## FERTILIZATION

Conventional methods of applying fertilizers to orchards, such as broadcasting, surface banding or drilling in liquid or dry materials, cannot be used in a drip irrigated orchard. The reason is simple; the soil area being continually wetted by the emitters is only a fraction of the total soil mass and consequently much of the trees' roots activities are confined to this restricted area. As a result of this situation, it follows that fertilizers must be applied through the drip system. While this means a departure from the more conventional methods of applying fertilizers, it results in a number of advantages. First, fertilizers and particularly nitrogen are being applied during the growing season when they are best utilized. This results in improved efficiency which reduces the amount of fertilizer needed and additionally reduces the labor and energy inputs into the orchard operations.

Unfortunately, our information about fertilizing through the drip system is still limited. We don't have all the facts we need on how frequently to apply fertilizers, the proper rate, the best timing or what nutrient levels in the leaves are adequate throughout the growing season so we can continually monitor the trees' nutritional requirements. Consequently, some of our recommendations are based on experience and observation and should be considered as such.

As research continues, our recommendations on fertilizing will improve. The following discussions will be helpful, but the orchardist must realize he or she needs to stay continually alert to the health of the orchard. A drip system can get a person into trouble quickly.

*Sources of Fertilizer Materials.* Following are many of the typical materials and the solubilities which can be applied through drip systems.

| MATERIAL | APPROXIMATE PARTS SOLUBLE IN 100 PARTS COLD WATER* |
|---|---|
| Ammonium nitrate | 118 |
| Ammonium sulfate | 71 |
| Calcium nitrate | 134 |
| Urea | 78 |
| UN-32 | Already a liquid |
| Potassium nitrate | 13 |
| Potassium sulfate | 7 |
| Micronutrient chelates | Highly soluble |

*1 gal. water weighs 8.3 lbs.

All the above materials can normally be applied through a drip system without precipating out in the lines and emitters and causing a clogging problem and under most situations, can be mixed together. It is possible under some situations that the increased nutrients in the water may enhance the growth of slime. Should this happen, then an algicide must be used.

Some fertilizers such as urea are coated with an inert material to prevent caking. This material may cause clogging. Avoid this problem by using fertilizers without these coatings unless they can be removed by filtration.

Missing from the list of fertilizers which can be applied through the system are the phosphorus compounds. The

reason is many of the phosphorus fertilizers can react with calcium and/or magnesium of the irrigation water, and should the water contain them at a high enough concentration, they will precipitate out as insoluble calcium and magnesium phosphates and clog the emitters. Fortunately, very few orchards require a phosphorus fertilization.

*Equipment for Applying Fertilizers.* There are many types of equipment for applying fertilizers through drip systems. Essentially there are three types of equipment. The first is a pressure differential or venturi system. Fertilizers are placed in an air tight pressure supply tank. The principle which causes this device to operate is that the difference in pressure between a connection above and one below the connection causes water to flow through the sealed supply tank. An advantage of this system is no power source is required.

A second type of equipment is one using an open supply tank with an electrically powered metering pump.

These systems are quite accurate and probably are easier to recharge with fertilizer materials than the sealed units. Both the pressure differential or venturi system and the metering pump are best suited for the continual injection of fertilizers over a long period of time. Usually the irrigation water contains less than 200 ppm fertilizer materials.

The third type of equipment is a gasoline powered pump for injecting a nitrogen solution for a brief period of time. Many fertilizer companies supply equipment for pumping their liquid nitrogen materials into the water lines. This is very common for injecting into a sprinkler system, but if it is handled this way for a drip system, then the high concentration of nitrogen fertilizer in the irrigation water can severely damage the trees. Care must be taken to keep the level of nitrogen low. As a general rule, the maximum concentration of nitrogen should not exceed 1000 parts per million of one days water application for a single or infrequent application.

Here is how to determine if the level of fertilizer nitrogen exceeds 1000 ppm. Figure out the total amount of water applied to the tree for the day the fertilizer is applied. As an example, there are 2 emitters per tree, each applying one gallon per hour and the system operates daily for 8 hours. This means 16 gallons of water is applied daily. Water weighs 8.3 lbs., per gallon, so 8.3 times 16 is 133 lbs. of water. Then divide 133 pounds by 1000 ppm and the answer is .133 lbs. (or 2.13 ounces). No single infrequent application should exceed .133 lbs. of nitrogen per tree. Then by multiplying .133 by the total number of trees, the orchardist knows the maximum amount of nitrogen he can apply to the orchard.

This last method of applying fertilizer should be confined to the young developing orchard when nitrogen amounts per tree are small.

Sometimes it's possible to actually place, by hand, the fertilizer on the emitter or dig a small hole under the emitter and place the fertilizer in the hole. Under some circumstances, a liquid fertilizer may be dripped into the irrigation water ahead of the pump.

*Timing and Rates of Fertilizer Application.* All fertilizer materials are applied sometime during the growing season when the drip system is in use.

But, the question remains concerning how frequently to apply nutrients and how much at any particular stage of growth. These answers are not available in any precise form. Even if they were, they would vary from orchard to orchard. Consequently, only a rough set of guidelines can be outlined and these are subject to debate. It's best to discuss these on a nutrient basis.

