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MULTIPLE INLET IRRIGATION for Rice

Introduction

Most of the rice-growing areas in Arkansas and Mississippi are blessed with abundant water supplies. However, the water from underground aquifers is not an infinite supply as some rice producers are discovering. Groundwater monitoring indicates that the water table is declining in certain areas of the Delta. Mississippi reports indicate that during the past decade the water table has dropped an average of 10 feet.[1] Six Grand Prairie counties in Arkansas have been designated as critical groundwater areas due to continued decline in the groundwater.[2] Multiple Inlet (MI) irrigation in rice has the potential to help producers conserve water and energy and reduce labor. Conserving water and energy and reducing labor helps protect and preserve natural resources and increases the profit potential in rice production.

Several studies on multiple inlet irrigation for rice have shown water savings of up to 50 percent and an average savings of about 25 percent.[3] MI irrigation is a method where each area between the levees is irrigated individually and at the same time. This method decreases the necessity for the water to flow from one levee to another and can reduce the amount of water leaving the field. MI can also provide for a quicker flood, which aids herbicide activation, increases fertilizer efficiency, and protects the Delta's natural resources. Pumping cost with MI irrigation is usually less than with most conventional flood irrigation and it can reduce cold-water areas, thus increasing yield uniformity and possibly the total yield. [3]

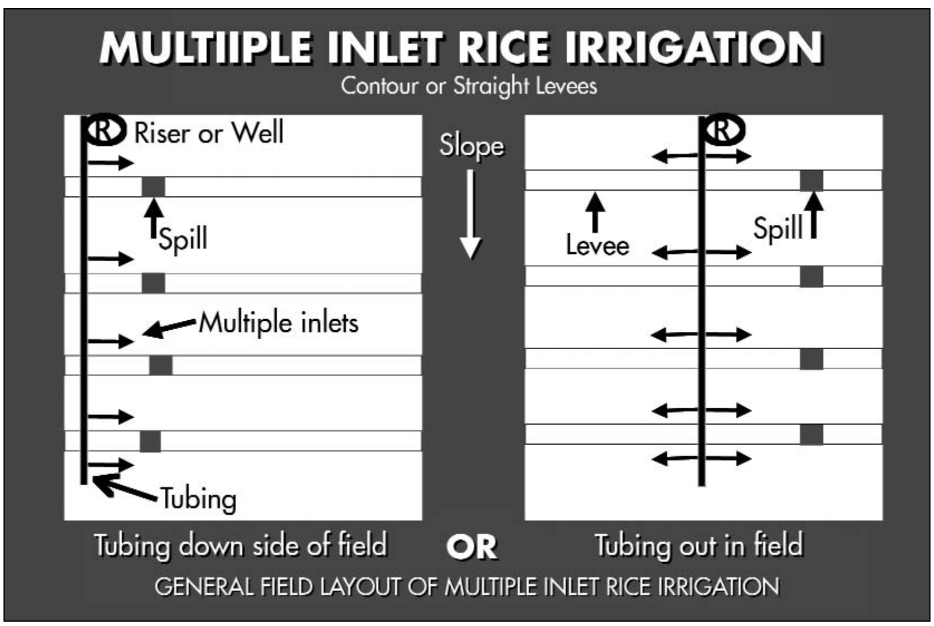


Figure 1

Multiple Inlet Rice Irrigation Installation

Figure 1 shows the general MI irrigation layouts for each levee to receive water at about the same time and rate so the whole field floods uniformly. Irrigation tubing can be laid on the edge of an elevated turnrow or pad beside a field. Tubing should be placed in a 2- to 4-inch deep trench to make sure it does not twist or roll once it is in place. This installation method requires some effort for holding the water in the pipe at the upper end of the field so all the water does not try to go to the low end of the tubing. This can be done by wrapping something around the tubing, placing barrels under the tubing, shoveling up dirt mounds under the tubing, or by whatever means is easiest for the grower to restrict flow. It is also possible to put a pipe in the end of the tubing so it can be elevated to restrict the water. When this is done, it is advisable to let some water flow out of the elevated pipe to water the lower levee areas in order to avoid bursting the tubing. The heavier grade (9-10 mil) tubing should be used for MI irrigation in rice.

