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**Fertilizing Small Grain**

Cooperative Extension South Dakota State University

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fertilizing small grain

Cooperative Extension Service
South Dakota State University
U. S. Department of Agriculture
The 5 million acres of small grain planted annually in South Dakota account for about 35% of the value of all feed grains, cash crops and hay produced in the state. Proper fertilization of wheat, oats, barley and rye could easily add $10 million to net farm income.

Putting your fertilizer dollars on small grain is a "good bet" in South Dakota. Research results from 140 experiments over the past 10 years show that small grain, fertilized on the basis of soil tests, returned more than $2.40 for each dollar invested in fertilizer. That's a 240% return on investment. In some cases the most profitable response was obtained by applying rates of fertilizer in excess of those recommended from soil tests. This is to be expected in some years because recommendations based on soil tests are for average conditions and are designed to produce near maximum profits over a period of years.

Small grain responds to proper fertilization because it grows during cool weather when the release of plant nutrients from the soil organic matter is slow. Consequently, the addition of some nitrogen (N) and phosphorus (P) usually produces a visual fertilizer response. Whether or not this initial response will increase yields depends on a number of factors such as rainfall, insects, disease, temperature and weed control.

Many South Dakota soils are no longer able to supply sufficient nutrients for best yields. The soils have been depleted of nutrients by continuous cropping and soil erosion to such an extent that in many cases low soil fertility limits small grain yields even more than lack of available soil moisture.
SMALL GRAIN PLANT NUTRIENTS

Nitrogen and phosphorus are the two nutrients most needed for small grain production in South Dakota. Under certain conditions, the use of potassium may also be justified. If the soil cannot supply sufficient nitrogen, phosphorus and potassium, then supplemental nutrients must be added as fertilizer. At present, addition of other elements is unnecessary for top yields of small grain. Apparently our soils are supplying these nutrients in sufficient quantities.

Nitrogen

South Dakota soils contain between 2,000 and 5,000 pounds of nitrogen per acre in the plow layer. However, most of this nitrogen is “tied up” in the organic matter (decayed crop residue) and is not readily available to plants. About 1% to 1½% of soil nitrogen becomes available to small grain crops each year. The actual amount depends on soil temperature and moisture.

A soil test for organic matter is a good guide for estimating the amount of nitrogen released and should be the first step in deciding how much nitrogen fertilizer to use. Other factors such as soil moisture, manure and legumes used, and nitrate accumulation, will also affect response to nitrogen fertilizer. For this reason they must also be evaluated in planning a fertilizer program for small grain.

NOTE: Nitrogen deficient small grain fields are easily recognized. The plants are pale yellowish-green and stunted. Severely starved plants can be identified by the yellow tips.

Phosphorus

South Dakota soils contain between 1,000 and 2,000 pounds of phosphorus (P) per acre in the plow layer. Both the organic and mineral portions of our soils contain some phosphorus. However, like nitrogen, it is not all readily available for crops to use. Availability of soil phosphorus depends on such factors as soil temperature, moisture and pH (a measure of acidity or alkalinity). A soil test is the best guide to determine the amount of phosphorus to add for top small grain production.

NOTE: A lack of phosphorus in small grain causes stunted growth. Mild shortages do not exhibit a color difference. Severe shortages usually cause the leaf tips to turn brown and eventually die. A phosphorus deficiency can be confused with nitrogen deficiency, although a general yellowing of field is normally associated with a lack of nitrogen rather than phosphorus.

FERTILIZER APPLICATION

Using a drill attachment, broadcasting prior to seeding, and top-dressing are three common methods of fertilizing small grain. The choice may be dictated by equipment available and kind of fertilizer used. Excellent equipment is available for applying both liquid and dry fertilizer materials.

Drill Attachment

Attachments which place seed and fertilizer in the same drill row have increased yields more than any other method of fertilizer application. In experiments where phosphorus fertilizer increased small grain yields, a grain drill attachment more than doubled the increase in yield as compared to broadcasting phosphorus ahead of seeding. The average yield increase from fertilizer applied with the drill attachment (table 1) was 5.2 bushels per acre, whereas broadcasting increased yields by only 2.5 bushels per acre.

There is no particular advantage in applying straight nitrogen materials with a drill attachment. However, when nitrogen and phosphorus are both recommended, it is desirable to apply both with a drill attachment.

The drill attachment is the most desirable method of applying phosphorus fertilizer to small grain.

Caution: Drilling more than 40 pounds of nitrogen per acre with the seed can cause germination damage.

Broadcasting Before Seeding

Broadcasting fertilizer is one of the most economical methods of application. It is acceptable for applying nitrogen. It is also suitable for applying phosphorus. However, higher rates are recommended to produce yield increases equal to those obtained when phosphorus is drilled with the seed (see table 2).

Phosphorus moves only a short distance from where it is applied. Therefore, it should be placed in a soil area that it suitable for root development. Plowing is the best means of working broadcast phosphorus into the soil. Disking is a poor second choice because of the shallow placement. This usually means that phosphorus is not readily available when the top few inches of soil dry out. Soil incorporation of fertilizer shortly after application will also help prevent the gaseous loss of nitrogen and the loss of fertilizer material through water erosion.

