COMPREHENSIVE RESEARCH ON RICE
ANNUAL REPORT

January 1, 1975 - December 31, 1975

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

II. PROJECT LEADER AND PRINCIPAL U.C. INVESTIGATORS: A. A. Grigarick, Professor of Entomology; M. O. Way, Staff Research Associate; C. L. Clement, S. Scott, and R. Harris, graduate students.

III. LEVEL OF 1975 FUNDING: $20,821.

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.

2) Experiment to determine rice plant injury and yield losses by the rice water weevil at different population levels (artificial and natural infestations) at varying distances from the field margin.

3) Experiments to determine injury by midge larvae in relation to time of flooding and planting.

OBJECTIVE B:

Determine the most effective control of rice invertebrate pests and maintain a quality of the environment compatible with the needs of society.

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

2) The tolerance of six varieties of rice to the rice water weevil were examined in the field.

3) Chemical control experiments on rice seed midges were conducted with the treatment of rice seeds and spray applications to field populations.

4) Chemical control experiments on the tadpole shrimp were conducted with the treatment of rice seeds; and granular insecticides as applied for rice water weevil control.

V. SUMMARY OF CURRENT YEAR'S WORK:

Objective A

1) Summary of rice water weevil seasonal life history and biology at Biggs, California. The increase in population of overwintering adult weevils recorded in core samples in the fall of 1974 and winter of 1975 was reflected by the highest number of adults collected in the light traps in the spring since 1969. This increase in flight activity also led to larger and more widespread larval infestations. Field margins examined in 1975 showed 92% of

the rice plants to be infested with larvae in early July compared to 72% in 1974. Egg development of field collected weevils was comparable to previous years and appeared to be at its maximum in late May. A survey for the rice water weevil in the San Joaquin Valley revealed evidence of its presence in rice fields of Merced County which is a southern extension of its distribution. Populations were not high in this county.

2) Rice plant injury by the rice water weevil.

Variety S6 was used in an experiment to compare the injury produced by artificial infestations of adults at 1 weevil per 2 plants and 4 plants, and natural infestations, to rice treated with carbofuran. These comparisons were made at 20', 60', and 100' from the field margin at 2 sides of 2 fields. These distances compared to 1, 2, and 3 airplane swaths from the margins of the field. Effect upon the plant was determined by measuring growth characteristics and yield. The weevil population levels were estimated by recording feeding scars on the newest leaves on a weekly basis and a single sample of larvae on the roots. A summary of the results is presented in Table 1. Yields were not significantly different in the treated and untreated (natural infestation) rings at 20', 60', and 100' from the field margins. Rice outside the rings from the field margin to 20' to 30' was noticeably affected by natural infestations of the weevil. Yields in the artificial infestations were significantly reduced. Numbers of larvae collected on the roots did not correlate closely with yield reductions although high larval populations were associated with yield losses. A closer correlation was noted between yield losses and the percent of newest leaves with feeding scars at the fifth week (June 6) and sixth week (June 13) from flooding and planting. At the 5th week the percentage of newest leaves with feeding scars ranged from 5 to 15 percent of the percent obtained in yield losses.

3) Rice plant injury by seed midges.

The relationships of two flooding dates and 3 planting times of 1, 7 and 14 days after each flooding were examined at two localities. The injury to rice seeds, and seedling roots and foliage by midges was recorded from a total of 300 seeds in three replications. The results are presented in Table 2. The most injury and greatest significance was found in the Davis experiments. The most significant injury to seeds and seedlings occurred at the latest flooding and the latest planting time after flooding. This supports observations last year and emphasizes the importance of planting the rice as early as possible after flooding to avoid injury by seed midges. The higher injury this year may be attributed to higher populations of the species *Cricotopus sylvestris*. Considerably more seed midge injury was observed in commercial fields in 1975 than 1974 and this injury was frequently associated with both late flooding and delayed planting after flooding.

Objective B Control of invertebrate pests.

1) Chemical control of the rice water weevil: a) Nine numbered carbamate analogues of carbofuran were screened in the greenhouse for weevil control. All showed systemic activity of varying degrees on adults and provided good control of larvae. The highest level of control of both stages was obtained by FMC 27291. b) Field tests were made with 10% Bux

granules (1.0 lb. AI/acre) and 5% carbofuran granules (0.5 lb. AI/acre) applied by aircraft. The Bux reduced the larval population by 53% along the field margins and plant growth appeared normal. One field with the carbofuran provided excellent larval control along the field margins but a second field showed only a 37% reduction of larvae and rice plants were obviously stunted along the field margins. Distribution of the 10 lbs. of material per acre of this formulation of granule may account for the variability in control.

