ai/ha, 2 lsr). Both treatment combinations provided good weed control and yield although the first combination had slightly higher yield. This compound is in the same class as other ALS (acetolactate synthase enzyme) inhibiting herbicides, so we would highly recommend not using it in combination with other ALS herbicides (Londax, Granite, Regiment, halosulfuron, Strada).

V-10219 (formulated mixture of thiobencarb and imazosulfuron)

V-10219 is a Valent corporation combination granule being tested for into-the-water application. This granule may not be the final formulation used for seeking registration. It was tested at three rates of application (1870 + 79, 2800 + 120 and 3203 + 134 g ai/ha of thiobencarb and imazosulfuron, respectively) at the 2 leaf stage of rice. The best weed control and yield was once again realized with the 2800 + 120 g ai/ha rate (Table 2). Precautions listed above would also apply to this material.

Stam 4SC (propanil)

Stam 4SC is a liquid suspension of propanil that is owned by UPI (United Phosphorus Inc.) and was available in 2008 in limited supply. It was tested in our continuously flooded experiment and in the pinpoint system. In the continuously flooded experiment it was applied alone following Cerano for direct comparison with Cerano followed by Super Wham

(Table 2). Weed control and yield were similar. It was also tested in tank mix with Londax with similar results. In the pinpoint trial it performed similar to other propanil formulations (Table 7).

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 implemented in 2009 in a collaborative effort with Dr. Bruce Lindquist and the rice Farm Advisors where certain alternative stand establishment techniques developed over the past five years at the Rice Experiment Station were implemented in grower fields around the valley. The majority of these involved the spring tilled stale seedbed technique where the field is conventionally tilled and rolled in the spring. Following this, the field is subject to pre-plant irrigation by flushing for a period of time necessary to get sufficient germination of the weeds deemed to be the most significant deterrent to satisfactory yields. This pre-plant irrigation is aimed at encouraging germination of watergrass (incl. "mimic"), barnyardgrass, sprangletop and smallflower umbrellasedge. Late season germinating weeds, or those requiring longer and near anaerobic flooding situations for germination, were not targeted by these technique to avoid a prolonged delay in planting rice. Once a substantial flush of weed emergence has been achieved, an application of a total, non selective, herbicide was made. The herbicide used in these cases was glyphosate, which provides control of all herbicide-resistant weed biotypes that can infest rice fields in California. One spring tilled stale seedbed implemented in 2008 in the Glenn County farm, followed this same technique and achieved excellent grass control. This season, the field was doubled in size by elimination of a road. The portion of the field where the technique was used in 2008 had far fewer grasses germinate with the flushing technique, demonstrating the ability of the stale seedbed technique to reduce weed seed bank of targeted species. By midsummer, the control of watergrass achieved in 2009 was in the low 90% range, while control of sprangletop was nearly 100% (Table 11). Highest yields in a test plot set up within this same field were in the 9,000 to 11,000 kg/ha range when the pre-plant application (stale seedbed) of glyphosate was followed at the three leaf stage of rice by either Super Wham (4484 g ai/ha), Granite SC (35 g ai/ha) or Regiment (44.5 g ai/ha) plus UAN (2% v/v). The untreated control yielded 2,268 kg/ha and plots with glyphosate alone yielded an average of 8,748 kg/ha. Grower's yields in the stale-seedbed treated field ranged from a low of 8,086 kg/ha to a high of 9,218 kg/ha. This is compared to an adjoining area in a conventional field where herbicide treatments were skipped and that yielded 5,141 kg/ha.

A fall tilled, no spring tilled field at the same farm was also subject to a stale seedbed treatment but not as many rice weeds emerged and rice stand establishment was not as good as in the spring tilled field. Grower yields for this treatment ranged from 4,827 to 6,339 kg/ha. Several other growers also tried the spring tilled stale seedbed this season. They were also successful in largely controlling resistant late watergrass. Details from this work will be reported elsewhere by those involved in its implementation.

3.2. Organic alternatives for stale seedbed

Several compounds were tested for use by organic growers in stale seedbed rice production and for potential use in conventional production to control herbicide resistant weeds. Currently available organic alternatives to glyphosate are strictly contact herbicides. They only cause burning of plant tissue that is contacted, and do not translocate in the plant. Since they do not necessarily kill the weed, there is a potential for re-growth. This has been seen in many other field crops. Rice production has an added advantage of flood water as a form of weed control. These materials were tested next to our regular spring tilled stale seedbed trial at the resistant watergrass site and at our on-station site in Biggs. The compounds used in these experiments were:

	Product name	Active ingredient	Dilution	Rate of application
1	GreenMatch	d-limonene	14 and 18%	60 gal/a
2	GreenMatch EX	lemongrass oil	10 and 15%	70 gal/a
3	Racer	ammonium nonanoate	5%	75 gal/a
4	WeedZap	clove oil and cinnamon oil	6%	70 gal/a

Initial burning of weeds was significant at both sites. The time elapsed between application and flooding at the resistant site (farm in Glenn co. mentioned early) was 5 days, which allowed for the re-growth of some treated weeds prior to implementation of the permanent flood and thus resulted in poor weed control (data not reported).

The second trial was set up in a location where rapid flooding after treatment with these compounds could be achieved. The same treatments as in the Glenn co. ”mimic” farm trial were applied here, and the field was flooded within hours. Grass control at this site was acceptable with certain treatments resulting in better yields than those of the untreated control (Table 12). Racer provided the best weed control and yield of the products tested; however, this material is unlikely to gain organic status. It may have use in conventional rice if resistance to glyphosate develops in weeds associated with rice. GreenMatch applied at 18% concentration was similar in yield to glyphosate. GreenMatch EX at either concentration was not as efficacious as GreenMatch and did not yield as well. WeedZap was not very efficacious and had low grain yield.

3.3. Exploring growth and adaptation differences between herbicide-resistant and –susceptible watergrass to detect management opportunities

Echinochloa phyllopogon (Stapf) Koss. is one of the most important weeds of rice in California, Japan and other temperate regions, and has evolved resistance in California to most available herbicides, thus severely limiting control options. Resistance to a wide variety of herbicide modes of action presents a need for non-chemical control measures.

A series of experiments were conducted to explore possible differences in *E. phyllopogon* growth, fecundity and competitive ability with rice. Growing at five densities within a rice stand, resistant (R) *E. phyllopogon* biotypes had lower biomass, relative leaf area and fecundity when compared to susceptible (S) biotypes. R-biotypes are morphologically and genetically homogeneous in California. However, rice biomass, grain weight, plant height and leaf area were not affected differently by R and S biotypes. Thus R plants' ability to interfere with rice was not disadvantaged by their inferior ability for light capture and biomass accumulation, suggesting other factors besides competition for light may be at play. These results also suggest the lower fecundity of the R biotypes could result in lower ecological fitness in the absence of herbicide selection pressure.

