Water Conservation Practices for Rice and Soybean Irrigation

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I way over-married and am blessed with two teenage daughters that are beautiful, inside and out.
Stress Test

There will be a picture of two dolphins...if you see anything other than two dolphins your stress level is critical – you should take a break, get a smoke, eat a snickers etc. but do something relaxing NOW!!
We irrigate most of our crops in the Arkansas Delta

- Rice: 1.5 million acres - all irrigated
- Corn: 350,000 acres – 80% irrigated
- Cotton: 1 million acres - 75% irrigated
- Soybeans: 3 million acres - 62% irrigated
- Milo: 250,000 acres – 50% irrigated

4.5 million irrigated acres – 74% of total acres
Where do we rank among states?

Arkansas Is Fourth in Irrigated Acreage Following Nebraska, California & Texas

USDA ARS Proposal National Irrigation Watershed Research Lab in Arkansas
Over 90% of the water for irrigation in Arkansas comes from groundwater

- Also primary source for municipal and industrial
- Critical groundwater areas have been identified
- Predicted that half of aquifers will be depleted by 2011*

* Scott et al. (1998)
Areas of declines greater than 5 feet
Areas of declines up to 5 feet
Areas of no change and increases
Contour lines of water level change (5 foot intervals)
Critical Ground Water Designations

Legend
- Future Study Areas
- Current Critical Areas
- Crowley’s Ridge
- County Boundaries
One well often shared among multiple crops, especially rice and soybean

- Irrigation of soybean usually dependent upon first being able to adequately irrigate rice
- Soybean often suffers drought stress because unable to stop watering rice long enough to complete soybean irrigation
Situation

Advantageous to the individual farmer as well as to everyone else in state to reduce irrigation requirement for producing rice.
Conventional Rice Irrigation

- Well or Riser
- Spill or Gate
- Levee
- High Side of Field
- Field Slope
Multiple Inlet Concept

Apply smaller amount of water to each paddy, rather than all to top paddy:

• Can often operate well at or near full capacity without fear of topping first levee
• Don’t have to overpump top paddies and guess when have enough water to flood lowest paddies
• Can leave some room to catch rainfall
Multiple Inlet Rice Irrigation
Contour or Straight Levees

Riser or Well
Spill
Multiple inlets
Tubing
down side of field
OR
Tubing out in field

Levee
Spill

General field layout of Multiple Inlet Rice Irrigation
Potential MIRI Advantages

- Flood field quicker *without over-pumping top levee.*
- *Improved fertilizer/herbicide efficiency.*
- Maintain shallower flood.
- Fewer problems with scum and algae.
- Reduced pumping time/costs.
- *Reduced* water pumped/runoff.
- Reduced cold water effect.
- Reduced labor (after initial setup).
Disadvantages

• Tubing and adjustable gate cost
• Riser bonnets (universal hydrants) cost
• Initial installation and adjustment
• Floating, moving and twisting of tubing
• Working around tubing with field equipment
• Animal damage to tubing - especially coyote
• Removal and disposal of tubing
Study initiated in 1999 to quantify the potential for advantages of a multiple inlet approach and check for any yield penalty

**Study Methods**

- Two similar-sized rice fields located close together, same planting, cultivar, soil type, management
- One assigned conventional irrigation (CONV), other multiple inlet rice irrigation (MIRI)
- Worked with grower in setting set up MIRI
Comparison Demonstrations

• 15 pairs of fields from 1999 through 2002 with complete water and yield data
• Data set includes counties from southeast (Ashley) to northeast (Poinsett) Arkansas
• Soils ranged from sandy loam to clay
• Field sizes range from 31 acres – 80 acres
Counties with demo. fields included in this report - 9
Counties working with MIRI in 2003 - 14
Other counties who have worked with MIRI - 15
Findings

Water Applied *

Multiple inlet rice irrigation (MIRI) fields required an average of 26% less water (10 inches) than the conventionally (CONV) flooded fields

* excluding flushing
Water savings is energy savings!

Energy costs tend to increase!!
Findings

The labor required with the MIRI fields averaged 30% less than the CONV fields.
Findings

Grain Yield *

MIRI yields averaged 3.6% (5 bu/ac) higher than CONV

* adjusted to 12% moisture content
Economic Impact

The savings in water and labor and the yield increase gives an estimated $16.60 per acre average cost savings (after paying for irrigation tubing) with the MIRI system.
Summary

• MIRI averaged 26% (10 inches) less water
• MIRI averaged 30% less labor
• MIRI averaged 3.6% (5 bu/ac) higher yields
• Estimated $16.60 per acre savings with MIRI
Providing multiple inlets to levee irrigated soybeans can improve water management.

The use of irrigation tubing for the water delivery in place of the canal or flume can conserve water and reduce soil erosion.
Border irrigation on precision graded (or nearly so) fields

Contour Levees

Border Irrigation

Water Source
- Irrigation tubing, pipe, or canal

Primary Slope
- Min. cross slope

100'-300'
- Spacing

Borders

Shutoff at approx. 70 - 80% of length unless sandy soil

Stop border approx. 30' from end of field

Water Advance

Water In

Water Shutoff
Border Irrigation

Minimal ground out of production

Less danger to small beans than with flooding
MIRI and Border Irrigation can make it easier to share a well between rice and soybeans.
University of Arkansas Cooperative Extension Service will continue to recommend that farmers consider multiple inlet rice irrigation, border irrigation etc. We will also work with producers who want to try different water management systems and methods that can help them conserve water and protect water quality.
Acknowledgment

Arkansas Soybean Promotion Board

Arkansas Rice Check-Off

University of Arkansas
Division of Agriculture
Cooperative Extension Service
Acknowledgments
Border made with middle buster type implement

Disk bedder implement for border and wiggle as go through field
Border irrigation can fit a no-till, double-crop production system.
Arkansas rice area increasing
(nearly 10,000 ha/year)

Harvested rice hectares in Arkansas = 9,900(year-1947) + 65,000; $R^2 = 0.836$

Estimated state average irrigation requirement for rice: 760 mm (Bryant et al., 2001)
Findings

Irrigation Water Use Efficiency – kg/ha-mm

MIRI fields averaged 38% higher irrigation water use efficiency than CONV fields.
MIRI Example

Well output: 1500 gpm
Field size: 100 acres

15 gpm/acre
(1500/100)

Paddy size: 3 acres; then
45 gpm (3*15) needed in paddy

2.5” gate capacity ~ 75 gpm

1 gate needed, partially open
Multiple Inlet Rice Irrigation not a “brand new” Idea - these pictures were taken in 1991 near Stuttgart, AR
Multiple (Side) Inlet Rice Irrigation

Contour or Straight Levees

- Riser or Well
- Spill
- Multiple inlets
- Tubing

Tubing down side of field OR Tubing out in field

General field layout of Multiple Inlet Rice Irrigation
Border irrigation precision graded (or nearly so) fields

Less danger to small beans

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Multiple-inlet rice can make it easier to share a well between rice and soybeans.
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