PROGRAM AREA: Production and Marketing Economics

PROJECT 69-28: Analysis and Improvement of Rice Production Systems

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OBJECTIVES: The agronomic objectives of this project are to develop and evaluate new seed-treatment, cultural, and crop-protection methods appropriate to more efficient and economical crop production systems.

WORK IN PROGRESS: Greenhouse studies are underway to provide guidance for field studies during the 1971 crop season.

EXPERIMENTS COMPLETED: (Agronomy and Range Science Department)

Seed Coating Experiments

Preparation of rice seed coatings. Methods were developed to coat rice seed with various inert materials, such as kaolinite, bentonite and talc, to add weight and thus eliminate pre-soaking. These were combined with fungicides, activated charcoal, micronutrients, and other materials that may improve stands or seedling survival. The basic method was to wet a batch of seed with a suitable adhesive, such as casein or polyvinylacetate glue, and then add the dry material gradually to form a smooth, dust-free coating while the seed tumbled in a small concrete mixer. Greenhouse studies indicated that most coatings improved seedling survival; although a few coating materials, including ammonium phosphate fertilizers, were found to be toxic.

Field evaluation of rice seed coatings. The survival of rice seed with kaolin-fungicide coatings was compared with that of uncoated and fungicide-treated seed in a Merced County trial in cooperation with Dr. R. K. Webster and Farm Advisor C. C. Conley. Uncoated seed treated with arasan at 2 oz ai/100 lb gave the highest seedling survival (77.5% of the 200 seed sown in 7 sq ft rings). This was not significantly higher than that of kaolin-coated seed with arasan at 1 or 2 oz ai/100 lb (64% and 66.5%, respectively) or uncoated seed treated with captan at 2 oz ai/100 lb (71% survival). Except for seed coated with kaolin alone, most of the coatings and treatments tended to increase seedling survival, but only the uncoated, arasan-treated seed established significantly better stands than the uncoated, untreated seed (60% survival).

Mean seedling survivals in a similar trial conducted at the U. C. Davis Rice Facility ranged from 41.5% (uncoated arasan-treated at 2 oz ai/100 lb) to 65% (uncoated-untreated-unsoaked control), with no significant differences among any of the experimental treatments. Cool climatic conditions at Davis during this 29-day experiment were probably responsible for its extremely variable results (CV = 21.5%). However, there were fewer "floaters" or "pulls" seen in the coated-seed plots than in uncoated-seed plots 15 days after seeding, indicating that the weighted seed stayed submerged better than soaked uncoated seed.

A yield trial at the Rice Experiment Station, involving quadruplicate 108 sq ft plots, failed to show any significant differences in grain yield among the various seed treatments used in the Davis trial. Mean yields ranged from 7,375 lb/A (kaolin alone) to 8,153 lb/A (kaolin with difolatan at 2 oz ai/100 lb). Only three other kinds of treated or coated seed yielded more than the uncoated, untreated soaked control: kaolin with arasan at 1 oz ai/100 lb (8,013 lb/A), talc with arasan at 2 oz ai/100 lb (7,983 lb/A), and talc-coated alone (7,967 lb/A). The yield of uncoated seed treated with arasan at 2 oz ai/100 lb, the best treatment at Merced, ranked 18th among the 25 treatments of this experiment. Since all yields were high, and treatment variability was low (CV = 6%), the crop probably compensated for differences in stand establishment that may have existed earlier in the trial even though the seeding rate was only 50 lb/A. The seedlings in most soaked-seed plots emerged from the water 19 - 20 days after sowing, while those in plots of unsoaked coated seed emerged only 1 - 2 days later. This showed that the emergence of coated seed was not delayed more than the normal soaking time in the field. After another week, there were no apparent differences in height or development between the seedlings of pre-soaked and dry-sown coated seed.