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. The past three seasons we have reported results of testing by including a picture showing the individual treatment effects on their 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 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.

4.2. Late watergrass resistance to quinclorac

The possibility of bringing quinclorac to California had been explored by potential registrants. Quinclorac is a watergrass/barnyardgrass herbicide with activity on certain other weeds, which is commonly used in rice fields of the south-eastern USA. In anticipation of a possible deployment of this compound in California, we decided to study whether our multiple-herbicide-resistant "mimic' would also be resistant to this herbicide. Quinclorac (3,7-dichloro-quinoline-carboxylic acid) is a pre and post emergence herbicide widely used to control grass weeds (*Echinochloa* spp., *Digitaria* spp., *Setaria* spp.) and some broadleaf species in rice and turf crops. Late watergrass (*E. phyllopogon* (Stapf) Koss.) is one of the most noxious weeds in California rice fields. It has evolved resistance (R) to multiple herbicides with different modes of action. A late watergrass biotype resistant to quinclorac has been found in a rice field of the Sacramento valley where quinclorac has never been applied. We characterized quinclorac resistance in this biotype and investigated the mechanism. Ratios (R/S) of the R to susceptible (S) GR_{50} (herbicide rate for 50% growth reduction) values ranged from 6 to 18 when quinclorac was applied as a foliar spray or hydroponically, respectively. Malathion (a cytochrome P450 monooxygenases inhibitor, P450) enhanced quinclorac reduction of chlorophyll fluorescence (Fv/Fm) and total biomass in both biotypes; thus in presence of the inhibitor, R plants became as susceptible to quinclorac as S plants. Quinclorac stimulated rapid (6 HAT) ethylene formation in S plants were increase in R plants in response to quinclorac treatment was just marginal. Pre-treatment with malathion prior to quinclorac application, did not affect ethylene formation in S and R plants. Similarly to the response to quinclorac R plants shows higher tolerant toward the co-product of ethylene biosynthesis cyanide. The resistance to quinclorac and cyanide observed in R plant is the results of higher *β*-cyanoalanine synthase activity fund in root and shoot of this biotype as compare to the activity in S plants. R plant have shown inducible *β*-cyanoalanine synthase when plant were pretreated for 48 hour with either quinclorac or KCN, the inducible and higher activity mainly found in R roots tissue. Malathion inhibits *β*-cyanoalanine synthase activity of all tissue in both R and S biotypes

These data suggest that resistance to quinclorac in the R late watergrass biotype involved two mechanisms: a) enhanced detoxification of either quinclorac or a quinclorac-induced toxicants; b) Insensitivity along the response pathway whereby quinclorac induces ethylene production ("target site resistance"). This adds new mechanisms of resistance to those already reported for this multiple-herbicide-resistant biotype that has already spread throughout most of the CA rice fields. Pre-existing resistance to quinclorac further complicates management of herbicide-resistant *E. phyllopogon* in rice.

4.3. Late watergrass resistance to clomazone

Echinochloa phyllopogon (Late watergrass) is a major weed of California rice that has evolved cytochrome P450-mediated metabolic resistance to different herbicides with multiple modes of action. *E. phyllopogon* populations from Sacramento Valley rice fields have also recently shown resistance to the herbicide clomazone. This study evaluated for the first time differential clomazone metabolism within strains of the same species to investigate whether enhanced oxidative metabolism also confers clomazone resistance to *E. phyllopogon*. Using reverse-phase liquid chromatography-tandem mass spectrometry techniques (RP-LC-MS/MS) in the multi-reaction monitoring mode (MRM) we are able to elucidate that presumably P450-mediated oxidative biotransformations are involved as a mechanism of clomazone resistance in this species. *E. phyllopogon* plants had greater hydroxylation affinity toward the isoxazolidinone ring of clomazone, while hydroxylation of the aromatic ring prevailed in the hydroponic growth medium. Clomazone hydroxylation activity was greater in resistant than in susceptible plants. The major clomazone metabolites resulted from monohydroxylation and di-hydroxylation of the isoxazolidinone ring. Resistant plants accumulated 6- to 12-fold more of the monohydroxylated metabolite compared to susceptible plants, while susceptible plants accumulated 2.5-fold more of the toxic 5-ketoclomazone. Thus, oxidative herbicide metabolism, presumably P450-mediated, endows multiple-herbicide-resistant *E. phyllopogon* with cross-resistance to clomazone, which helps explain failures to control *E. phyllopogon* with clomazone in the field. This enhanced metabolic ability to detoxify herbicides jeopardizes the control of this weed and complicates the introduction of new herbicides for rice in California.

4.4. Spring tilled stale seedbed system

This section was discussed earlier in the report under Objective 3.1.

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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. In addition, we have taken a couple of the alternative rice stand establishment systems developed from a long term study at the RES out to grower fields.
Experiments at the RES were conducted with rice 'M-206'. Advantages of the Continuous Flooded rice system include the suppression of watergrass by deeper water, which is particularly relevant when there is resistant watergrass, and the elimination of sprangletop as a problem, provided a uniform 4-inch water depth can be maintained. 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 boroad-spectrum weed control was achieved when this herbicide was followed by propanil (Super Wham, Wham, Stam, Rice Shot or Stam 4SC), Strada followed by Stam, Shark H2O, or Shark H2O plus Londax. Another successful follow-up application for Cerano was the mixture of the new compound V-10142 (imazosulfuron) plus Wham (one of the propanil products). Granite GR followed by 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. Other treatments that worked well were: V-10219 (a new into-the-water granular herbicide that is being developed by Valent Corporation that is a combination of thiobencarb and imazosulfuron), Bolero Ultramax followed by Super Wham, Abolish followed by Super Wham, Regiment, or Cerano followed by propanil tank mixed with Granite SC.

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 1-2 tiller stage after lowered (draining not needed) to expose 70% of weed foliage to the spray. Some of the best broad-spectrum treatments were: Clincher tank mixed with Granite SC followed-up by propanil, or propanil alone, Regiment alone or Regiment followed by propanil, Granite SC by itself or in tank mixture with propanil and then followed by Clincher, or Prowl plus propanil as early postemergent treatment. The new cyhalofop formulation, Clincher EZ, performed similarly to Clincher in all combinations.

