COMPREHENSIVE RESEARCH ON RICE

ANNUAL REPORT

January 1, 1976 - December 31, 1976

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

II. PROJECT LEADER AND PRINCIPAL UC INVESTIGATORS: A. A. Grigarick, Professor of Entomology; M. O. Way, Staff Research Associate; C. L. Clement; S. R. Scott, J. M. Benson, F. C. Zalom, graduate students.

III. LEVEL OF 1976 FUNDING: $23,786.

IV. OBJECTIVE A:

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

1) Survey of rice water weevil populations by light trap collections, periodic dissection of females for eggs; sampling for immatures on roots and overwintering adults on levees. Biggs, California.

2) Experiment to determine rice plant injury and yield losses by the rice water weevil at different population levels. Biggs, California.

3) Survey to determine injury by midge larvae in commercial fields in relation to time of flooding and planting. Butte, Yuba, Sutter and Yolo Counties.

OBJECTIVE B:

Determine the most effective control of rice invertebrate pests and maintain a quality of the environment compatable with the needs of society. All control experiments were conducted at the Biggs Rice Experiment Station.

1) Chemical control experiments on the rice water weevil were conducted with registered and unregistered compounds in field plots.

2) Studies on tolerance of rice varieties to the rice water weevil. a. The tolerance of five varieties (including 2 of short stature) of rice to the rice water weevil was examined in a standarized field test. b. Twelve crosses of two tolerant varieties with short stature varieties (F2) were examined for tolerance. c. Nine varieties reported to be tolerant in Louisiana were evaluated. d. Tolerant and susceptible varieties were subjected to artificial root pruning to seek information on the mechanism of observed tolerance.

3) Chemical control experiments on rice seed midges were conducted with seed treatments.

4) Chemical control experiments on the tadpole shrimp were carried out with standard rice water weevil treatments and seed treatments.

V. SUMMARY OF CURRENT YEAR'S WORK:

OBJECTIVE A:

1) Light trap catches of the rice water weevil were much lower than last year and comparable to the years 1973 and 1974. This may reflect a decreased survival rate through the winter as core samples taken from the overwintering sites on the levees showed a considerable reduction in weevils from previous years. Oviposition by overwintering females started earlier in 1976 which corresponds with the earlier rice planting.

2) Rice plant injury by the rice water weevil. Variety Colusa was used in an experiment to determine if a practical method could be developed to predict the level of yield loss that could be expected by examining adult weevil feeding on the leaves of rice plants at 4, 5 and 6 weeks from planting. Three week old rice plants were artificially infested with adults at the rate of one weevil per 2, 4, 6, 8 and 10 plants and a control treated with carbofuran. The rice plants were also sampled for larvae on the roots at 2 months following planting. The results are presented in Table 1. There was a relatively good correlation between the level of adult infestation, feeding scars on the newest leaves, and yield reduction. There was not a significant correlation between numbers of larvae found on the roots and the same 3 variables. The percentage of newest leaves fed upon decreased from the 4th to the 6th week. Examples of how this information could be used (if future experiments support this data) are as follows: 1) at the 4th week from planting, 30% of the newest leaves had feeding scars--expected yield reduction woudd be 5 to 10%; 2) 30% of the newest leaves with feeding scars at 5 weeks from planting--expected yield reduction about 35%. In either case the grower may decide to drain and treat (assuming no previous treatment) but particularly so in the latter example.

3) Survey of commercial rice fields for midge injury. Fields of 9 different growers encompassing 4 counties were sampled at 6 different areas in each field. Flooding times varied from early to late in the season and planting times after flooding also varied. Total injury recovered was less than one-half of one percent in any field.

OBJECTIVE B: Control of invertebrate pests.

1) Chemical control of the rice water weevil. Seed of variety S6 was treated with Lorsban (2 oz/100 lb.) and Mesurol (8 oz/100 lb.) and planted at 150 lb/acre. A third treatment consisted of 2 applications of Dimilin (each 1 lb. A.I./acre) to paddies with untreated rice seed. All seed was coated but not presoaked. Rice within aluminum rings on each treatment was artifically infested with water weevils at the rate of one per 2 plants. Immatures were collected from the roots 8 weeks after planting. The results are presented in Table 2. The 2 chemicals used as seed treatments did not control the water weevils but the 2 applications of Dimilin provided highly significant control. The Dimilin is a chemical that interfers with the normal growth of insects and it is assumed that its action was on the egg stage. Applications were made on the 3rd and 4th weeks after planting to cover the most critical flight period of the weevils.

