Milled Rice Yields

tests show yield and quality affected by drying-air temperature and humidity

S. M. Henderson

Laboratory rice drying studies conducted during the fall of 1956 investigated the effect of drying-air temperature and relative humidity on the quality of the milled rice. At the same time, a study was made of the possibility of drying with a one-pass column-drier using high relative humidities.

A quantity of field-run rice—Caloro variety—of 24% moisture content was stored in tight containers at approximately 38°F to hold the rice until needed for study. Thus, rice of uniform initial characteristics was available for all the tests. Prior to a test, sealed containers of the cold rice were transferred to room temperature — 70°F, approximately — and were permitted to warm up before opening so that condensate would not form on the grain during the warming process.

Quantities of approximately 1,800 grams—in a wire mesh container 14½″ square by 1″ thick—were dried in one pass through the laboratory dehydrator. The drying air was forced through the rice container at a rate exceeding 200 cubic feet per minute square foot. The moisture content of the supply of rice for test was determined by multiple vacuum oven determinations at the beginning and end of the series of tests. Moisture contents during and at the end of a test were calculated from drying container weights. Four samples were dried in an open shallow box under room conditions and used as milling standards. The dried samples were placed in paper bags and stored under outside atmospheric conditions for nearly two months before conducting the milling tests.

The results of the tests—made on a laboratory miller—are shown in the accompanying graphs. The milled rice observations are shown in pounds per 100 pounds dockage free rough rice. The samples averaged 4.5% foreign material, with 6.5% the largest amount.

The head yield is shown in the graphs as per cent whole kernels in the milled

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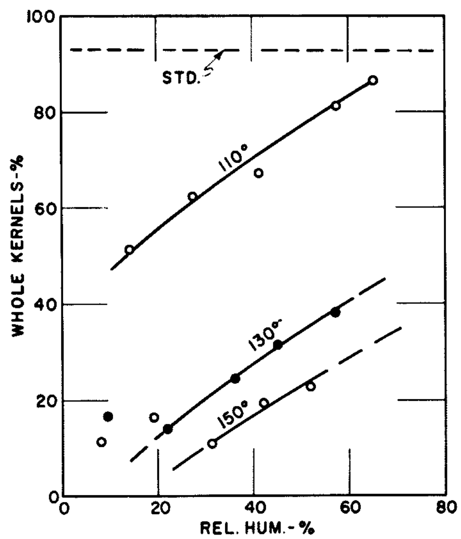
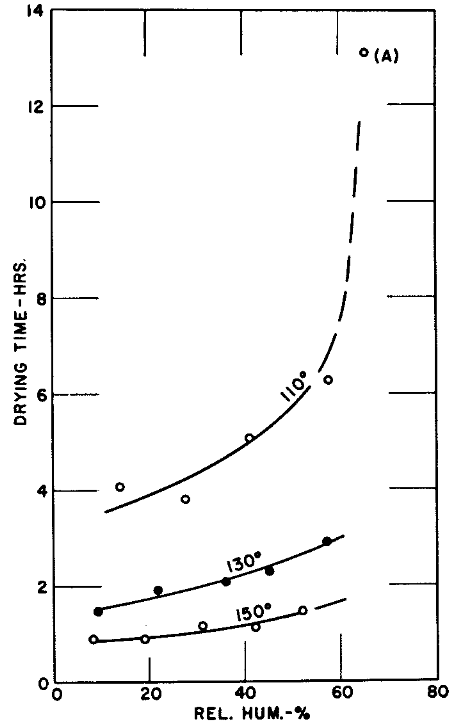
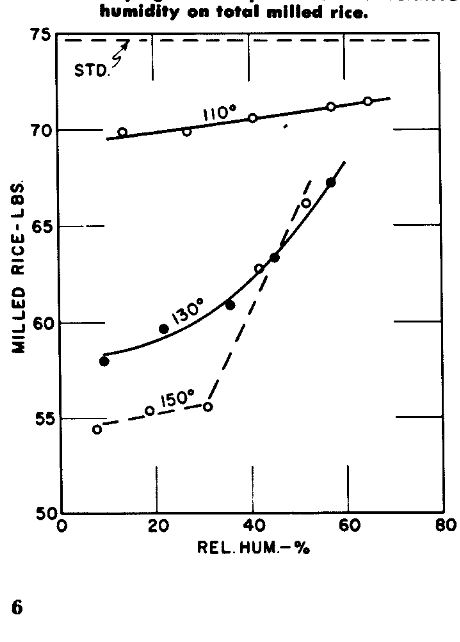


Effect of drying-air temperature and relative humidity on per cent whole kernels.

