Fertilization recommendations for winter wheat

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Summary: MSU Extension offers soil nutrient guidelines to get winter wheat off on a good start and for optimal use of fertilizer resources.

BOZEMAN – With Montana's harvest coming to a close, many of the state's agricultural producers and their advisers are likely thinking about soil nutrient needs for the next winter wheat crop.

In Montana, nitrogen, phosphorus, and potassium, and sometimes sulfur fertilizers are required to grow healthy winter wheat, each requiring unique management techniques. Farmers are encouraged to conduct annual soil tests, to best determine nutrient needs for the next growing season.

Nitrogen is the nutrient needed in the greatest quantity, and typically provides the biggest yield boost. MSU fertilizer guidelines are based on spring soil tests which are especially important to calculate nitrogen rates, to account for overwinter nitrogen gains or losses. For information on soil testing and calculating fertilizer rates see the MontGuides *Interpretation of Soil Test Reports for Agriculture* and *Developing Fertilizer Recommendations for Agriculture*.

Soils in fallow, pulse, or legume cover crop rotations can accumulate about half the nitrogen required for a winter wheat crop, but some of this soil nitrogen can be lost overwinter. A second sampling in the spring is strongly suggested if soil depth is less than two feet and if fall nitrate levels are greater than about 60 pounds nitrogen per acre.

It may seem wasteful to soil sample twice, yet laboratory soil analyses often cost less than $40, and under- or over-applying by just 10 to 15 pounds of nitrogen per acre can often affect the bottom line much more than the cost of soil testing.

To avoid always sampling twice a year, a comparison of fall with spring samples over a few years should identify whether a given field and rotation generally gains or loses nitrogen overwinter. Patterns of loss or gain can guide adjustments to spring nitrogen rates based on fall samples or the decision to spring sample.

Winter wheat requires an average of 2.6 pounds nitrogen per bushel, but the economically optimum rate will depend on grain prices, discounts, and fertilizer cost.

According to research by Rick Engel, associate professor in LRES, Montana producers can make initial nitrogen decisions based on previous years' grain protein levels. Engel found that if grain protein from a field is historically below 12.5 percent for winter wheat, then yields have been limited by lack of nitrogen.

Split nitrogen applications can reduce the risk of overwinter nitrogen loss and allow for rate adjustment in the spring according to growing conditions. About 60 percent of the total requirement for a realistic yield goal should be applied by early April and the remainder by early to mid-tillering. If drought has lowered yield potential at that point, then the second application can be reduced or eliminated.

Urea is the most common nitrogen source. It needs to be put into the ground whenever possible by subsurface banding (at least two inches prior to packing), water (at least half-inch in a single event) or tillage (at least three inches). Broadcast applications on cold or snow covered ground are risky; MSU research has found they can lose up to about 40 percent of their nitrogen to the air when not protected with a "urease inhibitor".

If wheat has not responded to nitrogen, or protein is unexpectedly low, then sulfur may be deficient. Since the soil sulfur test is not a strong tool to determine sulfur requirements, the consideration to fertilize with sulfur depends on crop and field history. Sandy, acidic, or low organic matter soils are more likely to be low in sulfur than other soils.

If the prior crop showed sulfur deficiency, then 10-15 pounds sulfur per acre before or at seeding could be a wise investment. Elemental-sulfur can be applied in the fall, while sulfate sources are best applied in the spring.

In contrast to nitrogen, both phosphorus and potassium should be applied before or at seeding. Therefore soil tests will need to be done this fall, or soil test values from 2015 or 2016 could be used since phosphorus and potassium soil levels are relatively stable.

Phosphorus is very important to winter wheat survival and yield and is most effective when placed with seed, and in bands adjacent to the seed, to help produce strong plants going into winter. An average safe seed-place phosphorus rate is 10 pounds $P_2O_5$ per acre. That rate can be adjusted up in fine textured soils, especially if moist or if using a wider than average opener.

The primary phosphorus fertilizer sources in Montana are monoammonium phosphorus (MAP; 11-52-0), diammonium phosphorus (DAP; 18-46-0), and liquid ammonium phosphorus (10-34-0). These are considered equal on a pound $P_2O_5$ per acre basis, although MAP is the preferred source since it allows a greater amount to be safely placed in the seedrow. Liquid bands are a higher risk to seed than MAP at same $P_2O_5$ rate, and DAP is very risky to place with seed.

Potassium deficiency is rare for Montana crops, but levels should be monitored especially in sandy coarse-textured soils or where straw is removed. Potassium soil test levels above 250 ppm are considered adequate for wheat production. However, winter wheat can respond to potash (0-0-60), the primary potassium fertilizer source, at higher soil test levels, especially in no-till where soils tend to be cooler than tilled soils early in the growing season.

Potash is best utilized when banded. However, if it is banded with the seed, limit the total amount to 10 pounds combined nitrogen and potash per acre, adjusted as needed for seed bed conditions. South Dakota State University and the International Plant Nutrition Institute have an online safe seed-placed rate calculator (http://www.ipni.net/article/IPNI-3268). Potash is also effective broadcast at or before seeding.

The MSU Fertilizer Recommendation tool (http://www.sarc.montana.edu/php/soiltest) and the Economic Nitrogen Calculator (http://www.msuextension.org/econtools/nitrogen/index.html) are online tools to help calculate fertilizer requirements. These and more resources, including steps for 'hand-calculating' fertilizer rates, are available at the MSU Soil Fertility Extension website (http://landresources.montana.edu/soilfertility/index.html). Contact Clain Jones at clainj@montana.edu or 994-6076 if you have questions.