ANNUAL REPORT
COMPREHENSIVE RESEARCH ON RICE
January 1, 2002 to December 31, 2002

PROJECT TITLE: Geographic and Environmental Factors Affecting Rice Milling Quality and Yield.

STATUS OF PROPOSAL: Continuing

PROJECT LEADERS:
Randall Mutters, UCCE Butte County, DANR Central Valley Region
James Thompson, Biological & Agricultural Engineering, UCD

PRINCIPAL INVESTIGATORS:
Richard Plant, Agronomy & Range Science, UCD
James Eckert, Postgraduate researcher, UCCE/UCD
David Kuntz, Postgraduate researcher, UCCE/UCD

COOPERATOR:
David Jones, Farmers Rice Cooperative, Sacramento, CA
Joe Alves, Farmers Rice Cooperative, Stegmann Station, Princeton, CA

LEVEL OF 2002 FUNDING: $21,940

OBJECTIVES AND EXPERIMENTS CONDUCTED BY LOCATION TO ACCOMPLISH OBJECTIVES:

The over all objective of the project is to investigate the crop-environmental interactions affecting head yields at a range of soil and grain moisture levels in a geographic frame of reference. The specific objectives of the proposal were:

Objective 1. Gather site specific information from growers describing cultural practices, harvest moisture, and quality appraisals. Head and total scores will be referenced to specific fields, when possible.

Objective 2. Design and develop a geo-referenced database describing dominant features of the rice producing area of the Sacramento Valley that may influence the relationship between harvest moisture and grain quality.

Objective 3. Analyze the factors that describe the crop-environmental interactions affect head yields during grain maturation. Physical factors, such as soil type or ambient weather conditions, will be assigned to field locations directly from the digital databases (i.e. soil) or by interpolation (i.e. relative humidity, wind speed, etc). Interpolated values based on the CIMIS meteorological network data will be used to describe local environmental variables. No cost, public domain multispectral remotely sensed data would be used to compare vegetation indices between fields where possible.

SUMMARY OF 2002 RESEARCH (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:

Objective 1.

In 2002, we sampled 78 loads of rice at the FRC West Sacramento receiving facility, looking for relationships between moisture and combine damage and rice quality. We also conducted two laboratory tests to determine the quality effects of holding freshly harvested rice for 24 hours.

Head rice showed the typical significant relationship correlation with moisture, quality drops significantly when rice is less than 21% moisture. Figure 1. Some of the scatter around the regression lines was correlated with damage in harvesting. A one percent increase in weight of hulled kernels in the sample corresponded to a one percent decrease in head rice loss. Most loads had a hulled kernel weight of 1% to 4%, although one load had nearly 10%. We will subject all of the samples to the Japanese soak test later in the year and report results at the winter meetings.