2) Tolerance of rice varieties to the rice water weevil. a The tolerance of the varieties 74-Y-52, D7, 1403, 6112 and Colusa to injury by the weevil was evaluated in a standardized field test six replications of insecticide treated plants were compared to the same number of untreated plants in rings that were artifically infested with adults at the rate of 1 weevil per 2 plants. Immatures on the roots were recovered and plant growth characteristics were examined in July. Yields were taken as the different varieties matured. The results are expressed in Table 3 as the percent difference of untreated from treated. Little difference was observed in the susceptibility of Colusa, D-7, and 74-Y-52. Varieties 1403 and 6112 showed some tolerance but not to the extent of previous years. Growing conditions in this test were not as good as previous years which was indicated by a 30% reduction in the yield of treated 1403. Blanking for 6112 was 57%, 1403-24%, and 5 to 15% for the other varieties. b. In cooperation with Howard Carnahan 12 crosses of F2 seed were obtained from rice water weevil tolerant parents and short stature varieties. Seven from 1403 and 5 from 6112. The seed was planted in rings and exposed to rice water weevil adults at 1 weevil per 2 plants. None of the crosses showed a drastic reduction in plant vigor or yield due to the weevil infestation. Seed from the most vigorous appearing plants of all crosses of the 1403 parent were saved for 1977 plantings and a standarized test similar to that of Table 3. c. Nine lines sent from Louisiana that were reported to be tolerant were exposed to natural and artificial infestations of weevils. Only 2 of the lines showed enough promise to be reevaluated next year. d. It was proposed that the mechanism of tolerance to the weevils be some rice varieties was due to their ability to rapidly grow new roots after being pruned by the larvae. An attempt to test this was made with 4 replications of the tolerant varieties 1403, 6112, and the susceptable Colusa. When the plants were 33 days old all were removed from the soil and 1/4, 1/2, 3/4 and no roots were hand pruned in each replication and replanted. One month later all the plants were removed, washed and their plant growth characteristics measured. No visable or statistically significant differences could be found between the pruned and unpruned plants. The test provided no information on the mechanism of observed tolerance but demonstrated that a single mechanical root pruning was not comparable with continuous feeding on the roots by larvae. It also pointed to the potential value of a late chemical treatment to control an established larval population in order to allow root regrowth and plant recovery.

3) Chemical control of rice seed midges. Variety S6 seed was treated with Lorsban (2 oz/100 lb.) and Mesurol (8 oz/100 lb.) and planted at Biggs. Fifteen hundred seeds we e examined from 3 replications of each treatment and the check. Incidence of injury to the seeds in the check was only 1.5% and the treatments about .75% so no evaluation of the seed treatment could be determined.

4) Chemical control of the tadpole shrimp. a) Airplane applications of granules of Bux (1.0 lb. A.I./acre) and carbofuran (0.5 lb. A.I./acre) were made to 3 replications (30-35 acres in each treatment) prior to flooding. Considerable variation in numbers of shrimp occurred in the replications so that no significant difference were found between untreated and treated.

Considerably more shrimp were found in the carbofuran treatment this year than last year. Two of the 3 replications of Bux provided excellent control. The field with the third replication of Bux was inadvertently harrowed after treatment and shrimp were abundant in this replication. Presumably this was the reason for the absence of control in this replication. b) Mature shrimp were placed in rings containing seed treated with Lorsban (2 oz/100 lb.) and Mesurol (8 oz/100 lb.) at planting and 8 days after planting. No mortality was observed.

VI. PUBLICATIONS AND REPORTS:

Clement, S. L. 1976. A structural and phenological analysis of the chironomid community of California rice fields: Implications to injury of rice plant seedlings. 74 pp. (Ph.D. Thesis).

Grigarick, A. A. 1975. Comprehensive Research on Rice, RP-3, 7 pp.

Grigarick, A. A. 1976. Pest and disease control program for rice. Leaflet 2748 Div. of Agric. Sci. U.C.

Grigarick, A. A., and M. O. Way. 1976. Egg development and oviposition by the rice water weevil in California. Proc. 16th Rice Technical Working Group. p. 58.

