

Fertilizing Corn Grain, Popcorn, Silage Corn, and Sweet Corn

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Although North Dakota is not considered to be part of the "Corn Belt," with good management, farmers can successfully grow high yielding corn. Improved practices such as early planting, adequate plant populations and recommended rates of fertilizer help reduce the influence of adverse weather.

Nutrient Requirements:

Nitrogen is the nutrient most often lacking in corn production. It has been determined that 65, 50 and 75 percent of the total accumulation of nitrogen, phosphorus and potassium, respectively, occurs by silking time, compared with only 45 percent of the total dry matter production by that stage of growth. **On the average**, approximately 1.2 pounds of nitrogen, 0.5 pounds of phosphate (P₂O₅) and 1.2 pounds of potash (K₂O) are used to produce a bushel of corn. A large proportion of this is normally supplied by the organic matter and mineral portion of the soil. If the soil cannot supply enough, the supply has to be supplemented with nutrients from other sources.

Excessive fertilizer use, especially nitrogen and phosphorus, has potential to degrade ground and surface water quality. Establishing realistic yield goals, carefully soil sampling fields and fertilizing crops according to soil tests will help preserve water quality.

Phosphorus is the next most likely deficient nutrient. Zinc may be needed on some soils.

Nitrogen Recommendations:

Tables 1, 2, and 3 show the amount of soil nitrate-nitrogen in the top 2 feet of the soil plus nitrogen fertilizer needed to meet the crop requirements for various yield goals. These data are based on nitrate-nitrogen levels in soil samples taken between September 15 and April 1. If soil samples are taken between July 1 and September 15 subtract 0.5 pound of nitrogen from the recommendation for each day that the soil was sampled prior to September 15. These adjustments are automatically included in recommendations received from the North Dakota State University Soil Testing Laboratory.

Nutrient recommendations for grain corn and popcorn.

Yield goal	Soil N plus fertilizer N required	Soil Test Phosphorus, ppm				
		Bray-I Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15
bu/a	lb/acre-2'	- - - -	- lb	P2O5/acre	- - - -	-
50	60		30	25	15	0
100	120		65	45	25	10
150	180		95	70	40	15
200	240		125	90	55	20

		Soil Test Potassium, ppm					
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'						
50	60		50	35	20	10	0
100	120		100	75	45	15	0
150	180		155	110	65	20	0
200	240		205	145	85	25	0

Nitrogen recommendation = 1.2 YG - STN + SDA - PCC

Bray-I P recommendation = (0.700-0.035 STP)YG

Olsen P recommendation = (0.700-0.044 STP)YG

Potassium recommendation = (1.1660-0.0073 STK)YG

The abbreviations used in the equations are as follows:

YG = yield goal

STN = soil test nitrogen

STP = soil test phosphorus

STK = soil test potassium

SDA = sampling date adjustment

PCC = previous crop credit

Nutrient recommendations for silage corn.

		Soil Test Phosphorus, ppm					
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-5	L 6-10	M 11-15	H 16-20	VH 21+
ton/a	lb/acre-2'						
10	105		50	35	25	10	0
14	145		70	50	30	10	0
18	185		90	65	40	15	0
22	230		110	80	50	20	0

		Soil Test Potassium, ppm					
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
ton/a	lb/acre-2'						
10	105		80	55	35	10	0
14	145		110	80	50	15	0
18	185		145	105	60	20	0
22	230		175	125	75	25	0

Nitrogen recommendation = 10.4 YG - STN + SDA - PCC

Bray-I P recommendation = (5.62-0.28 STP)YG

Olsen P recommendation = (5.62-0.35 STP)YG

Potassium recommendation = (9.50-0.06 STK)YG

The abbreviations used in the equations are as follows:

YG = yield goal

STN = soil test nitrogen

STP = soil test phosphorus

STK = soil test potassium

SDA = sampling date adjustment

PCC = previous crop credit

Nutrient recommendations for sweet corn.

		Soil Test Phosphorus, ppm					
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL 0-5	L 6-10	M 11-15	H 16-20	VH 21+
ton/a	lb/acre-2'						
10	105		50	35	25	10	0
14	145		70	50	30	10	0
18	185		90	65	40	15	0
22	230		110	80	50	20	0

ton/a	lb/acre-2'	lb P2O5/acre				
4	70	40	30	15	0	0
6	110	60	40	20	10	0
8	145	75	55	30	15	0
10	180	95	70	35	15	0

Soil Test Potassium, ppm							
Yield goal	Soil N plus fertilizer N required	Bray-I Olsen	VL	L	M	H	VH
			0-40	41-80	81-120	121-160	161+
ton/a	lb/acre-2'	lb K2O/acre					
4	70	75	50	30	10	0	
6	110	110	80	45	25	0	
8	145	145	105	60	20	0	
10	180	180	130	80	25	0	

Nitrogen recommendation = 18 YG - STN + SDA - PCC

Bray-I P recommendation = (11.000-0.533 STP)YG

Olsen P recommendation = (11.0-0.7 STP)YG

Potassium recommendation = (22.00-0.13 STK)YG

The abbreviations used in the equations are as follows:

YG = yield goal

STN = soil test nitrogen

STP = soil test phosphorus

STK = soil test potassium

SDA = sampling date adjustment

PCC = previous crop credit

Adjusting Nitrogen Recommendations When Sampling Below 2 Feet:

Recently there has been concern about accumulations of available nitrogen below the 2-foot depth. The original data gathered for calibration of the nitrogen test took into consideration available nitrogen to a depth of 5 feet. At that time sampling beyond 2 feet improved the recommendations somewhat, but it was decided that the extra effort to sample to a depth of 3 or 4 feet was not justifiable. Excessive applications of nitrogen can result in a buildup of available nitrogen in the soil profile. When fields are tested for nitrogen each year and only the recommended amount of nitrogen is applied, an accumulation of nitrogen below 2 feet is unlikely.

