10-1-1940

Rich Soils- Rich Corn

W. H. Pierre
Iowa State College

A. J. Englehorn
Iowa State College

Follow this and additional works at: http://lib.dr.iastate.edu/farmsciencereporter

Part of the Agriculture Commons

Recommended Citation
Available at: http://lib.dr.iastate.edu/farmsciencereporter/vol1/iss4/4

This Article is brought to you for free and open access by the Iowa Agricultural and Home Economics Experiment Station Publications at Iowa State University Digital Repository. It has been accepted for inclusion in Farm Science Reporter by an authorized editor of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
IF YOU get large increases in corn yields from improving your soil fertility, then probably your corn grain from the unfertilized land is deficient in phosphorus. It may contain less phosphorus than your livestock and poultry need for adequate nutrition.

This is the conclusion we have reached here at the Iowa Station following a study of the influence of soil treatment on the phosphorus content of corn. In our tests, when we got large increases in corn yields from fertility improvements, then we also got rather consistently large increases in the phosphorus content of the corn kernels; when fertilizers did not greatly step up corn yields, then the “step-up” in phosphorus content of the grain was relatively small.

Phosphorus is one of the minerals most likely to be deficient in the rations of farm animals. This mineral is found in all parts of the body. With lime, it forms the chief constituent of bone. Animals fed a ration deficient in phosphorus have been found to develop bone disease. One of the early symptoms of this disease is bone chewing or the gnawing of wood. This is usually followed by poor physical condition, poor appetite, stiffness in the joints and fragile bones.

Deficiency of phosphorus in the ration may exist long before symptoms of extreme phosphorus deficiency appear. In balancing a ration for farm animals a mineral supplement containing phosphorus is often fed. If we can make our crops richer in this substance, to that degree we reduce the necessity of adding phosphorus-containing mineral supplements to the ration.

The results of our study, briefly summarized here, show that the phosphorus content of corn grain is often quite low and that it varies considerably when the corn is grown under different soil and climatic conditions. More than 200 samples of corn obtained from different parts of the state were analyzed for phosphorus. The lowest value found was 0.17 percent and the highest 0.38 percent. This variation was found to be due in part to differences in the fertility of the soil and in part to differences in weather conditions.

The phosphorus contents of different hybrids and of a hybrid and an open-pollinated variety grown on the same soils were quite similar, indicating that the variety is much less important than the soil fertility and weather.

**Yield, Phosphorus**

Many Iowa soils do not contain enough available phosphorus to produce maximum crop yields. Field experiments we have conducted on different soils in various parts of the state show that phosphorus fertilizers often bring profitable increases in crop yields. This is true even on some of our more productive soils, but it is especially true on poor or poorly managed soils.

In order to see what effect good soil management has on the phosphorus content of crops, we took a number of samples of corn from the plots of 20 experimental fields located in different parts of the state. Samples were obtained from plots that had received no soil treatment over a period of years, and some from plots that had received lime to correct acidity and also manure and phosphate fertilizers at regular intervals. Manure was used at the rate of about 2 tons per year (applied to corn) and superphosphate was applied at the rate of 120 pounds per acre to all grain crops in the rotation.

The increase in yield from the use of manure, lime and phosphorus on two fields was as much as 31 bushels per acre, and the average increase for all fields was 13 bushels (21 percent). The increase in the phosphorus content of the grain as a result of good soil treatments varied from none on fields of high fertility to as much as 38 percent on a field of low fertility. The average increase in phosphorus on all fields was 14 percent.

The graph on page 10 shows that the average phosphorus content of the corn grown on the treated soils of the 10 fields which showed the least increase in yield from soil treatment (average of 7.4 percent) was 10.8 percent; whereas the
Low in Phosphorus; It Affects Fertility of Soil

...corn on the 10 soils which gave an average increase in yield of 37.8 percent from the use of lime, manure and superphosphate showed an increased phosphorus content of 19.1 percent.

The phosphorus content of corn grown on the same soil varies in different years. We found this true in all fields studied. Table 1 shows that the corn on the untreated plot of the Storm Lake field (Webster silty clay loam) contained 0.27 percent phosphorus in 1932 but only 0.24 percent in 1938. Similar differences were obtained on the plot receiving manure and phosphate fertilizer. The corn from the untreated plot in 1932 contained nearly as much phosphorus as that from the treated plots in 1938. These and other data show that the kind of growing season may influence the phosphorus content of corn considerably. Differences due to soil treatment still persist, however, even though the actual percentage of phosphorus in the grain may vary from year to year.

Test Hybrids

During recent years many questions have been raised as to the relative merits, from the feeding standpoint, of open-pollinated and hybrid corn, and also of different hybrids. We, therefore, compared the phosphorus content of various hybrids and of open-pollinated and hybrid corn when grown on the same soils. In 1938 one-half of the plots in the experimental field at Independence were planted to Iowa Hybrid 942 and the other half to open-pollinated corn. The analyses of the corn samples from these plots showed that there was little or no difference in the phosphorus content of the hybrid and open-pollinated variety.

In order to study this problem further a number of single crosses were planted side by side on the fertility plots of the 4-year rotation at Ames in 1939. Some of the plots had not received any soil treatment for 20 years, while others had been well manured and fertilized during this period. Although the 10 different hybrids all gave higher yields and a higher phosphorus content on the well manured and phosphated plots than on the untreated plots, there was no significant difference in the phosphorus content of the different hybrids. The protein content of the corn, on the other hand, varied more with the kind of hybrid than with the fertility of the soil.