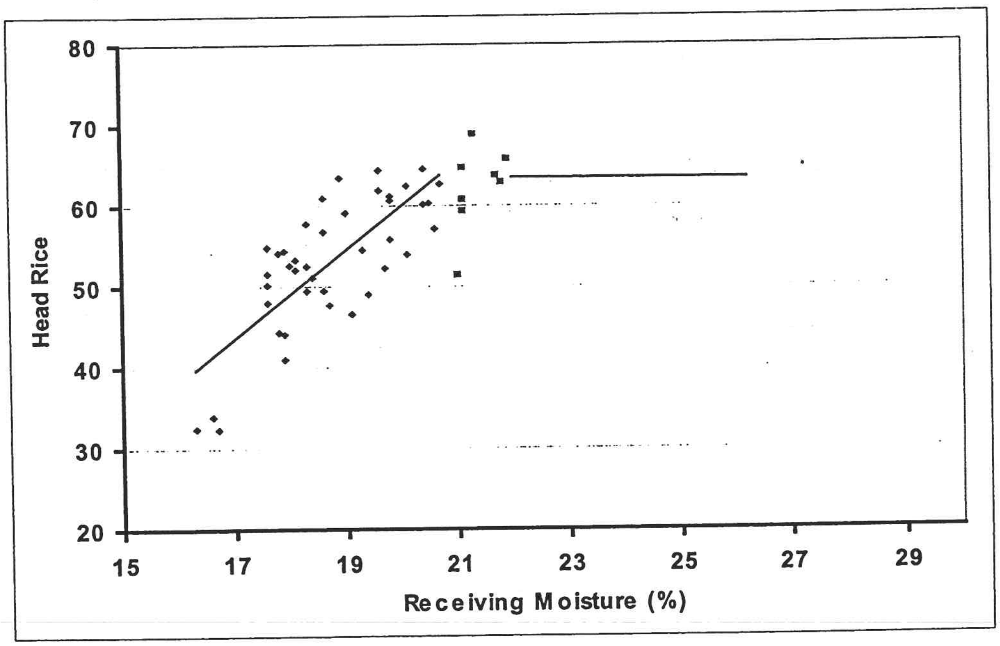

Figure 1. Effect of receiving moisture on head rice for 78 truckloads of medium grain rice.

Rice quality was also measured as the percent of unfissured head rice. This represents the amount of head rice that has no visible fissures when evaluated with a portable grain inspection device (Kett xm-50). Fissured whole kernels tend to break in cold water soaking causing poor eating texture. There was no apparent effect of harvest moisture on unfissured head rice. The average level of unfissured head rice was about 10 pounds less than head rice over the complete range of moistures for the 78 truckloads, figure 2.

Another possible reason for head rice loss is that there is an average of 16 percentage points of moisture difference between the driest and wettest kernels in the loads. This may cause the driest kernels to gain moisture rapidly enough from the wettest kernels to cause fissuring. This potential effect would be most likely for lots with average moistures below 21%, where head rice loss is most apparent. Two batches of commercially harvest rice were held for 24 hours in lidded plastic garbage cans. The first test with M104 rice showed no loss in head rice, Table 1. The next test was designed to apply a greater potential stress on the rice. The rice organic S102 rice with a great deal of redberry weeds seeds in the batch. It showed a significant decrease, but practically the effect was very small. We will also check our samples for fissuring and subject them to the Japanese soak test later in the winter.

