

# Harvest moisture effects on rice milling quality

Shu Geng □ John F. Williams □ James E. Hill

## Response to moisture content at harvest varies widely among cultivars

**T**he value of rough rice is partly determined by its milling quality — the particular mixture of whole and broken kernels. Each lot has a slightly different value, depending on the ratio of the two fractions. Milled whole kernels, known as head rice, sell for a higher price than do the various grades of milled broken kernels.

A typical milled sample in California for the period 1979-82 contained 54.3 percent head rice and 14.4 percent broken, for a head/total appraisal of 54.3/68.7. The latter number represents the percentage of total milled rice after the removal of hull and bran.

An apparent downward trend of head rice from 1979 through 1982 (see table) has renewed growers' and processors' interest in understanding and regulating the conditions that control rice milling quality. Many genetic and environmental factors directly or indirectly influence head yield. Important cultivar characteristics associated with milling quality are water sorption and desorption rates of the grain, time to maturity, ripening uniformity, and response to adverse climatic conditions during ripening. Cultural practices may also affect quality, including time of planting, seeding rate, nitrogen fertilization, pest and water management, harvest moisture content, and harvesting technique. Environmental conditions during filling and maturation, such as high daytime temperature, low sunlight, wide variations in day/night temperatures, low humidity, and dry winds, can all lead to low quality. Postharvest handling, drying, milling, and storage conditions also affect milling quality.

In this research, we evaluated final milling appraisals from a single laboratory that tested approximately 50 percent of the rice grown in California from 1979 through 1982. The laboratory used the same test procedures throughout the pe-

riod. We looked for trends showing the effect on head rice of certain cultivar characteristics and environmental factors. Although other relationships were defined in the complete study, this report deals only with the effect of grain moisture content at harvest on head and total of selected cultivars.

### Harvest moisture effects

Much previous research has shown that head yield of short- and medium-grain cultivars usually decreases as grain moisture content at harvest declines. Our study verifies this relationship and details the specific responses of most cultivars currently grown in California.

Generally, variability of head rice increased and amount of head rice decreased when rice was harvested at lower moisture, particularly in very early and early maturing cultivars. No single curve can adequately represent this relationship because of cultivar and environmental variations. Because of this high variability, the required moisture content at harvest for maximum head rice can only be defined in the wide range of  $25 \pm 5$  percent. Harvesting below 20 percent moisture increased the percentage of broken kernels for all short- and medium-grain cultivars. Harvesting at a moisture content above 30 percent reduced head and total because of a higher percentage of immature kernels, which fracture or disintegrate during milling.

Typical milling appraisal for California rice, 1979-82

Year	Percent head	Percent total
1979	55.5	68.9
1980	54.4	68.7
1981	54.7	68.4
1982	52.7	67.9

Source: Records from Rice Growers Association of California Quality Control Laboratory.

Responses to moisture were characterized for 13 cultivars planted in California during 1979-82 (see figures). Some varieties, such as S-201 and M-101, have a low head rice potential and are sensitive to low-moisture harvest. M9 was equally variable but produced a higher percentage of head rice. Late and intermediate varieties as a group were higher in head rice and less sensitive to low-moisture harvest. California Belle, a long-grain variety, was the only exception to the relationship between moisture and head rice; it produced a higher percentage of head rice as moisture content dropped below 20 percent. We need more data to verify the California Belle trend, since it is based on a small number of observations; preliminary 1983 results are similar, however.

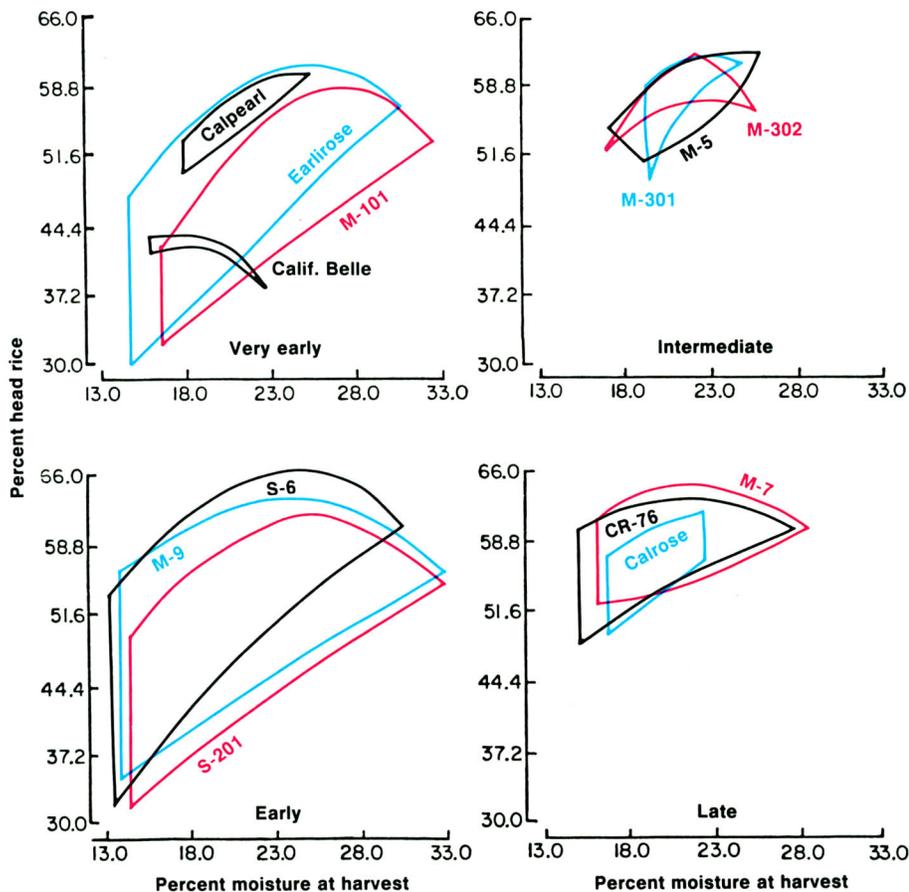
Harvest moisture content in a range of 15 to 27 percent had little effect on total rice. For most cultivars, harvest moisture levels above 27 percent tended to reduce total rice, although the rate of reduction was uncertain. However, the data suggested the following guidelines for ripeness: moisture content less than 25 percent, fully ripe; 25 to 27 percent, safe; 27 to 30 percent, uncertain; greater than 30 percent, not ripe.

