Scheduling the Last Irrigation on Wheat and Barley

The early water use pattern and rapid end-of-season ET decline make grain an effective rotation crop in water-short conditions, since water can be shut off on th

the Treasure Valley, the south side of the Snake River in the Magic Valley and in some areas of

Hard Dough: kernel starch is firm and can be divided with a thumbnail while holding its shape

As shown in **Figure 4**, calendar date is not very useful since onset of Soft Dough at Aberdeen ranged from June 9 in 1992 to June 28 in 1993. Visual appearance of the crop is not a good indicator since noticeable color change does not usually occur until Hard Dough (**Figure 5**). Therefore, the description listed above is still probably the most generally applicable, although a general rule of about 24 days after flag leaf emergence will be helpful in identifying the general time period.

Economic Implications of Early Irrigation cutoff

Table 6 summarizes the relative yield and quality of malting barley when irrigation is stopped at specified crop stages with a 2-foot root zone near field capacity. The yield relative to that at Soft Dough is the same as that shown in **Figure 2.** The relative price based on quality reflects less plump kernels when irrigation cutoff is at Milk, and the tendency toward black point with irrigation after Soft Dough on adequate water-holding soil. Combining these factors gives the calculated crop value per acre for irrigation cutoff at the indicated crop stages. This table may be used to estimate increase in crop value as last irrigation is scheduled at later crop stages. For example, scheduling the final irrigation at Soft Dough rather than Milk, increased crop value by $813-$634 or $179/acre. However, scheduling the last irrigation at post-Soft Dough (nearly Hard Dough) decreased crop value by $106/acre. **Table 7** summarizes crop value for last irrigation at specified crop stages for hard red wheat. As was the case for malting barley, irrigation past Soft Dough with a 2-foot root zone on a silt loam soil at field capacity decreases crop value relative to Soft Dough and incurs additional irrigation costs.

Table 8 indicates that 2 pivot irrigations or one set-move irrigation could be saved by irrigation cutoff at Soft Dough rather than Hard Dough on adequate water-holding soils. An alternative method of assessing irrigation cost is shown in **Table 9**, which shows the effect of system type and pumping lift. For example, the typical cost of applying one acre-inch of water by center pivot from a canal source is about $0.69, while it would be about $2.74 for a 400-foot lift. In contrast, the cost of applying one acre-inch with a set-move system from a canal source is about $4.35 or $6.87 for a 400-foot lift. The difference in cost is primarily due to labor and to the extra pressure and water required to deliver one acre-inch net with a set-move system.

An alternative approach to evaluating the need for additional irrigation at various crop stages is shown in **Figures 6 and 7**. The crop value and irrigation costs are summarized in **Figure 6**. The curve for total value of the product in **Figure 6** can be obtained by methods shown in **Tables 6 and 7**. Irrigation cost is for a center pivot with 200 foot lift. As shown earlier (**Figures 2 and 3**), the maximum crop value occurs when irrigation is stopped with a relatively full root zone at Soft Dough.

Figure 7 evaluates this same information in terms of the marginal cost of irrigation and the marginal crop value resulting from the last irrigation occurring at various crop stages. It shows that for all crop stages before Soft Dough, the crop value added by each irrigation exceeds the cost of that irrigation. Profit is maximum at the stage where the marginal cost of the irrigation equals the marginal value produced by that irrigation. This analysis also shows maximum profit occurring with irrigation stopped at Soft Dough with a full root zone (e.g. 2-2.5 inches of usable water in the crop root zone).

Stop at Hard Dough with full root zone: crop value=$679/acre
Irrigation cost=$9.86/acre

Incremental costs:

Stop immediately vs. Soft Dough with full root zone: crop value=$780-702=$78/acre benefit
Irrigation cost =$7.42-0 = $7.42/acre

Incremental benefit-incremental cost = $70.58

Stop immediately vs. Hard Dough with full root zone: crop value=$679-702=-$23/acre benefit
Irrigation cost=$9.86-0= $9.86/acre/acre

Incremental benefit-incremental cost =-$23-9.86=-32.86/acre

Stop at Soft Dough with full root zone vs. Hard Dough with full root zone:
crop value=$679-780= -101/acre
Irrigation cost=$9.86-7.42 = $2.44/acre

Incremental benefit-incremental cost = -$101-$2.44= -$103.44

It can be seen that the alternative of stopping at Soft Dough and adding another 0.8 inch irrigation is the most economically beneficial. Also, the incremental value of crop production for these alternatives is much larger than the incremental irrigation cost, although even $2.44/acre applied to several pivots would be a substantial savings.