SUGGESTED RATES OF NITROGEN MATERIALS PER TREE PER YEAR

| TREE AGE YEARS | N (PURE) (oz.) | UREA 45% (oz.) | AM. NITRATE 33% (oz.) | UN-32 (3.5 lb. N/gal.) |
|---|---|---|---|---|
| 1 | .5 | 1.1 | 1.5 | .009 gal. |
| 2 | 1.0 | 2.2 | 3.0 | .018 gal. |
| 3 | 2.0 | 4.4 | 6.1 | .036 gal. |
| 4 | 4.0 | 8.8 | 12.1 | .071 gal. |
| 5 | 8.0 | 17.8 | 24.2 | .143 gal. |

A young orchard actually has a low nitrogen requirement in relation to the amount needed by a mature orchard. Probably the nitrogen can adequately be applied on a monthly or bimonthly basis for the first four or five years of age. The above chart lists some of the nitrogen materials and the yearly requirements.

Assume the orchard is two years old. The grower wants to use urea for his nitrogen source. The chart indicates that 2.2 ounces of urea is all that is required the second year to supply 1 ounce of actual nitrogen. If he wants to apply it on a monthly basis, then for 8 months of irrigation he should put on one-eighth of the 2.2 ounces of urea each time.

Because of irrigation design, or wetting pattern of the emitters or other factors, the trees may not be adequately supplied with nitrogen. Visual observations for determining good leaf color and July leaf analysis can help to determine if the nitrogen requirements are being met. There is a lack of information on what the leaf nitrogen levels should be at different times of the year for precise determinations. Usually nitrogen levels start out high then decline in mid-summer and increase again the later part of the growing season. An orchardist would be well advised to run total nitrogen leaf analysis every two weeks. He would then be able to develop a nitrogen curve for his orchard.

Mature orchards probably should have nitrogen applied on a frequent basis. This could mean applying nitrogen over a weeks period once every two or three weeks. It could also mean applying nitrogen on a continual basis. The amount of nitrogen to apply could vary from one to three pounds per year, depending on a large number of factors, such as producing capacity, tree species, tree size, and soil type.

As stated earlier, no large amounts of fertilizer, particularly nitrogen, should be supplied in a single dose, since the trees could be damaged. As a rough rule, the concentration of nitrogen should not exceed 1000 ppm of the irrigation water applied during the day of the nitrogen injection.

The orchardist should change the form of nitrogen fertilizer he is using occasionally, since the continued use of any form can build up an acid condition in the soil.

POTASSIUM. Some orchards have a high potassium requirement, such as prunes. Since a drip system usually wets only a portion of the soil volume, the roots are restricted to a limited area to explore for nutrients. As a consequence, a potassium deficiency may more likely occur under drip irrigation than under more conventional irrigation practices.

Usually to correct a potassium deficiency 10 to 20 pounds per tree of potassium sulfate are drilled in. This is a massive treatment, but if effective, can last for a number of years.

Potassium is strongly absorbed on the soil so normal movement of potassium through the soil is greatly limited, perhaps only an inch or two.

Overcoming a potassium deficiency with a drip system can be successful. Potassium can be moved several feet into the soil

using a drip system, because a high concentration is applied to a very small area. As a result, the soil is saturated with potassium near the application site and the subsequent potassium moves by mass flow deeper into the root zone.

Potassium should be applied on a fairly continual basis throughout the growing season or surface applied under the emitters.

Limited research has demonstrated that a concentration of 190 ppm for a total of 5 pounds per tree can correct a potassium deficiency. Whether or not it needs to be applied yearly has not been determined.

MICRONUTRIENTS. If micronutrients, such as zinc or iron are needed, then these could be applied in the chelate form. Chelates are very soluble and can easily be applied through the drip system. If other inorganic salts of micronutrients are used, then these may react with other salts in the irrigation water and result in clogging.

## WEED CONTROL

A serious problem very common with drip systems is weed control. Many of the herbicides applied around the emitters break down rapidly because of a continually wet situation. As a result, weeds can take over quickly and cause problems, particularly in orchards where the crop is knocked to the ground to be picked up by harvesting equipment. Since fertilizers are applied through the dip system, this encourages abundant weed growth and also supplies the micro-organisms with an ideal environment to break down the herbicides. So far, we have not developed the expertise we need on applying herbicides through the drip system.

Right from the beginning, the grower must get the jump on the weeds. He should use an integrated program which involves prevention, hoeing, selective and contact weed control materials.

When the orchard is planted and a drip system is used for irrigation, tree wrappers should be used instead of painting the trunks with a white paint or whitewash. The tree rows then can be sprayed out with weed oil or fortified diesel oil without injuring the trees. Paraquat can also be used, but care should be taken since certain weeds are not successfully controlled by this material.

Certain soil applied residual materials can be applied down the tree rows depending on tree specie and age. Again a few annual weed specie may survive. These should be controlled by hoeing or with a contact material.

No specific weed control program can be described in this publication. Work closely with your farm advisor and pest control advisor and keep ahead of the weeds.

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