water spouts

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Irrigated Malt Barley Production: Managing Risk to Increase Profit

The North Dakota Irrigation Association believes that North Dakota holds a variety of irrigation opportunities. Western North Dakota has emerged as an area with high irrigated malt barley production potential. With established markets and contract prices more favorable for malt barley than other small grains, farmers in western North Dakota are giving irrigated malt barley a second look.

As with any crop, nature poses a substantial risk, but using irrigation as a management tool helps reduce risk, as well as increasing yields and the probability of meeting malt specifications. According to Bob Evans, a supervisory agricultural engineer for the U.S. Department of Agriculture's Agricultural Research Service, irrigated malt barley has the potential to outyield dryland barley 3-to-1 with the proper water management. Yields of 120 bushels or more per acre are possible under good water and nutrient management.

What does it take to produce irrigated malt barley?

If farmers are armed with current information on water and agronomic management, including general requirements, crop inputs, costs of direct inputs and production estimates, the level of risk is reduced considerably. Managing risk is a substantial factor in growing irrigated malt barley, as it is with many crops. However, with the right management techniques, irrigated malt barley has great potential for farmers in western North Dakota.

The following information provides general guidelines to assist irrigators and potential irrigators, generally west of U.S. Highway 83, on the management process to grow irrigated malt barley. Estimated crop budgets are available at *www.ext.nodak.edu/extpubs/ecguides.htm*.

General specifications

Individual buyers set quality specifications. The most common malt barley quality problem is the percentage of protein exceeding the maximum allowed protein content. Generally, malt barley needs to meet the following specifications to be accepted as malt quality:

- Plump – 70 percent or greater
- Thin – 5 percent maximum
- Protein – 11 percent to 15 percent
- Moisture – 13.5 percent maximum
- Sprout – 1 percent maximum
- Total volunteer crops (including green barley kernels and wild oats) – 2 percent maximum
- Insects – none

General requirements

- Most irrigable and conditionally irrigable soils are suitable for the production of malt barley. Each type of soil must be evaluated on the basis of its physical characteristics to prepare a crop management plan that has the potential to produce an economically feasible yield.
- Malt barley can be irrigated with both surface and sprinkler irrigation methods.
- Barley is tolerant of moderately saline soil and irrigation water. When this condition is prevalent, consult a soil scientist to evaluate potential crop effects.
- Conventional tillage, seeding and harvesting implements and machines used for most small grains are suitable for barley.
- Avoid fields where the previous year's crop may result in volunteer grain that cannot be removed. This can include wheat, durum, oats or other barley varieties. Row crops, such as sugar beets and corn, are best suited for preceding barley.
- Individual buyers set the seed requirements, which may include variety, seed source and seed certification.

Varieties

- Most contracts in North Dakota are for six-row barley, which is more sensitive to drought stress than two-row varieties.
- A brewer-accepted six-row malt barley variety specifically for irrigated production has not been developed. Some of the common six-row varieties produced under irrigation are Robust, Legacy, Tradition and Drummond.
- Under irrigation, these varieties get quite tall and have a greater tendency to lodge, or for heads to break off under wet and/or windy conditions. Varieties should be selected that exhibit the best growing characteristics under irrigation and receive the buyer's approval. Management practices, which are developed based on the irrigation method, can be used to minimize these potential problems. Growth regulators may help reduce plant height under irrigation.
- The buyer likely will provide advice on the variety that is best suited for the on-site soil, water, irrigation method and climate conditions.
- The seed should be treated at planting for soil fungi and insects.

Planting

- Barley is frost tolerant and therefore can be planted in early April or as soon as soil and climate conditions permit.
- To achieve high yield, establish a large plant population.
- The seeding rate is approximately 1.5 to 2 bushels per acre. One million live seeds per acre, which is the equivalent of slightly less than 2 bushels per acre, is some producers' objective.
- At the higher seeding rate, some producers will put down half the seed in one direction and half in another direction to achieve more even distribution under sprinklers.