In another yield trial at the Rice Experiment Station, involving triplicate 300 sq ft plots of Caloro rice, pre-soaked uncoated seed treated with captan at 1 oz ai/100 lb gave the highest mean grain yield of 6,103 lb/A; but this was not significantly different than the yields of seed coated with a mixture of talc and activated charcoal (5,660 lb/A), kaolin with captan at 1 oz ai/100 lb (5,659 lb/A), or talc with captan at 1 oz ai/100 lb (5,657 lb/A). Seed with a 25% coating of "Nutra-Phos K," to provide 6% Zn and 6.2% P, yielded 5,507 lb/A of grain, while those with a 30% coating of "Nutra-Phos Fe" (6% Fe and 7.7% P) gave the lowest yield (3,967 lb/A). Both nutrient coatings contained captan at 1 oz ai/100 lb, but the latter was the more toxic to germination.

Activated-charcoal coatings were found promising for protecting rice seed from injury by the pre-emergence herbicides dichlobenil, butachlor and RP-17623, all of which gave excellent weed control but seriously injured water-seeded uncoated rice seed. None of the coatings gave complete protection, but a talc plus charcoal coating was very effective against RP-17623 applied at 2 lb ai/A at time of seeding and 3 days after seeding. Herbicide selectivity was also improved by coatings of bentonite plus charcoal and a blended talc-charcoal mixture.

The costs for basic 25% weighted coatings of agricultural talc, bentonite and kaolinite, using casein glue as the adhesive, would be about $1.55, $1.50 and $1.45 per 100 lb of seed, respectively, for the materials. Additional materials, such as fungicides and activated charcoal, would increase these costs. The preparation of large quantities of coated seed by the batch in concrete mixers would also increase the cost of handling unless some continuous-flow technique could be developed.

Weed Control Experiments

Methods of molinate application. The combination of emulsifiable molinate with liquid-suspension fertilizer as a single-pass sprayboom application was compared with present multiple-pass methods of applying dry fertilizers and either liquid or granular molinate for pre-flood barnyardgrass control. To provide the same amounts of N, P, Zn and molinate as given by the sprayboom application (111 lb N, 52 lb P, 10 lb Zn and 3 lb ai molinate per acre), the use of uncombined materials required 3 or 4 separate passes with application equipment. A final pre-flood harrowing was common to all treatments of the 1,800 sq ft plots. Barnyardgrass control was excellent in all plots except the dry-fertilized ones not receiving molinate which gave a mean grain yield of 5,306 lb/A. This yield was not significantly different from those of the plots that received dry fertilizers and granular molinate (5,445 lb/A) or dry fertilizers and liquid molinate (5,447 lb/A). Since the mean yield of the sprayboom-applied plots (4,900 lb/A) was significantly different from those of the other treatments, which did not differ (LSD at 5% = 341 lb/A), the low yield more likely was caused by differences in fertilizer response than by those of weed control. Perhaps the liquid-suspension fertilizer was below specified concentrations of nitrogen and phosphorus.

Preliminary herbicide evaluation. The performances of 32 experimental herbicide formulations were evaluated at the Rice Experiment Station at different rates and times of application to 10 sq ft ringed plots of water-seeded rice in cooperation with Dr. D. E. Bayer of UCD Botany. Results of this work are reported in more detail in Project 69-3. The best-performing herbicides were the following: IMC-3950, U-27267, SD-30528, NC-8438, DPX-6774, and granular mixtures of molinate plus R-16938 and IMC-3950 plus 2,4-D ethyl ester.

