COMPREHENSIVE RESEARCH ON RICE

PROJECT NUMBER AND TITLE: RP-3: Protection of rice from invertebrate pests.

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OBJECTIVES:

I. The recognition of physical and biological factors that allow the buildup of pest populations that will cause economic injury to rice plants.

II. To find the most effective control of invertebrate pests that will cause the least disturbance to the environment.

WORK IN PROGRESS: Sorting of samples of midges for determination of numbers and identification of species from 1974 tests is still underway. Analyses of data, collected in 1974, are being made and prepared for presentation in reports, publications and meetings. Field studies of overwintering habits of pests, laboratory studies of midges and shrimp are in progress.

EXPERIMENTS COMPLETED - MAJOR ACCOMPLISHMENTS - WORK PLANNED:

Objective I. (Biology)

1) Seasonal life history of the rice water weevil at Biggs, California. Overwintering samples of adults as determined by core samples of levee grasses, 1973-74, was the lowest yet recorded. The collections of overwintering weevils this fall has sharply increased. Collections of adults by light trap during the critical flight period in May were only slightly lower than in 1973 but this represents the second consecutive year that records have shown a decrease in flight activity. The maximum number of larvae recorded per plant in the life history study areas was 3.2 which was slightly above 1973 but much lower than previous years. Late spring rains occurred during the last two years and these may be a factor causing the population decline. Egg production in the field reached a peak on May 30 with dissections showing a mean of 10.5 eggs per female. This is as high or higher than previous years which shows that fecundity of the females was not a reason for the low population of larvae per plant. Laboratory studies on oviposition with 19 isolated females in a controlled temperature cabinet showed a range of eggs laid from 65 to 210. The maximum number was laid in 48 days and the average number laid per female was 127.7 eggs from May 2 to July 15.

2) Economic population levels of the rice water weevil. The same experimental design was used for this test as in 1973 except that the variety Colusa was used and the test was located in a commercial field at a greater distance from the levees. The rice was again artificially

infested at three and five weeks with 1 weevil/4 plants and 1 weevil/ 2 plants. The early infestation resulted in significant reductions in yields of 18% and 26% at the two levels of weevils (Table 1). The late infestation showed no significant differences in yield which supports the 1973 results. The number of larvae recovered per plant was considerably less than for the same number of adults in the 1973 test but the percent loss of grain was greater in 1974 than for a proportionate number of larvae found in 1973. This could mean the variety of Colusa could support less larvae and was more susceptable than the R-57 variety used in 1973 or the sampling method for larvae does not give an accurate indication of the population. The presence or absence of feeding on the newest rice leaf was recorded this year on a weekly basis to compare with larvae recovered and resultant yield loss. It appears that the leaf feeding has potential as a means of indicating future yield loss. If a good correlation exists the technique offers a more simplified method better adapted for grower use than sifting the mud for larvae.

Further tests are planned for next year to compare with 1974.

TABLE 1. Results of test to determine rice plant injury and yield loss due to different population levels of the rice water weevil at different plant ages at Biggs, California.

Treatment	Avg. plant ht. (cm)	Avg. plant wt. (g)	Avg. root lgt. (cm)	Avg. no. larvae/ plant	Avg. grain yield (g)
Evaluation at 7 weeks					
Carbofuran	52.2 b	163.0	17.8 b	0.02 b	1896 c
Without treatment	49.4 ab	124.0	18.3 b	0.02 b	1669 bc
1 weevil/4 plants at 3 weeks	48.6 ab	132.7	15.3 ab	4.00 a	1457 ab
1 weevil/2 plants at 3 weeks	46.8 a	134.9	13.6 a	6.74 a	1317 a
Evaluation at 10.5 weeks					
Carbofuran	81.1	562.1	23.4	0.00 c	1842 c
Without treatment	68.3	567.3	20.0	0.07 b	1757 bc
1 weevil/4 plants at 5 weeks	76.6	601.9	18.9	2.61 a	1674 bc
1 weevil/2 plants at 5 weeks	78.4	603.1	20.9	3.96 a	1791 bc

3) Studies on the biology of seed midges found in rice fields were started in May at the Rice Facility at Davis and the Rice Experiment Station at Biggs. Experiments were designed to determine the effects of variation in time of flooding, time of planting after flooding and presence or absence of algae on the species composition of midges and the potential for damaging germinating rice seeds. The majority of the samples are still being processed but preliminary identifications for the plot at Davis showed the following species: Tanytarsus #5; Tanytarsus #6; Chironomus spp.; Paralauterborniella spp.; Cricotopus sylvestris; Critcotopus bicinctus; and Procladius sp. This test did not show any major trends with respect to species composition or numbers in relation to time of flooding. The maximum population of 12 larvae/sq. in. was attained by Tanytarsus #6 about 1 month after flooding. All species were no higher than about 3.6 larva/sq. in. during the critical germination period. Considerably fewer larvae were found in the plots without algae that were treated with copper sulfate. The rate of copper sulfate used in the test was determined not to be toxic to midge larvae in laboratory tests. The populations of midges found in plots flooded at different periods, planted at different intervals after flooding, and with or without algae did not cause significant losses in young seedlings at the Davis or Biggs plots. Hopefully the tests can be repeated next year with the possibility of higher midge populations at the critical period of rice growth.