Installation, continued

Tubing also can be laid in a trench at the base of the pad or turnrow, or in the trench of the levee constructed around the field. Since the tubing crosses the levees, the water is restricted from flowing directly to the low end of the field. The tubing should cross each levee at a 90º angle to avoid twisting and rolling as it goes over the levee. If the levee trench is deep where the tubing crosses, shoveling a small dirt ramp across it can provide for a smoother flow transition over the levee. A 1- to 2-inch depression for the tubing should be made on the top of levees that are settled and firm. This is not necessary on soft or fresh levees because the weight of the tubing and water will make a depression. In some cases the levee may settle too much under the tubing's weight and water can wash the levee out under the tubing. A levee tarp or scrap piece of tubing can be placed on levee crossings where this may be a potential problem.

The tubing can be laid out in the field or even through the middle of the field (Figure 1). As stated, it should be placed in a 2- to 4-inch deep trench. It is recommended that a 4- to 6-inch diameter pipe be placed under the irrigation tubing where it crosses the low side of the levee interval in the trench on the upper side of the lower levee. The pipe serves as a culvert, allowing water to flow under the tubing and distribute evenly on both sides of the field. Some growers choose to install levee spills on both sides of the tubing. This can help avoid washing out of levees if a big rain occurs and the pipes under the tubing do not allow the water to flow adequately. Tubing placed out in the field is more prone to float and be moved by the wind, which can cause it to twist and roll. A practical method for addressing this potential problem is to drive ¾- to 1-inch diameter PVC pipe through the tubing. This should be done when water is in the tubing and it is settled in place. A ½-inch diameter hole can be punched in the top of the tubing for the PVC pipe to be pushed through and then hammered down once it rests against the bottom of the tubing. The PVC pipe should be placed near the middle between levees. Big flat areas between levees may need to have two of the PVC pipes spaced out evenly between the levees. Once the rice gets tall and thick, the tubing is much less subject to moving.

Characteristics such as field size and slope, levee pattern, water location, flow, and grower preference determine how the tubing is laid out. It may not be practical to run the tubing to the last few levees if they account for only a small acreage and a significant amount of tubing would be required to cross them. In this situation, extra water can be discharged from the end of the tubing so it can flow through the levee spills and into the last few levees. Irrigation tubing is usually the delivery system of choice but gated aluminum or PVC pipe could be used if it could be laid out alongside a field. Running the tubing down the side of the field and straight over the levees seems to work best in most cases.


Tubing in field


Culvert pipe under tubing


Twisted tubing

Controlling the Flow

It is important the tubing is sized properly so it does not fail as a result of undersizing or stay too flat because of oversizing. Following are recommended flow ranges for the tubing:

12 inch – less than 1,200 gpm

15 inch – 1,200 to 2,200 gpm

18 inch – greater than 2,200 gpm

In many installations it may be advisable to size down to the next smaller size tubing after covering a significant amount of the field. An example would be to start with 15-inch tubing for a 2,000 gpm flow but go to 12-inch once half of the field has been covered and the flow is probably 1,000 gpm or less. When the flow in the tubing doesn't keep it rounded, gates and/or holes may not flow fully and the tubing may flap enough to cause it to tear. The flapping is more likely to be a problem on steeper fields and on the downslope side of levees. Proper-sized tubing can help reduce this problem but it may be necessary to use rope or strapping to restrict the tubing at a point below where it continues to flap against itself.


PVC pipe in tubing

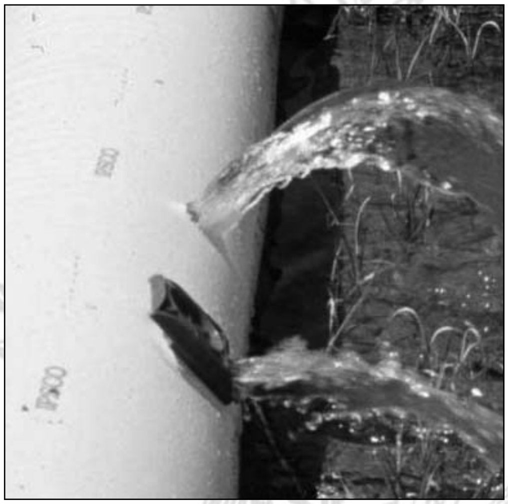

Choke rope on tubing

Adjustable 2.5-inch diameter slide gates and/or holes are placed in the tubing for water inlets to each levee that the tubing crosses. Gates and/or holes should be placed near the topside of the tubing at 11 or 1 o'clock position. They can be placed anywhere between the levees but when placed closer to the upper levee, the tubing will hold more water when not irrigating and be less likely to float or move. The holes or gates are adjusted when flooding the field so that each levee floods up at about the same rate. Most growers find that after the initial adjustments they don't have to spend as much time with the water management as they do with most fields that are flooded conventionally. Additional adjustments during the season may be necessary if the flow to the field changes significantly as is possible with pipeline systems that have several wells and multiple pumping outlets. It is important that small relief holes be punched in air pockets that form in the tubing. Air pockets restrict the water flow through the tubing and can become a hot spot where the tubing may stretch, become thin, and possibly rupture.