Tolerance of rice to molinate-chlorophenoxy combinations. Granular formulations of molinate + 2,4-D isopropyl ester and molinate + MCPA iso-octyl ester were prepared in the laboratory, using technical chemicals and 20-mesh sand, and applied to separate ringed plots of water-sown rice at 4-day intervals from 12 to 28 days after seeding (DAS) at rates of 1.5 + 0.5 or 3 + 1 lb ai/A. All applications gave excellent grass, sedge and broadleaf weed control. The trial was not taken to yield, because it was planted too late in a field that was drained too early for Calrose maturity. Based on rice stand, vigor and height, both mixtures were insufficiently selective when applied 12, 16 or 28 DAS at the higher rate, but they appeared safe to the rice when applied 20 or 24 DAS at either rate. The use of chlorophenoxy esters with molinate in granular form may be an economical way to achieve total weed control early without the later separate application of MCPA for sedge and broadleaf weed control.

Yield trial of promising herbicides. Eight promising herbicide formulations were compared with standard post-emergence molinate and MCPA treatments at the Rice Experiment Station. Performance ratings and yields were generally low, because of an unusually heavy infestation of barnyardgrass that was seeded before flooding. The only herbicides that performed as well as the standard molinate-MCPA treatment, which gave a mean grain yield of 4,544 lb/A, were granular nitrofen applied 2 days before seeding at 4 lb ai/A (5,023 lb/A), IMC-3950 applied 21 days after seeding at 6 lb ai/A (4,260 lb/A), and a new emulsifiable molinate applied 21 days after seeding at 6 lb ai/A (4,216 lb/A). None of these treatments was significantly different in yield from that of the untreated control (3,487 lb/A).

WORK PLANNED: The Agronomy and Range Science portion of this project was not funded for 1971. Further agronomic work to provide background information pertinent to improved rice production systems will be continued as a part of an Experiment Station project, while the weed-control work will be continued under Project 70-11.

Limited studies are planned to explore other ways of improving stand establishment by means of special seed coatings using different kinds and amounts of fungicides, root-growth stimulators and protective materials. Weed control studies will include preliminary and advanced herbicide evaluation, with emphasis upon interactions between rice varieties, cultural practices, weed competition and herbicides.

MAJOR ACCOMPLISHMENTS: Methods were developed to coat rice seed with various inert materials, such as kaolinite, bentonite and agricultural talc, to add weight and thus eliminate pre-soaking. Weighted coatings with different fungicides, micronutrients, and fast- or slow-release activated-charcoal were among the 200 batches of coated seed prepared. Field evaluations showed no outstanding advantages or disadvantages of 22 different fungicidal seed coatings, but a kaolinite coating alone reduced both stand-establishment and yield in separate trials. Several activated-charcoal coatings were found promising for protection of water-seeded rice from injury by some useful pre-emergence herbicides.

At least five experimental herbicides and two home-made granular molinate formulations were found sufficiently promising for larger scale evaluation next year. Single applications of these each gave broad-spectrum weed control and offered some new possibilities for alternative times and methods of application.

A single pre-flood sprayboom application of liquid molinate combined with a liquid-suspension fertilizer was found to give as good control of barnyardgrass as separate applications of liquid or granular molinate and dry fertilizers at the same rates. The sprayboom method offers savings in time and equipment costs, providing the liquid fertilizer is not required at uneconomical rates.

EVALUATION OF PROJECT: The use of pre-coated weighted rice seed is an attractive idea with many possibilities for economies in seed handling, seed sowing, and in seedling protection. Only a few aspects of the problem were explored so far with rather ambiguous results. Cheap materials were found to make the cost of coating about the same as present soaking and seed-treating costs, but the batch method would require handling and scheduling operations that may be impractical or too costly on a large scale. More definite advantages with respect to improved stands must be demonstrated, with better coating materials than we have now, before savings in seed handling or planting costs can be realized.

Alternative methods of weed control are needed before effective rice production systems can be designed and compared. Former alternatives actually have been reduced by the loss of the use of propanil in northern rice-producing counties. It was encouraging to find so many promising experimental herbicides and new weed control procedures among the trials this year.

PUBLICATIONS OR REPORTS: A brief preliminary progress report on this work appeared on pp. 35-36 of the "Accelerated Rice Research Program Progress Report to the California Rice Industry," in July 1970.