Grigarick, A. A., M. O. Way and S. L. Clement. 1976. Results of rice variety tolerance tests to the rice water weevil in California. Proc. Rice Technical Working Group pp. 63-64.

Scott, S. R. 1976. Laboratory studies of factors affecting egg hatch *Triops longicaudatus* (LeConte), the tadpole shrimp. 31 pp. (M.S. Thesis).

VII. GENERAL SUMMARY OF CURRENT YEARS RESULTS:

The percent of plants with adult weevil feeding scars on the newest leaf continues to show a good correlation with numbers of adults present, plant injury, and yield. This promises to be of predictive value for decisions on treatment. A decrease in feeding activity occurs from the 4th to 6th week from planting so that the sixth week appears to be the latest an evaluation can be made with this method. Weevil populations as low as 1 adult per 10 plants produced a 15% yield loss and as high as 1 adult per 2 plants caused a 65% yield reduction. The economic threshold for the variety Colusa appears to be falling at about 1 weevil/12 to 14 plants.

No significant injury to rice by seed midges was detected in 9 commercial rice fields in 1976.

Two applications of Dimilin (a growth inhibitor) aT 1 lb. A.I./acre on the 3rd and 4th week after planting provided excellent rice water weevil control. Seed treatments of Lorsban and Mesurol were not effective against this pest.

A standardized test for tolerance to the rice water showed the short stature varieties D-7 and 74-Y-52 to be as susceptable as Colusa. Varieties 1403 and 6112 were not as susceptable. The latter variety is being dropped because of undesirable agronomic characteristics. Evaluations of crosses with 1403 and short stature varieties are being continued. A study of varieties 1403, 6112 and Colusa showed that the effects of larval root pruning could not be duplicated with a single mechanical cutting of the roots.

Prefood applications of carbofuran and Bux granules at the rates used for water weevil control did not adequately control tadpole shrimp. A possible reason for the lack of control in one replication of the Bux treatment was because the granules were harrowed into the soil.

Table 1. Relationship of feeding scars on rice leaves to immatures found on the roots and rice yield. Biggs, California. 1976 1/

Treatment	% of youngest leaves with feeding scars			Avg. no. larvae/core	Avg. grain yield (g)
	June 3	June 9	June 17	6/24-7/6	
1 weevil/2 plants	85 a	58 a	29 a	13.9 a	753.1 a
1 weevil/4 plants	68 ab	31 b	20 ab	12.6 a	1306.4 b
1 weevil/6 plants	53 bc	27 b	12 bc	11.8 a	1443.4 bc
1 weevil/8 plants	43 cd	16 c	7 c	9.5 a	1630.5 bcd
1 weevil/10 plants	32 d	15 c	5 cd	9.6 a	1824.5 cd
Carbofuran	3 e	1 d	1 d	0.2 b	2153.3 d

1/ Planted May 5. Numbers followed by the same letter were not significantly different at the 5% level.

Table 2. Chemical control of the rice water weevil.

Treatment & formulation	Rate AI/ acre	Avg. plant ht. (em)	Avg. plant net. wt. (g)	Avg. root vol. (ml)	Avg. no. larvae/ core 1/
Dimilin 2/ spray	1.0lb.	65.8a	26.0a	6.1	0.7a
Lorsban seed treatment	2oz./ 100 lb.	60.7b	14.9b	4.5	13.7b
Mesurol seed treatment	8oz./ 100 lb.	59.3b	15.7b	4.2	13.8b
Untreated	--	55.1b	13.7b	4.1	15.2b
Significance		5%	5%	n.s.	1%

1/ Treatments associated with the same letter were not significantly different at the indicated level according to D.M.R.T.

2/ Applications of Dimilin were made at 3 and 4 weeks after planting.

Table 3. Rice variety tolerance to the rice water weevil. Biggs, California.

Variety	Percent difference from treated 1/					No. larvae/ plant
	Plant height	Plant weight	No. tillers	Root length	Grain yield	
Colusa	-14.5	-47.2	-34.4	-19.8	-35.3	8.92
1403	- 9.4	-35.8	-24.0	-10.3	-28.2	12.85
6112	- 9.8	-38.3	-22.0	-17.7	-25.2	7.53
D7	-14.9	-42.9	-30.3	-24.4	-41.3	10.85
74-Y-52	-12.8	-43.7	-24.6	-23.3	-40.9	8.97

1/ Data underlined were significant at the 5% level.