Our Drill-Seeded rice was flushed with water three times for establishment (June 4, June 11, and June 22), then a final permanent flood (3-4 inches deep) was applied when rice was at the 5 leaf stage (June 29). 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: a tank mix of Prowl H2O plus Granite SC plus Clincher, Granite SC plus Clincher followed by Super Wham, Granite SC followed by Clincher, Clincher followed by Super Wham, Super Wham plus Whip, Regiment plus Abolish followed by Super Wham, Super Wham plus Clincher, Prowl H2O followed by Super Wham, or a tank mix of Prowl H2O plus Super Wham and Clincher.

Certain alternative stand establishment techniques developed over the past five years at the Rice Experiment Station were implemented on a number of cooperating grower's fields in collaboration with Dr. Bruce Lindquist and the rice Farm Advisors. 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. After the application of glyphosate, follow-up herbicides in this system during the growing season were either: Super Wham, Granite SC or Regiment. A fall tilled, no spring tilled field at the same farm did not have as many rice weeds emerge, and rice stand establishment was not as good. Several other growers also implemented the spring tilled stale seedbed technique with good success in controlling resistant late watergrass.

Several organic alternatives for stale seedbed were tested for use by organic rice growers and in order to broaden the spectrum of compounds for this system beyond just glyphosate. Currently available organic alternatives to glyphosate are strictly contact herbicides. They only cause contact burning of aerial tissue. Control by these compounds was poor when re-flood was delayed by five days, but control improved significantly for certain treatments when re-flood was imposed within a day of application. GreenMatch had the best results for a currently accepted organic herbicide in our trials.

Table 1. Herbicides used and their active ingredient

Brand name	Active ingredient
Abolish	thiobencarb
Bolero Ultramax	thiobencarb
Cerano	clomazone
Clincher	cyhalofop
Clincher EZ	cyhalofop
Granite SC	penoxsulam
Granite GR	penoxsulam

Grandstand	triclopyr
Strada WG	orthosulfamuron
Strada GR	orthosulfamuron
Londax	bensulfuron methyl
Prowl H_2O	pendimethalin
Regiment	bispyribac-sodium
Shark H_2O	carfentrazone
Stam 80 DF	propanil
Super Wham	propanil
Wham 60DF	propanil
Whip 360	fenoxaprop-p-ethyl
Ricestar HT	fenoxaprop-p-ethyl
Rounup	glyphosate
MCPA	dimethylamine salt of 2-methyl-4-chlorophenoxyacetic acid
Stam 4SC	propanil
Halomax 75	halosulfuron-methyl
RiceShot	propanil
Sandea	halosulfuron-methyl
V-10142	imazsulfuron
V-10219	imazsulfuron plus thiobencarb
Unison	2,4-dichlorophenoxyacetic acid

Table 2. Continuous flood trial - Hamilton Road.

Treatment	Rate	Timing[3]	Application date			Phytotoxicity[1] 1st						Phytotoxicity[1] 2nd						Weed Control[2]												Yield (kg/ha)
						% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	BAORO	ECHPH	SCPMU	CYPDI	HETLI	ECHPH	SCPMU	CYPDI	HETLI	MOOVA	
	(g ai/ha)		1st	2nd	3rd	7 DAT			14 DAT			7 DAT			14 DAT			23-Jun			20-Jul				4-Aug					7-Oct
Untreated[4]	---	---																6	26	2	10	4	6	6	17	3	3	1	1	4747
Cerano fb. Superwham + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 1-3 Til	3-Jun	6-Jul		NA	NA	NA	0	8	78	3	4	1				58	94	0	92	48	77	33	98	31	73	13	100	5514
Cerano fb. Stam 4 SC + COC	673 fb. 6726 + 1.25% v/v	DOS fb. 1-3 Til	3-Jun	6-Jul		NA	NA	NA	0	9	76	3	8	1				92	96	0	91	23	100	73	100	0	73	25	100	5954
Cerano fb. Stam 4 SC + Londax + COC	673 fb. 6726 + 67 + 1.25% v/v	DOS fb. 1-3 Til	3-Jun	6-Jul		NA	NA	NA	0	0	75	7	8	9				67	96	0	80	67	92	56	96	67	75	25	100	5442
Cerano fb. Strada GR fb. Stam + COC	448 fb. 74.5 fb. 6726 + 1.25% v/v	DOS fb. 1-3 leaf sedge fb. 1 Til	3-Jun	15-Jun	6-Jul	NA	NA	NA	0	6	31	0	0	3	0	4	0	67	98	100	91	100	100	72	94	100	100	100	50	5534
Cerano fb. Stam + COC	448 fb. 6726 + 1.25% v/v	DOS fb. 1 Til	3-Jun	6-Jul		NA	NA	NA	0	4	23	1	7	1				57	86	0	89	74	92	67	88	80	82	46	75	5582
Cerano fb. Strada GR fb. Stam + Siapton + COC	448 fb. 74.5 fb. 6726 + ? + 1.25% v/v	DOS fb. 1-3 leaf sedge fb. 1 Til	3-Jun	15-Jun	6-Jul	NA	NA	NA	0	16	39	0	6	11	0	18	1	67	98	100	53	88	96	94	100	100	100	100	100	4449
V-10219	2800 + 120	2 lsr	15-Jun			0	0	0	0	1	0							23	95	100	94	100	94	78	98	100	82	88	100	6037
V-10219	1870 + 79	2 lsr	15-Jun			0	1	0	0	3	0							60	86	100	68	93	84	64	52	100	90	88	0	5221
V-10219	3203 + 134	2 lsr	15-Jun			0	0	0	0	0	0							39	81	83	69	25	95	50	69	56	100	50	50	5935
Cerano fb. V-10142 + Wham 60 DF	336 fb. 336 + 4484	DOS fb. 4-5 lsr	3-Jun	29-Jun		NA	NA	NA	0	1	8	0	0	5	0	0	0	60	89	0	69	88	100	17	81	92	95	13	100	6068
Bolero Ultramax fb. V10142 + Regiment	3923 fb. 168 + 22.4	2 lsr fb. 5 lf	15-Jun	29-Jun		0	0	1	0	2	0	3	0	0	4	0	0	62	46	75	94	88	99	89	98	93	100	100	25	5613
Untreated																		3	29	1	9	2	5	5	8	4	4	1	1	5326
Granite GR fb. Stam 4 SC + COC	40 fb. 6726 + 2.5% v/v	2-3 lsr fb. 1-3Til	17-Jun	6-Jul		0	0	3	0	4	2	8	8	1				37	84	100	94	100	100	100	100	100	100	100	100	5729
Shark H_2O fb. SuperWham + COC	224 fb. 6726 + 1.25% v/v	2-3 lsr fb. 1-3 Til	17-Jun	6-Jul		0	3	0	0	4	1	0	3	4				10	40	100	39	88	96	90	44	100	100	100	100	5154
Abolish fb. SuperWham + COC	4480 fb. 6726 + 1.25% v/v	PFS bf. 1-3 til	29-May	6-Jul		NA	NA	NA	0	1	0	1	0	1				49	59	88	76	100	92	64	86	100	100	75	0	5840
Bolero Ultramax fb. Superwham + COC	4480 fb. 6726 + 1.25% v/v	1-2 lsr fb. 1-3 Til	15-Jun	6-Jul		0	1	0	0	2	0	0	1	3				40	25	67	69	55	69	32	61	63	33	0	0	5692
SuperWham + COC	6726 + 1.25% v/v	1-3 Til	6-Jul			0	1	3										NA	NA	NA	72	93	100	45	79	100	100	25	0	6129
Superwham + Grandstand + COC	6726 + 280 + 1.25% v/v	1-3 Til	6-Jul			0	0	2										NA	NA	NA	58	88	100	70	28	94	100	100	25	5747
Regiment + NIS	37 + .125% v/v	1-3 Til	6-Jul			0	5	1										NA	NA	NA	60	80	86	53	81	85	30	100	50	5795
LSD (P=0.05)																														969

