Agricultural Extension Service ● University of Minnesota

FACT SHEET

Preservation And Storage Of High-Moisture Grain With Propionic Acid

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D. R. Hicks, H. G. Johnson, H. A Cloud,
C. M. Christensen and R. A. Meronuck

Extensive tests in England, Canada, and the United States during the past 10 years have shown that high-moisture grains, and especially corn, can be treated with acid for storage up to 1 year without damage or loss of feeding quality. Such grains are treated with propionic acid or propionic acid-acetic acid mixtures. In the United States, these treatments are marketed under various trade names. Most of the products are nearly 100 percent propionic acid.

Any grain preserving process must prevent the growth of micro-organisms. Drying, cooling, ensiling, or adding acid are ways to do this. Acid prevents the growth of many micro-organisms such as bacteria and fungi. The acid provides a low pH. Low pH inhibits micro-organisms even though temperature and moisture conditions may be suited to their growth.

Application and Handling

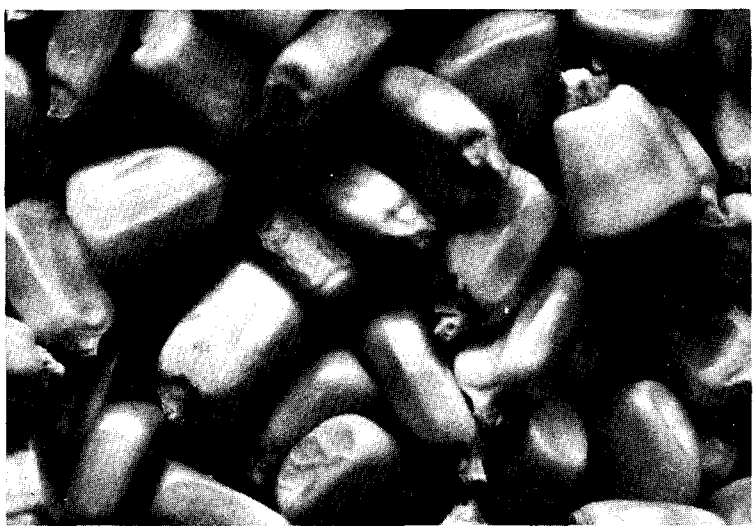
High-moisture grain should be treated as soon as possible after harvest. This is especially important during warm weather. Every kernel must be coated. If even a small amount of high-moisture grain lacks a coating of acid, a pocket of spoilage may develop. This spoilage will gradually spread.

The acids are applied mechanically. Equipment includes a constant delivery auger, a flow meter, an acid pump, nozzles to distribute the acid uniformly over the grain, and safety switches. The spray volume is adjusted for the auger capacity. The spray contacts a large percentage of the kernels. Further mixing of acid and grain occurs in the auger and during delivery to the bin. Applicators can be purchased for about $700 to $1,000. They can also be rented from the acid supplier.

The acid must be handled with care! Strictly follow the precautions on the container label. The acid can cause severe skin burns, and its vapors are extremely irritating to the eyes and lungs. For accidental spills, keep water nearby to wash off the acid. Wear a rubber apron, rubber gloves, and goggles. The acid vapors are very pungent and easily noticed. However, the vapors will dissipate in a few days. Never go into a bin until the vapors are gone (a few days after treatment).

Rate of Application

Rate of application varies with the moisture content of the grain and intended length of storage time. The following table (developed by the College of Agriculture, University of Guelph, Guelph, Ontario, Canada) gives the recommended rates for 100 percent propionic acid (these rates are for maxi-



The two photos show 30 percent moisture corn stored 1 month at 75°F. In the photo above, the corn was treated with 1.2 percent of a mixture of 80 percent propionic acid-20 percent acetic acid. The corn is sound and clean. The corn in the photo below was not treated and is heavily molded and decayed.

mum storage periods of 1 year and for preservatives of essentially 100 percent active ingredients):

Amount of 100 percent propionic acid required.

Percent of moisture content of grain	Percent by weight	Lbs. per wet bushel *	Lbs. per ton	Gallons per ton
16-18	0.50	0.28	10	1.3
20	0.75	0.42	15	1.8
25	1.00	0.56	20	2.4
30	1.25	0.70	25	3.0
35	1.50	0.84	30	3.6

* 56 lbs. of high-moisture corn.

