Comprehensive Research Program on Rice

Progress Report - January 1 to December 31, 1974

PROJECT NUMBER AND TITLE: RM-1, Integration and Improvement of Agronomic Practices for Rice Production.

PROJECT LEADER: D. E. Seaman, Agronomy and Range Science Department

PERSONNEL: D. E. Seaman and B. W. Brandon

OBJECTIVES:

(1) To evaluate new systems of rice culture in which improved crop management practices are integrated for maximum production efficiency of standard and improved rice varieties.

(2) To develop new or alternative crop-management practices, or appropriate combinations of them, that are likely to improve rice stand establishment, growth, yield and grain quality or to minimize management problems and costs.

(3) To determine the cultural and crop-protection requirements of improved California rice varieties and to develop suitable management systems for optimum grain-production economy.

(4) To investigate morphological, physiological, cultural or environmental factors affecting the responses of different rice genotypes to herbicides and other agricultural chemicals.

(5) To develop techniques of low-altitude aerial observation and photography for detection of cultural or management problems and the occurrence, distribution and control of weeds in California rice fields.

WORK IN PROGRESS:

(1) Studies of integrated systems of rice culture, including rice varietal interactions with different water depths, fertilizer rates and weed control methods.

(2) Studies of integrated systems of crop protection, including the development of weighted seed coatings containing fungicides and herbicides, the evaluation of new chemicals for control of algae and aquatic weeds that affect stand establishment, and the evaluation and development of new herbicide combinations suitable for improved rice varieties.

(3) Improvement of greenhouse methods of screening potential new rice varieties for possible adverse reactions to common herbicides and of determining the causes of these responses.

(4) Completion of yield-component measurements and data analyses from field experiments involving fertilizer nutrient losses to weeds and the competitiveness of rice varieties to different kinds of weeds.

EXPERIMENTS AND OTHER WORK COMPLETED:

(1) Crop-protection systems involving the use of liquid or granular formulations of benthiocarb, molinate, MCPA and granular molinate/MCPA-IPE at different rates and times of application, were compared for weed-control efficacy in the new rice variety S-6.

(2) Efficacies of systems involving the use of granular TD-1874, DPX-6774 or Hydrothol-191 were compared in 2 off-station trials for control of chara, southern naiad and American pondweed in varieties Calrose and CS-M3.

(3) Batches of rice seed with weighted coatings containing the fungicide difolatan and one of 12 different herbicides or herbicide combinations were used in 3 trials involving new rice-culture systems in which seeding and weed control are combined by using the seed as the granular herbicide carrier. The same herbicides or combinations were evaluated as separate applications in rice seeded in the usual manner, and a small-scale evaluation of 6 new herbicides as seed-coating components or separate applications also was conducted.

(4) Special high-rate treatments of rice with liquid and granular molinate were made to obtain performance and residue data in support of Stauffer Chemical Company's petition to increase the maximum allowable rate of Ordram to 6 or 7 lb ai/A in single or split applications.

(5) The fungicide Hinosan and the growth regulator Sustar were evaluated as possible stimulators of rice growth and yield in variety S-6.

(6) Applications of granular 06K were made at 3 rates in a ring trial to provide algaecidal performance data and residue samples requested by Amvac Corporation. A home-made granular simetryn treatment was included.

(7) In cooperation with Pennwalt Corporation, and under permits granted by the California Dept. of Food and Agriculture and EPA, 10-acre portions of 3 American pondweed-infested rice fields were treated with granular Hydrothol-191 by aircraft to obtain additional performance and residue data in support of the petition for tolerance and registration of this product for rice. A small 3-compartment rice-growing facility was set up at Davis in which applications of ^{14}C-labeled granular Hydrothol-191 were made to provide soil, water, grain and straw samples for determination of the fate of this herbicide by radioactivity detection methods as requested by EPA in connection with the tolerance petition.

(8) In cooperation with Chevron Chemical Company, 2 aerial applications of Bolero 8E were supervised, and special 0.3-acre sprayboom applications were made to obtain performance and residue data in support of the federal registration of Bolero for rice.