[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 May 29 to dry soil prior to flood
2. Trial seeded June 3, 2009 with 150 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 3.
   Watergrass was 1-2 leaf, ricefield bulrush was 1-2 leaf, smallflower was 1-2 leaf and ducksalad was 2 leaf on June 15.
   Watergrass was 1-2 leaf, ricefield bulrush was 1-2 leaf, smallflower was 1-2 leaf and ducksalad was 2 leaf on June 17.
   Watergrass was 1-2 tiller, ricefield bulrush was 5 leaf, ducksalad was flowering on June 29.
   Watergrass was 2 tiller, ricefield bulrush was 2 tiller,smallflower was 1-2 tiller, ducksalad was flowering on July 6.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on May 29: Air temperature 77o F, wind 1-2 MPH from the Southwest.
   Weather conditions on June 3: Air temperature 73o F, wind 2-3 MPH from the West.
   Weather conditions on June 15: Air temperature 66o F, wind 2-3 MPH from the South.
   Weather conditions on June 17: Air temperature 76o F, wind 2-3 MPH from the Southwest.
   Weather conditions on June 29: Air temperature 90o F, wind 0-3 MPH from the South.
   Weather conditions on July 6: Air temperature 80o F, wind 0-2 MPH from the southwest.

Table 3. FMC continuous flood - Hamilton road

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st						Phytotoxicity[1] 2nd						Weed Control[2]								Yield (kg/ha)
					% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	ECHPH	HETLI	BAORO	ECHPH	HETLI	MOOVA	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			23-Jun		13-Jul			2-Aug			8-Oct
Untreated[4]	--	--															2	5	3	12	1	6	1	2	4813
Cerano fb. Shark H_2O 40 DF	673 fb. 224	DOS fb. 2-4 lsr	3-Jun	17-Jun	NA	NA	NA	0	0	54	0	38	10	0	31	3	100	94	90	100	100	98	100	100	6523
Cerano fb. Shark H_2O 40 DF	673 fb. 196	DOS fb. 2-4 lsr	3-Jun	17-Jun	NA	NA	NA	0	0	45	0	20	14	0	24	5	100	96	90	100	100	93	100	100	6534
Cerano fb. Shark H_2O 40 DF + Londax	673 fb. 224 + 70	DOS fb. 2-4 lsr	3-Jun	17-Jun	NA	NA	NA	0	0	50	0	35	10	0	46	19	100	96	90	100	100	95	100	100	6335
Cerano fb. Shark H_2O 40 DF + Londax	673 fb. 196 + 70	DOS fb. 2-4 lsr	3-Jun	17-Jun	NA	NA	NA	0	0	48	0	23	13	0	26	11	100	96	100	100	100	98	100	100	6448
Cerano fb. Shark H_2O 40 DF	448 fb. 224	DOS fb. 2-4 lsr	3-Jun	17-Jun	NA	NA	NA	0	1	10	0	0	4	0	4	3	76	78	60	99	88	65	100	100	6280
Shark H_2O 40 DF + Bolero	224 + 4484	2-4 lsr	17-Jun		0	0	1	0	3	1							66	0	30	90	100	56	100	100	6860
LSD (P=0.05)																									1040

[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, 2009 with 150 lbs per acre of M206
2. Trial managed as a continuous flood with 4-5 inches.
3. No weeds visible on June 3.
   Watergrass was 2-3 leaf, bulrush was 2 leaf, and ducksalad was 2-3 leaf on June 17.
4. Weather conditions on June 3: Air temperature 73o F, wind 2-3 MPH from the West.
   Weather conditions on June 17: Air temperature 76^o F, wind 2-3 MPH from the southwest.

Table 4. Isagro pinpoint - Hamilton road

					Phytotoxicity[1]												Weed Control2								
					1st						2nd														
Treatment	Rate	Timing[3]	Date		% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	ECHPH	HETLI	MOOVA	BAORO	ECHPH	SCPMU	HETLI	MOOVA	Yield (kg/ha)
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			13-Jul				2-Aug				7-Oct
Cerano fb. Stam + COC	448 fb. 4484 + 1.25% v/v	DOS fb. 3-4 lsr	3-Jun	24-Jun	0	0	0	0	0	1	0	0	0	0	1	0	0	47	75	38	100	100	88	66	7547
Cerano fb. Stam + COC	448 fb. 6726 + 1.25% v/v	DOS fb. 5-6 lsr	3-Jun	30-Jun	0	0	0	0	0	1	0	1	0	0	0	0	50	91	83	88	100	100	100	66	7803
Cerano fb. Strada + Stam + COC	448 fb. 73.5 + 6726 + 1.25% v/v	DOS fb. 5-6 lsr	3-Jun	30-Jun	0	0	0	0	0	1	0	2	0	0	0	1	100	97	83	75	100	100	100	66	7868
Cerano fb. Stam + Grandstand + COC	448 fb. 6726 + 158 + 1.25% v/v	DOS fb. 5-6 lsr	3-Jun	30-Jun	0	0	0	0	0	1	0	1	1	0	0	0	100	95	83	75	100	100	100	66	7398
Cerano fb. Strada + Stam + Grandstand + COC	448 fb. 73.5 + 6726 + 158 + 1.25% v/v	DOS fb. 5-6 lsr	3-Jun	30-Jun	0	0	0	0	0	1	0	0	0	0	0	0	75	98	92	100	100	100	100	74	7532
Cerano fb. Strada + Stam + Siapton + COC	448 fb. 73.5 + 6726 + 321 + 1.25% v/v	DOS fb. 5-6 lsr	3-Jun	30-Jun	0	0	0	0	0	1	0	1	1	0	0	0	100	98	100	100	100	100	100	83	7867
LSD (P=0.05)																									968

[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).