Table 1. Effect of Broadcast and Drill Applied Phosphate Fertilizer on Small Grain Yield (Average of 16 experiments)*

<table>
<thead>
<tr>
<th>Method of Placement</th>
<th>Check Yield Bu/A</th>
<th>Fertilized Yield Bu/A</th>
<th>Yield Increase Bu. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill Attachment</td>
<td>25.5</td>
<td>30.7</td>
<td>5.2</td>
</tr>
<tr>
<td>Broadcast</td>
<td>25.5</td>
<td>28.0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

*Barley and oats adjusted to 60-pound bushels.
†Experiments that responded to P treatment, rates were similar within any one experiment.
Top-Dressing

Application of fertilizer on a growing crop is called top-dressing. It is satisfactory for applying nitrogen fertilizer; but best results can be expected when the nitrogen has been applied prior to or at planting time. Top-dressing should be used as an emergency measure for correcting a nitrogen deficient condition or where preplant applications were not possible. When it is necessary, satisfactory results can be expected up to 30 days after planting, provided sufficient rainfall occurs to carry the nitrogen into the soil. Phosphorus is unsatisfactory as a top-dress material for small grain.

FERTILIZER RECOMMENDATIONS

Fertilizer recommendations are based on soil tests that are related to fertilizer response in the field. A soil test is of little value if it is not based on research from field trials.

The nitrogen supplying ability of the soil is evaluated with an organic matter test because the ability of a soil to furnish nitrogen for crop growth depends on the release of nitrogen from organic matter. Manure, legumes, and summer fallow also affect the amount of nitrogen available for plant growth and these factors need to be considered when making recommendations. (See sections 15, 16 and 17 of Agronomy Pamphlet No. 31, “Explanation of Soil Tests” for a detailed discussion of summer fallow, manure and legumes.)

The phosphorus supplying ability of a soil is evaluated by measuring the amount of soil phosphorus extracted with a dilute hydrochloric acid and relating these values to response to phosphorus fertilizer in the field. There is excellent correlation between the phosphorus soil test and field response to applications of phosphorus fertilizer on small grain.

Recommended rates of fertilizer according to soil tests are shown in tables 2 and 3.

Spring Seeded Small Grain

Summer Fallow. Summer fallowing stores moisture by eliminating plant growth during one season. Nutrients are also stored during this period. Consequently, there is generally less need for fertilizer on summer fallow. No nitrogen is recommended for fallowed small grain when the soil organic matter content is above 2% (table 3). At present, phosphorus recommendations (table 2) are not altered for fallow because the “build up” of available phosphorus during the fallow period should show up in the soil test.

General Recommendation: 15 to 25 pounds of phosphorus.

Continuous Cropping. Spring seeded small grain planted on non-fallow land usually requires more nitrogen than that planted on fallowed land. Therefore, some nitrogen is needed at all levels of organic matter (table 3). The phosphorus recommendations (table 2) are the same for both fallow and continuous cropping.

General Recommendations: 20 to 30 pounds of nitrogen and 15 to 25 pounds of phosphorus (P₂O₅).

Winter Wheat

Most winter wheat is seeded on summer fallowed land which stores moisture and tends to accumulate available nutrients in the soil. Phosphorus “build up” should show up in a soil test. Consequently, it is not necessary to adjust the phosphorus recommendation for fallow and non-fallow conditions (table 2).

On the other hand, nitrogen “build up” will not show up on a soil test because the nitrogen test measures soil organic matter. This value would change very little during any one year. The nitrogen recommendations are adjusted for fallow and non-fallow conditions (table 3).

Malting Barley

Fertilizing malting barley is a special situation because the brewing industry requires that the protein content of the grain should not exceed 13.5%. This would suggest that nitrogen fertilization of malting barley might be undesirable. However, research indicates that recommended rates of nitrogen fertilizer can be used on malting barley without greatly increasing the protein content if adequate phosphorus is applied and the barley seeded early. Recommended rates of application are shown in tables 2 and 3.

Table 3. Nitrogen Recommendations for Small Grain According to Soil Test

<table>
<thead>
<tr>
<th>Organic Matter Test %</th>
<th>Nitrogen Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Fallow (lbs./A)</td>
</tr>
<tr>
<td>0-2.0</td>
<td>40</td>
</tr>
<tr>
<td>2.0-2.5</td>
<td>35</td>
</tr>
<tr>
<td>2.5-3.0</td>
<td>30</td>
</tr>
<tr>
<td>3.0-3.5</td>
<td>25</td>
</tr>
<tr>
<td>3.5-4.0</td>
<td>20</td>
</tr>
<tr>
<td>4.0-4.5</td>
<td>5-15*</td>
</tr>
</tbody>
</table>

*Drill attachment only, when P is also needed.
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BROOKINGS, SOUTH DAKOTA

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Here are other Facts Sheets you can obtain from your County Extension office for additional information on small-grain production:

- Fertilizer Rates and Profitability in Small Grains
- Wheat: Barley, Oats, Pea in Small Grains
- Small Grain Diseases

Fertilizing

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