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Helpful Tips for Chemigation of Papaya[1]

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Introduction

Chemigation is a process by which an irrigation system is used for transport and delivery of an agrochemical, generally fertilizers or pesticides, to a crop. Often times, the irrigation system used in chemigation is drip irrigation. The purpose of this report is to provide some helpful tips for papaya growers interested in chemigation.

Depending on the type of chemical being injecting, there are requirements that must be met by Florida law. Please refer to the following documents to ensure compliance with Florida law: 'Florida backflow prevention requirements for agricultural irrigation systems' IFAS Ext. Bul. 217 (Smajstrla et al., 1991) or Administrative Rule 5E-2.30, "Antisyphon Requirements for Irrigation Systems" (Department of Agriculture and Consumer Services).

Tip 1: Protect your equipment and material with check valves and filters

Check valves are components that are placed in the water flow line. Their function is to allow flow in only one direction. This prevents backflow from occurring, which protects your water source and chemical sources. Check valves are required to be placed between your water supply and the chemical injection point (Figure 1).

Another important component that should be placed in your irrigation line is a filter. Filters are placed directly after fluid sources to protect the irrigation system. Filters prevent line clogging in downstream of the filter and provide easier access for cleaning out unwanted debris.

As stated previously, other components are required by Florida law. Other such components are low pressure drains, vacuum breakers, and chemical supply shut-off valves.

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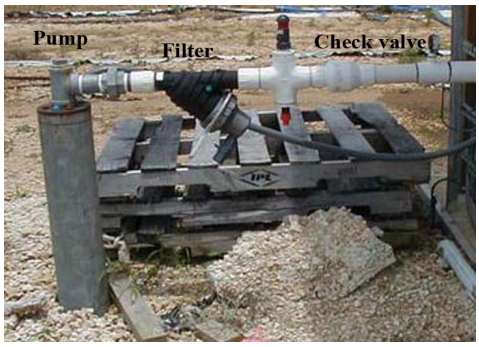

Figure 1. Water source, pump, and check valve assembly
Credits: Photo - Kati L. White.

Tip 2: Calculate how much chemical you need

For chemigation, a chemical is injected into an irrigation line. Using the right amount of chemical is very important (Table 1).

- The first step in this process is to determine the recommended rate of the particular chemical for the specific application. It should be expressed as an amount (lb or gal) for a particular location characteristic (area or plants) per time.
- The second step is to determine how many plants or the acreage being considered. REMEMBER, in calculating the area only include the planted area. This means that with drip irrigation and plastic, you would calculate the planted acreage as: row length * plastic bed width * number of rows.
- The third step is to calculate the amount of chemical needed based on information from the first and second steps.

Table 1. Example for determining the amount of chemical you need

Step	Example
Step 1: Determine recommended rate	10 gal per acre before planting
Step 2: Determine your planting characteristics	0.5 planted acres
Step 3: Calculate chemical amount needed	5 gal before planting

Tip 3: Calibrate your injector

Chemical injectors are generally one of two types: venturi injector and metering pump (positive displacement pump) injector. Chemical injector calibration is very important. In this process, how much chemical is being injected using different settings is determined. The balance between chemical injected and irrigation water flow rate are very important.

If **too little water** is in the chemical and water mixture, the following problems may be experienced:

- uneven chemical distribution
- high volatilization (chemical loss)
- chemical buildup in irrigation lines

If **too much water** is in the chemical and water mixture, the following problems may be experienced:

- dilution of chemical below effective concentrations
- loss of chemical to groundwater

The remaining discussion assumes that a metering pump injector is used for chemical injection. Calibration of the injector can be performed using the following equipment: injector, pen and paper, container marked with volumetric levels, and a timer. The container should be filled to a known volume. The injector should be set to a desired rate (usually expressed on a dial as a number). Next, decide on a volume of water to remove with the injector (making sure that the volume is appropriate for the container). Then, turn on the injector and start the timer at the same time. When the volume in the container is reduced to your predetermined amount, stop the timer. Record on the paper the injector setting, volume removed from the container, and the time. Repeat this process for different dial settings. From this, you can calculate the rate at which the injector operates (volume/ time) at each particular dial setting. Results from calibration of a nutrient injector are provided in Table 2.

Table 2. Results from chemical injector calibration

Calculated in the field				
Gauge setting	**Vol. (gal)**	**Time (min)**	**Rate (gal/min)**	**Time (min) to deliver 5 gal**
2	0.5	10.2	0.05	100
4	0.5	6.5	0.08	63
8	0.5	3.7	0.14	36
16	0.5	1.3	0.38	13

Tip 4: Be very careful with units

The units that are given with any product, such as lb, kg, gal, etc., should be carefully noted. Incorrect conversion between units or neglect of appropriate units can lead to chemigation mistakes. Some useful unit conversions are provided in Table 3.

Table 3. Quick reference for unit conversions

LENGTH:	**AREA:**
1 foot = 0.305 meters	1 acre = 0.405 hectares
1 inch = 2.54 centimeters	1 acre = 43,560 square feet
1 mile = 1.609 kilometers	1 acre = 0.002 square miles
VOLUME:	**MASS:**
1 pint = 0.473 liters	1 pound = 0.454 kilograms
1 gallon = 0.134 cubic feet	1 ton = 907.185 kilograms
1 gallon = 3.785 liters	1 pound/acre = 1.12 kilograms/hectare
1 fluid ounce = 29.57 milliliters	1 ounce = 28.350 grams
1 cubic inch = 16.39 cubic centimeters	
1 gallon = 0.134 cubic feet	
1 ounce = 29.574 cubic centimeters	

Tip 5: Use appropriate chemical and water combination

In order to use the correct chemical and water combination, the irrigation pump rate and the recommended dilution (or concentration) must be determined. This information should be available from the chemical company or your local extension agent. An example for determining the chemical injector setting is provided in Table 4.

Also, remember that some chemicals may not readily dissolve in water. If unsure of the chemical solubility of a compound, check with the chemical supplier or local extension agent. Chemicals that are used and not soluble may accumulate in your system resulting in a blocked line.

Table 4. Example steps for determining an appropriate injector setting

Item needed	Example value
Water pump rate	40 gpm
Recommended concentration	100 gal of water per gal of chemical
From Table 1, chemical needed	5 gal chemical
Water needed for dilution	500 gal
Time needed by irrigation pump to deliver water	12.5 minutes
From Table 2, select the injector setting that has a time for 5 gal to be injected that is closest to your needed irrigation time	Setting selection: 16

Tip 6: Keep your system in good repair

Routine maintenance is important to ensure proper operation of a chemigation system. Hence, take the time to inspect irrigation components and fix problems as they occur. A good method for checking the system is to turn on the irrigation and walk the field (if size appropriate). While walking through the field, look and listen for leaks. Most leaks will produce a whistling type sound and often times an obvious puddle. Be sure and note that this field inspection of components should be completed without the chemical injector operating.

Another good idea for maintaining the system is to insert pressure gauges in the flow lines. By checking these gauges, problems in your system can be detected.

For more information

To learn more about chemigation, additional EDIS publications may be helpful. More detailed publications are available on chemigation components (Haman et al., 1994) and chemical injection calculations (Clark et al., 2002).

References

Clark, G. A., D. Z. Haman, and F. S. Zazueta. 2002. Injection of Chemicals into Irrigation Systems: Rates, Volumes, and Injection Periods. BUL250, Agricultural and Biological Engineering Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. University of Florida.

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