



# Fertilizer . . . . for Better Crops

*on most North Dakota Soils*

By  
E. B. Norum  
Soil Scientist, Experiment Station  
Virgil L. Weiser  
Soils Agent, Extension Service

Farmers' experience and a large number of field trials have shown that fertilizer can be used profitably to increase the yield and quality of crops on most North Dakota soils.

Farmers using fertilizers in North Dakota generally have had good results. Its use on sugar beets and potatoes has long been an accepted practice. Many farmers in the commercial corn area now fertilize corn as a standard practice. The small grain acreage receiving fertilizer treatment is rapidly increasing each year in all parts of the state. In general, fertilizer on alfalfa and grass has given good results.

Field experiments in all parts of the state generally have shown profitable increases by using fertilizer on farm crops. Small grains have responded to phosphate used on fallow in 80 percent of these trials. Phosphate has given an average per acre yield increase of 4.8 bushels of wheat and 8.0 bushels of barley when used for these crops grown on summerfallow.

Trials with grains sown on land cropped to small grain or corn the previous year have shown that nitrogen fertilizer in addition to phosphate is usually needed for best results. Trials with wheat under these conditions have averaged 5.3 bushels per acre increase in yield from use of nitrogen and phosphate combined.

5  
544.3  
N9  
A8  
no. 271

Trial plots to test the effect of fertilizer on potatoes, corn, alfalfa and grasses have also shown good results in most cases.

**NDSU LIBRARIES**  
**NDAC Extension Service, Fargo**  
**NORTH DAKOTA AGRICULTURAL COLLEGE**

## WHAT CROP EFFECTS ARE USUALLY SEEN?

Well nourished crops usually grow faster and ripen earlier. Fertilizer helps plants to make rapid early growth, thereby smothering weeds and making more effective use of moisture.

Stooling is usually greater if grains are well supplied with nutrients. A substantial increase in grain yield is sometimes obtained from increased stooling alone, even though no other growth difference can be seen. Failure of a fertilized crop to grow faster or taller does not necessarily indicate that there is no yield increase.

With plenty of phosphate, plants commonly develop large fibrous root systems. This seems to help plants withstand effects of drouths of short to intermediate duration.

Fertilized grain commonly ripens 3 to 5 days earlier. On occasion it ripens 10 to 12 days earlier. In years when rust or heat injures crops, this advancement often helps to avoid the most serious damage.

Phosphate often makes the difference of ripe corn instead of soft corn. With adequate nitrogen, corn generally makes better growth. High nitrogen on corn gives more lush growth of leaves and stalks, increasing tonnage of forage.

The use of nitrogen on grasses increases growth and may increase protein content. It has been especially effective in increasing the yield of grass seed. Phosphate fertilizer usually improves the phosphorus content of grasses but has not produced important yield increases.

## RECOMMENDED FERTILIZER RATES AND METHODS OF USE FOR NORTH DAKOTA CROPS

The rates of application suggested are listed in pounds per acre of nitrogen (N) available phosphate ( $P_2O_5$ ) and water soluble potash ( $K_2O$ ). They are expressed in this manner because the many fertilizers and fertilizer combinations that can be used are too numerous to list here.

### Range of Rates

For each crop and fertilizer situation a range in rates of plant nutrients is given. Amounts near the middle of the range are considered best for average situations in respect to the soil supply of each of the three plant nutrients. The upper part of the range would be used when

