

COMPREHENSIVE RESEARCH ON RICE
ANNUAL REPORT
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PROJECT TITLE: Cause and control of rice diseases

PROJECT LEADER AND PRINCIPAL UC INVESTIGATORS: R. K. Webster;
J. Bolstad, Staff Research Associate; C. M. Wick,
Cooperative Extension

LEVEL OF 1981 FUNDING: \$28,619

OBJECTIVES AND EXPERIMENTS CONDUCTED TO ACCOMPLISH OBJECTIVES:

Long-range objectives of research project RP-2 are to provide expertise in identification and control of rice diseases that occur in California. Our goal is to learn as much as possible about the particular diseases and through study of factors that affect their occurrence and severity determine methods of control most effective and economical with minimal environmental impact. Specific objectives for 1981 were:

- (1) Continue studies of factors affecting the overwintering of S. oryzae and subsequent disease levels. Various biological and chemical treatments of residue as they affect inoculum production and carryover were studied.
- ✓(2) Determine relationship between stem rot and sheath blight disease severity in relationship to various cultural practices such as residue management, nitrogen fertilization, and cultivar differences.
- (3) Develop methods for determining soil inoculum levels of the sheath blight pathogen and its relationship to sheath blight severity.
- (4) Evaluate wild rice species and early generations of crosses between current cultivars and those species for germplasm sources resistant to stem rot and sheath blight.
- (5) Continue and expand studies on chemical control of stem rot and sheath blight of rice. These studies included treatment of soil, water, and foliage.
- (6) Continue study on effect of various methods of residue disposal, i.e. burning, removal or incorporation on stem rot and sheath blight disease severity.
- (7) Continue study on effects of alternate cropping and fallow on stem rot and sheath blight severity as it may relate to disease control.

Experiments conducted to accomplish the above objectives were carried out in the laboratory and greenhouse (Department of Plant Pathology, University of California, Davis) and at field sites in Yolo, Colusa, Butte, Sacramento, and San Joaquin counties. In addition surveys of stem rot and sheath blight occurrence and severity were conducted throughout the rice-growing areas of the state. Eight fields were studied (two in each of four counties) for monitoring the effects of alternate cropping on stem rot epidemiology and control.

SUMMARY OF 1981 RESEARCH (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:

Objective 1: Studies on the soil biology of Sclerotium oryzae to determine the effect of soil microorganisms, moisture and state of rice residue were continued. Results show that alternate wetting and drying of soil and sclerotia decreases sclerotial viability more rapidly than continuous wetting or drying. These treatments did not significantly alter the effects of fungistatic soil microorganisms on the viability of sclerotia. Soil drenches with various fungicides were effective in significantly reducing sclerotial viability.

Viability of sclerotia in treatments simulating field conditions with and without residue behaved similar to that observed in field experiments. A calculated half-life for sclerotia of 1.9 years was obtained. These findings and those from field experiments indicate that one year of fallow is not sufficient to obtain satisfactory stem rot control.

Studies on effects of temperature on growth and survival of S. oryzae indicate that sclerotia are produced in residue at temperatures above 52°F. Thus residue should be burned in the fall if possible to prevent buildup during the winter. We are monitoring sclerotial buildup in residue on the surface at several field sites this winter. The results will be essential in understanding the potential for stem rot disease following a season such as this year when the majority of residue is left in the field during the overwintering period.

Objective 2: The extensive use of short statured cultivars has been accompanied by an increase in occurrence and severity of sheath blight. Trials were conducted to determine the relationship between sheath blight and stem rot severity under various culture (residue management) and nitrogen fertilizer conditions. As in the past stem rot severity increased as preplant nitrogen levels were increased. Stem rot was significantly more severe at N levels above that where yield increases were realized. Maximum yield response to N-level varied for cultivar and location. Increases in sheath blight also were correlated to increases in preplant nitrogen rates although not as great as were those observed for stem rot.

Sheath blight severity and stem rot severity in the same plot were not positively correlated. It appears that even though both diseases may occur in the same field, individual plants are not usually affected by both.

Method of residue management also affects the disease cycle and inoculum level of the sheath blight pathogen. Experiments comparing burning vs incorporation of residue revealed lower sheath blight severity in plots where residue was burned. It appears that the disease cycle of sheath blight is very similar to that of stem rot. S. oryzae sativae sclerotia are produced in residue and the inoculum level increases when residue is incorporated. These studies are being continued for another season. At this point it appears that efforts to control sheath blight will be similar to those for stem rot.

Objective 3: Studies on sheath blight required a method for determining S. oryzae sativae inoculum levels. The method we developed is a modification of the floatation method used for S. oryzae. Sheath blight sclerotia are not as bouyant as are stem rot sclerotia but can be effectively extracted from soil samples by using sucrose solutions of varying density. Studies to determine the relationship of S. oryzae sativae inoculum levels and sheath blight severity will be continued this year.

A survey to determine the extent and distribution of sheath blight was conducted this season. The disease occurs essentially throughout the rice-producing areas of the state. Sheath blight was not found in Kern County. Its distribution closely parallels the distribution of stem rot. It was observed to be more severe in fields where short stature cultivars were grown.

Objective 4: Tests to measure cultivar differences in susceptibility to sheath blight were carried out both in the greenhouse and field. Late-maturing cultivars differed less in sheath blight disease reactions than did early-maturing cultivars.

