COMPREHENSIVE RESEARCH ON RICE

ANNUAL REPORT

January 1, 1977 - December 31, 1977

I. PROJECT NUMBER ACCORDING TO PROGRAM AREA:

RD-1 Rice Drying and Storage

II. PROJECT LEADER AND PRINCIPAL UC INVESTIGATORS:

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III. LEVEL OF 1977 FUNDING: $26,550

IV. OBJECTIVES ACCORDING TO 1977 PROPOSALS AND EXPERIMENTS BY LOCATION CONDUCTED TO ACCOMPLISH THESE OBJECTIVES:

Objective I. To increase the energy efficiency of rice dryers by: a) partial re-use of exit air, and b) the use of other drier configurations such as concurrent flow, counter-current flow, etc.

1. Experiments conducted with pilot-scale drier at UC Davis.
2. Field experiments conducted at Escalon with a counter-flow rice drier.
3. Field experiments conducted on a baffle-type drier at Firebaugh.
4. Experiments conducted on a new drying system at UC Davis.

Objective II. To determine the optimum time in terms of moisture content of rice when it is most economical to transfer rice from a column drier to a deep-bed drier.

1. Trials conducted at UC Davis to determine optimum tempering time.

Objective III. To develop computer-aided simulations of rice driers for evaluting the drier performance in terms of energy efficiency, rice quality, and increased capacity.

1. Continued studies to obtain fundamental data on thin-layer drying of rice.
2. Obtained experimental information on drying parameters in a cross-flow drier at UC Davis.

V. SUMMARY OF CURRENT YEAR'S WORK (MAJOR ACCOMPLISHMENTS) BY OBJECTIVE:

Objective I.
APPLIED STUDIES:

1. The pilot-scale rice drier constructed in 1976 was used to dry M5 rice at several air temperatures, passes and various configurations

of recycling exit air. Specifically, two pass, three pass, and four pass systems were anlyzed for an air temperature of 122°F; a two pass system with first pass at 125°F air and second pass at 110°F; five different configurations to use exit air from one drier module in another module for purposes of drying were investigated. The data were acquired using an advanced data acquisition system. It was found that under typical drying conditions in a cross-flow drier the rice temperature varies up to 15°F across the horizontal cross section. Samples were taken at various locations for temperature, moisture and head quality. The data are currently being analyzed to determine energy use per pound of water removal, moisture and head quality variations in the cross section of the drying column.

2. Preliminary data were collected from a commercial drier (baffle-type) located in Firebaugh (courtesy of Mr. Narval Davis). Temperatures of exit air and air velocity measurements were taken. The data are being used to determine energy use in the drying system.

3. Research on a counter-flow rice drier located in Escalon (courtesy of Mr. Fred Paulus) was continued based on financial support provided by Shivvers Enterprises, Corydon, Iowa. A final report will be made available in January 1978.

BASIC STUDIES

1. A new drying concept called "spouted bed drying" was studied to dry rice. Preliminary investigations indicate that this drying system has the advantage of minimum quality damage to rice. Our results indicate virtually no quality loss when head yield of dried rice is compared with rice dried with ambient air. The drying system will be further examined in the future for energy use and capacity.

Objective II.
APPLIED STUDIES:

1. A laboratory-scale study was conducted to determine the optimum tempering time for rice dried under several conditions. The results should help in determining the minimum time necessary for tempering for different drying rates and head quality. These studies will be extended to commercial locations in the future.

Objective III.
APPLIED STUDIES:

1. Studies have been initiated to develop comprehensive computer models based on fundamental information obtained in our laboratory. The models are being developed to simulate the pilot-plant rice drier. Follow-up work will focus on commercial drying operations.

BASIC STUDIES:

1. Mathematical equations describing thin-layer drying of rough rice are vital to developing computer models. A preliminary study was conducted in late 1976. This year a comprehensive study is being carried out to determine appropriate parameters.

2. Little or no published information is available on the physical and thermal properties of California grown medium and short grain

rice varieties. These properties are important in computer modeling. An experimental study was conducted to determine the following properties; bulk density, specific gravity, surface area, thermal conductivity, specific heat and thermal diffusivity. The data are submitted to the American Society of Agricultural Engineers for publication.

3. Literature search revealed that equilibrium moisture content of rice has been reported for a limited range of temperatures and humidities. Such information is necessary in computer modeling. A comprehensive experimental study, currently underway, involves obtaining basic data for the M5 variety.

VI. PUBLICATIONS OR REPORTS:

Agrawal, Y. C., and R. P. Singh. 1977. Thin-layer drying studies for short grain rice. ASAE Paper No. 77-3531.

Morita, T., and R. P. Singh. 1977. Physical and thermal properties of short grain rough rice. ASAE Paper No. 77-3510.

Chhinnan, M. S., A. S. Bakshi, and R. P. Singh. 1977. A study of high temperature drying of rice in spouted beds. ASAE Paper No. 77-3533.

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

Studies conducted with pilot-scale rice drier show significant temperature, moisture and head yield variation in the column cross section. Data on energy needed to dry rice in laboratory and field conditions have been determined. Several basic studies to develop computer-aided drying models are currently underway.