Rice Storage

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Goals of rice storage

Good storage practices prevent rice quality loss by:

1) keeping rice below a moisture which corresponds to a 65% equilibrium relative humidity,

2) keeping rice temperature within 10° F of the average monthly air temperature and below 60°F as long as possible during the year,

3) designing and operating aeration system to maintain uniform rice moisture and temperature,

4) storing only well cleaned rice.

Fungi (mold) growth is minimal below 65% relative humidity and bacteria growth is minimal at even higher relative humidities. Table 1 shows the safe long-term storage moisture for rice. It is based on equilibrium moisture data, Fig. 1 in the chapter on principles of rice drying.

Table 1. Rice moisture and temperature for safe, long-term storage.

Temperature (°F)	Moisture (% w. b.)
40	14.0
60	13.0
80	12.5

Rice can be stored above these moistures, but the risk of noticeable mold growth increases as moisture, storage time, and rice temperature increase.

Moisture migration during storage

Rice in storage is subject to moisture migration caused by differences in grain temperature. This is particularly true for grain stored in metal bins. Figure 1 shows likely locations of wet spots. In the late fall and early winter, stored rice tends to be warmer than the outside air. Warm air rises slowly out of the center rice, when this air contacts cold rice on the top of the bin it cools and increases in relative humidity and causes the top rice to gain moisture. Sometimes the temperature differences are great enough to cause condensation on the top rice. Air and rice close to cold walls or floors also cool. The air increases in humidity causing the rice closest to the cold metal to sometimes gain enough moisture to cause spoilage.

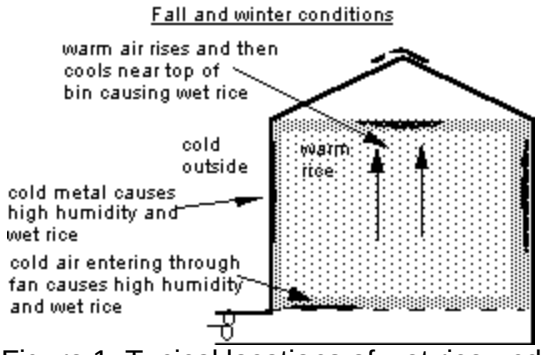

Figure 1. Typical locations of wet rice under winter storage conditions.

Moisture migration is slowed by aeration, regularly forcing outside air through the grain to reduce temperature difference between the grain and the outside. The rice temperature should be within 10°F of the average outside air temperature. Figure 2 shows the average air temperature conditions for two Sacramento Valley locations. During the fall aeration is used to cool the rice and maintain moisture uniformity. Later, in the winter, aeration is needed just to maintain moisture uniformity. When air temperatures rise in the spring the grain must be heated slowly to maintain the 10°F differential. Keep rice temperature as low as possible during the spring to reduce insect damage. They become active when rice temperature rises above about 60°F and infestation and damage are likely when the grain reaches 70°F.

Aeration system design and operation

Aeration requires a minimum of 0.2 cfm/cwt for bin storage and 0.4 cfm/cwt for flat storage. Higher air flow rates, which are often provided by drying fans, allow faster temperature equalization. Fan operation should be controlled by maintaining less than a 10°F difference between grain temperature and average outside air temperature. Fig. 2 shows that, in an average year, rice should be cooled to below 50° F by December. Improper aeration leads to mold development. Early signs of mold growth can be detected by smelling the first air that is exhausted from a storage after fans are turned on.

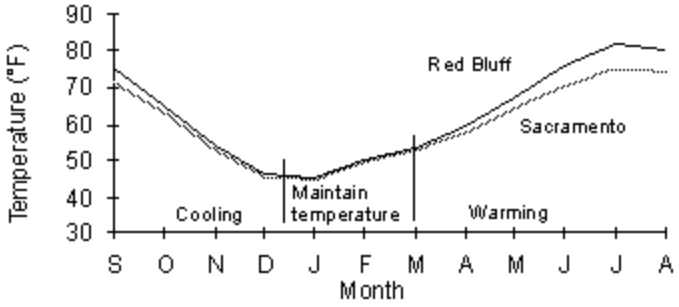

Figure 2. Average air temperature in the Sacramento Valley. Rice is cooled in fall, kept at low temperature in the winter and warmed in the spring.

Under many conditions, fans are operated about two times per week.

Generally fans can be operated when outside relative humidity is in the range of 55 to 70%. Table 2 in the bin drying chapter describes the specific air temperatures and humidities suitable for aeration at given rice moistures. Humidity below a recommended range will over dry the rice and humidity above the range will raise rice moisture to unsafe levels. During fan operation air temperature should be cooler than the rice in the fall and warmer than the rice during late spring. Aeration controllers are available which will automatically start and stop fans based on grain and air temperatures and some also control on the basis of air humidity.

Inspect rice regularly

During storage, inspect rice weekly. Test the discharge air for off odors which generally indicate a problem. Inspect rice on surface of bin during and after every storm to be sure no leaks have developed. If a leak has occurred, determine the extent of rice volume affected and take immediate steps to seal the leak. Spread the wet rice or remove and redry it. When dry, send sample(s) for rice quality appraisal before mixing with higher quality rice.

Minimize uneven air flow in stored rice

Air may be distributed unevenly in stored rice. Areas with little air flow are subject to mold growth. Air tends to travel through the shortest path in stored rice. For example in flat storage with tunnel ducts, areas near the floor and between the ducts get the least air flow (Fig. 3). Flat storages are designed with twice the aeration capacity of bins to help this unavoidable uneven air flow. Peaking rice in a bin causes poor air flow through the center rice (Fig. 4). Always level rice in a storage bin. Level rice in a bin has the potential for the best air flow uniformity of any storage system.

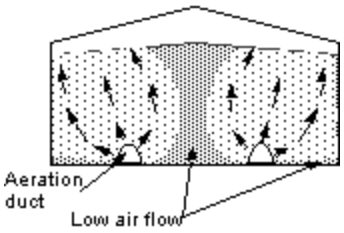

Figure 3. Location of low air flow in a flat storage structure.

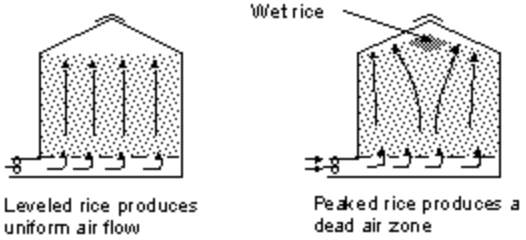

Figure 4. Effect of overfilling a storage bin.

Fine foreign material restricts air flow. Fines may collect in grain under

the filling spouts. Spreaders reduce this problem. In a bin the fines tend to collect in the center of the bin. After filling, the center cone of grain can be removed, passed through a scalper and aerator, and returned to the bin.