### Other factors

Response to moisture content at harvest, while highly variable, also appears to depend on cultivars. When we adjusted effects of environment by comparing cultivars at similar harvest temperatures and/or times, cultivars within the same maturity group responded differently to changing grain moisture content at harvest. These response patterns could be used to help determine optimum time of harvest for selected cultivars that lose head rice rapidly as moisture drops.

In 1979, 62 percent of the acreage was planted to tall cultivars; by 1982 approximately 99 percent was planted to high-yielding, short-stature types. As growers changed from tall to short-stature rice, they increased the proportion of early and very early maturing cultivars, which, as a group, produce lower milling quality. In 1979, approximately 78 percent of the acreage was planted to very early and early cultivars; by 1982, these cultivars occupied 94 percent of planted acreage.

Short-stature cultivars were accompanied by changes in cultural and management practices that may have added to the quality problem. For example, short-stature rice requires additional nitrogen to reach maximum yield potential; in excess, nitrogen can cause non-uniform ripening, which may reduce quality.



Rice cultivar responses to moisture content at harvest. Head rice (milling quality) increased in variability and decreased in amount at lower moisture contents, particularly among early and very early varieties. Late and intermediate cultivars generally showed higher and more stable head rice.

Acres during the 1979-82 period markedly increased, placing a strain on management ability, resulting in delayed harvest and possibly improperly adjusted combines. Rice driers during this period were also burdened with a large crop and a high energy cost; they reacted by placing moisture limits and quotas on incoming rice, so that some rice was harvested below desirable moisture levels. Even though 70 percent of the rice in this study was harvested in the 20 to 25 percent range, the average harvest moisture content was  $21.5 \pm 2.5$  percent. This is close to the low end of the critical range, and suggests that a substantial amount of California rice is being harvested too dry for maximum quality.

Harvest moisture content may also have indirect effects on milling quality. Rate of drying and cyclic water sorption and desorption caused by climatic conditions (dew, dry winds, sunlight) can cause kernel breakage and are associated with harvest moisture content. In other words, both how dry the grain is and how it got dry are important in the yield of head rice.

A preliminary analysis of the 1983 season indicated that the head rice percentage was higher that year than the average of the four years we studied. Reduced acreages, possibly higher moisture at harvest, less burden on dryer capacity, and favorable weather during the ripening period may have contributed to the increase.

Numerous environmental factors exist that, individually or collectively, can drastically affect head yield of a given lot of rice. In this analysis, cultivars varied in their response to moisture content at harvest, suggesting that sensitive cultivars such as M-101 and S-201 should be managed more closely to help alleviate this component of the quality problem.

*Shu Geng is Professor, and James E. Hill is Extension Agronomist and Associate in the Experiment Station, Department of Agronomy and Range Science, University of California, Davis; John F. Williams is Farm Advisor, Sutter-Yuba counties. The authors thank Dr. Maurice L. Peterson at UC Davis, Ray Porter of the Rice Growers Association, John Valpey of Butte County Rice Growers Association, and Farm Advisor Carl M. Wick for their kind consultation and the basic data for this research.*



Veronicas (*Hebe* spp.) are widely grown in California for their evergreen foliage and bright, persistent white and lavender blooms.

## Fertilizer Fusarium

**D**iseases caused by the fungus *Fusarium oxysporum* have long been a major problem in growing agricultural and horticultural crops. By means of thick-walled resting spores, the organism can survive in the soil for years without a living host as a food source. Because of the high cost of fumigation and the possibility that the fungus may be reintroduced, genetically resistant host plant lines have offered the most effective means of dealing with these diseases. Greenhouse studies, however, have demonstrated that the landscape shrub *Hebe buxifolia* and related cultivars that are extremely susceptible to a strain of *F. oxysporum* may be successfully grown in the presence of this pathogen through the use of certain fertilizer combinations.

### Fusarium wilt of *Hebe*

Species and hybrids of the genus *Hebe*, commonly called veronicas, are