Will it Wash?

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Will It Wash?

Low pressure sprinklers increase runoff. The cure is to change tillage.

by Darrell DeBoer, professor of agricultural engineering, Dwayne Beck, manager, Dakota Lakes Research Farm, and Hal Werner, Extension irrigation specialist

Surface runoff from irrigation is a waste of water and money, and it causes soil erosion.

There go the energy and the dollars you spent to irrigate. There, too, goes the yield increase you expected, because the irrigation event stored less water in the soil for the plants to use.

And runoff can cause other problems. Low spots or depressions where the runoff collects can cause traction problems for the center pivot, a decrease in net system capability, down time, and a certain number of frayed nerves for the operator, to say nothing of the muddy floors, the extra wash, and the tensions in the rest of the family.

The threat of surface runoff is higher with low pressure sprinklers. So what do you gain by switching to low pressure technology? Do you have to balance the operational cost savings from reduced energy requirements and changes associated with pumping water against the losses from runoff?

That's one way to look at it. There is an alternative. You can bring runoff down to safe levels by changing your tillage practices.

Reduced-pressure sprinklers have larger application rates than conventional sprinklers, which intensifies any surface runoff problems.

Ag Experiment Station staff ran a 5-year field study in north-central South Dakota west of Gettysburg to evaluate the impact of tillage practices on surface runoff under reduced pressure sprinkler irrigation. The management practices used were those of an operator aiming for high corn production, keeping soil water at a high level. That's one precondition for maximum surface runoff.

The soil was a Lowry silt loam, which has a tendency to crust during the irrigation season. Slopes averaged 4%, another factor that would give high runoff if the application rate exceeded the infiltration rate of the soil. Many irrigated fields have smaller slopes.

Sprinkler operating pressure has a significant effect on water application rates (Fig. 1). The low pressure sprinkler (15 psi) had the highest application rate of 3.4 in/hr while the 25 and 50 psi sprinklers had average application rates of 2.6 and 1.6 in/hr.

As expected, surface runoff increased with a decrease in sprinkler operating pressure (Fig. 2). The average runoff for the 15-psi sprinkler was 13% in 1984, while the runoffs were 8 and 5% for the 25- and 50-psi sprinklers.

The 13% value really means that 1.8 inches of water ran down the slope when the irrigation machine delivered 14 inches of water to the crop. Thus, only 12.2 inches of water infiltrated the soil.

Surface runoff can occur under all kinds of sprinkler irrigated conditions. If it is a problem under high pressure, then it surely will be a problem under low pressure conditions without a change in management practices.

Tillage practices also had an impact on surface runoff. Plow, disk, and ridge plant were the three primary tillage methods used in the field study. The disk produced the least amount of runoff (15%), while the plow and ridge plant practices produced similar values of 21 and 23%.

A secondary tillage practice called inter-row tillage (IRT) consisted of subsoiling to a depth of 12 inches between each corn row when the corn was in the eight-leaf stage of development.

Figure 1. Relationship between average application rate and sprinkler pressure.

- 3.4 inches / hr
- 2.6 inches / hr
- 1.6 inches / hr

<table>
<thead>
<tr>
<th>Pressure (psi)</th>
<th>15 psi</th>
<th>25 psi</th>
<th>50 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Runoff</td>
<td>13%</td>
<td>8%</td>
<td>5%</td>
</tr>
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Figure 2. Percent change in surface runoff for three sprinklers.
IRT had a major impact on surface runoff (Fig 3) reducing it by half for the plow practice and by two thirds for the disk and ridge plant methods.

Thus, you can use primary and secondary tillage practices to manage surface runoff under reduced pressure conditions.

The interrelationship between sprinkler and tillage can be illustrated with a hypothetical situation. Assume that an irrigator is using a high pressure sprinkler (50 psi) and plows as his primary tillage practice. He is considering reduced pressure (15 psi) technology.

We can assume the surface runoff factor for the high pressure/plow practice is 1.0. Conversion of his center pivot to a 15-psi operational pressure can produce a runoff factor of 2.0 (Fig. 4), which means he can expect to double his runoff problems.

Incorporating IRT into his management scheme can reduce the runoff factor to 1.0 again. Changing his primary tillage to a ridge plant or a ridge-type practice and using the IRT should reduce the runoff factor to 0.67.

Consequently, tillage practices can minimize the adverse effects of reduced pressure sprinklers with irrigation.

Each irrigator will have to consider his own set of management practices in compensating for potential surface runoff problems in his fields.

Stay with your current management practices if you can justify them through a long-term economic analysis, considering not just this year’s yields and input costs but also any potential soil erosion.

Tillage practices that can save one or more inches of runoff water should be seriously considered for incorporation into your management program. A tillage operation often costs less than one inch of irrigation water.