Trial Information

1. Trial seeded June 3, 2009 with 150 lbs per acre of M206
2. Trial managed as a pinpoint flood after initial water hold for Cerano. Water drained June 11 and final flood on June 14.
3. No weeds visible on June 3.
   Watergrass was 4-5 leaf, ricefield bulrush was 3-4 leaf, ducksalad was 3-4 leaf on June 24.
   Watergrass was 1-2 tiller, ricefield bulrush was 5 leaf, bulrush was 4 leaf, ducksalad was 4 leaf, waterhyssop was 4 leaf on June 30.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 3: Air temperature 73o F, wind 2-3 MPH from the West.
   Weather conditions on June 24: Air temperature 94o F, wind 0-1 MPH from the south.
   Weather conditions on June 30: Air temperature 71o F, wind 1-2 MPH from the south.

Table 5. RiceCo continuous flood - Hamilton road

					Phytotoxicity[1]												Weed Control[2]												
					1st						2nd																		
Treatment	Rate	Timing[3]	Date		% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	SCPMU	HETLI	BAORO	ECHPH	SCPMU	HETLI	MOOVA	ECHPH	SCPMU	HETLI	MOOVA	Yield (kg/ha)
	(g ai/ha)		1st	2nd	1 DAT			3 DAT			7 DAT			14 DAT			23-Jun				13-Jul				4-Aug				7-Oct
Cerano[4]	560.5	DOS	3-Jun														10	0	92	31	88	0	0	0	54	0	40	13	6141
Cerano fb. Riceshot + Agridex	560.5 fb. 6726 + 0.5% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	1	0	0	3	3	0	3	0	0	1	29	0	90	33	100	100	95	25	67	48	72	65	6731
Cerano fb. SuperWham + Agridex	560.5 fb. 6726 + 1.0% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	0	0	0	0	0	1	1	0	0	0	25	0	88	46	100	100	92	25	81	79	48	52	6992
Cerano fb. Riceshot + Granite SC + Agridex	560.5 fb. 6726 + 35 + 0.5% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	2	0	0	4	0	0	2	0	0	1	25	0	88	27	100	100	96	50	100	60	81	73	6901
Cerano fb. SuperWham + Granite SC + Agridex	560.5 fb. 6726 + 35 + 1.0% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	0	0	0	0	0	0	1	0	0	0	17	0	92	23	100	100	95	25	88	100	75	65	7037
Cerano fb. Riceshot + Unison + Agridex	560.5 fb. 6726 + 122 + 0.5% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	1	0	0	3	1	0	1	0	0	0	27	0	92	0	100	100	93	0	60	35	60	67	6849
Cerano fb. SuperWham + Unison + Agridex	560.5 fb. 6726 + 122 + 1.0% v/v	DOS fb. Mid till.	3-Jun	7-Jul	0	0	0	0	0	0	0	0	1	0	0	0	31	0	90	2	100	92	91	0	56	13	60	71	7103
Untreated																	12	2	13	3	3	3	30	1	3	3	3	4	4112
Bolero	3363	1-3 lsr	15-Jun														2	75	5	100	37	33	0	0	13	6	54	4	4768
Bolero fb. Riceshot + Agridex	3363 fb. 6726 + 0.5% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	1	1	0	0	5	0	0	3	0	0	1	17	63	0	100	53	100	93	25	65	75	67	38	5370
Bolero fb. SuperWham + Agridex	3363 fb. 6726 + 1.0% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	1	1	0	0	0	0	0	0	0	0	0	4	75	1	100	58	100	95	0	48	100	60	46	5237
Bolero fb. Riceshot + Granite SC + Agridex	3363 fb. 6726 + 35 + 0.5% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	1	1	0	1	2	1	0	2	0	0	1	13	100	38	100	58	100	93	0	60	88	92	46	5211
Bolero fb. SuperWham + Granite SC + Agridex	3363 fb. 6726 + 35 + 1.0% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	1	1	0	0	0	0	0	0	0	0	0	21	75	0	100	63	100	97	25	48	100	79	52	4999
Bolero fb. Riceshot + Unison + Agridex	3363 fb. 6726 + 122 + 0.5% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	1	1	0	0	5	1	0	2	0	0	0	19	75	0	100	53	88	88	25	60	73	85	52	5491
Bolero fb. SuperWham + Unison + Agridex	3363 fb. 6726 + 122 + 1.0% v/v	1-3 lsr fb. Mid till	15-Jun	7-Jul	0	2	1	0	0	0	0	0	2	0	0	0	17	50	0	100	58	100	93	0	40	69	67	60	5078
LSD (P=0.05)		Mid till = 3-4 till																											694

[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 3, 2009 with 150 lbs per acre of M206
2. Trial managed as a pinpoint flood with flood water lowered July 6 and reflood July 8.
3. No weeds were visible on June 3..
   Watergrass was 2 leaf, ricefield bulrush was 1-2 leaf, smallflower umbrellasedge was 2 leaf and ducksalad was 2 leaf on June 15.
   Watergrass was 2-3 tiller, ricefield bulrush was 1-3 tller and ducksalad was flowering on July 7.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on June 3: Air temperature 66^{o} F, wind 1-3 MPH from the south.
   Weather conditions on July 7: Air temperature 73^{o} F, wind 3-4 MPH from the south.

