

TIMELY INFORMATION

Agriculture & Natural Resources

High Tunnel Irrigation and Fertigation

Irrigation and fertigation have become standard practice in production of quality fruit and vegetables in most commercial systems. Irrigation is the process of supplying water for the crop and fertigation is the process of supplying nutrients through the irrigation system. With the use and benefits of plastic mulches came the necessity to supply water under the plastic for most of the plant's daily water needs. Along with water, irrigation systems can be designed to supply all or part of the nutrient needs of the plants being grown.

High tunnel or sheltered production systems, much like plastic mulch, prohibit the natural water received as rainfall. We create a dry desert like environment requiring the producer to supply all the water needed by the crop. Water availability, water quality, irrigation design, irrigation maintenance, and all aspects of water management are critical in a high tunnel system.

Water Availability and Quality

Irrigation water is a necessity for high tunnel production systems. Water sources may include wells, public water systems, harvested water and surface water. Since most of the water will be supplied through low pressure and low flow systems in a high tunnel the amount of water needed per minute and in volume will be much less than in sprinkler systems. The actual amount of water needed per minute will depend on the size of the high tunnel being used, type of tubing (ex. drip tube, emitter spacing and flow rate) used and number of irrigation zones operating at the same time.

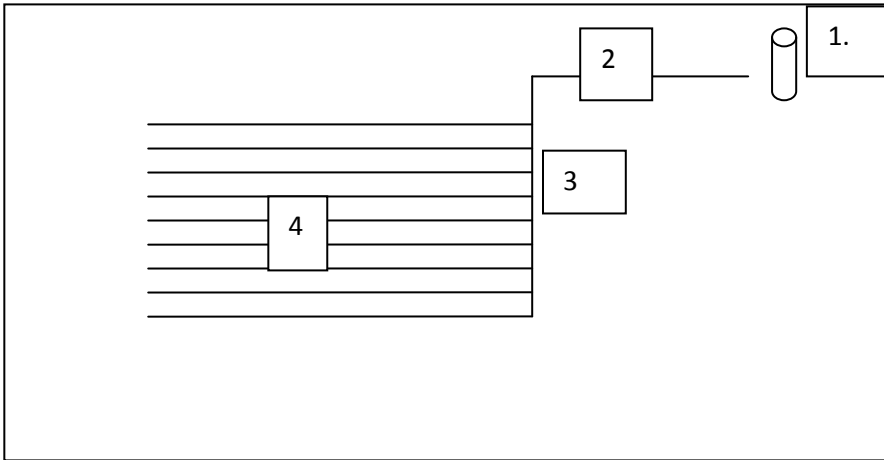
Water quality is almost as important as availability. Poor quality irrigation water can cause plugging of emitters by physical action such as algae, soil particles, and chemical reactions with fertilizers being injected for fertigation purposes. Physical water quality issues are more often encountered when using surface water and in some cases wells that are pumping sand or silt particles. However, chemical properties of water that could cause problems might come from all water sources. These would include high or excessive levels of carbonates, iron, phosphates, chlorine, sodium or other mineral elements.

A water analysis can be performed by the Auburn University Soil Testing Laboratory for \$16.00 per sample, which includes 15 different elements, pH, and soluble salts (electrical conductivity). Total alkalinity can be run for \$10 per sample. Testing forms can be found at www.aces.edu/anr/soillab/documents/WaterForm.pdf

Irrigation Design Basics

The design of the irrigation system for high tunnels is really just a small version of what would be done for a larger area. The major components are listed

1. *Water source* - **A BACKFLOW PREVENTOR SHOULD ALWAYS BE INSTALLED BETWEEN THE WATER SOURCE AND FERTILIZER INJECTOR TO PREVENT POSSIBLE CONTAMINATION**
2. *Supply line*
3. *Header*
4. *Laterals*



Design details can be found in **System Design, ANR-645 in the** Micro-irrigation Handbook, <http://www.aces.edu/anr/irrigation/microirriqhandbook.php> on the Alabama AG IRRIGATION INFO NETWORK,(See your County Extension Office for assistance)

Irrigation Scheduling

Scheduling how much water to apply and how often to apply it depends on several factors: crop being grown, growth stage of the crop, soil type, temperature, and other climatic considerations. There are a number of publications available to help you with making these decisions on the **AL AG IRRIGATION INFO, Network (see website address above)**. **Some of these publications are:**

Water Management and Scheduling, ANR-647

Basics in Vegetable Crop Irrigation, ANR-1169

Commercial Strawberry (irrigation), ANR-662

Fertilization and Fertigation

Proper soil fertility is important to proper plant growth and production. Well in advance of planting and developing a fertilization plan you should soil test to determine the soil fertility of your high tunnel site. Soil test supplies for the Auburn Soil Testing Laboratory are available from your County Extension Office and some farm supply companies handle supplies for other soil testing labs.

Soil pH

Most crops grow best when the soil pH is between 5.8 and 6.5. Your soil test results will provide you with how much limestone (lime) should be applied to raise the soil pH to an optimum level. Ideally, lime should be applied 3-6 months prior to planting your crop and incorporated (mixed) into the top - 6-8 inches of soil. Liming prior to construction of the high tunnel would make this task easier and should provide the proper pH range for 3-4 years. Soil moisture is needed for the lime to react with the soil. Therefore, if the high tunnel is already in place and covered, you should supply water to the area limed. Overhead sprinklers could be used for this purpose. Supply approximately one inch of water every two or three weeks.

