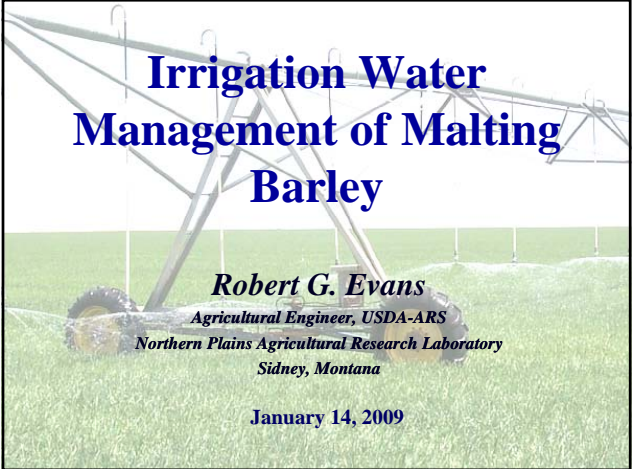




**Northern Plains Agricultural
Research Laboratory**



USDA
Agricultural Research Service
Sidney, Montana



**Irrigation Water
Management of Malting
Barley**

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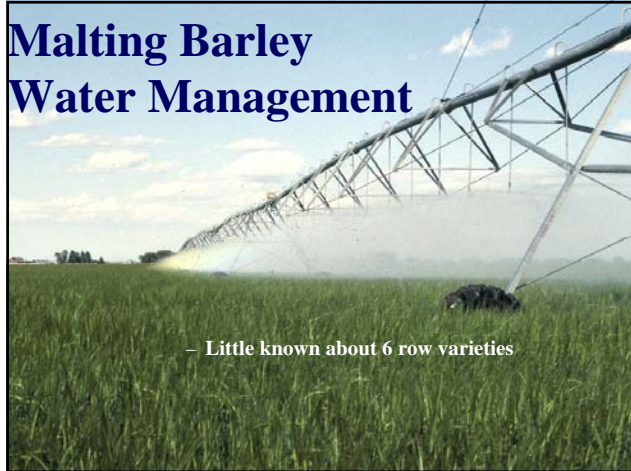
January 14, 2009

Setting the Stage...

- We know relatively little about irrigation and nitrogen management of 6 row barley varieties
- We assume mostly the same as 2 row varieties
 - 2 row is easier to grow, more forgiving
 - Fertility—totals similar (don't know about timing)
 - Critical growth stages similar
- Jury still out about water management
 - 6 row more sensitive to drought stresses/timing
 - Plumps and protein relationships?

Topics

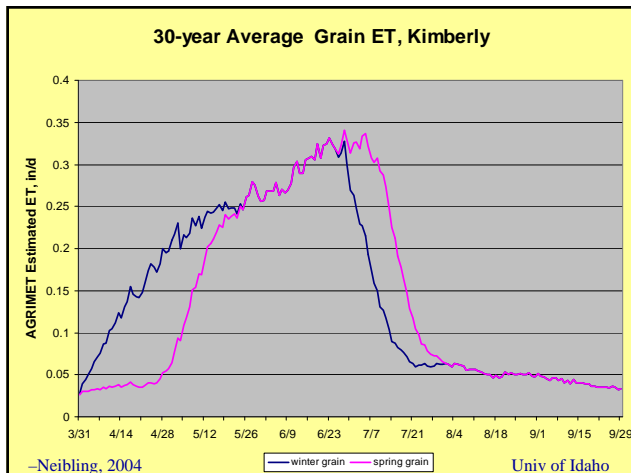
- **Malting Barley Water Management**
 - General Irrigation Considerations
 - H₂O Effects on yield, plumps and protein
 - Surface Irrigation of Malting Barley
 - Center Pivot Irrigation of Malting Barley
- **Soil water measurements**
- **Summary**



Summary

Growing Irrigated Malting Barley

- **Plant early** — early to mid April
- **Start the season with a nearly full (soil water) root zone**
- **Base irrigation decisions on soil water levels at various growth stages—not dates**
- **Most Critical times for soil water availability**
 - Tillering (~ 2-4 leaf)—determines yield potential
 - Boot through early seed fill
- **Last irrigation at soft dough stage (maybe)**



