SF-723 (Revised)

Fertilizing Malting and Feed Barley

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Revised N recommendations are included for western malting growers

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Barley has been an important cash and rotational crop in North Dakota and the region for many years. It is important as a feed grain, but by far its economic value is linked to the malting industry. Barley requires adequate nitrogen (N) for good yields, but since grain protein in excess of industry limits often results in rejection of a crop, and since excess N leads to smaller kernel size, the line between adequate N and excessive N is fine. In addition, excessive N may result in lodging, which lowers yields and increases the incidence and severity of head blight and other diseases in some years.

Due to the irregularity of rainfall in the region, a preplant application of N is important to adequately feed the crop through its short growing season. All of the N should be applied preplant. Top-dressing after crop establishment is discouraged because it contributes more to increased protein than increased yield.

Once the N application is made, managing the crop for high yield is important. Although yield is most directly related to the temperatures, soil moisture and rainfall of a growing season, growers have a number of things they can do to maximize yield in any given year. Note that high fertilizer applications will not push yield higher than environment and management decisions allow. Therefore, being conservative on N rates is important to maximize the odds of producing malting-grade barley.

Date of Planting

Research has shown that seeding barley early is extremely important. Seeding before May 15 provides the greatest chance of achieving malting grade at normal available-N rates for growers south of U.S. Highway 2 and May 25 for northern-tier county growers. Seeding two weeks later results in almost no chance of achieving malting grade unless available-N rates are very low. Very low yields that result from late planting and low N rates are not economically acceptable to most growers.

Seeding Rate

Adequate seeding rate with an approved malting barley variety is important for growing and marketing the crop effectively. The North Dakota Barley Council published a booklet, the "North Dakota Barley Guide," which is available through its Web site, *www.ndbarley.net* .

Other Management Tools

Adequately controlling insects, weeds and diseases is important for successful malting barley, or even high-quality feed barley production. NDSU has a variety of publications to help make these decisions. They are available from county Extension offices,or the NDSU Extension publications Web site at *www.ag.ndsu.edu/pubs/*.

Interaction of Environment and Yield Potential

In the past, NDSU fertilizer recommendations have been based on the concept of "yield goal." Yield goal should be the achievable yield that could be met in most years in a given environment with given soils. However, the term has been used by those filling out soil test forms to instead reach for higher yields than normally attainable in most years.

Although our N recommendation formulas imply a linear relationship between N and yield, reality is quite different. The environment most years in barley growing regions generally will support a 50- to 65-bushel yield potential. Barley will respond efficiently to N amounts needed to support plant development necessary to achieve these yields. Reaching higher yields requires cooler conditions and moisture sufficient to prevent stress and allow the plant to increase head size and kernel weights, thus increasing yield and N efficiency. As yield potential approaches yearly environmental limits, any excess available N not needed for yield lowers N efficiency as measured by bushels produced for each pound of applied N. Percent protein will increase with excess N and may result in rejection of malting grade by the malting industry buyer.

In drier soils, barley does not have the ability to utilize all of the N present in the soil, so it actually takes greater amounts of soil and fertilizer N per bushel to achieve maximum yields in a dry year, compared with a moist year. Conversely, in a year that supports higher yields due to cooler temperature, adequate stored water and seasonal precipitation, release of N (mineralization) from the soil organic matter and past crop residues is accelerated, and the N rate per bushel of yield achieved is lower than normal. Therefore, in dry or wet years, as long as early planting is achieved and other management factors are addressed, fertilizing based on yield potential (YP) would be a better plan than reaching for a yield that one wishes might happen.

The method that NDSU Extension economists use is to take the average for a farm back seven years, throwing out the high year and the low year. This usually results in a good moving average of climate effects on yield in a certain location.

Recent work from the Minot area west has shown that generally lower N amounts are required to achieve malting grade in this area. The yield potential generally is lower due to lower rainfall and higher temperatures. Therefore, two tables are presented to guide N recommendations for malting barley. Table 1 should be used for moister and cooler areas of production, while Table 2 should be used for historically drier and warmer areas. For transitional areas, consideration of long-term forecasts and the extent of recent droughts may cause Table 2 to be used in some years and Table 1 in others.

Nitrogen Application Methods

Nitrogen can be applied with the seed at planting as long as it does not exceed the limits recommended in Table 4. For more detailed charts that include variation in soil texture and soil moisture, please refer to NDSU Extension publication EB-62. Some growers also use a midrow band application of anhydrous ammonia, urea or nitrogen solutions successfully. As long as seed and fertilizer are separated by at least 1 ½ inches for urea and nitrogen solutions, and separated laterally by at least 3 inches for anhydrous ammonia, reasonable rates of nitrogen can be applied safely.

Fall application has been used successfully when the application is made after Oct. 1, and only when soil temperatures have declined below 50 degrees Fahrenheit in the morning at the 4-inch depth. Fall application should not be made to sandy soils, nor should it be made to heavier soils that are prone to early spring saturation.