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Fertilizer

- Proper nitrogen management of malt barley is critical.
- The general guideline for nitrogen application is 1 to 1.2 pounds of total nitrogen per bushel of yield goal. Excess nitrogen will cause high protein and may lead to lodging problems.
- The amount and uniformity of fertilizer application are important factors. The nitrogen must be used prior to the plant reaching the milk stage. Nitrogen options include urea, ammonium sulfate and anhydrous ammonia. Make a selection based on individual conditions. Although more costly, urea may allow for a more uniform application.
- The nitrogen may be broadcast and tilled into the soil or applied in a band offset from the seed row during planting. Producers seem to prefer the broadcast method.
- The desirable soil test level of phosphate should be above 16 parts per million, but a somewhat lower level may be acceptable. Potassium should be above 200 parts per million. Many producers apply fertilizer prior to or during seeding.

Irrigation (water requirements)

- A high-yielding barley crop that will meet malt specifications requires a total of 16 to 18 inches of effective moisture per year. The actual amount used will vary, depending on field and climate conditions, which requires an accurate irrigation scheduling program.
- Although the effective depth of the root system is 36 to 42 inches, for irrigation scheduling purposes, it should be considered to be about 24 inches under center pivots.
- The moisture content of the soil under pivots should be maintained slightly below field capacity to allow for storage of precipitation. The critical times are tillering (two- to four-leaf), heading and early seed fill. Depending on the growth stage, research has shown the yield can be reduced by 2 percent to 6.4 percent for every 10 percent reduction in water use resulting from soil moisture deficits below 50 percent allowable depletion, even for short times. Use an irrigation scheduling method.
- Limited moisture at tillering will reduce the number of heads, and a moisture deficit at flowering will reduce the number of kernels per head.
- The soil should be moist to at least 18 to 24 inches at planting.
- The peak water use will be 0.3 to 0.35 inch per day. To achieve the requirement, the pumping rate through a low-pressure center pivot irrigation system should be approximately 7.5 gallons per minute per acre irrigated. Lower pumping rates of 6 to 8 gallons per minute per acre may be adequate under normal temperature and rainfall.
- If the amount of rainfall is very low in warmer years, the irrigation system likely will run continuously from late May or early June until the crop reaches the soft dough stage.
- The irrigation should be discontinued at the soft dough stage with the soil profile filled to field capacity to achieve the best yields. In areas where fusarium head blight is a concern, consider making adjustments in irrigation water management.
- On sandy soils with relatively low-moisture holding capacity, irrigating after the soft dough stage may be necessary. However, this will increase the potential for disease, lodging and kernel staining.

Weed control

- A number of herbicides are available to control most weeds in barley. The North Dakota State University Extension Service's latest "Crop Production Guide" provides a guide for herbicide selection, or contact a crop consultant. Wild oats may be a dominant problem due to the inability to separate them from the barley.

Fungicide

- At least one fungicide application may be necessary to control fusarium, which may occur during the boot stage. Inspect crops and consult with a chemical company representative. Be sure to vary chemistries of all pesticide applications to delay resistance.

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Harvest

- The barley harvest must be managed to achieve optimum grain quality. The crop must be ripe with a moisture level less than 13.5 percent to minimize or eliminate green kernels.
- Swathing would help ensure ripe grain when dealing with a broad mix of maturity, and reduce associated shatter and head breakage. But, the wind-rowed grain is more susceptible to sprout damage and staining if moderate to heavy rainfall occurs.

Storage

- The barley must be stored in thoroughly cleaned bins that are kept free of insects. The bins should be treated with an insecticide that the buyer before filling.
- After filling, monitor the bins frequently for insects.
- A bin aeration system is important to maintaining a moisture level of 13.5 percent or less.
- Bins and truck boxes must be absolutely free of any treated seed previously stored or hauled. One treated kernel can result in rejection of a load, if not the entire crop.

Delivery destination

- The company that contracts for the barley determines its delivery destinations. The delivery destination for barley produced in western North Dakota may include Sidney, Mont. Other delivery points are available in the central and east-central portions of the state. The contract price is f.o.b. to the delivery destination.

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Energy Costs to Pump Water

Electricity and diesel fuel are the most common energy sources for pumping irrigation water. During the last 18 months, the cost of farm-delivered diesel fuel has increased tremendously. Irrigators with diesel- or propane-powered pumps will see their pumping costs for the coming growing season almost double, compared with just two years ago. Irrigation electric rates have stayed relatively constant during the last three years and probably won't increase much.