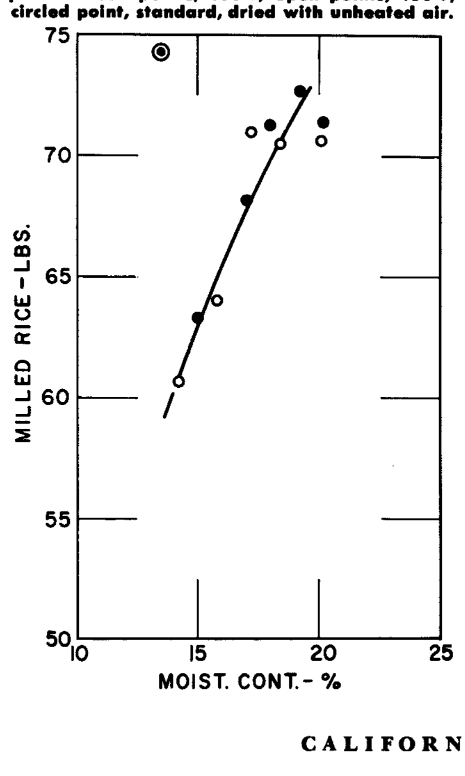


Time required to dry rice from 24% to approximately 13.5% moisture content at air temperature and relative humidity noted. The sample dried at 110°F and 65% relative humidity—A—was removed from test after 13 hours at a moisture content of 18.4%.

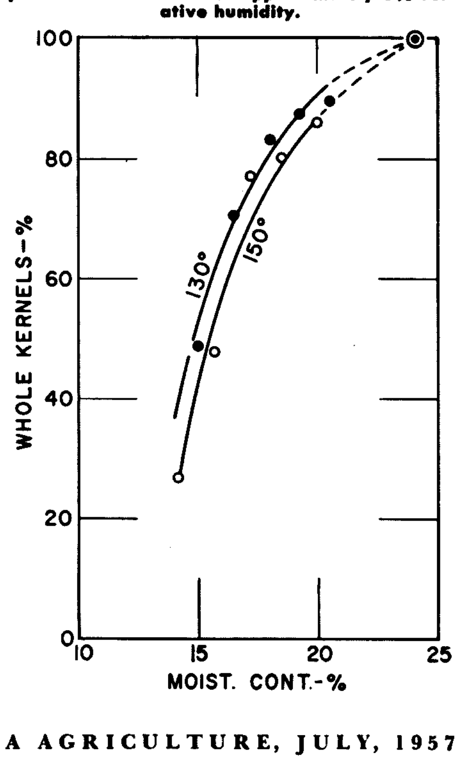
Effect of drying air temperature and relative humidity on total milled rice.



Reduction in total milled rice as drying takes place: closed points, 130°F; open points, 150°F; circled point, standard, dried with unheated air.



Reduction in whole kernels as drying takes place—dried with air of approximately 8% relative humidity.



the product is cased after freezing, costs are slightly higher with all methods. With the manual and the semi-mechanical methods the higher cost is caused by a reduction in the production standard for the casing workers to approximately 155 cases per hour. This increases estimated variable costs about 2% with the manual method and 8% with the semi-mechanical method. With the mechanized method an additional worker is required to guide the cartons from the freezing trays into the casing machine. This would increase estimated labor costs by $1.70 per hour per machine. Changes in the analysis—necessitated by these cost differences—could be approximated by corrections in the larger table on the preceding page. Such correction would show a moderately decreased cost advantage of the semi-mechanical method over the manual and of the mechanized method over both, with the amount of change depending on rate of output and number of hours operated.

To estimate potential savings to be effected by the mechanization of the casing operation in some plants—or producing areas—adjustments in production standards, wage rates, equipment replacement and depreciation, and other charges might be appropriate. Questions of plant flexibility and availability of qualified equipment maintenance personnel in small plants, as well as variation in charges for labor and equipment, might well enter the calculations but with suitable adjustment of the basic data, computations could be made for such cases.

