Fertigation

Fertilizer can be injected into the irrigation water during surge irrigation and thereby applied quickly and efficiently over the field. In this process, called fertigation, fertilizer is injected in front of the surge valve, flows along the furrow, and passes into the soil along with the infiltrating water. This method of applying fertilizer has both advantages and disadvantages compared to other fertilizing techniques.

Some of the advantages are:

- less potential for fertilizer to be lost to deep percolation
- lower cost
- the capacity to apply fertilizer at the time the crop needs it.

Disadvantages include:

- fertilizer present in surface runoff
- potential corrosion or pitting of aluminum gated pipe and surge valve
- the need to calibrate injection equipment

Timing

Applying fertilizer efficiently means applying it so that it is distributed evenly along the furrow and throughout the root zone. In surge irrigation, this requires timing the injection to the operation of the surge system. *Figures 1* through *4*, which were developed from studies conducted in Nebraska, show the effect of the injection period timing on the distribution of fertilizer in the soil profile.

Figure 1 shows the fertilizer distribution pattern (shaded area) resulting from an injection period continuing through the entire irrigation. Here fertilizer extends throughout the soil profile, but in a very non-uniform pattern, with more fertilizer applied along the upper part of the field than along the lower part. This uneven pattern can result in fertilizer percolating down beyond the root zone, while injecting during the entire irrigation can also cause fertilizer to be present in the surface runoff, requiring a tailwater recovery system to be put in place to prevent surface water contamination.

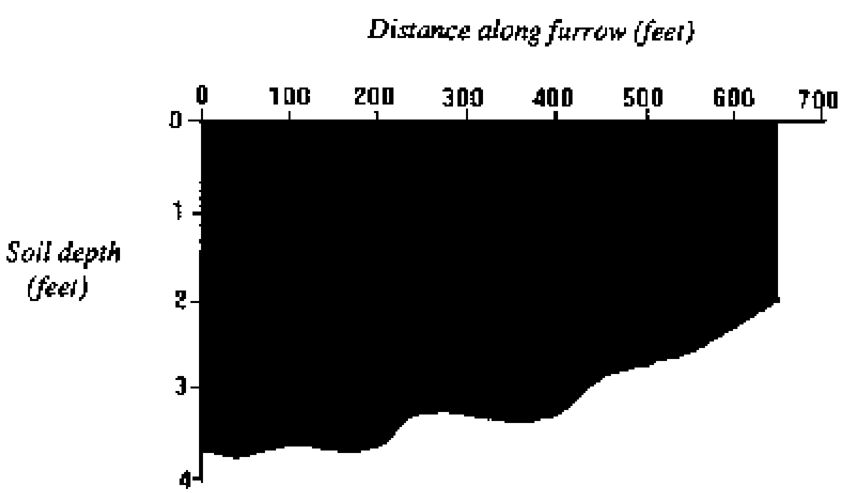

Figure 1. Fertilizer pattern resulting from injecting during entire irrigation.

Figure 2 illustrates the fertilizer distribution pattern resulting from an injection period timed to coincide with the water advance period - the time required for water to advance to the end of the field. Here injection was stopped when surface runoff began. In this test, the fertilizer was again distributed unevenly, with more fertilizer infiltrating along the upper part of the field than along the lower part. Because the fertilizer was applied only during the water advance period, water infiltrating during the latter part of the irrigation (the runoff period), moved the fertilizer deep into the soil profile, leaving little fertilizer available to the plant if most was leached down below the roots. As a consequence, though, not much fertilizer would be present in surface runoff.

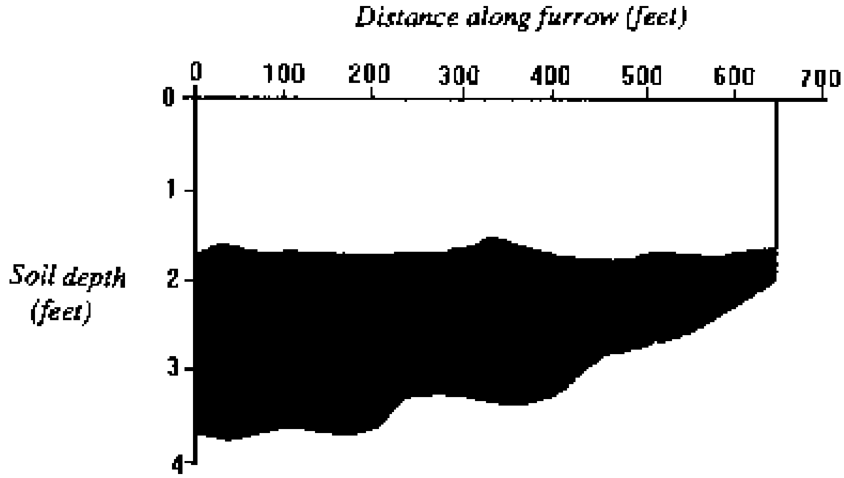

Figure 2. Fertilizer pattern resulting from injecting during the entire water advance period.

Figure 3 shows the pattern resulting when fertilizer is applied during the first part of the surface-runoff period. Here the distribution pattern is more uniform, but water infiltrating during the latter part of the runoff period leaches the fertilizer out of the upper part of the soil profile. The runoff water also contains fertilizer, making a tailwater recovery system necessary to prevent surface water contamination.