Figures 1 and 2 show the costs of pumping 1 acre-inch of water for a high-, medium- and low-pressure pumping plant. These graphs apply mainly to center-pivot sprinkler systems that obtain water from wells, and since the water has to be applied to the field, the energy to power the center pivot (whether electric or hydraulic) has been included in the pumping costs.

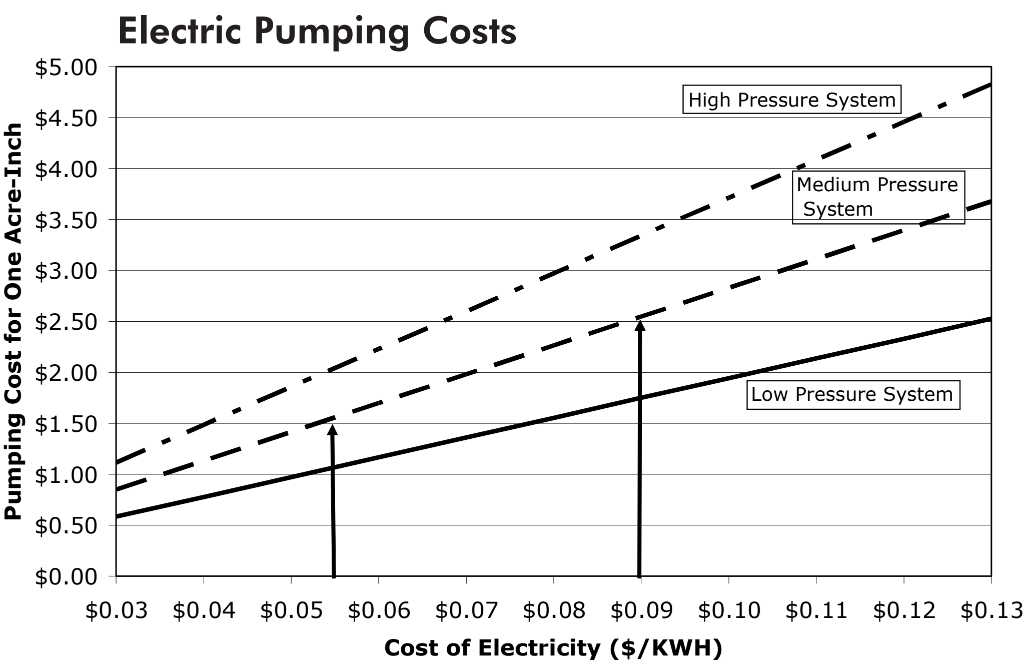

Figure 1.
Electric pumping costs for a high-, medium- and low-pressure irrigation pumping plant. The two arrows show the pumping costs for 5.5- and 9-cent-per-kwh electricity on a medium-pressure pumping plant are $1.50 and $2.50 per acre-inch, respectively.