4) Life history studies of the tadpole shrimp in the laboratory have concentrated on factors governing hatching of the eggs and methods of rearing to produce large numbers of eggs. Presently the rate of dessication and oxygen tension appear to be the two most critical factors but further testing is needed to confirm this. If large numbers of viable eggs can be obtained from the laboratory cultures and transferred to the field, the effect of treatments on the developing shrimp in the field can be based on a known population instead of the uncertainty of a natural population.

Objective II. (Control)

1) Testing rice varieties for resistance or tolerance to the rice water weevil. Last year, five California commercial varieties were tested to compare susceptibility to the weevil. This comparison was continued this season with the inclusion of S6 and Colusa was used as a standard. Varieties 6122 and 4572 showed the greatest tolerance in 1972 and were included in the 1974 test with the three varieties 1815, 1403, and 1349. The later three varieties were obtained from Louisiana where they showed the highest level of tolerance to the weevil. All varieties were artificially infested with adults (1 weevil/2 plants) and compared to the same variety treated with carbofuran. Plant growth characteristics and the larval population were sampled in early July and the yields also were taken. The results expressed as the percent difference of untreated from treated are presented in Table 2. The number of larvae recovered per plant was rather low for the number of adults placed for the artificial infestation but the plant growth characteristics and yield losses were high. The greatest yield reductions were recorded for Colusa and S6.

The highest yields of infested varieties were measured for 6112 and 1403 and these two varieties should be tested again next year. Variety 1349 also showed potential but 1815 and 4572 should be dropped, the latter because of low yields in the chemical treatment.

TABLE 2. Rice variety tolerance to the rice water weevil. Biggs, California.

Variety	% difference from treated 1/					No. larvae/ plant
	Plant height	Plant weight	No. tillers	Root length	Grain yield	
Colusa	- 7.3	-16.1	-18.4	-16.1	-33.9	4.35
S6	-11.7	-37.3	-39.0	-26.3	-27.2	4.58
6112	-10.0	-12.7	- 8.4	- 7.7	-16.3	3.07
4572	- 7.6	-34.7	-18.7	+ 2.3	-16.6	2.67
1815	- 7.9	-30.5	-42.2	-25.2	-22.7	2.65
1403	-11.1	-19.5	-16.8	- 5.2	-13.1	4.27
1349	- 5.8	-12.4	- 8.3	-18.5	-18.5	3.35

1/ Data underlined were significant at the 5% level

2) Chemical control of the rice water weevil. Field and greenhouse tests with experimental and registered insecticides were conducted in 1974. More effective and safer insecticides are being routinely examined to refine and update current control recommendations. Experimental carbamates Cv. 17116, 17033 and 18373 were quite effective in the greenhouse and the field at 1.0 lb. active ingredients per acre. Baygon, Dasanit, and GA-4-653 provided unsatisfactory control. A minimum of research is planned in this area in 1975.

3) Chemical control of seed midges. Spray applications of Dursban (.2 lb. AI/acre), Parathion (.1 lb. AI/Acre), and Sevin (1.0 lb. AI/acre) were made to fields flooded 3 and 4 weeks at Biggs and Davis. Preflood applications of Dasanit (1.0 lb. AI/acre), Bux (1.0 lb. AI/acre), and Furadan (1.0 lb. AI/acre) at Biggs were also examined for midge control. Variation within the plots was such that no significance in control could be determined but some midges were present in all treatments. Sevin showed the lowest number of midges.

Seed treatments utilizing the chemicals Dursban, Mesurol, Zinc Coposil, Largon, and Copper were examined with an untreated check for midge injury but an infestation of larvae failed to develop.

Injury by midges in commercial fields has been very erratic and unpredictable and the evaluation of chemicals for their control will be very difficult because of the unpredictability of infestations. Possibly future studies will provide methods of artificially inducing infestations.

IMMEDIATELY APPLICABLE RESEARCH RESULTS:

Rice water weevil - The newly released variety S6 was found to be as susceptible to the weevil as Colusa but it presents no special problems with respect to susceptibility.

EVALUATION OF PROJECT:

The annual cost of controlling invertebrate pests of rice, the losses of yields due to these pests, and the increased demand for water quality and safety of wildlife warrant the continuation of this project to attempt to reduce these losses without major disturbances to the rice field ecosystem.

PUBLICATIONS OR REPORTS:

Grigarick, A. A. 1974. Comprehensive report on Rice, RP3. 7 pp.

Grigarick, A. A. 1974. Rice variety tolerance to the rice water weevil in California. Proc. 15th R.T.W.G. pp. 43-44.

Grigarick, A. A. 1974. Invertebrate pests that reduce seedling stand establishment. Rice Field Day. pp. 11-13.

Grigarick, A. A., M. O. Way and S. L. Clement. 1974. Problems of determining economic injury levels of the rice water weevil in California. Nat. Meeting, Ent. Soc. Amer., Minneapolis.

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