CROP	SOIL - MANAGEMENT CONDITION OR AREA	RECOMMENDED LBS. PER ACRE			SPECIAL SUGGESTIONS
		N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	
<u>Small grain</u> Wheat Durum Barley Oats Rye	<b>ON SUMMERFALLOW -</b> On legumed or manured fallow and on well drained soils high in organic matter where fallow was started early and kept free of weeds or where lodging has been a problem.  On soils low in organic matter, or soils slow to warm up in the spring and on all soils where fallow was started after June 15 or considerable weed growth occurred during the latter part of the fallow season.  <b>ON NON-FALLOW -</b> Manured or legume plowed down within past 2 years. No manure or legumes.	0  5-10  20-30 25-50	15-35  15-35  15-35 15-35	0  0  0 0	<u>Phosphate</u> Drill attachment - rates as suggested. If broadcast - double or triple given rates.  <u>Nitrogen</u> In moist soil rates up to 30 lbs./A may be applied by drill attachment; at higher rates broadcast part of nitrogen before seeding to avoid stand injury.
Flax	Flax gives erratic response to fertilizer. Fertilizer will stimulate weeds. Best chances of success are on relatively weed-free land-- or where weeds are controlled by proper spray program.	Rates and kinds of fertilizer listed above for small grain are suggested for flax.			<u>Phosphate</u> - same as above. <u>Nitrogen</u> - 10 lbs./A or less by drill attachment; for rates above 10 lbs./A broadcast part of N to avoid stand injury.
Corn	First consideration in fertilizing corn should be given to a starter application as follows: <u>Basic Recommendation (by planter attachment)</u> If fertilizer checked in hills If fertilizer banded along the row Where this is the only application made, use the higher rates.	10 10-20	20-40 20-40	0-15* 0-15*	<u>In hill or row</u> (1) Fertilizer should not be placed in direct contact with the seed. (2) Rates given are considered safe when planting in dry soil. Rates of nitrogen may be doubled when planting with favorable soil moisture. (3) * Potash (K <sub>2</sub> O) recommended on sandy soils. (4) The sum of nitrogen plus potash as a hill application should not exceed 20 pounds per acre.
	For higher corn yields, supplemental applications of nitrogen and phosphate in addition to the basic recommendation given above are required. Supplemental fertilizer, preferably, should be broadcast and plowed down in the spring. Rate of application of supplemental fertilizer recommended depends on rates used in basic application. Basic plus supplemental rates of application recommended are 50 pounds of nitrogen (N) and phosphate (P <sub>2</sub> O <sub>5</sub> ). Not less than 25 pounds of phosphate are recommended for supplemental application.				
	<u>Supplemental Recommendation (broadcast)</u>	30-40	25-30	0	
	Where moisture becomes limiting, especially during the tasseling to silking stage, increases in yield may not be forthcoming even though vegetative responses may have been noted.  Prospects of yield increases are improved with final stand densities of 12,000 to 16,000 plants per acre.				
Soybeans	While high fertility levels are beneficial to soybeans they generally give poor response to direct fertilization - best chances for response are on soils very low or low in phosphorus. (innoculate)	0-10	20-40	0	Rates given are for planter attachment with fertilizer banded along the row but not in close contact with the seed - double or triple phosphate if broadcast.
Potatoes	<b>ON SUMMERFALLOW</b> Soil - sandy loam and coarser loam or finer	0-12 0-12	40-75 40-75	20-60 0-30	Rates given are for planter attachment application - double or triple phosphate and double potash if broadcast.
	<b>ON NON-FALLOW</b> Soil - sandy loam and coarser loam or finer	50-75 50-75	40-75 40-75	20-60 0-30	
Sugar beets	<b>ON SUMMERFALLOW</b> Row Supplemental broadcast	0-10	40-75 0-100	0-10 0-60	Plowdown of broadcast applications preferred -- may be broadcast and worked in after plowing.
	<b>ON NON-FALLOW</b> Row Supplemental broadcast (Usually irrigated)	0-10 50-100	40-75 0-100	0-10 0-60	
Alfalfa and Sweet Clover	<b>ON ESTABLISHED STANDS</b> - broadcast and work lightly into soil on sloping fields. <b>ON NEW SEEDINGS</b> - <u>Without companion</u> crop - part or all of phosphate may be applied by drill attachment with up to 10 lbs./A of N. <u>With companion crop</u> - fertilizer suitable for companion crop may be used and phosphate for legume broadcast before seeding or after stand established.	0	40-100	0	Broadcast applications may be made in fall or spring.
Grasses for hay pasture or seed	<b>ON ESTABLISHED STANDS</b> - Eastern North Dakota Central North Dakota Western North Dakota	100-130 60-100 40-60	0 0 0	0 0 0	Broadcast - late fall best. Early spring next best. Avoid application when growing grass is wet from dew or rain.
	<b>NEW SEEDINGS</b> - generally do not respond to nitrogen fertilizer and weed growth may be				

soil tests or other conditions indicate a low level of availability in a particular nutrient and the lower part of the range when a higher than average availability is indicated.

It is well to compare results from several rates of application over a period of years to determine the general level of crop response to different rates on your soil. Be sure to leave an unfertilized strip for actual harvested yield comparisons.