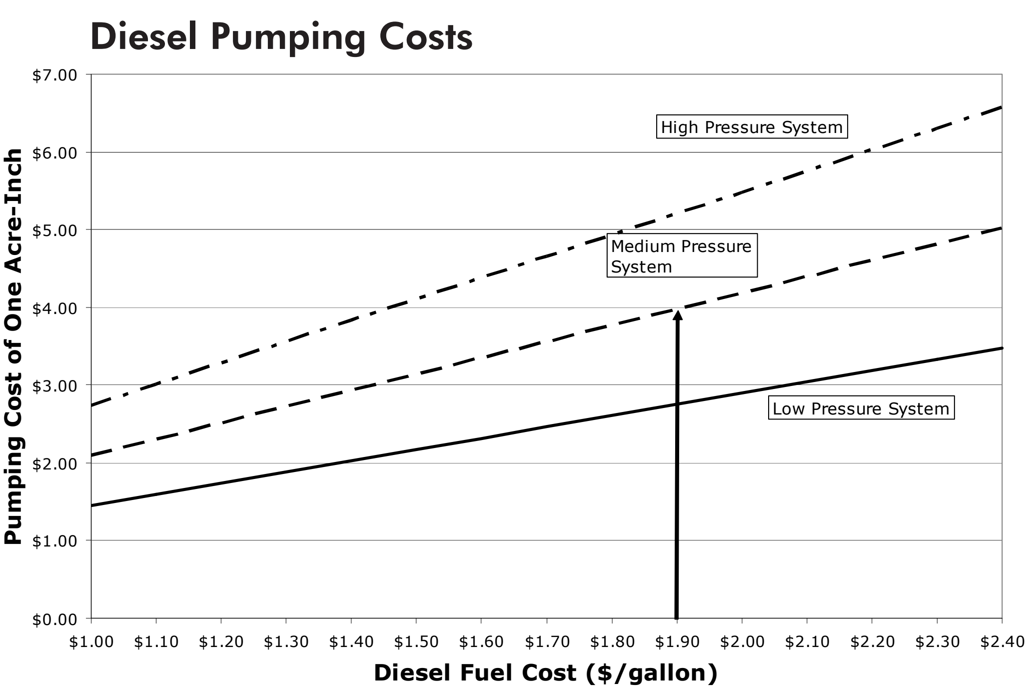

Figure 2.
Diesel pumping costs for a high-, medium- and low-pressure irrigation pumping plant. The arrow shows that with farm-delivered diesel fuel cost of $1.90 per gallon, pumping an acre-inch of water through medium-pressure irrigation system will cost $4.

The high-pressure system assumes a 50-foot lift in the well and 100 pounds per square inch (psi) of pressure at the pump. The medium-pressure system assumes a 50-foot lift in the well and 70 psi of pressure at the pump. The low-pressure system assumes a 50-foot lift in the well and 40 psi at the pump.

The statewide average irrigation cost for off-peak electric power is about 5.5 cents per kilowatt-hour (kwh) in North Dakota when adjusted to include the energy charge, the demand charge and/or annual charges. As the arrow shows on Figure 1, the cost to pump water at this price for a medium-pressure pumping plant is about $1.50 per acre-inch of pumped water.

The statewide average irrigation cost for regular-rate power is about $0.09 per kwh when adjusted to include the energy charge, the demand charge and/or annual charges. As shown on Figure 1, this corresponds to a pumping cost for a medium-pressure pumping plant of $2.50 per acre-inch of pumped water.

The current price for farm-delivered diesel fuel is about $1.90 per gallon. As shown on Figure 2, this results in a pumping cost for a medium-pressure pumping plant of $4 per acre-inch of pumped water. Compared with off-peak electric power rates, this is a difference of $2.50 per acre-inch of pumping costs. Compared with regular electric power rates, it's $1.50 per acre-inch.

For the last 10 years, the annual statewide average of pumped water per acre of irrigated land has been about 10 acre-inches. Using this amount, the additional pumping cost using diesel on a per-acre basis is $15 and $25, compared with regular and off-peak electricity, respectively. For a typical center pivot irrigating about 128 acres, the difference in pumping cost between diesel and electricity would be about $1,920 at regular power rates and $3,200 with off-peak electric rates. The increased costs might prompt some irrigators to consider changing their diesel engines to electric motors.

Let's explore that idea. Three-phase electricity is the preferred power source for pumping irrigation water. The reason many irrigators installed diesel-powered instead of electric-powered pumps was the cost of access to three-phase power. Based on a survey of electric cooperatives and investor-owned electric suppliers, the cost of extending three-phase power to a field site is about $30,000 per mile. Many electric suppliers have programs to help reduce the cost of installing three-phase line, including cost-share and multiyear power-use contracts, but the additional costs still add to the total. All other installation costs being about equal, seeing why diesel would be the preferred power source is easy if the well or pump were located more than a mile from three-phase power.

If you believe the cost of farm-delivered diesel fuel will stay high for the next few years, we have two scenarios we should study. The first scenario relates to you considering whether to install a new irrigation system. When you add up the investment costs, the economics of the project may show that the increased costs of extending three-phase power more than a mile are worth the investment.

The second scenario is determining if converting an existing diesel-powered pumping system to electric is economical. In addition to the three-phase line extension charges, you have to factor in the cost of an electric motor, power control panels, underground electric line from the pole to the well and labor. If purchased new, all these could add $12,000 to $16,000 to the cost. Of course, the diesel engine, fuel tank and other parts have some salvage value.

Other factors to consider are the reliability of electricity, not having to maintain the diesel engine (changing oil and filter every 150 hours) and whether you can live with controlled (off-peak) electric service. If you are considering changing from diesel to electric, plan to visit both your electricity supplier and irrigation dealer.

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