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This is the second in a series of progress reports on efficiency in the processing and marketing of frozen fruits and vegetables. The studies are being conducted cooperatively with the State Experiment Stations in Washington, Oregon, and Hawaii and the Agricultural Marketing Service, U.S.D.A.

WEEDS

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were drained beginning June 15 when the rice was 7″–8″ high. The fields drained rapidly and it was possible to get into the fields with ground equipment by June 23.

The spray equipment was mounted on a track-type tractor with special extensions attached to the tracks. The extensions were needed only in a few exceptionally wet spots in the field. A volume of 28 gallons per acre was applied at 20 pounds pressure through a broadjet nozzle covering a 40′ swath.

All spraying was done at night—to take advantage of still air conditions and minimize the possibility of drift from air movement—with 220 acres sprayed in three nights. Because of concern over mounting daytime air temperatures, 100 acres were left unsprayed. Previous experimental work and field experience had shown increased susceptibility of the rice plant to injury when daytime temperatures reached 95°F and higher. During the period of spraying—June 23, 24 and 25—maximum day temperatures ranged from 95°F–100°F. On June 26 the maximum reached 101°F. It rose to 105°F on June 27 and 108°F on June 28, falling thereafter.

The MCPA was applied to part of the field at 10 ounces of actual MCPA per acre. Due to error in mixing, another part of the field received only 4¾ ounces of actual MCPA. Weed control was good even at the lower rate but was better at the 10-ounce rate. Skips and unsprayed areas were a mass of weeds with rice plants barely discernible. The most abundant weed was umbrella sedge with water plantain and burhead present in quantity.

Flooding was begun soon after the spraying and it took an average of six days to reflood the various fields. The entire operation from draining to flooding covered 19 days.

The average yield on the 220 acres sprayed was 4,450 pounds of dried paddy rice per acre. The unsprayed field yielded 2,200 pounds per acre. The rice lodged in the unsprayed field when the water was taken off before harvest because the heavy growth of umbrella sedge pulled the rice down as it settled. The sprayed rice did not lodge.

All investigative work to date indicates that 55–65 days after planting is the safest period to spray. However, the two instances of plane and ground rig application indicate the possibility of early spraying on drained rice with MCPA at low rates. MCPA is more selective than 2,4-D and that increased selectivity is especially important if spraying is done early or when temperatures are high.

Early spraying should be considered as a last resort where weed competition is extremely severe.

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rice to eliminate the milled rice variable which would exist if pounds head were used. An approximate pounds head value can be obtained by multiplying the per cent by an appropriate total rice value—for example—80% times 70 pounds total milled rice gives 56 pounds head rice.

The yield of total milled rice in the humidified drying-air study was reduced significantly by an increase in drying temperature or a lowering in drying humidity. The reduction rate was nearly constant as drying progressed.

Humidification of the drying-air improves the quality of the dried rice remarkably. One-pass drying at 110°F and about 33% relative humidity produced the same head yield as three-pass drying at 110°F with unhumidified air. Higher humidities produced even higher head yields.

Humidification caused an extension of the drying time. The three-pass drying required 2.2 hours. One-pass humidified drying required 4.5 hours to yield the same quality product.

Checking of the rice increases at a faster rate as drying progresses at any given humidity. During the removal of the first 4% of moisture—at 130°F—12% checked while 45% checked during the last 4% of moisture removed.

The results of these studies indicate the possibility of increasing both yield and quality of column-dried rice by using elevated humidity drying air. However, because this process extends the drying time considerably, a procedure would be required that would yield satisfactory capacity such as stage single-pass drying—using high-temperature low-relative-humidity air to remove the first few per cent of moisture, finishing with lower-temperature higher-relative-humidity air—reducing the number of passes by humidifying during one or more passes or additional drying capacity to use complete low-temperature high-relative-humidity drying.

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FERTILIZER

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ing an ammonium source of nitrogen and providing for its maintenance in flooded soils for rice was shown to be an important factor in achieving the best utilization of nitrogen for the best growth and yields of rice.

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