(9) Glyphosate (Roundup) was applied at 8 lb ae/A to a rice field before flooding, and to a rice-field levee 30 days before rice harvest, to provide the Monsanto Company with soil, water, grain and straw samples for residue-analysis data in support of a petition to allow the use of glyphosate for control of perennial weeds in and near rice fields.

(10) At the request of Occidental Chemical Company, 6 fields treated before flooding with the fertilizer-herbicide combination 19-9-0 + 0.75% Ordram at 400 lb/A were inspected by airplane to evaluate the performance of molinate.

(11) The results of 3 water-run applications of Ordram 8E conducted by Stauffer Chemical Company personnel in Colusa County were observed to evaluate the performance of molinate applied to the intake water during flooding.

(12) Results of 1973 trials involving aerial applications of the liquid copper hydroxide triethanolamine complex K-Lox(R) were submitted with those of small-plot algaecide experiments in partial support of federal registration of these new liquid copper-complex algaecides for rice.

WORK PLANNED

(1) To continue development of combined planting and crop-protection systems involving weighted seed coatings containing fungicides and herbicides.

(2) To determine the extent of fertilizer and energy conservation by effective systems of algae and aquatic-weed control, weed-competitive rice varieties, and improved management of water depth and flow.

(3) To repeat experiments comparing the performance and economy of liquid and granular benthiocarb and molinate under different seedbed and water management conditions.

(4) To evaluate new systems of herbicide application, such as in combination with liquid or granular fertilizers or water-running during initial flooding.

(5) To determine probable relationships of rice-plant morphology, such as height, leaf area, leaf angle and mesocotyl length, to injury by MCPA, molinate, benthiocarb, and the new herbicides perfluidone and PP-888.

(6) To evaluate new chemical systems for improvement of rice stands and yields and decrease of application costs by use of complementary algaecide-herbicide and herbicide combinations.

(7) To locate serious rice-field infestations of American pondweed, horned pondweed and southern naiad by aerial survey or field inspection, help arrange for their treatment with granular Hydrothol-191, and assist with the evaluation of weed control by sequential aerial survey and photography.

(8) To supervise implementation of crop-management systems involving aerial applications of experimental algaecides or herbicides for obtaining pre-registration chemical performance and residue data in seed-rice fields.

MAJOR ACCOMPLISHMENTS

Combined cultural and crop-protection systems. The use of coated rice seed as granular herbicide carriers was found to be a feasible means of combining planting and weed-control operations without presoaking the seed. Coating methods and materials were improved to make the process adaptable to single batch or continuous flow coating systems using either wettable powder

or emulsifiable herbicide formulations. Field trials showed that stands, yields and weed control in plots of coated seed containing the herbicides M-3432 or NTN-4725 separately treated with MCPA, or combinations of M-3432 + simetryn or NTN-4725 + simetryn not treated later with MCPA, were as good or better than those in presoaked-seeded plots separately treated with molinate and MCPA. Since these herbicides and combinations also were found effective as separate soil applications, the future of their use as seed-coating additives will depend on their development as rice herbicides by their manufacturers. All new herbicides tested were too injurious to rice in seed coatings, but perfluidone (Destun(R)) and PP-888 appeared promising as separate pre- or post-flood herbicides in ordinary water-sown rice.

Improvement of crop-protection systems. As shown in the following table, granular benthiocarb (Bolero) and molinate (Ordram) were found greatly superior to their respective emulsifiable formulations in a field where barnyardgrass caused about 50 cwt/A, or 75 percent, decrease in yield of untreated plots.

Performance of different herbicide formulations in S-6 variety rice at the California Rice Experiment Station in 1974

Herbicide formulation	Application rate (lb ai/A)	Application time	Rice stand 1/ (%)	Grass control 1/ (%)	Grain yield 2/ (Cwt/A)	Grain-yield differences (Cwt/A)
Benthiocarb (E)	4	PF 3/	93	43	45.9	
Benthiocarb (G)	4	PF	98	96	59.0	+ 13.1
Molinate (E)	4	PFI	95	60	45.5	
Molinate (G)	4	PFI	98	97	62.4	+ 16.9
Benthiocarb (E)	4	10 DAS	98	53	51.2	
Benthiocarb (G)	4	10 DAS	98	94	69.4	+ 18.2
Molinate (E)	3	18 DAS	100	64	49.5	
Molinate (G)	3	18 DAS	95	88	60.3	+ 10.8
Molinate (E)	6	35 DAS	98	40	47.1	
Molinate (G)	6	35 DAS	100	85	54.6	+ 7.5
Untreated	-	---	93	13	18.7	- 50.7 (cf. 69.4 max.)

