

North Dakota fertilizer recommendations are based on current information available from fertility research, demonstrations and general farm experience.

Plant nutrients recommended are those that have been found to produce a profitable yield increase. The rate of application which provides profitable increases varies with the plant nutrient element and the degree of deficiency, the crop to be grown, climatic areas of the state, the available soil moisture supply, the kind of soil, the past management of the field and the method of fertilizer application.

Nitrogen (N)

Profitable yield increases from nitrogen fertilizer are often obtained with small grains, grasses and other non-legume crops, especially if grown on land not summerfallowed. Inoculated legume crops usually do not give paying responses to nitrogen fertilizer.

Low rates or no nitrogen are recommended for crops to be grown on summerfallow

Available nitrogen in summerfallow is usually near adequate for crops to be grown on it. Available nitrogen may often be low and deficient for crops to be grown on land that was not fallowed (nonfallow). For this reason nitrogen recommendations in tables 1A and 1B are separated for crop on fallow and nonfallow.

Note that the range of nitrogen (N) rates for most crops grown on summerfallow are from none to 10 pounds per acre. Well managed fallow, started by June 1 and kept free of plant growth, on well drained soils high in organic matter or legumed or manured, will usually have adequate supplies of available nitrogen.

Paying responses to 5 to 10 pounds per acre of fertilizer nitrogen often occur on soils poorly drained or slow to warm up, or where tillage was started

EXTENSION SERVICE
NORTH DAKOTA STATE UNIVERSITY
FARGO, NORTH DAKOTA 58102

North Dakota FERTILIZER GUIDE

VIRGIL L. WEISER SOIL SPECIALIST
EDFRED H. VASEY ASSISTANT PROFESSOR OF SOILS
EXTENSION SERVICE EXPERIMENT STATION

CIRCULAR A-350

MARCH 1966

late, or where there was considerable plant growth such as weeds or cover crops present in the latter part of the fallow season.

Recommended nitrogen (N) rates for crops on non-fallow vary with available soil nitrogen supplies

Soil conditions and past management of soils and crops on nonfallow influence soil nitrogen supplies.

Following is a guide for estimating available soil nitrogen in your nonfallow fields.

Past Management or Soil Condition	Relative Amount of Available Soil Nitrogen
1. Manure in the past 2 years	Above average available soil nitrogen
2. Alfalfa or sweetclover in the past 2 years	
3. Early fall tillage, (before Aug. 15) with moist soil conditions and little plant growth following early fall tillage.	
1. Large fall growth of weeds or volunteer crop after harvest	Below average available soil nitrogen
2. Following a late maturing crop; where soil nitrogen is removed during fall months.	
3. Large amounts of straw and stubble returned to the soil	
4. Poorly drained or cold wet soil	
5. Low organic matter soil	
6. Recently broken sod (including soil bank) especially if grasses were dominant. (moisture may also be limiting)	

NITROGEN RECOMMENDATIONS

TABLE 1 A. Nitrogen Recommendations for Small Grains, Flax, Mustard and Rape Seed. Pounds per acre of Nitrogen (N)

Crop	Area of state	On summerfallow	On nonfallow (continuous cropping)						Methods and time of application and other special suggestions
			Soil nitrogen average or below			Soil nitrogen above average			
			Stored soil moisture			Stored soil moisture			
			Low	Medium	High	Low	Medium	High	
Small grains (Hard wheat, winter wheat, durum, feed barley, oats, rye)	Red River Valley	0-10	15-25	30-45	50-65	10-20	20-30	35-50	Up to 30 pounds of nitrogen per acre (except as urea or cyanamid) may be applied by drill attachment even in a relatively dry soil seed zone. If seed zone has good moisture, full nitrogen treatment may be applied by drill attachment. Nitrogen amounts higher than those safely applied by drill attachment should be broadcast. Either fall or spring broadcast nitrogen is equally effective on most soils of medium to fine texture. Some losses of fall broadcast nitrogen may occur on sandy loam or coarser textured soils or on soils subject to flooding or ponding in early spring. Nitrogen can be top-dressed after seeding. For small grains other than malting barley nitrogen can be top-dressed until early boot stage of growth. For malting barley top-dress early. The later it is applied the more it is likely to increase protein.
	East Central	0-10	10-20	25-40	45-60	5-15	20-30	30-45	
	West Central	0-10	5-15	20-35	40-50	5-10	15-25	25-35	
	West	0-10	5-10	15-30	35-45	5-10	10-20	20-30	
Malting barley	Red River Valley	0	15-25	25-40	40-55	10-20	20-30	30-40	Use these rates if malting barley is seeded late.
	East Central	0	10-20	20-35	35-50	5-15	15-25	25-35	
	West Central	0	5-15	15-30	30-40	5-10	10-20	20-30	
	West	0	5-10	10-25	25-35	5-10	10-15	15-25	
		Suggest malting barley not be grown on recently legumed or manured fallow - because of high protein hazard.							
Flax Mustard Rape seed	Red River Valley	0-10	15-25	25-40	40-55	10-20	20-30	30-40	Up to 10 ponds per acre of nitrogen can be applied by drill row application; higher rates should be broadcast or banded at least 1 inch away from the seed. Fertilizer will stimulate weeds, especially if broadcast. Best chances of success are on relatively weed-free land or where weeds are controlled by proper spray program.
	East Central	0-10	10-20	20-35	35-50	5-15	15-25	25-35	
	West Central	0-10	5-15	15-30	30-45	5-10	10-20	20-30	
	West	0-10	0-10	10-25	25-35	0-10	10-15	15-25	

