Using Fluid Fertilizers In Drip Irrigation

Timing of fertigation injections may range from daily to weekly to monthly, depending on crop.

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Summary: Grape production areas of CA and other western states are grown almost exclusively on drip or micro sprinklers. Water is the greatest limiting factor and allows exceptionally high efficiency rates of water, but also creates the value-added opportunities for using high- quality fluid fertilizers within these systems.

Western agriculture depends on water for all aspects of production agriculture as it relates to plant development. Without water and its efficient delivery systems, all else pales in comparison. As crop production expands into other marginal areas of the world, irrigation will need to follow. As climates become less predictable, there will continue to be a reliance on water and concerns with the quantity and quality of that resource. Factor that with an ever-increasing population (plus the dietary changes within those populations) will be a major concern for advancing water delivery systems and making the most out of an already limited resource--water. It is easy to understand how advancing drip irrigation into areas where it has not been used before is becoming an everyday reality and concern.

Limited water

California (CA) and other parts of the west rely so heavily on irrigation water to bring (CA) an estimated 6 million acres into production. This past year that amount of land has been decreased to less than 600,000 acres. It is all related to the shortness of irrigation. With the limited supply of water there also comes a price for water delivery and the extreme need to improve efficiency. The majority of acres in (CA) and the West still remain surface irrigated with water-use-efficiency ranging from 40 to 60 percent. To expand the limited supply of water and still remain economically viable, drip irrigation is being expanded at a rapid rate. It has always been a part of a management strategy for certain high-value crops like berries, vegetables, and tree crops, but with the advent of drip irrigation, and especially subsurface drip irrigation (SDI), even row crops of cotton, corn, sorghum, and alfalfa are becoming more common.

Advantages

Subsurface drip irrigation has several advantages that would include both the obvious observation of increased water efficiency, but also additional attributes of increased yields, improved crop quality, and less disease. The latter advantage would also relate to less crop protectants being needed. As a better understanding of drip takes place, marginal water can be more fully used to grow a crop. However, caution needs to be taken when using water with high osmotic potential (salts) to assure that enough leaching would take place to avoid salt damage from high concentrations of those salts on the wetting boundaries to the system. The authors would recommend studying papers specifically related to the advantages and disadvantages of drip in articles like "Subsurface Drip Irrigation in California Here to Stay?" (J.E. Ayars, A. Fulton, and B. Taylor).

Disadvantages

It should also be pointed out that there are also disadvantages to drip that also need to be considered:

- One factor is certainly that within

a watershed there is only so much water to be had. If a grower uses water more efficiently on one part of his farm, there is a tendency to use any extra water in another location. This makes sense, but the result ends up with no extra water leaving the watershed.

- The other challenge, especially with drip irrigation, is maintenance. What cannot be seen may not be readily fixed and, therefore, excellent monitoring of a system is also essential.

Managing

Fertilizer management through these drip systems is an expanding interest and deserves to be explored. If greater water efficiency can be obtained with drip, then it would be reasonable to assume that fertilizer efficiencies can also be achieved, but this is only true as long as a grower understands both the crop requirements of nutrients based on yield and quality estimations. This can be done, but not on a casual basis or relying on norms that might have been the standards of performance in the past.

Knowledgeable

Understanding of drip fertility requirements will always begin with a detailed understanding of soil nutrient background status as a base level for anything being applied through the drip system. Without this understanding, high potential for waste and economic challenges can easily occur. Local laboratories that are reputable and participate in a certification program are highly recommended.

NPK

Nitrogen, phosphorus and potassium (NPK) are major nutrients that need to be addressed and can be used through drip irrigation. However, it is wise to balance dry fertilizer programs with the use of fluid fertilizers (or dry soluble fertilizers) being applied through the drip system.

Nitrogen availability through a growing system can be a challenge with both mineral forms of ammonium and nitrate, as well as that of N, being released from the organic matter being accounted for. Organic N can be released anywhere from .5 to 2.0 pounds/A/day.

