Irrigation of Malting Barley in the Northern Great Plains

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Irrigation vs. Dryland

The eastern Montana/western North Dakota (MonDak) area has rapidly become a major six-row malting barley production area producing up to 50% of the six-rowed malt barley produced in the United States. The region is semi arid with annual precipitation below the full water requirements of malting barley. Consequently, much of the most successful 6 row malting barley production is grown under irrigated conditions. Rejection rates in the MonDak area may be as much as 3 to 5 times higher for dryland malting barley than for irrigated, primarily because of too high protein.

Soil moisture management and nitrogen fertility are major, interacting factors impacting acceptance rates (protein, color and plumps) of six-rowed varieties, and need to be considered together in order to maximize yields and quality. Grain protein, a major quality component of malt barley, is affected by timing and severity of drought stresses as well as the timing and availability of soil nitrogen, and different varieties may react differently to these stresses. Barley can have an effective root zone 36-42 inches deep, but most of the crop's water and N use will be in the top12 to 18 inches.

Price of Nitrogen

The current high price of nitrogen fertilizer is causing many growers to look more closely at malting barley production because the N requirements are less for malting barley than for high protein spring wheat. However, proper nutrient management is absolutely critical in satisfying yield and end-use quality requirements for spring barley. Inadequate N nutrient levels lower yields, whereas excess nitrogen can decrease yields and quality (e.g., protein) and cause significant economic loss if contract specifications are not met. Excessive plant tissue nitrogen concentrations also tend to advance vegetative growth, which increases the potential for foliar diseases and promotes lodging. High soil nitrogen also increases the potential for environmental degradation from nitrate leaching. Research at Sidney, MT indicates that malting barley requires about 1.2 lbs N (applied and soil residual) per bushel yield goal under irrigated conditions. Growers need to soil sample before applying fertilizers to properly manage the critical N and then fertilize for appropriate yield goals.

Photo courtesy of University of Missouri Extension.

Total annual water use of malting barley varies with local environment and the timing of rainfall. Hot dry locations will have higher daily and seasonal water use than in cool areas. It is estimated that malt barley requires 18-22 inches, including effective rain, stored soil water and irrigation to produce a malting quality crop in the MonDak area. Peak maximum daily water use in eastern Montana and western North Dakota will be in the range of 0.30-0.35 inches per day, whereas the Red River Valley will often be in the range of 0.25 to 0.28 in/day.

Managing 6-Row Varieties

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Most of what we know about managing 6 row varieties is by grower experience as there has been little research on water management for this crop. Producers generally have the best results if they start the season with a nearly full (soil water) root zone before planting. Soil water in the plants' active rootzone under center pivots should be maintained at fairly high levels and not allowed drop below about 20%-25% from emergence until soft dough stage because most machines lack the capacity to apply large enough amounts of water to refill the rootzone. As a general rule for gravity (surface) irrigation methods, side roll or solid set sprinklers, effective rootzone soil moisture should not be depleted by more than 50% of total available water from emergence until flag leaf, at after which depletions should probably not exceed 40% of the total available soil water until the soft dough stage.

Research and experience has clearly shown that water management should be based on growth stages and soil moisture, not calendar dates. The first critical stage to ensure good soil water availability is at tillering (2-4 leaf) where the potential number of heads per plant (yield potential).is established. Another critical growth stage requiring high soil water levels is at boot through early seed fill, which determines kernels per head. Preserving the maximum kernels/head is very important for obtaining high yields from 6 row varieties. Lastly, having relatively good soil moisture at soft dough will increase the percentage of plumps by providing enough water to finish the crop. Irrigation applications after soft dough stage are not recommended regardless of the irrigation method due to potential lodging and staining problems.

Irrigation Management in the MonDak Region

Normally, border or flood irrigation of malt barley will require 2-3 irrigations on heavier soils corresponding with critical growth stages. Light, sandy soils may require more frequent irrigations. Center pivot irrigators need to build up the soil water profile to near field capacity (leaving a little room for rain) early in the season and then keep it at higher levels (more wet) until the soft dough stage, which often requires 2 or more applications each week during hot periods.

Endguns

Because malting barley quality is greatly influenced by drought stresses, it is advisable to turn off end gun(s) under center pivots and to not plant end gun areas due to the highly variable water applications. If end gun areas are planted, they should be harvested separately and kept in separate trucks or bins until the malting quality can be assessed.

Growers should implement soil water monitoring programs and some form of scientifically-based irrigation scheduling to manage crop water status throughout the season. Soil water monitoring sites should be located so as to adequately represent the most dominant soil variability zones inherently present in any field. There should be a minimum of two depths per site (e.g., 6 and 24 inches) that are read at least once a week.