NITROGEN RECOMMENDATIONS

TABLE 1 B. Nitrogen Recommendations For Other Crops - Pounds per acre of Nitrogen (N)

Crop	Area of state	On summerfallow	On nonfallow (continuous cropping)	Method and time of application and other special suggestions
Corn	<u>In SE Counties</u> Richland, Ransom Sargent, Cass.	0-10	All nitrogen applied by attachment at 2" x 2" away from seed Hill dropped 10-30 Continuous band 10-50 or Nitrogen applied by combination of: 1. Planter attachment 10-25 2. Plus broadcast 20-50 For a total of 1 & 2 30-60	If split boot attachment is used and nitrogen is hill dropped, limit nitrogen rate by planter to 10 pounds per acre if soil is dry; limit to 20 pounds if soil is moist. If nitrogen is applied in a continuous band by split boot, limit nitrogen to 20 pounds per acre in dry soil and to 40 pounds in moist soil. When corn follows alfalfa or sweetclover reduce nitrogen rate to 10 pounds per acre. For each ton of manure applied, reduce nitrogen rate by 5 pounds per acre. Nitrogen applied separate from planting can be broadcast in fall or spring or side-dressed before corn is 1 foot high. Some losses of fall applied nitrogen may occur on sandy loams or coarser textured soils or soils subject to flooding or ponding in early spring. In SE counties prospects of yield increases from fertilizer are improved with final stands of about 12,000 plants per acre when soil moisture is low at planting time and about 16,000 plants when soil is well supplied with moisture at planting time.
	<u>Remainder of the state</u> Red River Valley East Central West Central West	0-10 0-10 0 0	By planter attachment 2" x 2" away from seed. 20-40 20-30 15-25 10-20	
Soybeans		0	5-10	
Sunflowers		0-10	10-40	By planter attachment with 2" x 2" placement away from the seed.
Sorghum and Sudan Grass		0-35	10-60	Broadcast the nitrogen in excess of 20 pounds per acre. Adjust nitrogen rate to moisture supply, soil nitrogen status and area of state as for small grains on non-fallow. (See table 1 A)
Potatoes		0-12	50-75	By planter attachment application.
Sugarbeets	Red River Valley (dryland) West (irrigated)	0-10	Row 0-10 Supplemental broadcast 50-100	
Seed millet Canary seed		0-10	15-25	Adjust rate to stored moisture supplies at seeding time as for small grains on nonfallow (See table 1 A)
Seeded grasses without legumes for hay, pasture or seed production. Native range for speeding recovery of range condition	Red River Valley East Central West Central West		100-130 80-100 50-80 25-50	Broadcast - late fall best; early spring next best. Avoid application when growing grass is wet from dew or rain. Grasses generally do not respond to nitrogen fertilizer applied at time of seeding. Fertilize in the fall of the first season on established stands and repeat each year. For improving low condition native range, fertilizer use should be coupled with deferred or reduced stocking and herbicide spray to control weedy invaders.

PHOSPHORUS RECOMMENDATIONS

TABLE 2. Phosphorus Recommendations For All Crops - Pounds per acre as P_2O_5 or P^* .

