Tips On Using And Calibrating Injectors

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Injectors or proportioners are wonderful labor-saving devices commonly used in most greenhouses and nurseries to apply chemicals which can be diluted with water – such as water-soluble fertilizers, wetting agents, pesticides, plant growth regulators, and mineral acids – to adjust excess irrigation water bicarbonate levels. A properly functioning injector system is an invaluable production asset. However, when things go awry, poor crop growth or even crop failure can arise due to insufficient or toxic dosing of the applied chemicals. Additionally, valuable time and labor as well as expensive materials can be wasted if injectors are not properly used, maintained, and monitored.

There are several types of injectors: those working on the Venturi principle and those using positive displacement. Venturi-types such as Hozon® and Syfonex® utilize a pressure differential between the stock tank and the water line to suck concentrated solutions into the faucet connection, and then blend them with water in the hose. They easily attach to faucets and are inexpensive, but are not as precise as positive displacement types. The proportion ratio is fixed averaging around 1:16, but pulsing of fertilizer concentrations occurs as water pressure and hose length can affect proportioning performance. Venturi-types require a large-volume stock tank and are generally best for small growing areas. They are also not recommended for acid injection.

Positive displacement injectors such as Anderson, Dosmatic, Dosatron, Gewa, and Smith products use mechanical or electrical pumps or water pressure to inject concentrated stock solutions into the irrigation stream. These are more expensive but much more accurate and versatile than Venturi types, having broader proportioning ratios and more manageably-sized stock tanks. There is a wide variety of these types with fixed or variable proportion ratios, single or multiple heads for injecting several separate solutions, and varying abilities to handle a variety of chemical compounds.

Choosing an Injector

When choosing an injector, one should consider a variety of factors:

Determine reasonable stock tank size based on proportion ratio and daily water usage.

Match correct model to actual water flow rate. Determine this by using water meter readings before and after collecting a given volume of water, by using a pump pressure gauge or by measuring the time it takes to fill a given volume (gallons per minute). Using an injector at higher-than-recommended water flow rates can wear out the injector crankshaft sooner, while lower flow rates will result in inaccurate proportioning.

Consult your injector manufacturer to see if the injector is recommended for the chemicals you commonly use (e.g. acid-resistant fittings).

Do you need multiple injection heads (for application of incompatible chemicals)?

Do you need the flexibility provided by injectors with adjustable proportion ratios?

Is a portable or stationary unit required?

Determine the manufacture's reliability, knowledgeable technical support, service, and other qualifications.

Using Injectors

While injectors are generally consistent "star" performers, it is easy to forget common sense use and maintenance tips to keep them running up to expectations.

Provide a plumbing bypass to allow for clear watering and removal for repair.

Provide backflow prevention to prevent contamination of irrigation water supply if negative pressure occurs.

Know your dilution ratio and how to properly adjust it.

Tracer dye in water-soluble fertilizer is designed only to indicate the presence of fertilizer and not to determine concentration of fertilizer solution. A change in diluted solution dye intensity does not necessarily mean that an injector is not functioning properly. A method for estimating fertilizer concentration by measuring electrical conductivity will be described below.

Higher dilution ratios (> 1:200) require more concentrated solutions; be aware that there may be problems exceeding maximum solubilities.

Check chemical product labels and with manufacturers to determine if specific products or combinations should be used with an injector – i.e. Are they acidic or corrosive? Do pesticides have a chemigation provision on the label?

Avoid improperly prepared concentrate solutions and incompatible mixtures (such as a combination of calcium nitrate and 20-9-20 in the same tank).

Cold water may take longer to dissolve chemicals – wait for stock solution to warm up before injecting.

Be aware that wettable powders suspend but do not dissolve in water (they need agitation to avoid settling out).

Dirty water (silt) can clog injectors, accelerate wear, and cause damage – strain or filter.

Check strainer frequently for clogging, and inspect tube for cracking.

Dirty fertilizer can clog check valves and gum up or damage the inner workings of an injector – use an intake or dip tube strainer and suspend the tip several inches above the bottom of the stock tank to avoid taking up solids.

Cover concentrate stock tank to avoid buildup of algae, contamination, or evaporation of stock solution.

Clean out stock tank between uses to avoid incompatible/insoluble reactions.

