Laboratory Evaluation of Fungicides for the Preservation of Moist Grain

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The major cause of deterioration of moist foodstuffs is mold growth, and the use of fungicides as moist hay and grain preservatives has been suggested and tried (1,2,3,4). However, when mold growth on moist wheat was inhibited with fungicides, the grain developed off-flavors and odors and the milling and baking quality declined (3,4). Although mold growth was controlled, the grain became unfit for human consumption and the chemical treatment of moist grain was considered not practical.

The possibility of using fungicides to preserve moist grain for animal feed has not been fully explored. If preservatives will prevent mold growth and the accompanying high dry matter losses in moist grain without seriously altering the palatability of the grain, they might be used on grains that are grown for animal consumption. Preserving moist grain with an inexpensive fungicide has some definite advantages over other methods of handling such grain. Equipment costs for applying the chemical would be relatively small compared to drying equipment. The amount of time required for treating moist grain with fungicides would be much less than the average time for drying. Also, chemicals can be purchased on very short notice when their need is indicated.

Dawson, et al. reported that under laboratory conditions several of the chlorinated phenols inhibited mold growth in moist hay (1). Schenk and Kennedy confirmed this work and reported that several other compounds also showed promise as hay preservatives (5). Under field conditions Kennedy and Schenk were able to prevent molding and large dry matter losses in moist hay with high rates, of 2,4,6-trichlorophenol, but did not know whether or not the same results would be obtained with moist grain (2).

During 7- and 10-day storage periods, Milner and co-workers found that dry matter losses of moist wheat treated with certain fungicides were small but since the quality of the wheat for human consumption quickly deteriorated, the grain was not stored for longer periods (3,4). Schenk reported that several fungicides not only prevented mold growth on moist grain but inhibited germination and probably curtailed the respiration rate of the grain itself. As a result of Schenk’s study this work was undertaken to determine if certain fungicides could control both mold and grain respiration when used as preservatives for moist grain.

PROCEDURE

Duplicate 100.0-gm. samples of wheat containing 29.0 ± 0.2% moisture were treated with 0.125, 0.25 or 0.50% 2,4,6-trichlorophenol; 0.10 or 1.0% thiourea; 0.05 or 0.2% butanone; or 0.80% ethanol. Two samples of wheat were also included. The samples were placed in Erlenmeyer flasks in a 25°C constant temperature cabinet. The flasks were connected to a source of carbon dioxide and approximately 10 liters of such air was passed through daily. The carbon dioxide which evolved from the wheat was collected and measured. Initially the samples were weighed daily, but as the experiment progressed, each flask was made at weekly intervals for visible mold growth.

After 55 days, measurements on completely rotten samples were discontinued but the checks and those which were still well preserved were continued for a total of 79 days. At the end of their respective storage periods, each flask was weighed, oven-dried and reweighed to determine the final wet weight and the total loss of dry matter.

The carbon dioxide was initially removed from the air by forcing it through the bottom of a 20-inch vertical column of 10 N NaOH solution (Figure 1). The air was then passed through a sintered glass filter stick, into a 1,000-ml. flask containing distilled water and then through a glass filter stick 1,000 ml. of a saturated solution of Mg(CIO₄)₂. Theoretically, after passing through this saturation column, the air was in equilibrium with 93% relative humidity.

The air was then passed by means of a manifold to the individual flasks of grain. The air from each were then passed through a drying column containing both a layer of Caroxite and Mg(CIO₄)₂. The air then passed through a piece of capillary tubing with 0.28 mm. diameter to equalize the air flow through all samples. Finally, the air passed through a CO₂ absorption tube containing an amount of Caroxite and Mg(ClO₄)₂.

In order to maintain nearly constant air pressure a 1,000-ml. flask of distilled water was connected to the manifold by means of a glass tube which was inserted about 2 inches. Any excess air bubbled into the bottom of the flask.

The carbon dioxide evolution was measured with a 24-channel paper chromatograph per 24 hours. For the first 4 weeks the carbon dioxide evolution was measured daily except that the Caroxite tubes were attached to the apparatus until final measurements were made at the end of the experiment. The air was allowed to flow through the flask, not just when the Caroxite tubes were attached.