Table 1. Relationship of feeding scars on rice leaves to immatures found on the roots and grain yield. Biggs, California, 1975. 1/

| Treatment | % of youngest leaves with feeding scars: May 31 | June 6 | June 13 | June 20 | Avg. no. larvae/core | Avg. grain yield (g) |
|---|---|---|---|---|---|---|
| **20 feet from field margin** | | | | | | |
| Carbofuran | 7 | 4 a | 0 | 2 | 0.03 a | 2,396 c |
| No treatment | 45 | 22 b | 8 | 22 | 4.73 d | 2,240 bc |
| 1 weevil/4 plants | 84 | 62 cd | 31 | 32 | 10.50 e | 871 a |
| 1 weevil/2 plants | 88 | 82 d | 57 | 29 | 9.28 e | 732 a |
| **60 feet from field margin** | | | | | | |
| Carbofuran | 1 | 0 a | 1 | 4 | 0.05 ab | 2,379 c |
| No treatment | 20 | 8 a | 12 | 1 | 1.98 c | 2,518 c |
| 1 weevil/4 plants | 78 | 38 bc | 35 | 18 | 8.78 de | 1,509 abc |
| 1 weevil/2 plants | 91 | 77 d | 53 | 27 | 8.88 e | 603 a |
| **100 feet from field margin** | | | | | | |
| Carbofuran | 8 | 1 a | 1 | 1 | 0.20 ab | 2,461 c |
| No treatment | 18 | 5 a | 11 | 3 | 1.13 bc | 2,375 c |
| 1 weevil/4 plants | 85 | 57 cd | 34 | 29 | 10.15 e | 1,318 ab |
| 1 weevil/2 plants | 87 | 77 d | 45 | 28 | 10.80 e | 572 a |

1/ Numbers followed by the same letter were not significantly different at the 1% level according to D.M.R.T.

Table 2. Results of field experiments in 1975 to determine injury to rice by midge larvae in relation to time of flooding and planting. 1/

| Date of flooding | Planting time after flooding (days) | Percent of damaged seeds | Percent of damage to seeds, roots, & foliage |
|---|---|---|---|
| | | Davis, California | |
| | 1 | 1.67 a | 6.67 a |
| May 12 | 7 | 3.33 a | 17.67 a |
| | 14 | 16.00 b | 30.00 a |
| May 22 | 1 | 3.67 a | 10.00 a |
| | 7 | 16.33 b | 38.67 b |
| | 14 | 36.00 b | 55.33 b |
| | | Biggs, California | |
| | 1 | 1.33 a | 10.00 a |
| May 18 | 7 | 9.00 b | 23.33 a |
| | 14 | 10.33 b | 19.33 a |
| | 1 | 5.00 a | - |
| May 28 | 7 | 4.33 a | - |
| | 14 | 6.67 a | - |

1/ Numbers followed by the same letter were not significantly different at the 5% level according to D.M.R.T.

2) Rice variety tolerance to rice water weevil.

Varieties Colusa, Earlyrose, MS, 72-3764, 1349, and 1403 were evaluated for their tolerance to the weevil. Six replications of insecticide treated plants were compared to untreated plants in rings that were artificially infested with adults at the rate of 1 weevil/2 plants. There was also a heavy natural infestation which led to high larval populations (5.3 to 15.1 per plant) and a severe test on the rice varieties. Plant growth characteristics were examined in early July and yields were taken as the different varieties matured. The results were expressed as the percent difference of untreated from treated and are presented in Table 3. The varieties ranked from greatest to least tolerance as follows: 1403, 72-3764; Earlyrose; 1349; M5; and Colusa. The variety 1403 has shown the highest tolerance for the last two years. It was sent to us in 1974 from Louisiana where tests also showed it to be tolerant to the rice water weevil. The variety 6112 showed considerable tolerance in 1972 and 1974 and was planted this year but a very poor stand prevented its inclusion in the 1975 evaluations.

3) <u>Chemical control of rice seed midges</u>: a) Seed treatments for seed midges were conducted at Davis and Biggs with Mesurol (8 oz./100 lb. seed), captan (1 lb./100 lb. seed), copper (12 oz./100 lb.), and Dursban (2 oz./100 lb.). Results at Biggs were not significant but at Davis 6 replications of seeds totaling 300 showed an 8% loss of untreated seed to midges at a planting 10 days following flooding. The only chemical to show a significant reduction of midge injury was Dursban which reduced this seed injury to 2%.

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 | <u>-45.9</u> | <u>-86.3</u> | <u>-66.7</u> | <u>-68.7</u> | <u>-72.0</u> | 5.28 |
| Earlyrose | <u>-32.2</u> | <u>-56.9</u> | <u>-44.6</u> | <u>45.3</u> | <u>-25.5</u> | 9.42 |
| M5 | <u>-36.1</u> | <u>-78.4</u> | <u>-58.8</u> | <u>-59.1</u> | <u>-51.7</u> | 6.82 |
| 72-3764 | <u>-20.0</u> | -63.8 | -23.9 | -38.2 | <u>-35.8</u> | 10.07 |
| 1349 | <u>-30.9</u> | <u>-66.6</u> | <u>-45.2</u> | <u>-46.5</u> | <u>-45.4</u> | 15.12 |
| 1403 | <u>-15.3</u> | <u>-34.2</u> | -17.3 | <u>-23.2</u> | -11.9 | 12.25 |

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

b) Chemical control of seed midges by spray applications to flooded fields. Methyl parathion, Sevin, Copper Sulfate and Dursban were applied at 9 days and 15 days following flooding. Three replications totaling 2.19 sq. ft. of substrate were collected from each treatment and the mixed species populations of live midge larvae were recorded. The results are presented in Table 4. Variation in midge populations in the first test indicated no significance in the 9 day postflood treatment but the higher populations of the 15 day test did result in significant differences. Dursban was the only effective treatment and resulted in a 97% and 98% reduction of midge larvae for the two treatments. The value of treatments at this time would be to control the midges before a replanting if previous losses in stand by midges necessitated replanting.