Malt Barley Irrigation

- **Annual water use varies with environment**
 - 18-22 inches – including effective rain and stored soil water from winter and last fall
- **At Peak--Maximum daily water use ~ 0.30-035 inches per day**
 - May have to run pivots a lot by early June—especially if no rain to help
- **Full root zone (36-42 inches)**
 - Clays ~ 3.5 to 4 inches total available (~ 10-12 days)
 - Sandy soils ~ 2 to 2.5 inches total available (~ 5-7 days)

6-Row Malt Barley Irrigation

- Most of what we know is grower experience—little research
- Base water management on growth stages—not dates
- Most Critical times for soil water availability
 - Tillering (~ 2-4 leaf)—determines yield potential
 - Boot through early seed fill
 - Preserving max kernels/head very important for yields of 6 row varieties (determined in the boot)
 - We know water stress at boot through flowering limits number of kernels per head
- Water applications after soft dough—not recommended
 - Lodging?
 - Staining?
 - Need enough soil water at this time to finish crop

Growth Stage – Stress Effects

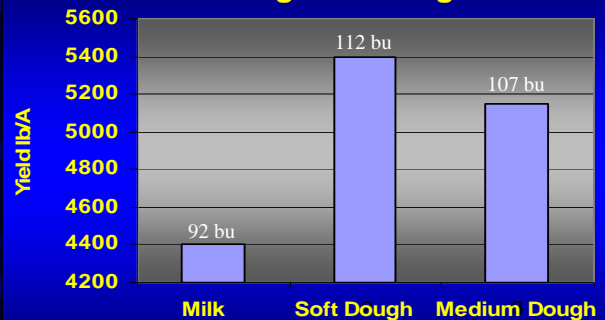
- Tillering (2-4 leaf stage)
 - Stress limits number of heads (determines yield potential)
 - Total # heads & # seeds/head determined by end of tillering & start of elongation (height about 6 in)
- Vegetative (except tillering)
 - Stress shortens plant
 - Yield reduction: 2% / 10% < ET
- Flowering
 - Stress reduces number of kernels/head
 - Yield reduction: 6.5% / 10% < ET
- Yield formation
 - Stress: incomplete head fill, limits kernel size & protein up
 - Yield reduction: 5.5% / 10% < ET

–Yields/ET data from Qureshi, 2003 (ID)

Some Irrigation Research Findings

- Irrigation cutoff at milk stage with a full soil profile (ID)
 - Results in about 70% of “best” yields
 - Probably reduced test weights
 - Try to have full soil profile at early- to medium soft dough stage (ID)
 - “Best” yields
 - Low black tip, scab, etc., (if present)
 - Best test weights
 - Best water use efficiency (bu/inch of water)
- 2 row varieties

Yield vs. timing of last irrigation



2 row Barley: 48 #/bu

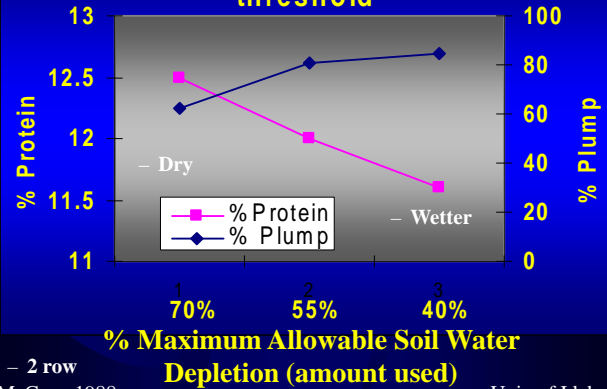
McCann 1988

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Proteins

- Timing and severity of drought stresses
- Timing and availability of nitrogen
- Varieties act differently

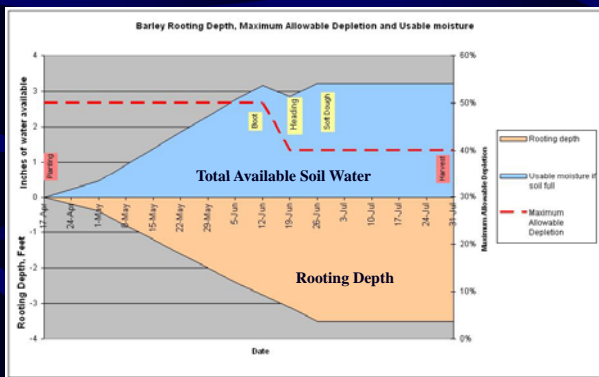
Protein and Plump vs. irrigation threshold



