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The Change in Weight of Grain in Arid Regions During Storage

By FRANK S. HARRIS and GEORGE THOMAS

Logan, Utah, January, 1914
UTAH AGRICULTURAL EXPERIMENT STATION

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The Change in Weight of Grain in Arid Regions During Storage

By FRANK S. HARRIS and GEORGE THOMAS.

Introduction.

In handling grain the question of the changes that may occur in weight after threshing is always before the dealer. If there is any considerable loss during storage his profits are consumed, while if there is a gain it is possible for him to work on a much closer margin.

Before rational methods of dealing with the problem can be worked out, it is necessary to have experimental data to show just what takes place under each set of conditions. It is in response to this need that the following data are presented. It is believed that these results will be of service in answering questions arising between the producer of grain on the one hand and the buyer and shipper on the other.

The results herein shown will not hold for all conditions. Under a different climate or with other methods of handling the grain different results might be expected. These data, however, can be used as a guide to what will probably take place under the conditions of the experiment.

Any change in weight is due primarily to absorption or evaporation of moisture. There is probably a very small continuous loss due to respiration of the grain, but this is of practically no consequence under favorable conditions of storage. If the grain had not thoroughly dried at harvest it would doubtless lose in weight due to the evaporation of moisture. This would be particularly true if it were taken into a drier climate than that in which it was harvested. On the other hand, if the grain was very dry when threshed it might take up moisture and increase in weight as the season advanced.

In talking with farmers on the subject, they almost invariably believed there would be a decided loss during storage.
This loss was usually estimated to be between five and twenty-five per cent. Most farmers were willing to sell at a considerably lower price at harvest than later, even though storage cost them nothing. They thought the loss in weight would be sufficient to make the difference. The idea that there might be any increase in weight after harvest met with very little favor.

Plan of the Experiment.

During the summer of 1911 the authors, realizing the need of information on the subject, decided to undertake an experiment to see what the loss or gain would be in grain raised under irrigation and dry-farming and harvested and threshed by the methods usually employed in arid regions. Wheat and oats were used. They were taken directly from the threshing machine and placed in burlap sacks, each holding about 130 pounds of wheat and a little less of oats. The bags of grain were stored in a grain room of the barn belonging to the Agricultural College at Logan, Utah. They were placed on a platform where there could be a free circulation of air.

The experiment was begun August 17, 1911, and continued two years. The bags were weighed once a month, the same scales being used for all the weighings.

The temperature and precipitation records were obtained about 100 feet from the barn.

Description of Grain.

Nine bags of grain were used in the experiment. A number of these were duplicates, as it was desired to see how nearly they would check. Numbers 1 and 2 were Gold Coin wheat from the Farrell farm at Peterboro, on the west side of Cache Valley, Utah. The wheat was raised on a dry-farm and harvested and threshed with a combined harvester on August 17, 1911.

Nos. 3 and 4 were Lofthouse wheat from the dry-farm of C. C. Cressall of Peterboro. It was cut with a header and stacked ten days before being threshed on August 17th.

No. 5 was Danish oats from the Greenville Experiment Farm and was raised under irrigation. It was cut, bound and allowed to stand in the ordinary shock for a week before being threshed on August 26, 1911.
No. 6 was Red Rust Proof oats raised and harvested in the same manner as No. 5.

Nos. 7 and 8 were New Zealand wheat from the Greenville farm raised under irrigation. The method of harvesting was the same as for Nos. 5, 6, and 7.

No. 9 was Turkey Red wheat from the dry-farm of Willard S. Hansen at Collinston, Boxelder County, Utah. It was not received until September 18, 1911. The method of harvesting is not known.
Discussion of Results.

The results are given in curves, each curve representing a sack of wheat. The figures indicate the gain in weight of grain in per cent of the original weight.