25

Crop	Soil test level								Methods and time of application and other special suggestions
	High		Medium		Low		Very low		
	P ₂ O ₅	(P)	P ₂ O ₅	(P)	P ₂ O ₅	(P)	P ₂ O ₅	(P)	
Small grains - wheat, barley oats, rye	0	(0)	15-20	(7-9)	20-25	(9-11)	25-35	(11-15)	Rates are for drill row application on summerfallow or nonfallow. If phosphorus is broadcast double or triple rates indicated. If stored soil moisture at seeding is low reduce rate of P ₂ O ₅ to 15-20 pounds per acre on low and very low test levels.
Flax, mustard, rape seed	0	(0)	0	(0)	15-20	(7-9)	20-25	(9-11)	Row application of over 25 pounds per acre of P ₂ O ₅ can injure germination. If phosphorus is broadcast double or triple indicated rates.
Corn - In SE counties									
1. By planter attachment	0	(0)	20-25	(9-11)	25-30	(11-13)	30-35	(13-15)	Phosphorus applied separate from planting can be broadcast in fall or spring before planting and plowed down or applied on plowed ground and worked in.
2. Plus broadcast and plow down.	0	(0)	20-25	(9-11)	25-30	(11-13)	30-35	(13-15)	
Total of 1 and 2	0	(0)	40-50	(18-22)	50-60	(22-26)	60-70	(26-30)	Where moisture becomes limiting, especially during tasseling or silking stage, increases in yield may not occur even though growth responses may have been noted.
In remainder of state									
By planter attachment	0	(0)	20-25	(9-11)	25-30	(11-13)	30-35	(13-15)	By planter attachment.
Sunflowers	0	(0)	10-15	(4-7)	20-25	(9-11)	25-30	(11-13)	By planter or drill attachment.
Sorghum and Sudan Grass	0	(0)	10-15	(4-7)	15-20	(7-9)	20-25	(9-11)	High fertility levels are beneficial, but these crops generally give poor response to direct fertilization. Best chances for response are on soils of very low phosphorus test levels. Do not place fertilizer in contact with the seed. Rates given are for placement along the row, away from the seed. Double or triple rates if broadcast.
Soybeans and Field Beans	0	(0)	15-20	(7-9)	20-30	(9-13)	30-40	(13-18)	Rates given are for planter attachment application - double or triple rates if broadcast.
Potatoes			40-50	(18-22)	50-60	(22-26)	60-75	(26-33)	Plowdown of broadcast applications preferred to broadcasting and working in after plowing.
Sugarbeets									
Row application	0-40	(0-18)	40-50	(18-22)	50-60	(22-26)	60-75	(26-33)	By drill attachment.
Supplemental broadcast	0	(0)	40-60	(18-26)	60-80	(26-35)	80-100	(35-44)	
Seed Millet and Canary Seed	0	(0)	40-15	(4-7)	15-20	(7-9)	20-25	(9-11)	For new seedings: Broadcast and work in before seeding - if companion crop is used additional fertilizer may be applied for companion crop.
Alfalfa and alfalfa grass mixtures where 30 per cent or more of the stand is legume.	0	(0)	40-60	(18-26)	60-80	(26-35)	80-100	(35-44)	New alfalfa seedings may give good response even though poor response is obtained in top-dressing established stands.
									For established stands: Top-dress in fall or spring or between cuttings. On established stands, try a test strip for response before treating the whole field.
Seeded grasses	Limited research has shown possible response of seeded grasses to phosphorus fertilizers, especially where nitrogen treatments have been repeated for several years.								

*Phosphorus is given as both P_2O_5 and P because of a proposed change in fertilizer labeling.

POTASSIUM RECOMMENDATIONS

TABLE 3. Potassium Recommendations For Selected Crops - Pounds per acre as K_2O or K^* .

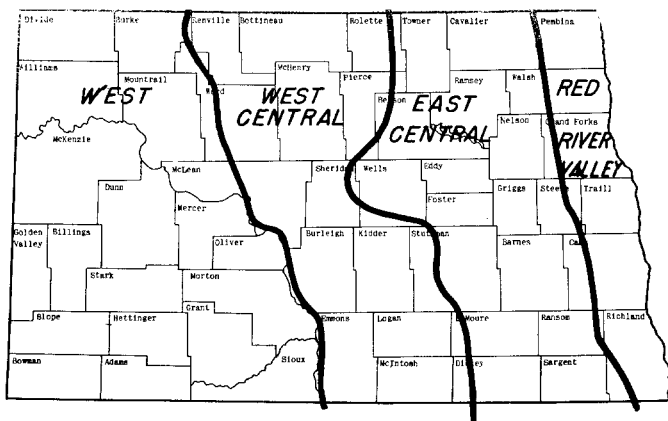
Crop and condition	Suggested pounds per acre		Method and time of application and other special suggestions
	K_2O	(K)	
Malting barley	15-20	(12-17)	Potassium is suggested for malting barley for possible improvement in quality, straw strength, and occasional yield increase. Rate is for drill row application on either summerfallow or nonfallow. To avoid germination injury, drill row application of $N+K_2O$ combined, should not exceed 35-40 pound per acre.
Corn - In SE counties Richland, Ransom, Sargent, Cass On Soils: Loam or finer Sandy loam or coarser In remainder of the state Red River Valley East Central West Central West	 0-10 10-20 0-10 0 0 0	 (0-8) (8-17) (0-8) 0 0 0	Rates are for planter attachment application along with nitrogen and phosphorus with placement 2 inches to the side and 2 inches below seed level. When split boot attachment is used, nitrogen plus potash should not exceed 10 pounds per acre hill drop in dry soil or 20 pounds in moist soil. If banded continuously along the row, by split boot attachment, limit nitrogen plus potash to 20 pounds per acre in dry soil and 40 pounds in moist soil.
Potatoes On Soils: Loam or finer Sandy loam or coarser	 0-30 20-60	 (0-25) (17-50)	Rates are for planter attachment application, banded along the row. Double the rate per acre if broadcast. Rates suggested are for potatoes planted on either summerfallow or nonfallow.
Sugarbeets Row Supplemental broadcast	 0-10 0-60	 (0-8) (0-50)	Plowdown of broadcast applications preferred to broadcasting and working in after plowing.