- 2 row
McCann 1988

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Loamy Soils



Surface (Border) Irrigation of Malting Barley

- One irrigation or Two? (planting by mid April)
- Dry Spring—may have to irrigate up
- “Normally” start season with full root zone
 - 1st Irrigation by at least June 1 (dry years may be as early as mid May (leading to 3 irrigations))
 - 2nd Irrigation at or before soft dough (about July 1)
- 1.2-2.5 inches must be applied to soil to put 1 inch in rootzone (tough to apply less than 4 inches per irrigation)

Surface Irrigation of Malt Barley

- Start with good soil moisture for germination, tillering and early growth (otherwise must irrigate up)
- Schedule water and chemicals to avoid drought stress
 - Do not dry down more than 50% available soil moisture—tillering through vegetative (root zone changes with growth)
 - Shift at boot stage—only use 40% or less of available soil moisture through soft dough (less stress)
- Check soil water levels regularly
 - Sensors (many types)
 - Hand probes, shovels
- Last irrigation at soft dough
 - Have a full root zone to finish crop (plumps)



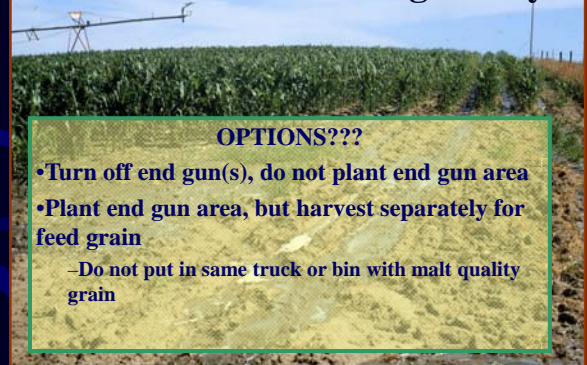
Sprinkler Irrigation of Malting Barley

- Light irrigations may be needed to activate herbicides or for germination (pays for itself!!)
- Start Early—fill the root zone (shallow)
 - First Irrigation at or before 2-4 leaf (tillering) ~ early May (planting by mid-April)
- Tillering and flowering (boot) are the most sensitive stages to drought stress on yield
- Pivots keep soil “reserves” near Field Capacity
 - Running full time by June 1?
- Last irrigation at soft dough (if possible)

General CP Water Management

- Build up soil water profile early—then keep it up
- Maintain constant soil water profile during growing season (just below FC—leave a little room for rain)
- Have enough capacity to “catch up” when system is down or turned off for a few days (i.e., sprays)
- Check soil water levels regularly
 - Sensors (many types)
 - Hand probes, shovels
- Schedule water and chemicals to avoid drought stress

End Guns and Malting Barley?



OPTIONS???

- Turn off end gun(s), do not plant end gun area
- Plant end gun area, but harvest separately for feed grain
 - Do not put in same truck or bin with malt quality grain

Fall Irrigations before Barley???

- Good idea with dry fall (we don't know if we will get winter/spring precip to germinate)
 - Germinates weeds
 - Increases soil "heat capacity" to reduce cold damage to roots and dehydration in open winters
- Improves tillage and weed/volunteer germination for better fall chemical control
- Add just enough to fill top 18-24 inches – about 2 – 3 inches -- leaves room for snow melt/rains (the applied water will redistribute and move deeper)
- Try for late irrigations on sugarbeets (if possible)

Soil Moisture Monitoring

- Highly Recommended for Surface Systems
- Required for Pivots!
- Install and Start Measurements just after Planting
 - If low -- refill root zone ASAP
- Monitor Throughout the Season (1-2X/wk)
- Rain gauges at or near SM sites



Summary

Irrigated Production of Malting Barley

- Start the season with a nearly full root zone
- Plant early to mid-April (if possible)
- Base irrigation decisions on growth stages and soil water levels—not dates
 1. Tillering (yield potential)
 2. Boot through heading (kernals per head)
 3. Soft dough (plumps?)
- Protein content
 - Timing and severity of drought stresses
 - Timing and availability of nitrogen

“...water is the true wealth in a dry land.”

Wallace Stegner