Table 6. FMC continuous flood - J-9

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1] 1st						Phytotoxicity[1] 2nd						Weed Control[2]				Yield (kg/ha)
					% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	ECHPH	HETLI	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			8-Jun		21-Jun		1-Oct
Untreated[4]	--	--															38	2	13	3	3229
Cerano fb. Shark H_2O 40 DF	673 fb. 224	DOS fb. 2-4 lsr	12-May	26-May				0	5	6	0	8	1	0	1	1	68	42	40	52	5459
Cerano fb. Shark H_2O 40 DF	673 fb. 196	DOS fb. 2-4 lsr	12-May	26-May				0	6	6	0	4	1	0	0	1	72	17	46	42	5729
Cerano fb. Shark H_2O 40 DF + Londax	673 fb. 224 + 70	DOS fb. 2-4 lsr	12-May	26-May				0	5	5	0	8	1	0	1	4	82	17	59	50	6115
Cerano fb. Shark H_2O 40 DF + Londax	673 fb. 196 + 70	DOS fb. 2-4 lsr	12-May	26-May				0	3	5	0	5	1	0	0	1	97	42	83	60	7175
Cerano fb. Shark H_2O 40 DF	448 fb. 224	DOS fb. 2-4 lsr	12-May	26-May				0	3	3	0	0	1	0	0	0	30	0	0	50	4848
Shark H_2O 40 DF + Bolero	224 + 4484	2-4 lsr	26-May		0	3	0	0	0	0							54	29	47	69	4913
LSD (P=0.05)																					1420

[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 12, 2009 with 150 lbs per acre of M205
2. Trial managed as a continuous flood with 4-5 inches.
3. No weeds visible on May 12.
   Watergrass was 1-2 leaf, bulrush was 1-2 leaf, and ducksalad was 2 leaf on May 26.
4. Weather conditions on May 12: Air temperature 82^o F, wind 2-4 MPH from the West.
   Weather conditions on May 26: Air temperature 98^o F, wind 1-2 MPH from the south southwest.

Table 7. Pinpoint Trial - Hamilton Road

					Phytotoxicity[1]												Weed Control[2]								
					1st						2nd														
Treatment	Rate	Timing[3]	Date		% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	ECHPH	CYPDI	HETLI	ECHPH	LEEFA	CYPDI	Yield (kg/ha
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			23-Jun		13-Jul			11-Aug			7-Oct
Untreated[4]																	3	6	7	12	23	8	1	14	4500
Clincher + Granite SC + COC fb. Stam 4 SC + COC	280 + 35 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	0	0	0				0	0	1	0	0	0	NA	NA	92	92	97	98	25	98	7441
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	24-Jun	6-Jul	0	0	0				0	0	0	0	0	0	NA	NA	100	95	93	94	25	94	6814
Prowl H2O	1120	3-4 lsr	16-Jun		NA	NA	NA	0	1	0							0	0	23	0	4	7	75	0	4632
Prowl H2O + Stam 4SC + COC	1120 + 3363 + 1.25% v/v	3-4 lsr	16-Jun		NA	NA	NA	0	1	0							6	2	89	94	59	86	75	82	6373
Stam 4SC + COC	3363 + 1.25% v/v	3-4 lsr	16-Jun		NA	NA	NA	0	0	0							75	83	78	69	50	70	25	82	6409
Granite SC + COC	35 + 2.5% v/v	3-4 lsr	24-Jun		0	0	1										NA	NA	100	95	100	97	0	93	6636
Granite SC + Stam + COC fb. Clincher + COC	35 + 6726 + 2.5% v/v fb. 315 + 2.5% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	0	1	3				1	0	4	0	0	0	NA	NA	84	100	42	94	75	96	6601
Untreated																			100	88	90	95	50	92	
Clincher + COC	315 + 2.5% v/v	3-4 lsr	24-Jun		0	0	0										NA	NA	100	0	0	85	100	0	5246
Clincher + COC fb. Stam + COC	315 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	0	1	0				2	2	1	0	0	0	NA	NA	100	93	86	73	75	92	6213
Super Wham + Clincher + COC	4484 + 315 + 2.5% v/v	3-4 lsr	24-Jun		0	1	0										NA	NA	93	100	23	82	100	97	6421
Regiment + NIS	30 + 0.125% v/v	3-4 lsr	24-Jun		0	0	6										NA	NA	98	95	99	82	50	70	6713
Regiment + NIS fb. Super Wham + COC	30 + .125% v/v fb. 6726 + 1.25% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	1	3	6				0	0	1	0	0	0	NA	NA	100	97	100	91	25	95	6494
Abolish	3363	3-4 lsr	24-Jun		0	0	0										NA	NA	0	64	1	0	75	32	5320
Regiment + Abolish	30 + 3363	3-4 lsr	24-Jun		0	0	4										NA	NA	73	68	80	57	75	60	6327
Stam 80 EDF + COC	4484 + 1.25% v/v	3-4 lsr	24-Jun		1	0	0										NA	NA	38	95	39	67	50	97	6889
LSD (P=0.05)																									1159

[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 3, 2009 with 150 lbs per acre of M206
2. Trial managed as a pinpoint flood with flood water drained June 15, flushed June 22 reflood June 26.
3. Watergrass was 2 leaf, bulrush was 0.5", ducksalad was 2 leaf, smallflower was 0.5" on June 16.
   Watergrass was 4-5 leaf, ricefield bulrush was 4 leaf and ducksalad was 3-4 leaf on June 24.
   Watergrass was 2-3 tiller, ricefield bulrush was 1-3 tiller, smallflower was flowering and ducksalad was flowering on July 6.
5. Spray applications made with 20 gallons/acre using 8003 nozzles.
6. Weather conditions on June 16: Air temperature 73^{o} F, wind 2-4 MPH from the south.
   Weather conditions on June 24: Air temperature 94^{o} F, wind 0-1 MPH from the south.
   Weather conditions on July 6: Air temperature 73^{o} F, wind 0-1 MPH from the south.