Surface application of urea generally is not desirable unless the urea will be incorporated within a 48- to 72-hour period, depending on weather conditions. Adequately incorporating urea in low-residue situations takes a steady one-half to three-quarters of an inch of rainfall. Under no-till, incorporating the urea might take more rainfall. Under no-till, subsurface application of urea or nitrogen solutions containing urea is strongly recommended, as the conversion from urea to free ammonia is very fast when residues are present. Heavy harrows may not be enough to cover the urea adequately with soil if enough rain does not fall soon enough to dissolve the urea and move it past the residue and into the soil.

Phosphorus Application

Phosphorus application is most efficient and results in the highest yield and economic returns if banded near or with the seed. If phosphorus is banded near or with the seed, rates can be reduced by one-third, compared with chart rates in Tables 1-3. The amount of fertilizer that can be applied safely with the seed has limits. The restrictions have more to do with the ammonium-N content of the fertilizer than with the salt index, although fertilizer salt still needs to be considered. For an abbreviated chart of the maximum urea-N fertilizer rates recommended with barley seed at planting, see Table 4. For a more detailed chart that includes variation in soil texture and soil moisture, please refer to NDSU Extension publication EB-62.

Table 1. Barley, malting grade, in cooler, moister climates within North Dakota.*

			Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
YP†	Soil N plus fertilizer N required	Bray-1 Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
60	90		43	31	19	7	0	67	47	26	5	0
80	120		57	41	25	9	0	89	62	35	7	0
100	150		71	51	31	11	0	112	78	44	8	0

† YP is Yield Potential, STN is soil test nitrate-N to 2ft. depth, PCC is previous crop credit N

Nitrogen recommendation = 1.5 YP-STN-PCC
Bray-I P recommendation = (0.785-0.039 STP)YP
Olsen P recommendation = (0.785-0.050 STP)YP
Potassium recommendation = (1.2860-0.0085 STK)YP

Early planting is critical for greatest success.
Planting later than May 15 south of U.S. Highway 2 or May 25 in the northern tier of counties will require lower N rates.
Applying potassium chloride (0-0-60) at 15-20 lb K_2O/acre may increase kernel plumpness on well-drained soils if a chloride test is not available.

Table 2. Barley, malting grade, in warmer, drier climates within North Dakota.*

			Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
YP†	Soil N plus fertilizer N required	Bray-1 Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
60	72		43	31	19	7	0	67	47	26	5	0
80	96		57	41	25	9	0	89	62	35	7	0
100	120		71	51	31	11	0	112	78	44	8	0

†YP is Yield Potential, STN is soil test nitrate-N to 2 ft. depth, PCC is previous crop credit N

Nitrogen recommendation = 1.2 YP-STN-PCC
Bray-I P recommendation = (0.785-0.039 STP)YP
Olsen P recommendation = (0.785-0.050 STP)YP
Potassium recommendation = (1.2860-0.0085 STK)YP

Early planting is critical for greatest success.
Planting later than May 15 will require lower N rates.
Applying potassium chloride (0-0-60) at 15-20 lb K_2O/acre may increase kernel plumpness on well-drained soils if a chloride test is not available.

*This recommendation is most useful for the North Dakota region from north of Williston south, and everything west of the Missouri River (see Figure 1). In years with low soil moisture, growers further east may benefit from this formula.

Table 3. Barley, feed grade.

			Soil Test Phosphorus, ppm					Soil Test Potassium, ppm				
YP†	Soil N plus fertilizer N required	Bray-1 Olsen	VL 0-5 0-3	L 6-10 4-7	M 11-15 8-11	H 16-20 12-15	VH 21+ 16+	VL 0-40	L 41-80	M 81-120	H 121-160	VH 161+
bu/a	lb/acre-2'		lb P_2O_5/acre					lb K_2O/acre				
60	100		43	31	19	7	0	67	47	26	5	0
80	135		57	41	25	9	0	89	62	35	7	0
100	170		71	51	31	11	0	112	78	44	8	0

†YP is Yield Potential, STN is soil test nitrate-N to 2 ft. depth, PCC is previous crop credit N

Nitrogen recommendation = 1.7 YP-STN-PCC
Bray-I P recommendation = (0.785-0.039 STP)YP
Olsen P recommendation = (0.785-0.050 STP)YP
Potassium recommendation = (1.2860-0.0085 STK)YP

Early planting is critical for greatest success.
Applying potassium chloride (0-0-60) at 15-20 lb K_2O/acre may increase kernel plumpness on well-drained soils if a chloride test is not available.

Table 4. Maximum N + K_2O recommended for application with the seed, based on planter row spacing, planter type and seed spread.