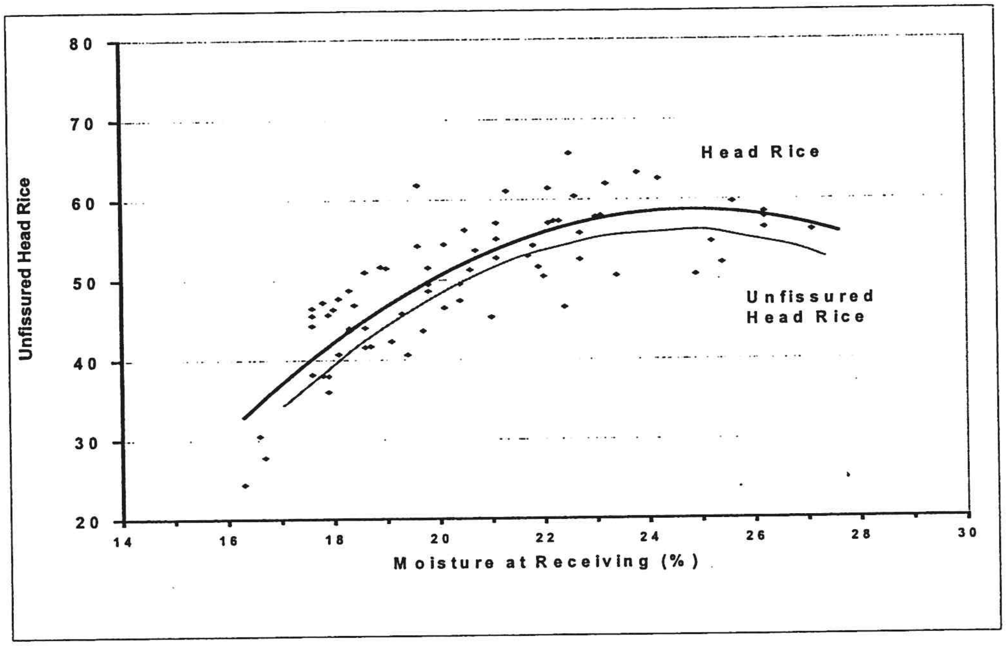

Figure 2. Effect of receiving moisture on unfissured head rice for 78 truckloads of medium grain rice.

Table 1. Twenty-four hour storage of freshly harvested rice. Rice was held in lidded cans immediately after commercial harvest.

Variety	Moisture (%)	Relative humidity above rice (%)	Initial head rice	Final head rice
M104	16.4	82 - 87	46.8	46.9
S102 Organic	18.5	91 - 94	51.4	50.5

Objective 2.

Design and develop a geo-referenced database describing dominant features of the rice producing area of the Sacramento Valley that may influence the relationship between harvest moisture and grain quality.

The following geo-referenced databases were secured from state agencies and university sources at no cost.

1.) California irrigated farmlands;
2.) USGS Digital Elevation Model 7.5 degree quadrants for Northern California;
3.) County administrative boundaries;
4.) Public Lands Survey (township, range, section);
5.) Latitude and longitude coordinates for CIMIS weather stations and the relevant weather data for each station;
6.) Latitude and longitude coordinates for field locations of study farms;
7.) Digital soils maps of the rice producing counties;
8.) Various geo-referenced databases (i.e. surface hydrology, roadways) for map composition and graphic output;
9.) Satellite image of rice farmlands in Sacramento Valley.

These data are necessary for constructing the database within a geographic information system needed to analyze head yields in terms of environment variation. This approach increases the probability of determining significant relationship between regional unique variables (e.g. soil, dew point) and rice quality. Production and environment variables along with associated rice quality are assigned to individual fields. Individual fields of cooperating grower are identified using remotely sensed images (Figure 3). A similar database is being developed to describe the entire rice growing region of the Sacramento Valley.

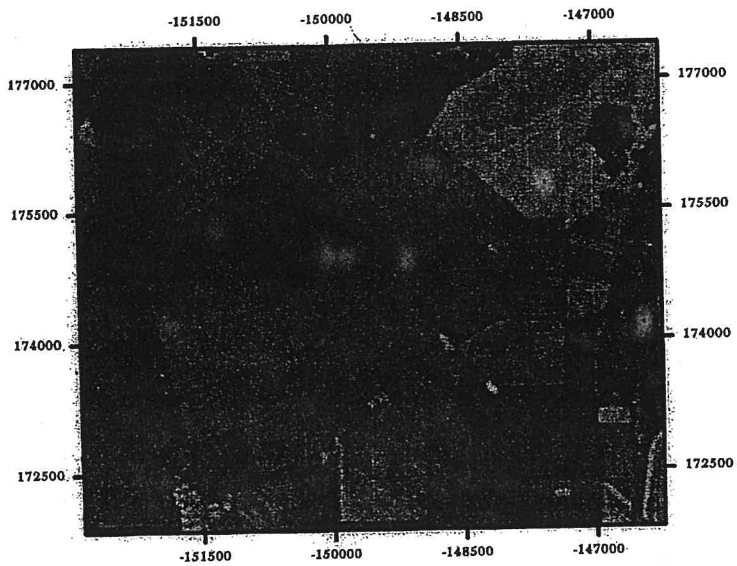

Figure 3. Color enhanced image of the farm of a cooperating grower in Butte County.

Objective 3.

Analyze the factors that describe the crop-environmental interactions affect head yields during grain maturation.