### **Nitrogen Needs Vary**

Crops grown on fallow are usually well supplied with nitrogen. Nitrogen is commonly very deficient for non-legume crops grown on land that wasn't fallowed the previous year.

Fields on which manure or legumes are used in the rotation or where lodging has been experienced are likely to have an above average available nitrogen level. Fields on which large amounts of straw, stubble and plant materials are returned to the soil, where soils are light colored and low in organic matter, or where crops are not vigorous but light green in color, a low level of nitrogen availability is indicated.

### **Determining Phosphate Needs**

North Dakota soils are commonly deficient in available phosphorus for all crops except grasses. Deficiencies occur on both fallow and non-fallow situations. Phosphorus fertilizer alone will not give good results where other nutrients are definitely deficient.

Recent soil tests on a field will be a good guide to phosphate rates. On soils testing very low, use the higher portion of the range of rates. On soils testing low use the middle portion. For soils testing medium use lower rates. Soils testing high indicate no need for phosphate fertilizer. Without a soil test of the field, use phosphate rates at the middle of range and above or, as experience is gained with different rates on the field, use rates that have given best results.

### **Potash**

Most North Dakota soils furnish sufficient potassium for the needs of most North Dakota crops. Potatoes, sugar beets and corn are more likely to respond to potash fertilizer than are the other farm crops. With these crops potassium is more likely to be needed on sandy soils than on clayey soils. When high rates of nitrogen and phosphate are used, need for potash is greater than with low rates of nitrogen and phosphate.

Even though the above crops give response to potash fertilizer this does not mean small grains will also respond to potash on the same field.

### Choice of Fertilizer

The chart and accompanying information will help you to determine the amounts of each plant nutrient suited to a particular crop and field condition. Then it becomes necessary to select a fertilizer or combination of fertilizers that will supply the desired amount of nutrients.

Choice of fertilizer to provide recommended amounts of nutrients will often depend on fertilizer materials available locally.

EXAMPLE: You have a field on which you are going to plant and fertilize wheat. You have determined from the chart that 25 pounds of nitrogen and 30 pounds of available phosphate are the desired amounts of nutrients. The fertilizers available are 16-20-0, 11-48-0 and 33-0-0.

To figure the pounds of 16-20-0 needed to supply the 25 pounds of nitrogen use the following formula.

$$\begin{array}{rcl} \text{DIVIDE} & \text{lbs. of nitrogen needed (25)} & \\ \text{BY} & \text{lbs. of nitrogen per 100 lbs. (16)} & \\ & \text{(16-20-0)} & \end{array} = 1.56 \times 100 = 156 \text{ lbs. of 16-20-0}$$

needed to supply the 25 lbs. of nitrogen.

Use the same formula to figure pounds of 16-20-0 needed to supply 30 lbs. of phosphate.

$$\begin{array}{rcl} \text{DIVIDE} & \text{lbs. of phosphate needed (30)} & \\ \text{BY} & \text{lbs. of phosphate per 100 lbs. (20)} & \\ & \text{(16-20-0)} & \end{array} = 1.50 \times 100 = 150 \text{ lbs. of 16-20-0}$$

needed to supply the 30 lbs. of phosphate.

By using 150 pounds of 16-20-0 per acre you will be applying 30 pounds of phosphate and slightly less than 25 lbs. of nitrogen.

As an alternative you could use a combination of 11-48-0 and 33-0-0 (Using the above formulas.) First figure the amount of 11-48-0 needed to supply the phosphate. Then figure the amount of 33-0-0 needed to supply the balance of the nitrogen. The desired rates of each will be as follows:

62 pounds of 11-48-0 to supply 7 lbs. of nitrogen + 30 lbs. phosphate  
55 pounds of 33-0-0 to supply 18 lbs. of nitrogen

Giving a total of 25 lbs. nitrogen and 30 lbs. phosphate

Using this combination of fertilizers the 55 pounds per acre of 33-0-0 could be broadcast before seeding and the 62 lbs. per acre of 11-48-0 could be applied at seeding time by drill attachment; or the two fertilizers could be mixed in the proportions given and applied together by drill attachment.

North Dakota Agricultural College and the United States Department of Agriculture Cooperating. E. J. Haslerud, Director of Extension Service. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.