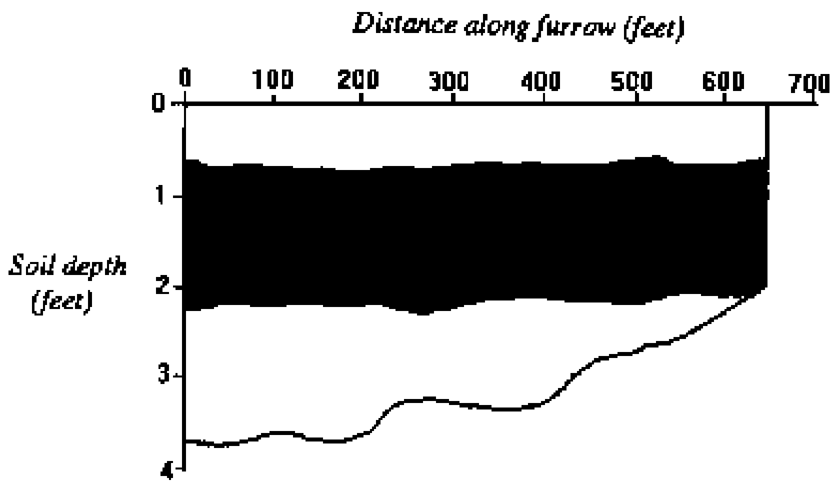

Figure 3. Fertilizer pattern resulting from applying fertilizer during the first part of the surface runoff period.

Figure 4 shows the fertilizer distribution pattern resulting from applying fertilizer during the latter part of the runoff period. Here the distribution is even, with fertilizer contained in the upper part of the soil profile, thereby minimizing any loss to-deep percolation. Fertilizer will be present in the surface runoff.

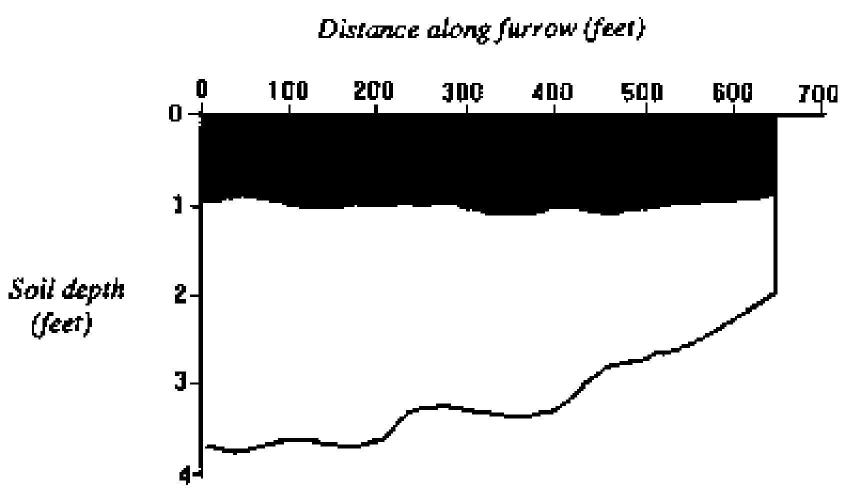

Figure 4. Fertilizer pattern resulting from applying fertilizer during the latter part of the surface runoff period.

Colorado growers are advised to add fertilizer during the next-to-last cycle in the runoff period -- as long as that leaves enough time for the fertilizer to infiltrate -- and to reserve the last cycle for flushing the solution out of the system and for moving the fertilizer down into the soil. For fertilizers like phosphorous that do not move readily in the soil, injection should start at the beginning of the surface runoff period.

Pressure and Injection Rate

The injection method must provide enough pressure to inject the fertilizer at the desired rate, which will depend on the irrigation flowrate and on the concentration needed to inject the fertilizer during the on-time of the runoff cycle. The pressure will be low, since surging is a low-head irrigation method. The injection rate can be calculated from the following equation:

$$\text{Injection rate} = \frac{(NA \times A)}{(2 \times NS \times ON)}$$

Where injection rate = gallons per minutes
NA = pounds of nitrogen needed per acre
A = acres irrigated per set under surge irrigation
NS = pounds of nitrogen per gallon of fertilizer solution
ON = on-time of runoff cycle (minutes)

Example: Calculate the injection rate needed to apply 30 pounds of nitrogen per acre. The on- time is 25 minutes and 4 acres are irrigated per set. The fertilizer solution is 32-0-0, which contains 3.54 pounds of N per gallon of solution.

$$\text{Injection rate} = \frac{(30 \times 4)}{(2 \times 3.54 \times 25)} = 0.68 \text{ gpm}$$

References

Boldt, A.L., D.G. Watts, D.E. Eisenhauer, and J.S. Schepers. 1992. *Simulation of water applied fertilizer distributions under surge irrigation.* American Society of Agricultural Engineers Paper 92-2518.

Champion, D., and R.C. Bartholomay. 1992. *Fertigation through surge irrigation.* Colorado State University Service in Action Leaflet No. 508.

Ostermeier, K.A., D.G. Watts, A.L. Boldt, and D.E. Eisenhauer. 1992. *Verification of fertigation model for surge irrigation.* American Society of Agricultural Engineers Paper 92-2519.

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