Two approaches have been taken to achieve this objective. On a valley wide scale, with the assistance of FRC, 45 farm were identified where receiving data (e.g. appraisals, harvest moisture content) were available for the past 5 years. With at the assistance of Joe Alves, FRC, the locations of the farms (latitude, longitude) and available production information were obtained. This is a regional wide approach to identifying factors effecting quality. On-farm resolution is diminished. However, regional effects (e.g. soil) are more readily identified.

Concurrent to the regional approach, an on-farm study was also initiated The on-farm approach allows us to study the more detailed aspects of how farm operations affect grain quality. Growers were identified to have good head rice across a range of harvest moisture content were identified and contacted. These growers were ask to provide specific on-farm production information (see list below) for the past 3 to 5 years. Five growers agreed to provide the requested information in August. Thus far only one set of farm data has been received. Growers are busy and the time required to compile the information is often lacking. However, it does illustrate the difficulty in basing the analysis strictly on interviewing growers.

Table 2. Production information requested from participating growers.

Planting date
Harvest date
Variety
Yield
Head and Total Yields
Drain date
Irrigation management (e.g. leathers method, continuos flood)
Fertilizers: N, P, K, Zn, S (amounts, timing, material)
Herbicides (material, rate, timing)
Quadris (rate, timing, disease ratings if available)
Copper sulfate (rate, timing)
Insecticides (material, rate, timing)
Combine (header, speed if available, settings)

These data will be combined with weather data for analysis. This part of the project is still under way. One important piece of information, soil moisture at harvest, is generally not available to focus on the crucial role of this variable on quality controlled field experiments are needed. Preliminary results indicate wind speeds before and after harvests are not always good indicators of head yield even in years with strong north winds (Figure 2). Wind was not a correlated with head yields in fields harvested before after a period of north wind. This data is from one farm where operations were comparable between fields. Work is underway to refine the effects of production and environment variables on quality.

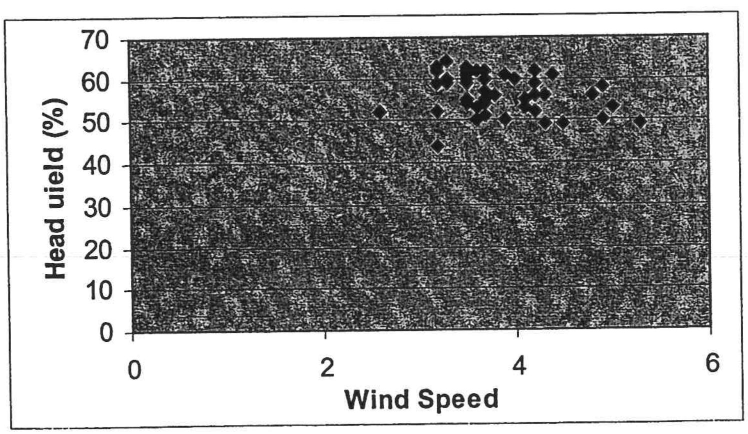

Figure 4. Head rice as a function of average wind speed one week before harvest.

PUBLICATIONS

No publications to date.

CONCISE GENERAL SUMMARY OF CURRENT YEAR'S RESULTS

In summary, quality analysis of samples taken at the FRC receiving facility in West Sacramento indicated that head losses occurred at harvest content below 20-21%. Head rice yield fell precipitously below this point. The number of 'skinned' kernels was a weak indicator of head rice. Unfissured head rice (as determined by a soak test) was unrelated to harvest moisture content. Interestingly, high redberry content did not appear to effect quality.

Several geographic databases were acquired and the development of a geographic information system describing production is being developed. The study of the production and environmental factors that influence rice quality are being studied at two levels of resolution, regional with data provided by FRC and on-farm using grower provided information. Timely acquisition of the needed information remains a challenge. Preliminary analysis points to need to conduct controlled experiments to ascertain the relative importance of environmental variables, grain-wetting cycles, and duration of dew in the context of grain maturity.