Table 8. DOW Pinpoint Trial - Hamilton Road

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1]												Weed Control[2]								Yield (kg/ha)
					1st						2nd														
					% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	SCPMU	HETLI	MOOVA	ECHPH	SCPMU	CYPDI	MOOVA	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			13-Jul				11-Aug				7-Oct
Untreated[4]																	7	1	5	2	10	15	2	2	6498
Clincher + COC	284 + 2.5% v/v	3-4 lsr	24-Jun		0	0	0	0	0	0							26	50	0	0	89	0	0	8	6821
Clincher EZ + COC	284 + 2.5% v/v	3-4 lsr	24-Jun		0	0	0	0	2	0							24	0	0	0	66	0	0	33	6964
Clincher + COC	315 + 2.5% v/v	3-4 lsr	24-Jun		0	0	1	0	2	0							39	0	0	0	94	0	13	42	7106
Clincher EZ + COC	315 + 2.5% v/v	3-4 lsr	24-Jun		0	3	0	0	1	0							0	0	0	0	98	0	25	67	7295
Clincher + Granite SC + COC	315 + 35 + 2.5% v/v	3-4 lsr	24-Jun		0	0	2	0	1	0							77	0	81	88	69	75	88	75	7800
Clincher EZ + Granite SC + COC	315 + 35 + 2.5% v/v	3-4 lsr	24-Jun		0	0	5	0	1	0							0	0	0	75	88	38	75	100	7652
Clincher + Stam + COC	315 + 6726 + 2.5% v/v	3-4 lsr	24-Jun		0	0	3	0	0	0							68	0	67	0	80	93	88	17	7348
Clincher EZ+ Stam + COC	315 + 6726 + 2.5% v/v	3-4 lsr	24-Jun		0	0	3	0	0	0							63	0	46	0	92	95	100	42	7664
Clincher + Stam 4SC + COC	315 + 6726 + 2.5% v/v	3-4 lsr	24-Jun		3	0	1	0	0	0							92	98	0	0	89	98	100	75	7634
Clincher EZ+ Stam 4SC+ COC	315 + 6726 + 2.5% v/v	3-4 lsr	24-Jun		0	0	4	0	0	0							73	25	3	0	92	97	100	67	7987
Clincher + COC fb. Stam 4SC + COC	315 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	0	0	0	0	1	2	0	0	0	0	0	0	81	100	44	75	100	86	100	42	7725
Clincher EZ + COC fb. Stam 4SC + COC	315 + 2.5% v/v fb. 6726 + 2.5% v/v	3-4 lsr fb. 1-2 Til	24-Jun	6-Jul	0	0	1	0	2	2	0	0	0	0	0	0	56	100	44	50	98	84	100	50	7937
LSD (P=0.05)																									790

[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 3, 2009 with 150 lbs per acre of M206
2. Trial managed as a pinpoint flood with flood water drained June 22 reflood June 26.
3. Watergrass was 4-5 leaf, ricefield bulrush was 4 leaf and ducksalad was 3-4 leaf on June 24.
   Watergrass was 2-3 tiller, ricefield bulrush was 1-3 tiller, smallflower was flowering and ducksalad was flowering on July 6.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 24: Air temperature 94o F, wind 0-1 MPH from the south.
   Weather conditions on July 6: Air temperature 73^{o} F, wind 0-1 MPH from the south.

Table 9. RiceCo pinpoint flood - Hamilton road

				Phytotoxicity[1]												Weed Control[2]						
				1st						2nd												
Treatment	Rate	Timing[3]	Date	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	% Stunting	% Stand	% Injury	ECHPH	HETLI	MOOVA	ECHPH	SCPMU	MOOVA	Yield (kg/ha)
	(g ai/ha)		1st	1 DAT			3 DAT			7 DAT			14 DAT			13-Jul			2-Aug			7-Oct
Untreated[4]																2	8	2	1	1	2	6070
Riceshot + Agridex	5605 + 0.5% v/v	5 lsr	29-Jun	0	0	2	0	1	4	0	0	7	0	0	6	42	56	13	48	75	46	6689
Riceshot + Granite SC + Agridex	5605 + 35 + 0.5% v/v	5 lsr	29-Jun	0	0	3	0	1	4	0	0	6	0	0	5	67	97	29	57	100	54	6328
Riceshot + Clincher EZ + Agridex	5605 + 284 + 0.5% v/v	5 lsr	29-Jun	0	0	2	0	2	3	0	0	4	0	0	4	41	79	25	57	100	54	6602
Riceshot + Granite SC + Clincher EZ + Agridex	5605 + 35 + 284 + 0.5% v/v	5 lsr	29-Jun	0	0	1	0	0	0	0	0	1	0	0	1	85	96	0	79	100	83	6443
SuperWham + Agridex	5605 + 1.25% v/v	5 lsr	29-Jun	0	0	1	0	1	1	0	0	1	0	0	1	44	81	17	43	100	46	6826
SuperWham + Granite SC + Agridex	5605 + 35 + 1.25% v/v	5 lsr	29-Jun	0	0	1	0	1	1	0	0	2	0	0	1	50	92	46	43	100	46	6525
SuperWham + Clincher EZ + Agridex	5605 + 284 + 1.25% v/v	5 lsr	29-Jun	0	0	1	0	0	1	0	0	4	0	0	3	71	87	8	62	92	54	6720
SuperWham + Granite SC + Clincher EZ + Agridex	5605 + 35 + 284 + 1.25% v/v	5 lsr	29-Jun	0	0	1	0	2	1	0	0	4	0	0	2	78	92	29	62	100	63	6467
Regiment + Abolish	30 + 3363	5 lsr	29-Jun	0	0	0	0	1	0	0	0	1	0	0	4	79	96	-50	62	67	54	6508
LSD (P=0.05)																						697

[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 3, 2009 with 150 lbs per acre of M206
2. Trial managed as a pinpoint flood with flood water drained June 28 reflood June 30.
3. Watergrass was 1 tiller, bulrush was 5 leaf, ducksalad was flowering on June 29.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 29: Air temperature 96^{o} F, wind 3-5 MPH from the southwest.

Table 10. Drill seeded trial -Hamilton Road

Treatment	Rate	Timing[3]	Date		Phytotoxicity[1]												Weed Control[2]						Yield (kg/ha)
					1st						2nd												
					% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	% Stunt	% Stand	% Injury	ECHPH	LEFFA	ECHPH	LEFFA	ECHPH	LEFFA	
	(g ai/ha)		1st	2nd	7 DAT			14 DAT			7 DAT			14 DAT			13-Jul		28-Jul		2-Aug		7-Oct
Untreated[4]	---	---															20	20	15	12	8	8	3746
Prowl H2O	1120	DPRE	8-Jun														19	79	59	62	1	57	4955
Prowl H2O fb. Super Wham + COC	1120 fb. 4480 + 1.25 % v/v	DPRE fb. 3-4 lsr	8-Jun	24-Jun							0	2	5	0	1	0	91	78	96	80	94	70	7109
Prowl H2O	1120	2-3 lsr	17-Jun		0	0	0	0	0	0							90	23	73	59	47	0	5048
Prowl H2O + Super Wham + Clincher + COC	1120 + 4484 + 280 + 1.25 % v/v	2-3 lsr	17-Jun		0	5	0	0	1	0							85	52	90	67	74	61	6823
Regiment + Abolish fb. Super Wham + Clincher + COC	25 + 3360 fb. 6726 + 315 + 1.25 % v/v	2-3 lsr fb. PPF	17-Jun	6-Jul	0	3	0	1	8	0							96	90	82	95	99	68	7371
Super Wham + Whip + COC	4484 + 32 + 1.25 % v/v	3-4 lsr	24-Jun		0	1	2	0	0	0							95	75	88	87	93	69	7787
Clincher + COC fb. Superwham + COC	280 + 2.5% v/v fb. 4480 + 1.25% v/v	2-3 lsr fb. 3-4 lsr (AFF)	17-Jun	24-Jun	0	0	0	0	6	1	0	3	2	0	2	1	99	78	97	80	100	58	7586
Granite SC + COC fb. Clincher + COC	35 + 2.5% fb. 315 + 2.5% v/v	2-3 lsr fb. PPF	17-Jun	6-Jul	0	0	0	0	3	0							100	33	98	78	100	45	7302
Granite SC + Prowl H2O + Clincher + COC	35 + 1120 + 315 + 2.5 % v/v	2-3 lsr	17-Jun		0	0	0	0	4	0							99	92	99	86	100	81	7734
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	17-Jun	6-Jul	0	0	0	0	0	0							99	76	98	83	100	83	7543
KSU 12800	327	DPRE	8-Jun														19	72	36	53	2	62	4108
LSD (P=0.05)																							1540