Clean out injector with fresh water after each use.

Avoid freezing – which can cause cracking/warping of injector parts.

Calibrate periodically to ensure that the injector is functioning properly (see following explanation).

Periodic cleaning and maintenance is important, especially if the injector will be in a prolonged period of disuse. Inspect and service O-rings. Occasionally inspect the inner chamber and clean to remove deposits.

An injector should accurately mix a concentrated chemical solution into the irrigation water flow at a defined ratio. For example at a 1:100 proportion ratio, an injector should mix 1 part of concentrate with 99 parts of water. Therefore 1 gallon of concentrated stock solution will result in approximately 100 gallons of finished solution.

Monitor Injectors

There are several simple methods to confirm that your injector is functioning according to expectations:

Calibration by measuring volume of concentrate injected into a diluted solution:

Start injector so air bubbles are removed and system is charged with concentrate solution from stock tank. Turn off injector.

Remove intake or suction tube from stock tank and place it into a large graduated cylinder (at least 500 ml in volume).

Fill graduated cylinder with a known volume of concentrate solution.

Turn on injector and collect a known volume of diluted solution (e.g. 5 gallons).

Turn off injector and record the volume of concentrate used to make the diluted solution.

Calculate the actual ratio of the injector.

Example: Injector is set for a 1:100 ratio. If (in the above test) 185 ml of concentrate was used up to make 5 gallons (18,925 ml) of diluted solution, the actual ratio = ml of dilute fertilizer collected (ml of concentrate injected or 18,925/185 = 102/1. This result is pretty close to expected, because it is only off by 2 percent. You might want to repeat this test a few times, especially if the actual ratio is much smaller or greater than the desired ratio. Consult your injector manufacturer to determine your injector's expected dispensing accuracy variation. If you determine large deviations from the manufacturer's specifications, maintenance, repair, or replacement may be necessary.

Measuring electrical conductivity (EC) of diluted fertilizer solutions:

This method is commonly used with water-soluble fertilizer. It is an excellent means to periodically (i.e. measure and record weekly) monitor your fertilizer program. Key attention should be given to mixing and monitoring the feed source. Fertilizer suppliers generally provide the information needed to use this test method on the fertilizer bag or in accessory technical bulletins. For this method to work, it is critical to follow the manufacturer's guidelines for making up concentrate solutions.

Although fertilizer stock recipes specify that a given weight of fertilizer should be blended with a given amount of water, the use of coffee cans as a measuring tool still is common. Remember that variability in adding fertilizer to a stock solution will result in variability in the concentration of the diluted finished solution.

Method

Use a reliable conductivity meter which can be calibrated and standardized with standard solutions to maintain good measurement accuracy.

Collect a representative sample of incoming irrigation water (without fertilizer) by opening the water line for several minutes to flush out pipes and collect the sample in a clean container.

Test EC of the irrigation water.

Allow injector to run sufficient time before collecting a representative sample of the diluted fertilizer sample in a clean container.

Test EC of the diluted fertilizer sample.

Calculate the EC contribution of fertilizer: EC of solution - EC of water = EC contributed by fertilizer.

Consult charts or the bag label supplied by the fertilizer manufacturer, or call the manufacturer's technical help hotline.

Example: Injector is set for a 1:100 ratio. Grower is using Technigro® 20-9-20 at a desired concentration of 200 ppm N. To make the concentrate solution, the grower mixes 13.4 ounces by weight into each gallon of stock solution. If, in the above test, the grower determines that the EC of the irrigation water is 0.25 mmhos/cm (which is relatively low) and the EC of the diluted fertilizer solution is 1.7 mmhos/cm; the actual EC contributed by the fertilizer is 1.7 - 0.25 = 1.45 mmhos/cm. The technical sheet for this particular fertilizer states the expected EC for 200 ppm N is 1.38 mmhos/cm. Therefore the actual dilution ratio is off by a factor of about 5% (1.45 ÷ 1.38 = 1.05). This method will give a ballpark estimate on monitoring your fertilizer program. As well as estimating the variability of the injector, there is additional variability due to mixing errors and EC measurement errors. In general, however, it is a very effective means for monitoring feed and monitoring your injector's performance.

Reprinted from Ohio Florists' Association Bulletin, Number 819, January 1998...