If you suspect an accumulation of available nitrogen below 2 feet, have your fields tested. The following guidelines are used to adjust nitrogen recommendations:

1. If the amount of NO₃-N in the 2- to 4-foot depth is less than 30 pounds NO₃-N per acre no adjustment is made. This is the normal amount found in most soils in North Dakota.
2. If the amount of NO₃-N in the 2- to 4-foot depth is more than 30 pounds NO₃-N per acre, the nitrogen recommendation is reduced by 4 pounds for each 5-pound increment above 30 pounds found in the 2- to 4-foot depth. In other words, if there were 50 pounds of NO₃-N in the 2- to 4-foot depth, the nitrogen recommendation would be reduced by 16 pounds (80% of 20 pounds).

P and K Recommendations:

If your soil test is very low in phosphorus (less than 10 ppm) and potassium (less than 40 ppm), the NDSU recommendation will result in a small increase in the soil test level. If your soil test is low in phosphorus or potassium, the recommendation will just replace what is removed by the crop.

Because phosphate and potash chemistry is different than that for nitrogen, the simple method of subtracting the soil test level from the amount needed for the crop does not work. The amounts of phosphate (P₂O₅) and potash (K₂O) needed to meet different goals are given in Table 1. All phosphorus and potash recommendations given in Table 1 are for broadcast application.

Since phosphorus and potassium move very little in the soil it is possible to "build up" or increase the available level of these nutrients in the soil. The application of approximately 20 pounds of P_2O_5 per acre will increase the phosphorus soil test level by 1. In other words, if your phosphorus soil test is 5 and you prefer to operate at a test level of 12, the application of 140 pounds of P_2O_5 (305 pounds of 18-46-0) per acre thoroughly mixed in the top 6 inches of soil will raise the soil test by 7. Likewise, the application of 10 pounds of K_2O per acre will increase the potassium soil test by 1.

Fertilizer Application:

Interest in "pop-up" fertilization (placement of small amounts of fertilizer in direct contact with corn seed) has been evident in recent years. If this fertilization method is used, rates should not exceed 5 to 10 pounds of N, 10 pounds of P_2O_5 and 5 pounds of K_2O per acre. On sandy soils, such rates may damage germination because these soils are more likely to dry out before the crop is up. If the fertilizer attachment places the fertilizer in a band that is to the side and below the seed, you can apply the entire recommended rate with the planter. The recommended fertilizer band location is 2 inches to the side and 2 inches below the seed. Planter attachment application of fertilizer can benefit corn in many growing seasons. Germination conditions (cool, wet conditions cut availability and uptake of nutrients), distribution of nutrients in the sampled depth and concentration of nutrients in the immediate seed zone all influence the possible need for starter fertilizer.

All phosphate and potash recommendations given are for **broadcast applications**. If all the phosphorus is to be banded, reduce the broadcast rate on **very low testing soils** by one third. Apply all broadcast applications before a primary tillage operation such as plowing or if you are using minimum tillage program, apply the fertilizer in a band 5-6 inches deep.

If the fertility level is low in potassium, handle band rates as in the case of phosphorus. If the potassium fertility level is low or above, use the K_2O rates given in Table 1 for band applications. It is suggested that some potash be reserved for starter application.

Secondary and Micronutrients:

Zinc is a micronutrient that is sometimes deficient for corn in this area. Although only about 0.002 pound of zinc is required per bushel, even this small amount occasionally is not available. The zinc level in soil can be raised easily by broadcasting zinc sulfate fertilizer at the rate of 10 to 15 pounds of zinc (30 to 45 pounds of zinc sulfate) per acre. If a severe zinc deficiency occurs on a growing crop, a foliar spray can be used. A suggested rate is to dissolve 20 pounds of zinc sulfate in 200 gallons of water and apply at the rate of 20 gallons per acre.

Iron (Fe) deficiency is rare on corn in North Dakota but has been observed on wet, calciferous sandy ground. The youngest leaves of Fe deficient plants will be chlorotic and in severe cases turn white. Soil treatments to correct Fe deficiencies are not usually effective. A suggested foliar treatment would be to dissolve 20 pounds of ferrous sulfate in 100 gallons of water and apply at a rate of 10-20 gallons per acre. This will quickly eliminate deficiency symptoms but may not result in a profitable yield increase.

Sulfur deficiencies are not common in North Dakota but may occur early in the growing season on sandy soils. If a crop appears to be deficient in nitrogen but does not respond to nitrogen applications the soil may be deficient in sulfur.

Responses to copper, manganese, and chloride have not been observed on corn in North Dakota.

Time of Application:

Fall applications of nitrogen are not recommended on sandy soils or on soils with a high water table. On these soils, apply nitrogen as near to planting time as possible. You may also sidedress a portion of the recommended rate before the corn is 1 to 2 feet high. Under dryland conditions, preplant application of nitrogen fertilizer is preferred. With irrigation, you can apply much of the nitrogen through the irrigation system.

Phosphorus, potassium and zinc may be fall or spring applied on most soils.

Caution Nitrate Accumulation:

Drought-injured corn is often baled or cut for silage in order to salvage some value from the crop. Such forage should be tested for nitrates before feeding.

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