ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE
January 1, 1996 - December 31, 1996

PROJECT TITLE: Metabolic basis of rice seedling vigor under submergence.

PROJECT LEADER:
Teresa E.-M. Fan, Department of Land, Air and Water Resources, UCD

PRINCIPAL UC INVESTIGATORS:
James E. Hill, Department of Agronomy and Range Science, UCD
Michael D. Carriere, Graduate student, Agronomy & Range Science, UCD

COOPERATORS:
David J. Mackill, Research Geneticist, USDA-ARS, Agronomy & Range Science

LEVEL OF 1996 FUNDING:
$ 10,675

OBJECTIVES AND EXPERIMENTS CONDUCTED BY LOCATION TO ACCOMPLISH OBJECTIVES:

The overall objective of this research is to characterize the metabolic mechanism(s) which contribute to increased seedling vigor of rice varieties in California's water-seeded, continuously flooded culture. An important component of seedling vigor in such a system is the tolerance to low oxygen conditions of submergence. Thus, our initial aim is to elucidate metabolic pathways that are tightly linked to submergence tolerance in rice. To achieve this objective, we have conducted two series of experiments that subjected seedlings of 30 rice cultivars to oxygen deficiency treatment and to screen differences in metabolite profiles among cultivars differing in submergence tolerance.

SUMMARY OF 1996 RESEARCH (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:

We have examined the profile of more than 35 primary metabolites in seedlings of 30 rice cultivars grown under normal and oxygen deficient conditions. Our data indicate that submergence tolerance is correlated with the accumulation of alanine and γ-aminobutyrate (GAB) in several rice seedlings. The pathways leading to the synthesis of these two amino acids are thought to have beneficial effects on cellular metabolism in oxygen deficient plants. Therefore, these pathways may play a key role in imparting submergence tolerance in at least some varieties of rice seedlings.

Among the cultivar screened, several *indica* subspecies also accumulated alanine and GAB but they are not known to be submergent tolerant. This deviation may be confounded by the genetic diversity of the 30 cultivars screened. This confounding factor can be minimized by working with rice hybrids that have nearly identical genetic background but differing in the submergence tolerance trait. We have initiated such an experiment to follow submergence-induced changes in metabolite profiles of rice seedlings that are progenies of submergence sensitive and tolerant parents. These progenies are being generated by Dr. David Mackill in the effort to introduce the submergence tolerance trait into the California's M202 variety. Our initial results indicate that several metabolite changes including the accumulation of alanine and malate are associated with the submergence tolerance trait in the progeny. We are very encouraged by these results and plan to pursue this direction in conjunction with Dr. Mackill's effort on establishing submergence tolerance trait in California's rice varieties.

PUBLICATIONS OR REPORTS:

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS:

We have uncovered several biochemical changes common to the seedlings of various submergence-tolerant rice cultivars under low oxygen conditions. In particular, the higher accumulation of the amino acid, alanine, was found to be associated with the submergence tolerance trait in a hybrid between California's M202 and a submergence-tolerant IRRI variety. These biochemical changes can be translated into seedling survival under oxygen deficient conditions. Screening of genetically related rice hybrids in this way will help identify submergence tolerance gene(s), which can lead to the development of superior-performing varieties under submergence, while avoiding undesirable traits.