Some companies have developed reduced rates of application for grain to be stored less than 1 year. However, treatment for a whole year is recommended. If a partial rate is applied, periodic checking of the grain is essential.

Some preservatives with only 10 to 20 percent propionic acid have been marketed. Tests have shown these preservatives to be useless when applied at the rates recommended by their manufacturers. Their application rates would have to be increased 5 to 10 times to obtain the amount of active ingredient necessary for effective grain preservation. Investing in preservatives with an unknown amount of propionic acid is not recommended.

Storage Facilities

Acid-treated grain can be stored any place where it is protected from snow, rain, and soil moisture. Grain can be piled on plastic sheeting. If aeration is provided, the grain can also be covered with plastic sheeting. The acid is corrosive to metal and to concrete, so these should be coated with acid resistant paint which is available from the acid supplier.

Acid-treated grain should not cause corrosive damage to feed mills, self-feeders, and feed delivery augers since the acid has been absorbed by the grain. However, augers used during acid application should be flushed with water to prevent corrosive damage.

Aeration

Moisture will migrate from portions of the grain with higher temperatures to portions with lower temperatures. With grain of 25 to 30 percent moisture, such migration can result in an accumulation of free water. This water seeps down, leaching acid from the grain. Rapid grain spoilage could result. Therefore in all types of storage, aeration equipment should be installed that will move air through the grain at a rate of about 0.1 cubic foot per minute per bushel of grain. This aeration should be continued until all the grain has a uniform temperature, preferably lower than 35°F. Occasionally check the temperature in different parts of the pile or bin.

Use of Acid-Treated Grain

The Environmental Protection Agency has ruled that grain treated with propionic acid and propionic acid-acetic acid mixtures can be used in food. The Food and Drug Administration generally recognizes the above acid-treated grains as safe. However, because of the odor and high moisture acid, treated grains will be discounted in regular market channels. Thus it is recommended that acid-treated grains be used only for livestock feed or sold in generally recognized high moisture market channels. Feeding trials with cattle and swine show acid-treated corn has the same feed efficiency as nontreated, high-moisture corn.

Cost

The major cost of this storage method is for acid (with some costs associated with applicator use, bin liners, etc.). The retail price (summer 1974) of the acid is about 40 cents per pound. Cost of treatment can be calculated from the application rates given in the table and from the preservation cost. For example, assume you will preserve 25 percent moisture corn with a 100 percent propionic acid costing 40 cents per pound. The application rate is 0.56 pounds per wet bushel or 20 pounds per ton. For preservative only, treatment will cost 22.4 cents per wet bushel or $8 per ton to preserve 25 percent moisture corn for 1 year.

With drying and/or sealed storage systems, most costs are fixed (depreciation, interest, taxes, repairs, and insurance). Actual operating costs are low. For example in a drying system, the operating costs (fuel and electricity) will be 4 to 6 cents per wet bushel. By comparison, fixed costs may range from 6 to 15 cents per wet bushel, depending on volume dried and equipment used. Another alternative for small amounts of corn is custom drying. For comparison, custom drying costs range from .75 to 1.3 cents per wet bushel per percent moisture removed (e.g. custom drying 25 percent corn to 13 percent would cost about 9 to 15.6 cents per wet bushel).

Summary

Propionic acid treatment of high-moisture grain is an effective and safe storage method for grain storage periods of 1 year or less. Treated grain is recommended only for livestock feed. Preserved grain is palatable to livestock and nutritionally equal to nonacid-treated, high-moisture grain.

Propionic acid treatment may be practical in the following situations:

*As an exclusive grain handling method.
*As an emergency storage method. Yields may exceed the normal farm storage capacity. Overflow grain can be treated and stored in temporary structures such as "plastic silos" on the ground.
*During years when fuel for drying operations may be scarce or prohibitive in cost, part or all the grain could be prepared for storage by acid treatment.
*As a method for handling a small amount of grain.
*As a handling method for farmers who are not sure of their long range plans and may not want to invest in a drying, handling, and storage system or a high-moisture corn feeding system.

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