Wild rice species were evaluated as potential sources of sheath blight resistant germplasm. The results indicate that several wild species are significantly more resistant than our present cultivars. Collections of Oryzae nivara, O. sativa var. fatua, O. glaberina, O. officinalis and O. minuta showed high levels of sheath blight resistance. Other collections of O. rufipogon, O. nivara, O. spontania and O. australiensis also were resistant. These species are currently being crossed to selected cultivars to determine if the resistance can be transferred and utilized in the breeding program at Biggs.

Studies on progeny from crosses of California cultivars and wild species of Oryzae showing resistance to stem rot are being continued.

(Studies on resistance to sheath blight and stem rot in wild species of Oryzae are being carried out in cooperation with Dr. J. N. Rutger. As useful sources of resistance are identified they will be given to Dr. Carnahan for use in the breeding program.)

Objective 5: Continued and expanded studies on chemical control of Stem Rot and Sheath Blight.

Trials to determine suitable chemicals for control of stem rot and sheath blight were conducted in both the field and greenhouse this year. Nine chemicals selected from last year's studies were tested in ring trials to determine rate and time of application in controlling both diseases. All were compared to Du-Ter for effectiveness. Two experimental compounds showed good activity against both diseases. These chemicals will be advanced to yield trials next year.

Du-Ter was tested in large field trials at 0.5 and 1.0 lb per acre. Both stem rot and sheath blight were effectively controlled in trials with 1.0 lb/acre. Stem rot was controlled in the 0.5 lb test while sheath blight control was less at the lower rate.

The test sites with Du-Ter involved twenty acres. Residue data were collected from water, mud and plant tissue throughout the season. These data will be included in requests for registration of Du-Ter for use on rice.

The prospects for obtaining permission to use Du-Ter on rice in California look better at this time than ever before. This is based on the fact that Section 18 permission was granted for use of a similar compound in the South last year. We will continue to cooperate in attempts to obtain registration.

Objective 6: A three-year study on effects of various residue collection, removal or disposal systems on stem rot epidemiology and sheath blight infection was continued this year. Data are still being analyzed and prepared for a final interpretation and report. Upon completion it will be forwarded to the board.

Objective 7: Effects of alternate cropping and fallow on rice disease epidemiology are being continued. The half-life results on S. oryzae sclerotia obtained under objective 1 are applicable to this objective. We have monitored selected fields for the past two years. In the coming season, rice will be grown in all of them. At that time we will be able to take direct disease readings on stem rot and sheath blight for comparison with fields in which continuous rice, rice-fallow-rice, and rice-wheat rice have been grown. We hope to continue this study for at least two more years. Preliminary results indicate that one year of fallow or alternate cropping does not significantly reduce S. oryzae and S. oryzae sativa inoculum levels.

PUBLICATIONS OR REPORTS:

- (1) Webster, R. K., C. M. Wick, D. M. Brandon, D. H. Hall, and J. Bolstad. 1981. Epidemiology of stem rot disease of rice: Effects of burning vs. soil incorporation of rice residue. *Hilgardia* 49(3):1-12.
- (2) Webster, R. K. 1980. Progress in reducing agricultural burning and alternatives to burning agricultural wastes. Part I. In: *Agricultural Burning: Sacramento, Solano, and Yolo Counties. Proceedings of Agricultural Burning Conference.* Sponsored by The Community Service Program of the University of California pp. 42-49.
- (3) Webster, R. K. 1980. Report to California Rice Research Board. Project RP-2. Cause and control of rice diseases. 5-10 pp mimeo. In *Annual Report of Comprehensive Rice Research 1980.* University of California and U.S. Department of Agriculture.
- (4) Figoni, R. A., J. N. Rutger, and R. K. Webster. 1980. Transfer of stem rot resistance from wild species to cultivated rice. *Proceedings 18th Meeting Rice Technical Working Group.* Agricultural Information Department, Texas A&M University, College Station, Texas, p. 35.
- (5) Wick, C. M., and R. K. Webster. 1980. Relative susceptibility of California rice varieties to stem rot disease. *Proceedings 18th Meeting Rice Technical Working Group.* Agricultural Information Department, Texas A&M University, College Station, Texas, p. 37.
- (6) Webster, R. K., and C. M. Wick. 1981. Influence of various methods of rice residue management on severity of stem rot disease. In: *Agricultural Residue Management: A Focus on Rice Straw: Report of the Residue Management Task Force,* University of California, p. 19-30.
- (7) Figoni, R. A., J. N. Rutger, and R. K. Webster. 1981. Inheritance of resistance to stem rot (*Sclerotium oryzae*) in rice. *American Society of Agronomy* (Atlanta, Georgia - December 1981).

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

Sclerotia of S. oryzae and S. oryzae sativa are produced in residue in the field when temperatures exceed 52°F. Thus it is likely that fields that were not burned this fall may experience higher disease levels next year.

Nitrogen fertilization levels above those needed for optimum yield enhance stem rot and sheath blight severity. This appears to be so for all cultivars currently grown.

The disease cycles for sheath blight and stem rot are similar. Inoculum levels of both pathogens increase in fields where residue is incorporated to a greater extent than where residue is burned.

The sheath blight disease is widely distributed throughout the rice-growing area. Sheath blight is more severe on short stature cultivars than on taller cultivars. Early-maturing cultivars are affected more severely by sheath blight than are late-maturing cultivars.

Several wild Oryzae species appear to be promising sources of resistant germplasm to sheath blight as well as stem rot.

No chemicals more effective than Du-Ter for control of stem rot and sheath blight have been identified. Projects for registration of Du-Ter for the coming season are encouraging.