Contrary to what was expected it was found that in every case there was a gain in weight instead of a loss. The same general kind of a curve was made by each bag of grain. There was a gradual increase in weight during the fall and winter until a total gain of from three to nearly five per cent of the original weight had been made.
During the spring, about April, there began to be a loss which continued through summer and into the fall, when the weight began to increase again. During the second winter the grain became even heavier than during the first. The second spring there was a falling off similar to the first. The greatest gain made was in No. 5—Danish oats raised under irrigation—and the least gain was in No. 7—New Zealand wheat, also raised under irrigation. On the average there seems to have been little difference in the grain raised under irrigation or dry-farming conditions.
These results do not show any consistent difference due to method of harvesting, whether it was done with a combined harvester and threshed at once, with the header and stacked ten days before threshing, or cut, bound and left standing in the shock ten days before threshing. It is probable that the stage of maturity and dryness at harvest are the chief factors that determine changes in weight, rather than the variety, the method of raising, or the method of harvesting.
A diagram of the average temperature and precipitation during each month of the two years is given in Figure 10. A comparison of this with the weight of the grain shows that the change in weight is affected by both the temperature and the rainfall, the latter probably being in a general way an index to the humidity of the air. During the winter of 1911-12 the coldest month was December, while the grain continued to take up moisture till March. This was perhaps due to the high humidity of the atmosphere accompanying the spring rains.
During August, 1913, the grain was lighter than at any time during the previous summer. An examination of the curves for the weather shows this to have been almost a rainless month, and at the same time it was hotter than any month during the summer of 1912. This high temperature and low humidity would have been expected to cause a loss; but it will be noted that even in this extreme the grain weighed distinctly more than when threshed on the same date in 1911.

**Per Cent Moisture in the Grain**

A determination of the amount of moisture at the beginning and at the end of the experiment was made with the following result, expressed in per cent of dry grain.

**MOISTURE IN GRAIN AT BEGINNING AND END OF EXPERIMENT.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Grain</th>
<th>Per Cent Moisture August, 1911</th>
<th>Per Cent Moisture August, 1913</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wheat</td>
<td>6.51</td>
<td>9.25</td>
<td>2.74</td>
</tr>
<tr>
<td>2</td>
<td>Wheat</td>
<td>6.48</td>
<td>9.23</td>
<td>2.75</td>
</tr>
<tr>
<td>3</td>
<td>Wheat</td>
<td>6.98</td>
<td>9.30</td>
<td>2.32</td>
</tr>
<tr>
<td>4</td>
<td>Wheat</td>
<td>7.33</td>
<td>9.31</td>
<td>1.98</td>
</tr>
<tr>
<td>5</td>
<td>Oats</td>
<td>6.25</td>
<td>8.57</td>
<td>2.32</td>
</tr>
<tr>
<td>6</td>
<td>Oats</td>
<td>6.12</td>
<td>8.24</td>
<td>2.12</td>
</tr>
<tr>
<td>7</td>
<td>Wheat</td>
<td>8.67</td>
<td>9.28</td>
<td>.61</td>
</tr>
<tr>
<td>8</td>
<td>Wheat</td>
<td>7.54</td>
<td>8.99</td>
<td>1.45</td>
</tr>
<tr>
<td>9</td>
<td>Wheat</td>
<td>6.72</td>
<td>8.95</td>
<td>2.23</td>
</tr>
</tbody>
</table>

This table brings out the increase shown in the curves and in addition shows just how much moisture there was in each sample of grain.

No. 7 contained the highest initial per cent moisture and made the smallest gain. On the other hand, No. 6 had less moisture to begin with than No. 5 and also made less gain. This may have been due to a difference in the varieties.

It will be noted that when in equilibrium with the atmosphere wheat in every case contained a higher percentage moisture than the oats.
Summary.

1. Contrary to popular opinion, there is a gain of from $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent instead of a loss in the weight of grain during the fall after harvest.

2. While this holds for Cache Valley, Utah, other conditions would probably not give just the same results.

3. Farmers and grain dealers should know what changes take place in the weight of grain handled by them.

4. The method of raising or harvesting grain did not seem to have as much effect on the change in weight as the temperature and humidity.

5. In every case there was a gain in weight during the winter, and a loss during the summer, but the grain weighed less at threshing than at any time later.