4) <u>Chemical control of tadpole shrimp</u>: a) Preflood soil treatment with Bux and carbofuran and treatment of seeds with copper at 1, 3, and 5 days postflood. These treatments were made at Biggs in rings in which 100 shrimp eggs were placed on the soil before flooding. More than 3,000 shrimp eggs were obtained from shrimp reared in the greenhouse for this test. Hatching and development of tadpole shrimp was so low that no significance in treatments could be determined. The majority of eggs may have been covered by

clods as they broke down during flooding. Previous tests in the laboratory showed that eggs covered with soil would not hatch. b) Preflood airplane treatments with granules of Bux (1.0 lb. AI/acre) and carbofuran (0.5 lb. AI/acre) were evaluated in 3 replications of rice fields at Biggs totaling 33 to 35 acres per treatment and untreated checks. The treatments of Bux and carbofuran provided significant control of tadpole shrimp at the 5% level. The Bux provided an 85% reduction and the carbofuran a 90% reduction of shrimp from that of the untreated checks. The level of control may have been greater but there was some movement of shrimp from the untreated to the treated paddies via the weir boxes. This test should be repeated since it is known that preflood soil treatments with these chemicals do not always provide adequate shrimp control. The reason for variation of control may be due to temperature regulation of egg hatch and the time the chemical remains in the water. High water temperatures and rapid hatch could possibly lead to higher control levels.

Table 4. Results of chemical spray treatments for control of seed midges. Biggs, California.

| Treatment | 9 day postflood treatment<br>Mean no. larvae 1/ | 15 day postflood treatment<br>Mean no. larvae 1/ |
|---|---|---|
| Untreated | 181.7 a | 363.0 a |
| Methyl Parathion<br>.5 lb. AI/acre E.C. | 133.3 a | 275.3 a |
| Sevin<br>1 lb. AI/acre S.P. | 107.3 a | 230.7 a |
| Copper Sulfate<br>5 lb. AI/acre crystals | 64.3 a | 399.0 a |
| Dursban<br>.2 lb. AI/acre E.C. | 6.3 a | 8.3 b |

1/ Numbers associated with the same letter were not significantly different at the 5% level according to D.M.R.T.

## VI. PUBLICATIONS AND REPORTS:

Grigarick, A. A. 1975. Comprehensive report on rice, RP-3, 5 pp.

Grigarick, A. A. 1975. Invertebrate pests of rice. Winter Rice Production School. pp. 23-25.

Grigarick, A. A. 1975. Rice pest investigations in California. Rice Journal, July.

Grigarick, A. A. 1975. Varietal susceptibility to the rice water weevil. Rice Field Day. pp. 12-14.

## VII. GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

Numbers of weevil larvae found on the roots of rice plants in June and July do not always closely correlate with the amount of yield reduction. The percentage of rice plants with the newest leaves with feeding scars at the 5th week following flooding showed a direct correlation with yield losses within 5 to 15% in a test at Biggs.

Rice varieties exposed to heavy populations of the rice water weevil ranked from highest to least tolerance as follows: 1403; 72-3764; Earlyrose; 1349; M-5; and Colusa. The yield of Colusa was reduced by 72% but the yield of variety 1403 was only reduced by 12%. This latter variety was equally tolerant last year and is considered one of the more tolerant varieties in tests in Louisiana.

A 10-day difference in flooding dates in May at Davis resulted in greater seed losses and seedling injury by rice seed midges. Planting times of 1, 7, and 14 days following these flooding dates resulted in increased seed losses and seedling injury with each delayed planting.

Injury to rice seeds by midge larvae was reduced from 8% of untreated seeds to 2% injury with a Dursban seed Treatment at 2 oz. active ingredients per 100 lbs. of seed. Treatments with Captan, copper, and Mesurol did not show a significant reduction in seed damage. Spray treatments to flooded fields for control of seed midge larvae showed Dursban at 0.2 lb. active ingredients per acre to provide a 98% reduction in the larval population. Methyl parathion (0.5 lb.), Sevin (1.0 lb.) and copper sulfate (5.0 lb.) did not signficantly reduce the numbers of midge larvae. The application was made 15 days after flooding which would correspond to the approximate time a grower may be reseeding if this was necessary because of prior midge injury.

Bux at 1.0 lb. AI per acre and carbofuran at 0.5 lb. AI provided 85% and 90% reduction in tadpole shrimp respectfully when applied as preflood granules for rice water weevil control. The entire fields were treated as opposed to treatment of the margins only. This method of treatment does not always adequately reduce the tadpole shrimp populations. The variability in control is probably related to water temperature, rate of hatch of shrimp eggs, and rate of dissipation of the chemical.