Agronomy Farm Results

At the Agronomy Farm near Ames where the experimental plots have been under different treatments for 25 years, the increase in the phosphorus content of corn from the use of lime and manure has been somewhat greater than for the average of outlying tests. The phosphorus content of the corn was about 30 percent greater on the plots receiving lime and manure than on the untreated plots in 1939. The increase in yield from the lime and manure treatment in the same experiments varied between 18 and 25 bushels per acre. The use of phosphate fertilizers on this well manured land in a good rotation gave very little increase in corn yields, and the phosphorus content of the grain from the phosphated plots was only slightly higher than from the plots receiving manure and lime. This indicates that with the large applications of manure on a relatively fertile soil, enough phosphorus was supplied to meet the needs of the crop.

The phosphorus content of the corn from some of the untreated plots at the Agronomy Farm in 1939 was quite low. Corn from one of the untreated plots contained 0.17 percent phosphorus, whereas the corn on the other untreated plots varied from 0.20 to 0.26 percent phosphorus. The corn from several of the treated plots in another rotation contained 0.34 percent phosphorus.

Because we found corn containing as little as 0.17 percent...
TABLE 1. PHOSPHORUS CONTENT AND YIELD OF CORN GROWN ON THE SAME PLOTS IN DIFFERENT YEARS.
Webster Silty Clay Loam—Storm Lake.

<table>
<thead>
<tr>
<th>Year</th>
<th>Phosphorus in grain (%)</th>
<th>Yield (bu. per A.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Untreated plot</td>
<td>Manure &amp; phosphate plot</td>
</tr>
<tr>
<td>1932</td>
<td>.27</td>
<td>.31</td>
</tr>
<tr>
<td>1938</td>
<td>.24</td>
<td>.28</td>
</tr>
<tr>
<td>Average</td>
<td>.26</td>
<td>.30</td>
</tr>
</tbody>
</table>

Manure was applied at a rate of approximately 8 tons per acre every 4 years, and 20-percent superphosphate was applied at the rate of 120 pounds per acre to all grain crops in the rotation.

TABLE 2. COMPARISON OF THE PHOSPHORUS CONTENT OF CORN AND OF RED CLOVER HAY.

<table>
<thead>
<tr>
<th>Experimental field</th>
<th>Corn grain</th>
<th>Red clover hay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Untreated plots</td>
<td>Treated* plots</td>
</tr>
<tr>
<td>Princeton field (Clinton silt loam)</td>
<td>Percent P .31</td>
<td>Percent P .36</td>
</tr>
<tr>
<td>Independence field (Carrington loam)</td>
<td>.23</td>
<td>.29</td>
</tr>
<tr>
<td>Average</td>
<td>.27</td>
<td>.33</td>
</tr>
</tbody>
</table>

* Treated plots received ground limestone, manure and superphosphate. Manure was applied at a rate of approximately 8 tons per acre every 4 years, and superphosphate was applied to all the grain crops in the rotation at the rate of 120 pounds of 20-percent superphosphate per acre.

The Princeton field was in clover in 1931 and in corn in 1932; the Independence field was in clover in 1931 and in corn in 1933.

phosphorus and many samples with less than 0.28 percent, a farmer may wonder how these amounts compare with the amounts needed in the ration of farm animals. Animal husbandry men have studied this problem for many years, and they have come to the conclusion that for young growing cattle and for pregnant or milking cows, the ration should contain about 0.30 percent phosphorus, whereas for large fattening cattle a ration containing 0.20 percent phosphorus is satisfactory. For growing chickens, brood sows and growing pigs the minimum requirement is about 0.5 percent phosphorus. Mature or fattening animals require less than growing animals.

It is evident from these figures that corn is not a concentrated feed in regard to phosphorus, and that when fed along with low quality roughage, it will not meet the phosphorus needs of growing animals.

Corn vs. Clover Hay

The phosphorus content of hay crops is also increased as a result of good soil treatment. In fact, the increase is usually larger than with corn. Moreover, the phosphorus content of good legume hay, such as red clover or alfalfa, may be as high as that of corn grown on poor soil. This is shown in the results obtained on two experimental fields where samples of clover hay and of corn grain from the different plots were analyzed for phosphorus (see table 2). On the untreated plots the corn averaged 0.27 percent phosphorus and the red clover hay averaged 0.19 percent. On the treated plots corn averaged 0.33 percent and clover hay 0.25 percent. But note that the clover hay on the well manured and phosphated plots of the Independence Field contained a higher percentage of phosphorus than corn on the untreated plots.

Hay crops will, of course, vary considerably in phosphorus content. Grass hays are usually considerably lower in phosphorus than legume hays. If in making hay the leaves are lost, it will lower the phosphorus content, since leaves are considerably higher in phosphorus than the stems. Young plants are also much higher in phosphorus than the older plants. This means that pasture forage, when young and nutritious and grown on good soil, contains relatively high amounts of phosphorus.

GOOD SOIL TREATMENT INFLUENCES BOTH YIELD & PHOSPHORUS CONTENT OF CORN
(Summary of 20 experimental fields in different parts of the state)

GROUP I - 10 FIELDS
(increases in yields from soil treatment less than 20%)

GROUP II - 10 FIELDS
(increases in yields from soil treatment more than 20%)

Average Increase in yield

Average Increase in phosphorus