

Fertilizing Winter Wheat II Phosphorus

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Soil testing and residual phosphorus application in wheat are discussed. Worksheets to calculate the recommended phosphorus rates for various application methods are included.

Wheat responds to applied phosphorus more than the other major Nebraska grain crops. Soil test levels of phosphorus must be higher for wheat than for corn, grain sorghum, or soybeans. Research results have indicated that phosphorus mainly increases tillering in fall, which increases the number of heads harvested, and thereby, grain yields. To a lesser extent, phosphorus increases seed size and number of kernels in the head.

Because of the effect of phosphorus on wheat rooting, winterkill is often associated with phosphorus deficiency. Phosphorus deficiencies also result in delayed maturity, which is clearly visible on eroded and high pH soils where soil phosphorus availability is low. Areas of green wheat among mature golden wheat also are good indicators of phosphorus deficiency. Such areas can benefit from spot treatment with phosphorus in subsequent years and generally require higher application rates to optimize yields. These areas should be soil sampled separately from other areas to provide a more accurate representation of variations in the field. All soils are not phosphorus deficient for wheat, so good soil sampling and testing are necessary to minimize unnecessary phosphorus applications and to maximize profits. Soils should be sampled for phosphorus and soil pH every three to five years.

Plow-layer samples (0-8 inches) should be taken for phosphorus analysis. Collect composite cores from at least 15 points in the field. More than one set of samples may be necessary from some fields if parts of the field differ in slope or soil characteristics such as color, sandiness or previous crop. For more information on soil sampling see NebGuide G91-1000, *Guidelines for Soil Sampling*.

The optimum phosphorus rate for winter wheat can be calculated according to the following equations or by using *Worksheet 1* for row or dual placement or *Worksheet 2* for broadcast application.

Optimum Phosphorus Rate for Row or Dual Placement

Bray-1 P Test:

$$P_2O_5 \text{ rate (pounds per acre)} = (-9.98 - 2.38 \times LN \text{ Bray-1P} + 4.39 \times LN \text{ YG}) / (P \text{ PRICE} / \text{WHEAT PRICE})$$

Olsen P Test:

$$P_2O_5 \text{ rate (pounds/acre)} = (-9.98 - 2.38 \times LN \text{ (OlsenP} \times 1.5) + 4.39 \times LN \text{ YG}) / (P \text{ PRICE} / \text{WHEAT PRICE})$$

Optimum Phosphorus Rate for Broadcast Application

Bray-1 P Test:

$$P_2O_5 \text{ rate (pounds/acre)} = (17.13 - 3.21 \times LN \text{ (Bray-1P)} + 2.89 \times LN \text{ YG} - 9.81 \times LN \text{ pH}) / (P \text{ PRICE} / \text{WHEAT PRICE})$$

Olsen P Test:

$$P_2O_5 \text{ rate (pounds/acre)} = (17.13 - 3.21 \times LN \text{ (OlsenP} \times 1.5) + 2.89 \times LN \text{ YG} - 9.81 \times LN \text{ pH}) / (P \text{ PRICE} / \text{WHEAT PRICE})$$

Where LN is the natural logarithm,
Bray-1P is the soil phosphorus test (ppm) for use in acid or neutral pH soils,
OlsenP is the soil phosphorus test (ppm) for use in alkaline soils,
YG stands for yield goal in bushels per acre,
pH is soil pH,
P PRICE is dollars per pound P_2O_5 ,
WHEAT PRICE is in dollars per bushel of wheat
(includes actual selling price and yield-bound government subsidies).

Phosphorus Application Methods

Three basic methods of phosphorus application can be used for wheat: applying directly with the seed; broadcasting and incorporating prior to seeding; or dual placement which is applying liquid phosphorus (ammonium polyphosphate 10-34-0) together with anhydrous ammonia prior to seeding.

With new air seeders and air distribution fertilizer, many variations of these three application schemes are now available. For example, a producer using different kinds of tillage and placement shovels or sweeps or a no-till seeding system

Example for Worksheet 1: Phosphate Fertilizer Requirement for Dual or Row Application

A grower has a field with the following soil test value: Bray-P1: 4.0 ppm. His yield goal is 50 bushels per acre. He will pay \$0.30 per pound of P₂O₅ and plans to sell the wheat crop for \$3.00 per bushel.

1) Soil test value:	Bray-P1 <u>4.0</u>	ppm.....Factor 1 (from Table I):	<u>-13.28</u>
	OR	OR	OR
	Olsen _____	ppm.....Factor 1 (from Table I):	_____
2) Yield Goal:	<u>50</u>	bu/acreFactor 2 (from Table II):	<u>17.17</u>
3) Add Factor 1 and Factor 2			<u>3.89</u>
If result is negative, STOP, NO fertilization is required.			
4) Price per bushel of wheat			\$ <u>3.00</u>
5) Price per pound of P ₂ O ₅			\$ <u>0.30</u>
6) Divide Line 4 by Line 5			<u>10</u>
7) Multiply result of Line 3 by the result of Line 6.			<u>38.9</u>

Result of Line 7 is the amount of fertilizer (pounds of P₂O₅/acre) required.

Example for Worksheet 2: Phosphate Fertilizer Requirement for Broadcast Application

A grower has a field with the following soil test value: Olsen P: 3.0 ppm, soil pH 7.2. His yield goal is 60 bushels per acre. He will pay \$0.35 per pound of P₂O₅ and plans to sell the wheat crop for \$2.70 per bushel.

1) Soil test value:	Bray-P1 _____	ppm.....Factor 3 (from Table III):	_____
	OR	OR	OR
	Olsen <u>3.3</u>	ppm.....Factor 3 (from Table III):	<u>11.96</u>
2) Yield Goal:	<u>60</u>	bu/acreFactor 4 (from Table IV):	<u>11.83</u>
3) Soil pH	<u>7.2</u>	Factor 5 (from Table V):	<u>-19.37</u>
4) Add Factor 3 and Factor 4 and Factor 5			<u>4.42</u>
If result is negative, STOP, NO fertilization is required.			
5) Price per bushel of wheat			\$ <u>2.70</u>
6) Price per pound of P ₂ O ₅			\$ <u>0.35</u>
7) Divide Line 5 by Line 6			<u>7.71</u>
8) Multiply result of Line 4 by the result of Line 7			<u>34.1</u>

Result of Line 8 is the amount of fertilizer (pounds of P₂O₅/acre) required.

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