Additional Resources

University of Idaho Bulletin 833 “Estimating water requirements of hard red spring wheat for final irrigations”

University of Idaho CIS 236 “Irrigation Scheduling Using Water Use Tables”

USDA-NRCS “Estimating Soil Moisture by Feel and Appearance”

Robertson, L.R. “Spring Barley & Spring Wheat Weekly Growth Stages”

http://www.ag.uidaho.edu/scseidaho/growstage/growth_stage_index.htm

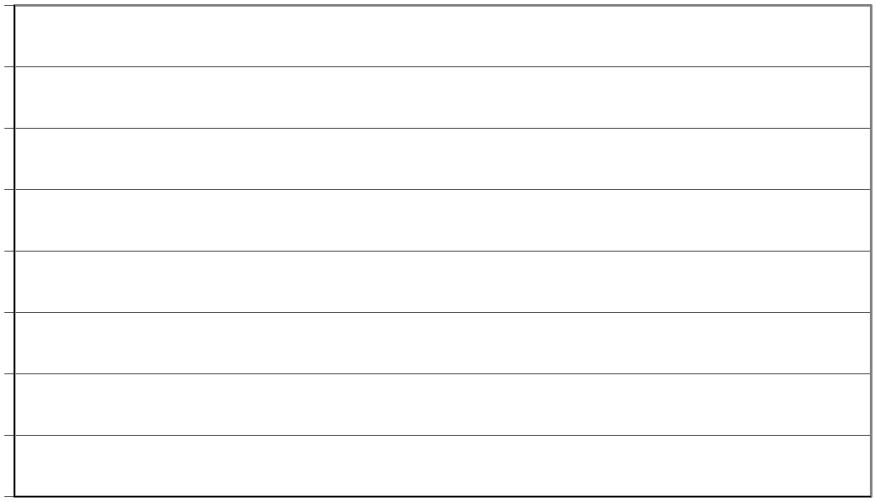

Figure 1. AGRIMET estimated ET for winter and spring grain at Kimberly, ID, 30π year average.

Figure 2. Yield response to crop stage at last irrigation for hard red winter wheat 1997π1998), hard red spring wheat (1999, 2000). Water supply by surface drip irrigation.

Figure 3. Malting barley yield at specified irrigation cutoff relative to yield with full-season irrigation.

Figure 4. Variation in timing of crop stages at Aberdeen. Crop stages achieved earliest in 1992,

Early Milk Soft Dough Hard dough

Figure 7. Marginal physical product (MPP), Marginal irrigation cost (MIC) and Marginal value of product(MVP) for hard red

Table 2. crop water used (inches) for selected malting barley and hard red spring wheat crop stages and total seasonal use.

Crop stage	2π row malting barley	Hard red spring wheat
Emergence to milk	11.6*	14.3**
Milk to Soft		

Table

Table 7. Relative crop yield and 4-year average value of **hard red wheat** production per acre for each irrigation cutoff treatment.

Irrigation stopped with root zone filled to field capacity at:	Relative yield (SD base)	Crop value $/ac *
Early Milk	0.69	304
Late Milk	0.78	343
Early Soft Dough	0.93	409
Soft Dough	0.95	418
Late Soft Dough	1	440
Hard Dough	0.96	422

* Based on average price of $4.00/bu and average yield of 110 bu/ac

Table 8. Total irrigation and number of events for the season , two-row malting barley, 3-year average.

Treatment	Total Irrigation Season		
	Irrigation Depth, inches	Estimated # of Pivot Irrigations *	Estimated # of Solid-set or Set-Move Irrigations **
Emergence to :			
Milk	11.6	14	6
pre-Soft Dough	13.6	17	8
Soft Dough	14.9	19	8.5
post-Soft Dough	16.0	20	9
Hard Dough	16.8	21	9.5
Harvest	17.6	22	10

* Net irrigation of about 0.8 inches per revolution

** Net irrigation of about 1.8 inches per set

Table 9. "Typical" cost per acre-inch applied (considering system application efficiency).

System type	Water source				
	Surface	Groundwater lift in feet			
	canal	100	200	300	400
Center pivot	0.69	1.23	1.69	2.21	2.74
Set - move	4.35	5.09	5.58	5.92	6.87