*Potassium is given as both K_2O and K because of a proposed change in fertilizer labeling.

The prevailing conditions that influence soil nitrogen supplies will help you in selecting the appropriate column under "On nonfallow (continuous cropping)" in table 1A.

Recommended nitrogen rates vary by areas of the state

The map shows the state divided into areas. (Note the area in which your land occurs.)



Field experiments and experience have shown that higher average rates of nitrogen can be used profitably in eastern areas than in western areas of the state. Tables 1A and 1B suggest nitrogen rates for major crops for the four areas of the state.

Recommended nitrogen rates vary with stored soil moisture

If you are planning a fertilizer program for non-fallow (land cropped the previous year), you can improve your chances for a good return from fertilizer nitrogen by first estimating stored soil moisture and adjusting the rate of nitrogen to the estimated moisture level.

A crop well supplied with moisture can use higher rates of nitrogen profitably than one with limited moisture. Total moisture available to a crop includes that stored in the soil at the beginning of growth in the spring plus the rainfall received during the growing period. Recommended rates of nitrogen for crops on nonfallow are based on amount of stored moisture in the soil at seeding time. Nitrogen (N) rates are given for three levels of plant available stored soil moisture present to a depth of 4 feet at seeding time, as indicated in table 1A.

A rough estimate of the relative amounts of plant available stored soil moisture can be made by examining the soil just before seeding. An estimate of the amount of stored soil moisture can be determined from the following table based upon the depth of wet soil* and soil texture.

Estimating moisture content of soil somewhat below fully wetted capacity is difficult. If soil

seems to be moist to only half its wetted capacity, there would be only half as much available water as in fully wetted soil.

In most soils consider the moisture in depths to 4 feet. Small grains seldom remove moisture below 4 feet in North Dakota.

A dry soil zone will prevent crops from using moisture below the dry zone until there is enough rain to soak through the dry soil. Moisture below a definite dry soil layer cannot be safely considered as available.

Phosphate (P_2O_5) or Phosphorus (P)

Statewide soil test results indicate low to very low available phosphorus in about 3/4 of North Dakota soils, moderate to slight deficiencies in about 1/5 and adequate available phosphorus in less than 1/10. Most crops respond profitably to phosphorus fertilizer treatment on the deficient soils if moisture is adequate.

Sample your fields and have them tested for phosphorus every 4 or 5 years. A phosphorus test rating is important in determining the most profitable rate of fertilizer phosphorus to apply. See table 2 for suggested rates of phosphorus for crops grown on soils of various test levels and adjustments in rates for small grains on soils with low stored soil moisture.

Potash (K_2O) or Potassium (K)

While most North Dakota soils are relatively high in plant available potassium, profitable responses to potassium fertilizer are obtained on some soils with some crops.

Crop responses to potassium are more likely to occur on sandy than on fine textured soils. Root crops (potatoes and sugarbeets) need higher levels of available potassium than other crops. Potassium recommendations are given for crops and soil conditions where profitable returns have been obtained in fertilizer trials. See table 3. If a crop is not listed in this table, potassium fertilizer is not recommended.

Depth of wet soil* in inches				Estimated available stored soil moisture	
Clay silty clay clay loams	Silt silt loam, loam, very fine sandy loam	Fine sandy loam, sandy loam	Loamy sand	Inches	Rating
0-12 inches	0-15 inches	0-20 inches	0-36 inches	0-2 inches	Low
12-22 inches	15-28 inches	20-36 inches	36-68 inches	2-4 inches	Medium
over 22 inches	over 28 inches	over 36 inches	over 68 inches	over 4 inches	High

*Wet soil means the soil is holding all the moisture it can against the pull of gravity (field capacity). This would be the condition a day or so after a rain and before drying had begun.