		Planter Spacing, inches			
Planter type	Seed spread	6	7.5	10	12
	inches	lb N + K_2O/acre			
Double disc	1	20-30	19-28	17-23	15-20
Hoe opener	2	32-44	27-38	23-31	20-27
	3	44-58	37-48	30-40	26-34
Air seeder	4	56-72	46-58	37-48	32-42
	5	68-86	56-68	51-55	38-49
	6	80-100	66-79	58-74	44-56
	7		76-90	66-83	50-64
	8			73-92	56-71
	9			80-100	62-78
	10				68-86
	11				74-93
	12				80-100

This table assumes a coarse-textured soil for the lower end of each range and a heavier texture for the upper end of the range. For more detail, see NDSU Extension publication EB-62.

Potassium/Chloride Application

Potassium may be required for some sandy soils, but the main reason for its application is as a carrier for chloride. Potassium chloride is approximately 50 percent chloride (Cl). The indicator for the need of chloride is a soil test from 0 to 2 feet in depth. If soil levels are below 30 pounds/acre Cl, then an application of 10 to 20 pounds of Cl/acre might result in an increase in yield and some additional tolerance to certain soil and leaf diseases. This will not be a substitute for a needed fungicide application later in the season. Banding the Cl is not necessary, but if the other fertilizer is being banded and the addition of the fertilizer does not result in exceeding the $N+K_2O$ limit in Table 4 or in publication EB-62, then banding will offer convenience to the grower. Research in North Dakota has shown a yield increase, mostly due to larger kernel size, about half of the time when soil levels are low.

Sulfur and Micronutrients

In wetter years, sandy soils may be deficient in sulfur. The soil test for sulfur is not a good predictor of sulfur needs. Generally, growers should use the rule of thumb that says if the soil is sandy and low in organic matter, and the last season was normal to above normal in rainfall, the next crop might benefit from sulfur. If the soil is medium or finer textured and organic matter is at least 2.5 percent, then the area probably will not benefit from the application of sulfur.

No micronutrients have been found to benefit barley in North Dakota soils. All crops have different abilities to extract nutrients from the soil. Barley is one crop that does not appear to lack micronutrients in our soils.

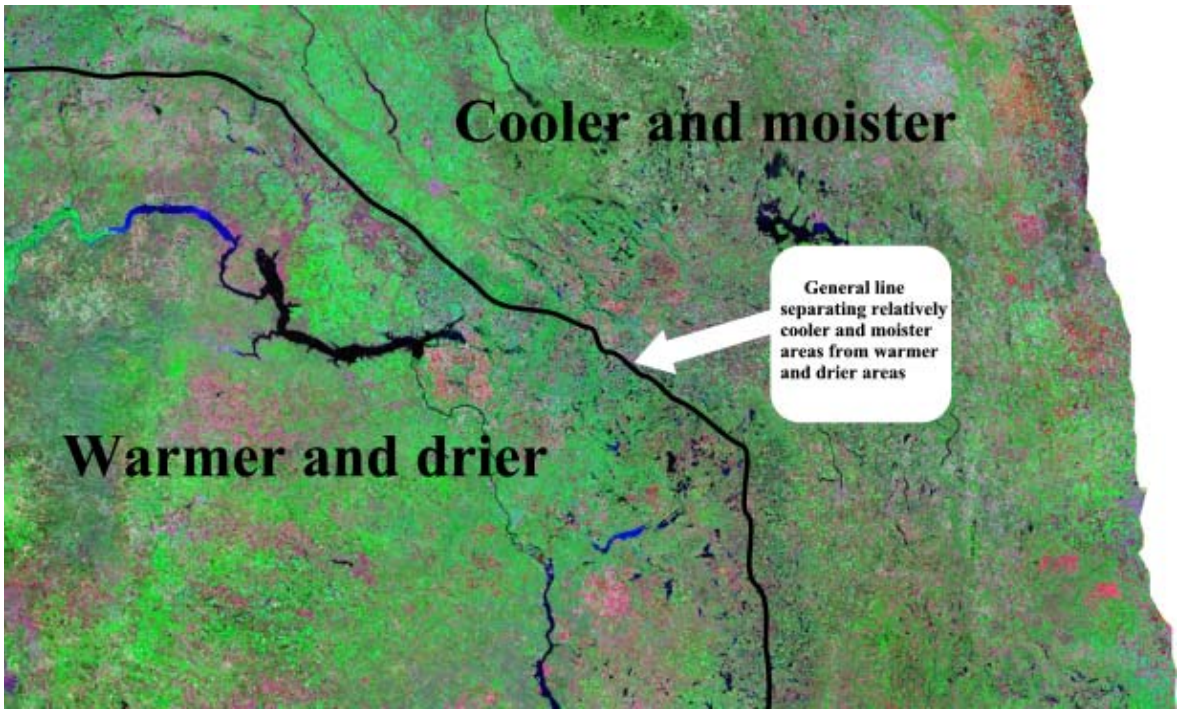

Figure 1. General delineation of cooler and moister regions of North Dakota, compared with warmer and drier regions. In any given year, the line may move east or west, depending on local conditions. *(Image courtesy of NASA, Angela King – image compiler, and Hobart King of Geology.com-publisher).*

For more information on this and other topics, see: www.ag.ndsu.edu

SF-723

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