1/ Mean visual ratings made at 63 days after seeding (DAS).
2/ Mean yield of rough rice at 12% moisture.
3/ Abbreviations: E = 8 lb ai/gal emulsifiable; G = 10% ai granular; PF = preflood; PFI = preflood soil-incorporated.

This trial utilized static-water management systems to minimize chemical losses and improve herbicide action after the applications. The increased grass control and yields given by the granular formulations more than compensated for any additional cost of using granular instead of liquid forms of the herbicides both before and after flooding. It should be noted that 4 or 6 lb ai/A are not yet legal rates for molinate in California, but when higher rates are allowed, 6 lb ai/A of granular molinate as late as 35 DAS appears justified at today's prices where potential weed losses are high.

Among other 1974 trials, the positive performance of granular TD-1874 in control of American pondweed, southern naiad and chara was confirmed; granular simetryn and 06K gave excellent filamentous algae control at 1.5 kg ai/ha; Hinosan applications at booting and heading times at 0.7 to 1.4 lb ai/A increased rice yield up to 7 cwt/A, while Sustar injured rice and decreased S-6 yield at 2 lb ai/A; and the granular molinate/MCPA-IPE combination gave as good or better weed control and grain yields as separate applications of molinate and MCPA without injury to varieties S-6, 70/3597, 70/6526 and the very short-stature line 74#39. Fertilizer interactions trials indicated that higher amounts of basal nitrogen generally decreased populations of barnyardgrass, monochoria or roughseed bulrush in varieties S-6, 74#39 and 70/6526 in response to increased rice plant populations, although these results were less marked in the shorter-stature lines with which the weeds competed more severely.

IMMEDIATELY APPLICABLE RESEARCH RESULTS

Hopefully, the positive results of 1974 aerial applications of granular Hydrothol-191 in control of rice-field infestations of American pondweed, and the study of the fate of ^{14}C-labeled Hydrothol-191, should fulfill EPA requirements so that this herbicide finally will become available to California rice growers in 1975 under an experimental label at least.

This and previous year's results also have contributed to the probable experimental registration of benthiocarb for California rice in 1975 as well as an increased label rate for molinate. We can now prescribe improved systems of water management, rates and times of application, and preferred formulations for obtaining maximum efficacy of these herbicides in water-sown rice.

Results of 1973 trials with liquid copper-triethanolamine complexes may enable the commercial availability of 3 formulations of these algaecides in 1975, if EPA acts favorably on petitions for their federal registration. We are not yet convinced that these algaecides perform better or are more economical than copper sulfate, but growers need not worry about their safety to rice at label rates and times of application.

EVALUATION OF PROJECT

The transition of research by personnel of this project from pure weed-control to agronomic-systems objectives has been accomplished without much disruption of continuity, and progress on new lines of investigation has been satisfactory. The work with new rice genotypes has emphasized the importance of developing improved integrated crop-management systems for new rice varieties with respect to water depth and flow, choice and use of herbicides and other chemicals, and fertilizer conservation. Evaluation of new plant types for relative competitiveness to weeds also appears worthwhile and coincides with rice-breeding objectives. Although the rice seed-coating systems of combining planting and herbicide or algaecide application may never become a practical reality, development of the concept has attracted the interest and future cooperation of a private seed-coating company, which indicates the idea may not be too farfetched.

PUBLICATIONS OR REPORTS

Seaman, D. E. 1974. Management of new varieties. In: Program for Rice Field Day, Sept. 4, Rice Expt. Sta., Biggs, Calif., pp. 14-15.