Air pocket in tubing

Calculating the Irrigation Plan

To use multiple inlet irrigation, a grower must know the field acreage, the pumping capacity in gallons per minute, and the approximate acres in each levee. While estimates may be used to determine basic layout, more accurate information makes the system easier to set up. Setting up MI irrigation in a field requires time and labor early in the production season. However, the labor for the rest of the season is typically about 30 percent less than that required with conventional flood. [3]



Blue gate photo

To set up MI irrigation, divide the pumping capacity by the field acreage to get a ratio in gallons per minute per acre (gpm/ac). Then multiply this ratio by each levee's acreage to get the gpm needed in each levee so the water is proportioned evenly across the entire field.

Example: An 80-acre field has 7 levee areas and a well that pumps 2,000 gpm. Dividing 2,000 gpm by 80 acres gives a ratio of 25 gpm/ac. The first four levees areas are about 13 acres each, and the last three are approximately 10 acres each. Therefore, each of the first four levees needs 325gpm (13ac x 25gpm/ac) and each of the next three need 250 gpm (10ac x 25 gpm/ac). The 2.5-inch adjustable slide gates deliver about 75 gpm when fully open. A possibility for the first four levees is to punch four gate holes in the tubing to get 300 gpm (4 gates x 75 gpm/gate) and then install one gate to regulate the remaining 25 gpm that is needed. Each of the last three levees could have three gate holes punched for 225 gpm (3 gates x 75 gpm/gate) and one gate installed to adjust for the remaining 25 gpm. Growers who have a lot of experience with punching the smaller holes for row watering may be able to determine the size and number of holes to punch for each levee and plug holes if the flow needs to be reduced.

Regulating flood depth is typically easier with multiple inlet irrigation but water may still flow through some of the levee spills. It should be possible to set levee spills 1- to 2-inches higher than the desired flood depth leaving room for rain to be captured on the field rather than being lost as runoff. MI irrigation can also reduce the risks of levees washing out from overpumping the top levees and/or getting a rain when the field already has a deep flood. If needed, extra water can be added directly to any levee area out in the field without having to flow through the levees above it as would be necessary with conventional flood irrigation. This is helpful when some levee areas are sandier or if the levee leakage or seepage is increased due to muskrat holes or other reasons. If a field has to be drained for straighthead control, MI irrigation could be helpful in reestablishing the flood quicker than with a conventional flood system.

Multiple Inlet Irrigation Advantages

Growers using multiple inlet irrigation report there are other water management advantages that it provides:

- Getting and keeping water on the bottom of certain fields.
- Sharing of water with other irrigated crops
- Maintaining shallower flood early to avoid stretching of rice
- Faster recovery from well shutdowns or delays in starting pumping
- Reduces problems associated with scum and algae buildup at levee spills
- Better able to manage the irrigation water on fields with steep slopes

Growers and/or the irrigation water managers initially question the effectiveness of MI irrigation for rice because it is so different than what they have always done. However, almost all who try multiple inlet irrigation end up using it on some if not most of their rice fields. MI irrigation alone will not totally address the long-term concern over declining groundwater resources. Efforts to develop surface water sources and other irrigation methods that can conserve groundwater will need to be continued. However, MI irrigation is a practice that many growers can implement now to help address the situation on their farm while other long-term solutions are being developed.

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[1] Pennington, Dr. Dean, Executive Director, YMD Water Management District, Stoneville, MS. 2003. Oral communication.

[2] Arkansas Groundwater Protection and Management Report For 2003. Arkansas Soil And Water Conservation Commission.

[3] Vories, Earl D. and Phil L. Tacker. 2003. ASAE Annual Internal Meeting. Investigating A Multiple Inlet Approach To Reduce Water Requirements For Rice Production – Paper Number 032014. University of Arkansas.

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