The Vapor-Pressure or Relative Humidity Approach to Moisture-Testing for Safe Farm-Storage of Harvested Crops

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IN MANY regions of the world, the vast majority of farm products are dried and stored on the farms where they are produced. Millions of tons of hay and billions of bushels of grain are involved.

The determination of the proper degree of drying to permit safe storage has been more of an art than a science, and the techniques learned have been passed on from one generation of farmers to the next. Hay is twisted, smelled, rattled, or scratched with the fingernail, while grain may be bitten or chewed to estimate moisture content and the probability of safe storage. Many efforts have been made over the years to devise simple, more reliable methods to estimate the storability of produce on the farm and hundreds of papers (1) might be cited of studies concerning storability. In general, the moisture percentage in the sample has been related to the spoilage in storage. However, it was soon learned, for example, that flax seed at 13% moisture was much too wet for storage, while white beans at the same moisture were considerably drier than was necessary. Hay might be stored as loose, long hay at 25% moisture, but if allowed to pack without “mowing away” it would heat and mold. Chopped hay might keep without molding everywhere except where it had been tramped upon. Moisture contents required for safe storage ranged widely, depending upon the nature of the material or the storage conditions.

As more scientific studies of the problem continued, it became evident that moisture content, as such, was not the determining factor. Studies of storage in closed containers with air at various relative humidities showed that molding occurred at more or less constant relative humidities of the air surrounding the particles of grain or hay. The air in the bin between beans at 16% moisture may be as damp (75% R.H.) as the air between flaxseeds at 10%, wheat at 14% or alfalfa hay at 16%. Thus, Milner and Geddes (1, p. 163) in reviewing the literature remark: “It is now quite generally agreed that the so-called critical moisture level for any individual species is the percentage at which the seed is in equilibrium with an atmospheric humidity of about 75%”.

In view of these facts, a moisture testing system or a farm storage practice based on relative humidity of the interstitial air rather than on percentage moisture seems sensible.

Numerous studies (1, Chap. 3; 15) have attacked the problem of storage from another angle, namely, requirements, in terms of relative humidity of various specific molds. There is a great difference among molds in this regard; but below a relative humidity of about 75%, there is little or no growth. If it is able to bring the surrounding air up to a relative humidity of 75%, little molding occurs, regardless of moisture in the sample.

It has been shown that all samples of a given type, such as winter wheat or spring wheat—are by no means identical in protein or mineral content. In the same way, samples are not identical in the moisture content at which they will mold, nor will they produce the same relative humidity at any given moisture content (13). The same is true of various hays (9).

It is difficult to establish that the tendency to mold is wholly due to the relative humidity of the air at any temperature (3). Certain materials seem more readily adapted to mold growth (1, 9). Furthermore, it has frequently been observed that dead or dying seeds mold more readily by saprophytes than are fully viable ones (3, Chap. 3, 4). It is so difficult to maintain a constant relative humidity in all parts of a container that the effects of temperature and respiration are somewhat academic. For most practical purposes, an accurate estimate of relative humidity seems a criterion of safe storage available.

In ordinary farm storage, recognition and utilization of this principle is a reliable basis of sound practice.