Plant Nutrients

There are 17 essential plant nutrients needed for plant growth and development.

Carbon, Hydrogen, Oxygen - supplied through air and water, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulfur - supplied through soil and maintained through fertilization and liming. Iron, Manganese, Zinc, Copper, Nickel, Boron, Molybdenum, Chlorine - supplied through the soil and occasionally added by fertilization to the soil or plant. If the soil pH is corrected these elements already in the soil are more readily available to the plants.

The nutrients you will supply are based on soil test results and specific recommendations for the plants you are growing in the high tunnel. Prior to planting your crop, nutrients like phosphorus and potassium are normally applied to the soil and incorporated. From 20 to 40 percent of the nitrogen used may also be applied and incorporated prior to planting. As soon as the crop is planted, the irrigation system should be operational to water plants and supply additional nitrogen or other nutrients as required. An injector will be used to supply most of the post planting nutrients.

Key Fertigation Points

1. Functioning check valve (backflow preventer) between water source and injection.
2. Fertilizers **should not** be combined with pesticides or chlorine.
3. Injection site must be upstream of the filters.
4. Irrigation system must be at full operating pressure before injection begins.

Injectors

The purpose of the injector is to take a concentrated solution of fertilizer and move it into the irrigation system while it is operating. A diluted nutrient solution will be supplied as the plants are being watered. Irrigation suppliers can help with the type and size of injector that you will need for your system. There are two basic types of injectors, pressure differential or venturi types.

Calculating Fertigation Injection Amounts (Source: Applying Fertilizers Through The System, ANR 653)

Simple arithmetic can be used to calculate amounts of fertilizer materials to inject. The steps are slightly different for dry and liquid materials, but in both cases the purpose is to figure amounts of as-purchased fertilizer materials to apply, based on the recommended fertilizer rate per acre, percent to

be applied per application, number of acres irrigated (the zone size), and percent analysis of the materials.

For dry fertilizer materials, the formula to use is:

$$\frac{\text{lbs actual nutrient needed/ acre}}{\text{number of weekly applications}} = \frac{\text{lbs actual}}{\text{week}}$$

Example: $\frac{120 \text{ lbs N (nitrogen)/acre}}{12 \text{ weekly applications}} = \frac{10 \text{ lbs N / acre}}{\text{week}}$

In the example above, 10 lbs N (nitrogen)/ acre is required per week. The fertilizers we purchase contain various percents of the nutrient(s) we want to supply.

Fertigation Calculation Continued

Example: Ammonium Nitrate Fertilizer is 34% N (nitrogen) so a 40 lbs bag contains 13.6 lbs actual nitrogen. Remember, 34% = 0.34.

$$40 \text{ lbs Ammonium Nitrate (34\% N)} \times 0.34 = 13.6 \text{ lbs N}$$

To determine how much ammonium nitrate (34% N) we need for each weekly fertigation we divide the actual amount of N needed (10 lbs N/acre/week) by the percent of actual N contained in the product (34%).

Remember 34% = 0.34

$$\frac{10 \text{ lbs N/ acre/ week}}{0.34} = 29.4 \text{ lbs Ammonium Nitrate/acre/week}$$

We now have the amount of fertilizer product to inject per acre per week but, you don't have an acre inside your high tunnel so what do you do? **1 acre = 43,560 sq ft.** (REMEMBER THIS VALUE). Inside the high tunnel you have 8 rows that are 90 ft. long. (the process is the same no matter the size of the high tunnel).

What percent of an acre are you fertigating? We need to determine the number of square feet we have per row. We have 90 feet length and, say 2.5 feet width per row (90 ft. X 2.5 ft. = 225 sq. ft/ row). We said we have 8 rows total, so we have...

$$225 \text{ sq. ft. / row} \times 8 \text{ rows} = 1,800 \text{ sq. ft. total and } \frac{1,800 \text{ sq. ft.}}{43,560 \text{ sq. ft.}} = 0.04 \text{ acre}$$

Since we only have 4 hundredths of an acre (0.04) we need to adjust our 29.4 lbs ammonium nitrate/ acre/ week to (lbs ammonium nitrate/ 0.04 acres/ week).

29.4 lbs ammonium nitrate/acre/week X 0.04 acre = approximately 1.2 lbs ammonium nitrate/ week

The process might seem complicated at first but, it is important to become comfortable in calculating fertilizer rates on a number of different size areas, for different nutrients, and various fertilizer products that can be used for fertigation purposes.

Keep in mind since we are working with only a small portion of an acre we will be using smaller amounts of fertilizer. Everything we do inside the high tunnel will be a fraction (literally) of most of the recommendations found in many publications and labels for crop production. The high tunnel grower must be able to convert these amounts to fit the size of his high tunnel and the area devoted to each specific crop or irrigation zone within the high tunnel.

Available resources include <http://www.aces.edu/anr/irrigation/microirrihandbook.php>

and your Alabama Cooperative Extension Agents

Robert T. Boozer, Ted W. Tyson, and Tony A. Glover

Alabama Cooperative Extension System, 5/24/10