[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, 2009 with 120 lbs per acre of M206
2. Trial managed as a drill seeded with initial flush on June 4, additional flushes on June 11, June 22 with final flood on June 29.
3. No weeds present on June 8.
   Watergrass was 2-3 leaf, ducksalad 2-3 leaf, smallflower 2" on June 17.
   Watergrass was 3-4 leaf, sprangletop was 3 leaf and smallflower was 1" on June 24.
   Watergrass was 1-2 tiller, sprangletop was tillering, smallflower was 4-6" on July 6.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on June 8: Air temperature 64^{o} F, wind 1-3 MPH from the southwest.
   Weather conditions on June 17: Air temperature 76^{o} F, wind 1-2 MPH from the southwest.
   Weather conditions on June 24: Air temperature 94^{o} F, wind 0-1 MPH from the south.
   Weather conditions on July 6: Air temperature 66o F, wind 1-2 MPH from the southwest.

Table 11. Stale seedbed - resistant site

Treatment	Rate	Timing[3]	Date		Weed Control[2] ECHPH	LEEFA	SCPMU	CYPDI	Yield (kg/ha)
	(g ai/ha)				6-Aug				24-Sep
Untreated[4]					9	26	2	4	2268
Roundup + UAN	v/v + 2% v/v	After flush	28-May		92	97	63	100	8748
Roundup + UAN fb. Super Wham + COC	2% v/v + 2% v/v fb. 4484 + 1.25% v/v	After flush fb. 3-4lsr	28-May	6-Jul	93	99	92	100	11219
Roundup + UAN fb. Granite SC + COC	2% v/v + 2% UAN fb. 35 + 2.5% v/v	After flush fb. 3-4lsr	28-May	6-Jul	90	100	63	100	10596
Roundup + UAN fb. Granite SC + Clincher + COC	2% v/v + 2% UAN fb. 35 + 315 + 2.5% v/v	After flush fb. 3-4lsr	28-May	6-Jul	90	98	88	100	9404
Roundup + UAN fb. Regiment + NIS + UAN	2% v/v + 2% v/v fb. 44.5 + 0.25% v/v + 2.0% v/v	After flush fb. 3-4lsr	28-May	6-Jul	88	99	50	79	10305
LSD (P=0.05)									1658

[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
May 3 Flood field and hold shallow water to keep soil wet
May 20 Begin drain of field
May 28 Plots layed out in an area of the field where there was an even stand of weeds and stale seedbed treatments applied
May 29 main field sprayed with 2% glyphosate using ground rig
June 2 field flooded
June 4 Seed applied at 180lb/a, M104
June 9 ammonium sulfate applied at 158 units of N/a
July 3 Drain field
July 6 follow up treatments applied to test plots
July 9 Apply 2oz/a Granite SC to main field, forgot to add crop oil
July 10 applied 6lb ai/a propanil to main field
July 12 Flood field
July 20 applied Quadris

2. Trial managed as a stale seedbed with pinpoint drain for foliar herbicide applications.
3. Watergrass and sprangletop were 2-3 leaf, bulrush was 1-2 leaf, smallflower ws 1-2 leaf, ducksalad was 1-2 leaf on May 28.
   Watergrass was 3 tiller, sprangletop was headed, smallflower was flowering, ducksalad was early flower, redstem 5 leaf on July 6.
4. Spray applications made with 20 gallons/acre using 8003 nozzles.
5. Weather conditions on May 28: Air temperature 92^{o} F, wind 0-2 MPH from the southwest.
   Weather conditions on July 6: Air temperature 84^{o} F, wind 1-2 MPH from the east.

Table 12. Organic stale seedbed - Hamilton Road

Treatment	Rate	Timing[3]	Date	Weed Control[2] ECHPH	Weed Control[2] LEEFA	Yield (kg/ha)
	(g ai/ha)			14-Aug		17-Oct
Untreated[4]				54	25	0
Roundup + UAN	2% v/v + 2% v/v	After flush	17-Jun	84	49	3689
Greenmatch + Nu-Film-P	14% v/v + 0.2% @ 1 liter/plot	After flush	17-Jun	78	81	3368
Greenmatch + Nu-Film-P	18% v/v + 0.2% @ 1 liter/plot	After flush	17-Jun	85	78	3670
Greenmatch EX + Nu-Film-P	10% v/v + 0.2% @ 1.2 liters/plot	After flush	17-Jun	43	21	1784
Greenmatch EX + Nu-Film-P	15% v/v + 0.2% @ 1.2 liters/plot	After flush	17-Jun	65	70	2423
Racer + Nu-Film-P	7% v/v + 1% @ 1.3 liters/plot	After flush	17-Jun	99	92	4499
WeedZap + Nu-Film-P	6% v/v + 1% v/v @ 1.2 liters/plot	After flush	17-Jun	64	0	1904
LSD (P=0.05)						950

[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

June 1 Flood field and hold shallow water to keep soil wet

June 14 Begin drain of field

June 17 Burn down treatments applied to test plots

June 18 Field flooded

June 19 Seed applied at 150lb/a, M206

2. Trial managed as a stale seedbed
3. Watergrass and sprangletop were 1-2 leaf on June 17.
4. Spray applications made with 20 gallons/acre for Roundup and 60-70 gallons/acre for organic herbicices using 8003 nozzles.
5. Weather conditions on June 17: Air temperature 72^{o} F, wind 0-4 MPH from the south.