



# SOIL

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## Fertigation

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### Quick Facts...

The most common nutrient applied by fertigation is nitrogen. Other nutrients include phosphorus, potassium, sulfur, zinc and iron.

Anhydrous ammonia is not recommended for sprinkler systems.

Applications of phosphorus in irrigation water are subject to precipitation problems.

Design a tailwater recovery system for each irrigation system to recycle water and prevent downstream pollution.

The application of nutrients through irrigation systems is called “fertigation,” a contraction of fertilization and irrigation. The most common nutrient applied by fertigation is nitrogen. Elements applied less often include phosphorus, potassium, sulfur, zinc and iron.

This technique can reduce fertilizer application costs by eliminating an operation. It may also improve nutrient efficiency by applying them closer to when the plant needs them. Also, it could conceivably reduce leaching or denitrification (gaseous) losses of nitrogen and lower the luxury uptake of nutrients by plants.

A rule of thumb is that nutrients that are not absorbed by the soil (anion forms) and that move with soil water are best for sprinkler application. This may limit the list to nitrogen, sulfur and some of the chelated micronutrients (ZnEDTA, FeEDDHA, CuDTPA). Phosphorus, potassium and inorganic forms of micronutrient cations may be soluble in water. However, because of immobilization in the soil, they may accumulate in the top 1 to 2 inches of the soil surface and not be distributed throughout the root zone.

### Applying Ammonia in Water

Anhydrous ammonia can be distributed in irrigation water, but it is not recommended for sprinkler systems. Most irrigation water in Colorado contains considerable amounts of calcium and magnesium salt. When anhydrous ammonia is injected into water, the pH of the water is raised. This causes precipitation of calcium and magnesium carbonates, which are the white, solid deposits that form on ditch banks and inside siphon tubes and gated pipe. This precipitation can be prevented by injecting into the water, ahead of the anhydrous ammonia, an inhibitor (water softener) called sodium polyphosphate that can be purchased under the trade name of “Calgon.” Suggested rates of  $\text{NH}_3$  application and amounts of inhibitor required are shown in Table 1.

Ammonia injection into ditch or siphon tube irrigation systems is somewhat less troublesome. However, siphon tubes can become encrusted with the precipitated calcium salts and are not easily cleaned. If precipitation occurs in the irrigation ditch, no particular problems are encountered.

Another major problem in applying anhydrous ammonia or free ammonia-containing solutions through sprinkler systems is the fact that volatilization losses of ammonia occur from the time that the ammonia-water mixture leaves the sprinkler until the ammonia reaches the soil surface. Admittedly, some of the nitrogen is present as ammonium ions but much more is in the ammonia gas form. Subsequently, as water vaporizes, ammonia also is lost to the atmosphere.

**Table 1: Suggested anhydrous ammonia in inhibitor rates.**

Irrigation water hardness		Maximum ammonia app./1,000 gpm water	Inhibitor required per 1,000 gpm water
ppm	grains/gal	lbs/hr	lbs/hr
35-120	2-7	37	0.25
120-170	7-10	37	0.38
170-425	10-25	37	0.63
425-850	25-50	28	0.75

Source: H. R. Mulliner, *Applying Anhydrous Ammonia in Irrigation Water*. University of Nebraska NebGuide G 74-129, 174.

**Table 2: Amount of various nitrogen fertilizers required to give 20, 30 and 40 lbs of nitrogen per acre.**

Kind of fertilizer solutions	N %	Rate of N per acre, lb			
		Wt/gal lb	20 gal/A	30 gal/A	40 gal/A
Urea-ammonium nitrate	28	10.65	6.7	10.0	13.4
Urea-ammonium nitrate	32	11.06	5.7	8.6	11.4

## Applications of Nitrogen Solutions in Water

In irrigated agriculture, water applications of nonpressure urea-ammonium nitrate (UAN) solutions have become increasingly popular as a way to improve nitrogen efficiency. The nitrogen sources will not cause salts to precipitate out of the irrigation water. Losses due to leaching are minimized by split or multiple nitrogen applications as compared to applications prior to seeding, particularly on sandy soils. The amount of nitrogen fertilizer required to give 20, 30 and 40 pounds of nitrogen per acre is given in Table 2.

## Phosphorus Application

Injection of phosphorus fertilizers into irrigation water is less common than injection of nitrogen. It is not recommended on most crops. Problems related to application of phosphorus in irrigation water are at least threefold:

1. Precipitation may be encountered when ammonium polyphosphate-containing liquids are injected into high calcium and magnesium water.
2. Phosphorus must be applied early in the growing cycle for most crops, particularly if there is a definite phosphorus need, in order to prevent any early season reduction of yield potentials.
3. Phosphorus applied through irrigation water will remain on or near the soil surface if not incorporated by a tillage operation.

The latter problem may be insignificant in the irrigation of established crops such as alfalfa and grasses.

## Potassium and Sulfur Application

Application of potassium usually has involved small treatments in each of several irrigations (10 lb/A K). Usually, a nitrogen-potassium solution has been used as the potassium source. Farmers and fertilizer dealers believe that this process may improve plant absorption of potassium and result in higher yields where soil solution potassium is low due to low exchangeable potassium, leaching or heavy plant use.

Sulfur applications are more common than applications of potassium. Injection of sulfur is easy and usually involves the use of ammonium thiosulfate (12% N, 26% S) or solutions of ammonium sulfate. These sulfur carriers already contain nitrogen but can be easily blended with nitrogen solutions. Interest in this technique has been intense in sulfur-deficient areas where sandy soils are common and where soil organic matter levels are low. Generally, potassium and sulfur should encounter no detrimental reactions in the water even if the water is quite high in soluble calcium or magnesium.

## Fertilizer Meter-Injectors

There are many commercial meter-injectors on the market for injecting fertilizer solutions into sprinkler, gated pipe or siphon tube irrigation systems. Tests conducted at the University of Nebraska indicate that an ordinary tap into the irrigation piping system is all that is required to get uniform mixing of the fertilizer solution with the irrigation. To be sure of uniform mixing, inject the fertilizer solution into the system just ahead of an elbow or tee in the irrigation line. Turbulence in the water created by the pipe fittings ensures uniform mixing.

Safety devices should be an integral part of the entire injection system. Devices to automatically cut off flow into the main water discharge line, as well

as to prevent back flow of chemicals or fertilizer materials into the irrigation water source, are essential.

A float box that gives a uniform flow of the fertilizer solution into the irrigation water is all that is needed for siphon tube irrigation. A good place to meter the fertilizer solution into the irrigation system is at the pump site. Usually there is a stilling basin or a structure to dissipate the energy created by the water as it comes out of the pump discharge pipe. The fertilizer can be metered into the irrigation water at this point for adequate mixing of fertilizer and irrigation water.

## Tailwater Management

Design a tailwater recovery system for each individual irrigation system. Collect tailwater from the ends of the irrigated fields and transport it to a recovery pit. The reuse of tailwater can increase the irrigation water supply by the amount of water recovered and prevent downstream pollution. With an ever-increasing emphasis on the environment, it is important to capture tailwater and prevent agriculture from being the cause of pollution of soluble fertilizers to downstream rivers, lakes and reservoirs.

## For More Information

See fact sheet 4.713, *Applying Pesticides With Center-Pivot Irrigation*.

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