Adjustments will also need to be based on cropping system and residual stover as well as soil texture. For example, sandy coarse- textured soils may need an additional 20 to 30 lbs. more N compared to finer-textured soils growing the same crop. Western agricultural crops generally will follow biomass production, with peaks of nutrient use usually associated with crop development. Potatoes, for example, will have a peak above ground concentrations but these higher levels of nutrients will always be translocated from the above-ground biomass into the tubers. Onions will follow a similar pattern.

Nitrogen and K are the most easily injected and are also required at the highest level for all cropping systems. Nutrient applications through the drip system are an efficient way to incorporate these nutrients to meet crop requirements. There is a greater potential to address specific crop needs of both N and K with minimum leaching or environmental losses of N.

Other forms

Improvements in manufacturing of N have created clean, very soluble, and reliable N solution products. All of the dry N formulations can easily be solubilized and put through drip. The most common source of fluid fertilizer is urea ammonium nitrate (UAN). However, potassium nitrate, calcium ammonium nitrate, or calcium nitrate are all suitable and acceptable forms being currently applied with drip. Potassium dry forms may have impurities in them that can contribute to plugging emitters. Potassium chloride is soluble and lends itself to fertigation, but does have a high salt index. Dry soluble or fluid forms of K are excellent forms of K to apply through the drip lines. These include potassium nitrate or potassium thio-sulfate (KTS) and will provide other essential nutrients as well as the K.

Managing P

Phosphorus fluids are the most difficult, but not impossible to manage. Much of the P should be applied at planting for row crops or vegetables prior to forming beds. However, much of the seasonal use of P can be applied through the drip lines by controlling or solubilizing the bi-carbonates, which is measured by lowering water pH to between 5 and 6.5. This can be done by injecting an acid (sulfuric, N phuric, or phosphoric) prior to P injection. Measurements of pH become essential to avoid insoluble precipitates that will form primarily from Ca. Once the pH is controlled and monitored, P solutions can be injected successfully. Large commercial scale drip farms with permanent crops are especially interested in fluid P use and quite often will use phosphoric acid. The challenge with over-use is in creating a large, available concentration of P within the drip beds. The authors have observed P soil test levels well over 100 ppm where P acid only has been applied. It would make much more sense to use N–Phuric or be skilled enough to use sulfuric acid to lower water pH.

Four fundamentals

To make the most efficient application of fluid fertilizers, crop advisors and growers should consider four fundamental factors:

- Nutrient requirements of the crop
- Specific soil and environmental site considerations
- Timing of nutrients being injected to meet yield and quality demands
- Water controls within the drip irrigation system to avoid leaching of soluble nutrients below the root zone.

The latter is especially concerning as it relates to both environmental stewardship and grower economic returns. Leaching losses of N are of the greatest concern as they carry with them the added negative challenge of potentially building up high levels of nitrates in groundwater. There are no environmental or health challenges associated with K losses, but certainly economic ones. With the increased concern of dissolved soluble P and losses from land, crop advisors and growers need to be especially mindful of both increasing high P levels within the field, as well as the drip zone.

Timing

Timing of fertigation injections may be variable and range from daily to weekly to monthly, depending on the targeted crop. Both fertilizers (N and K) are rather straight forward and injected fairly easily with calculations of nutrients often based on the rate per area needed, amount of water being delivered over a period of time, and an injection system developed to deliver those specific quantities.

Other options

Zn and other micronutrients can also be applied through an acidified water delivery system. It appears that the most effective source of Zn is an EDTA (chelated form of micronutrients). This source can be added to both APP and ortho-based P sources like 3-18-18 or other low-salt fluid fertilizers with limited problems. Other micro-nutrient sources can also be applied, but doing a self-test would be advisable.

Working together

The Fluid Fertilizer Foundation (FFF) continues to support directed research with fluid fertilizer management strategies on drip irrigation. It is currently supporting Dr. Fred Below from the University of Illinois and has supported studies in California, Kansas, and other states. It is imperative that the fluid fertilizer industry directs programs that promote nutrient use and water use efficiency. This works hand-in-hand with the larger priorities of the 4R Nutrient Stewardship program. With drip as a delivery mechanism for water and nutrients both of these critical programs can be addressed.

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