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Fertilizing Wheat

Cooperative Extension South Dakota State University

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FS 677

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Cooperative Extension Service
South Dakota State University
U.S. Department of Agriculture

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High wheat yields require large quantities of available plant food. For example, each bushel of spring or winter wheat will take up, in addition to the secondary and trace elements needed, the equivalent of approximately 2.4, .8, and 1.9 lbs of nitrogen (N), phosphorus (P_2O_5), and potassium (K_2O) in the plant and grain.

There are at least 13 mineral elements considered necessary for plant growth. Besides nitrogen, phosphorus and potassium (the primary plant foods), they include calcium, magnesium, and sulfur (the secondary nutrients) and the trace elements boron, chlorine, copper, iron, manganese, molybdenum, and zinc.

Few (if any) soils can consistently provide the levels of all of these essential nutrients necessary to assure maximum potential yields. The best fertilizer rate and ratio will depend on existing soil fertility levels, yields desired, and past management (such as tillage, use of manure and legumes, etc). Recommended rates of nitrogen, phosphorus and potash, based on soil test and yield goal, are shown in Tables 1, 2 and 3.

Nitrogen

Nitrogen fertilizer is not normally used as extensively on winter wheat as it is on spring seeded wheat. Winter wheat is traditionally seeded in fallowed soils that will provide a 2-year soil nitrogen supply. Nevertheless, nitrogen fertilizer use often will be profitable on fallowed fields, seeded to either winter or spring wheat, where soil test organic matter levels are 2.0% or below.

Spring wheat is most commonly seeded in soil cropped the previous year and which contains less available nitrogen. Where winter or spring wheat is seeded on soil cropped the previous year, higher rates of nitrogen are usually needed.

The amount of actual nitrogen recommended for a desired yield can be determined by subtracting the nitrate nitrogen soil test values from the total nitrogen requirement shown in Table 1. General recommendations for nitrogen use are also shown in Table 1 for fields where nitrate tests were not made and only organic matter test levels are known.

Nitrogen as it affects protein

Nitrogen in excess of the crop's needs for optimum plant growth and grain formation will usually result in higher protein levels.

These nitrogen needs for optimum growth will fluctuate from year to year, depending on climate and other factors. So the amount of additional nitrogen needed will also vary. Rates of approximately 20 to 30 lbs actual nitrogen, over and above that recommended normally for a given yield, would be suggested.

Moderate leaf burn may occur when liquid nitrogen fertilizers are applied at this rate; however, final yield loss will be insignificant. Some varieties lodge more easily than others when high levels of soil nitrogen are available. Variety selection and good soil testing programs can help minimize or reduce such loss.

Time of application, when trying to increase grain protein levels with topdress fertilization, also can affect final results. In general, nitrogen applied early tends to improve yield, whereas that applied late (early heading) increases protein levels. Climate variation and cash market premium variability prevent growers from realizing regular profits when producing crops with high protein levels. It is difficult, therefore, to justify use of nitrogen solely for this purpose. It may have greater appeal to those growers who like to feed the higher protein crop to livestock.

Phosphorus

Phosphorus needs and fertilizer recommendations will seldom vary between winter and spring wheat for the same field and yield potential, as shown in Table 2. Neither will

Table 1. Nitrogen recommendations, lbs/A

Yield goal, bu/A	Nitrate nitrogen	Nitrogen soil tests					
		% Organic matter					
	Nitrogen needed, lbs N/A*	Non-fallow			Fallow		
		Low 2.0	Medium 3.0	High 4.0	Low 2.0	Medium 3.0	High 4.0
		Nitrogen recommended, lbs N/A					
20	48	20	0	0	0	0	0
30	72	30	30	0	0	0	0
40	96	50	40	20	20	0	0
50	120	65	50	25	30	20	0
60	144	80	60	30	45	30	20
80	192	100	80	60	70	45	20

*Values for determining nitrogen recommendations based on nitrate tests at 2-foot level.
Example for 40 bu/A yield: **96** (N needed) - **40** (nitrate soil test) = **56** lbs N to be applied. Computer would print a 55 lb N recommendation.

Table 2. Phosphorus recommendations, lbs P_2O_5/A

Yield goal, bu/A	Phosphorus soil tests, lbs P/A		
	Low 6 - 15	Medium 16 - 25	High 26 - 35
	P_2O_5 recommended, lbs /A		
20	30	20	0
30	40	20	0
40	40	30	15
50	50	40	15
60	60	45	15
80	65	50	15

Table 3. Potassium recommendations, lbs K_2O/A

Yield goal, bu/A	Potassium soil tests, lbs/A		
	Low 51 - 120	Medium 121 - 210	High 211 - 300
	K_2O recommended, lbs/A		
20	20	0	0
30	30	15	15
40	35	15	15
50	45	25	15
60	55	30	15
80	100	40	15

phosphorus recommendations vary between fallow and nonfallow field conditions. Readily available soil reserves of phosphorus do not build up in fallow, as does nitrate nitrogen.

Available soil phosphorus levels, as measured by soil test, will not fluctuate from high to low in 1 or 2 years, as will nitrate nitrogen. Neither will they change from low to high in 1 or 2 years, unless unusually high rates of fertilizer or manure are applied.

Phosphorus is readily converted to less available forms when mixed extensively with soil. This is part of the reason phosphorus fertilizer is more effectively used when applied with the seed in a band with a drill attachment than when broadcast and worked into the soil.

Potassium

Potassium uptake requirements of wheat closely match those of nitrogen but greatly exceed those of the other essential elements. Fortunately, most South Dakota soils contain high levels of available potassium, so this nutrient is not required in fertilizer as often as nitrogen and phosphorus. There are, however, a number of fields (particularly in the eastern third of the state) that are low in this nutrient and receive soil test recommendations for potassium fertilizer use.

Secondary and trace elements

Secondary and trace elements are as essential for high yielding levels of quality wheat as are the three primary plant foods. However, they are required in smaller amounts, particularly the trace elements. It appears that most South Dakota soils have adequate available reserves of these nutrients. SDSU research has not shown significant profitable wheat yield increases to date from fertilizer containing these nutrients. This may change with continued cropping and release of new varieties.

Fertilizer application

Most of the recommended phosphorus and potassium should be applied during or before seeding time. Broadcast rates of these two nutrients can be reduced 35 to 40% without lowering yields when applied with a grain drill fertilizer attachment. Nitrogen can be applied before, during, or after seeding with nearly equal results.

Thinner plant stands or reduced seedling vigor can occur if too much nitrogen and/or potash are placed in contact with the seed. This type of injury happens more easily in dry or sandy soils. The total amount of actual nitrogen plus potash placed with the seed in a drill attachment (6-inch row spacing) should be kept below 25 lbs per acre in such soils. That total should be reduced 40-50% if drill row spacing is 12-14 inches.

Plant food needs in excess of these rates should be broadcast and worked in before planting. That total should be reduced by 50% (only 10-12 lbs nitrogen plus potash) if the drill applied form of nitrogen is urea or other ammonium-type nitrogen sources.

Topdress nitrogen applications after seeding should be made well before early boot stage for best results. Lack of rainfall after topdressing can make this method of application less effective than preplant incorporation. Topdress applications of liquid fertilizer, particularly nitrogen solution, are effective when done prior to flagleaf growth stage. Nitrogen rates in excess of 25 lbs actual per acre, when applied in this manner, can seriously burn the crop and reduce yield potential. Research to date shows very low volume foliar feeding fertilization practices (2 to 3 gal per acre) to be of very questionable value.

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