

CANNABIS: FERTIGATION

Choosing the right system

Fertigation is the process of delivering plants nutrients and water to produce a quality crop with higher yields. For traditional horticulture and commercial agriculture, fertigation is common, and its application in the production of cannabis is growing. Automated fertigation has been seen to make a difference in grow facilities over 10,000 square feet, cutting fertilizer and labor costs dramatically (McConnon, 2014). CBS News recently aired a segment that interviewed Meg Sanders, the CEO for Colorado medicinal and recreational cannabis producer, Mindful. Water and nutrient systems are used to feed the cannabis plants in their cutting edge, 44,000 square-foot marijuana factory (Whitaker, 2015).

“Horticulturally speaking, there is no difference between the fertigation requirements for cannabis and other commercial crops”, says David Flood, greenhouse technologist for Argus Control Systems (part of the Conviron Group of companies), “The principles and techniques are the same.”

There are two common ways to supply fertilizers through an irrigation system for cannabis production: dilute tank control and in-line injection.

DILUTE TANK CONTROL:

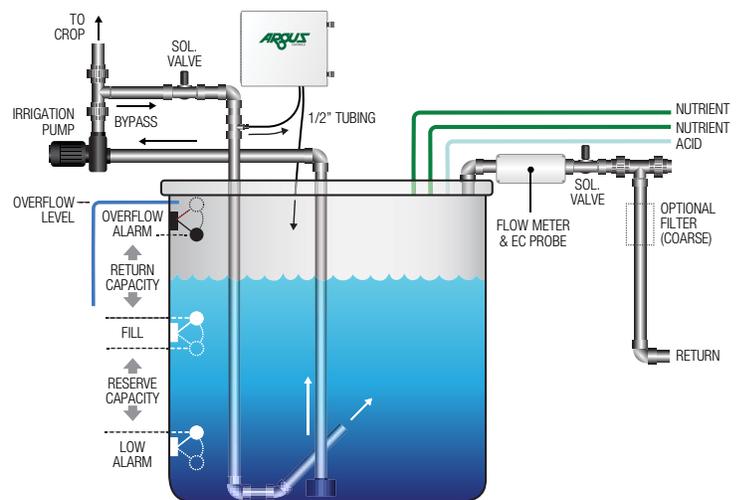
Batch Method

Using the dilute tank control method, fertilizers are premixed at the final feed strength concentration for the crop and stored in a tank or reservoir until used. This method is the simplest, safest and potentially most accurate way to achieve the final dilution strength. Dilute tank batches can be prepared by hand or the process can be fully automated. Since the mixing process is completely separate from distribution, the

An automated fertigation system can be integrated with the facility’s environmental control system

dilute solution can be removed from the tank at practically any flow rate without ever affecting the concentration accuracy. Additionally, the volume of ready-made feed solution acts as a safety reserve in case of problems with chemical or water supply.

Despite these positive features, dilute tanks are not as popular as in-line injection systems, particularly for larger operations. Large, costly storage tanks are required and each combination of fertilizer formulation and concentration requires its own tank. It is generally only practical to adjust the fertilizer strength and formulation when refilling a tank from empty. A re-pressurizing irrigation pump is also required to deliver the dilute solution to the irrigation system.



Dilute Tank Control dosing system

IN-LINE INJECTION: Continuous Methods

In-line injection equipment can range from simple mechanical injectors driven by water flow to fully automated nutrient control systems. Pressurized in-line systems preserve the pressure and flow characteristics of the water supply system, eliminating the need for a re-pressurizing pump. In contrast, atmospheric injection systems blend the fertilizer and water in a non-pressurized tank and require a re-pressurizing pump.



Argus A/B in-line injection system using two stock tanks

In-line injection is generally more popular than dilute tank systems since it does not require large holding tanks and they offer more flexibility. With in-line systems, concentrated stock solutions are continuously injected into the water stream as irrigation events are underway. Mixing usually occurs in the downstream section of the irrigation pipe or in a small mixing section of the injector. Injection volumes are based on system flow rates, electrical conductivity (EC) sensor feedback or a combination of the two.

When automated injection controls are used, it is possible to rapidly change the dilute solution concentration by adding more or less stock materials relative to the water flow. This is useful if the feed strength needs to be adjusted throughout the day to match growing conditions or if the feed recipes or nutrient concentration need to be changed for various crops. In some instances the actual fertilizer formulation can be changed by either switching to different sets of stock tanks or employing a 'single-element' dosing design where the individual fertilizer



Single-element nutrient dosing system

constituents are separated into several stock tanks. This enables an in-line injection system to operate in a multiplexing capacity, where the operator can simply 'dial-in' different feed recipes on the same irrigation system (although only one at a time).

In-line injection systems do have some weaknesses compared to dilute tank systems. Low buffer volumes and poor blending may result in dosing accuracy errors and poor final product uniformity. These problems can become more pronounced at low flow rates relative to the design flow rate. If, however, the system is well-designed, tuned and managed, prevention strategies within the software can counteract these issues. For example, the multi-feed injection system from Argus tracks EC and pH targets for each recipe to ensure accuracy and as a basis for automatic feed strength correction, alarm monitoring, and quality assurance. Rather than rely exclusively on typical deviation based closed loop control, Argus 'Feed Forward' software intelligence can achieve precision dosing at all design flow rates without any striping inaccuracies, settling times or feedback loop oscillations.

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- David Flood

Greenhouse technologist for Argus Control Systems

CONSIDERING AUTOMATED SYSTEMS

Whether you select dilute tank feeding or an in-line injection system there are a range of options for automating the nutrient dosing process. While automated dosing systems offer many management and productivity features, including reduced fertilizer and water runoff, and better crop quality, they do so at a higher cost and complexity.

Consider a Dilute Tank Control system when:

- The whole crop can be administered with a single feed solution.
- The dilute feed composition and strength (EC) does not change often.
- The pH of water does not need frequent adjustment.

Consider an In-Line Injection system when:

- Irrigation scheduling and nutrient dosing are integrated.
- Supplying more than one nutrient formulation on the same irrigation system (different crop requirements).
- The ability is needed to vary the feeding strength (EC) without having to prepare new stock solutions.

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AUTOMATED FERTIGATION

Some automated systems only manage the nutrient dosing equipment while other systems are capable of integrating irrigation scheduling with nutrient dosing activities. An automated fertigation system can be integrated with the facility's environmental control system where it can be monitored and managed from a centralized user interface along with all the other controlled processes within the grow operation.

Fertigation systems vary with each application and should be capable of adapting to the design and operation of the overall facility. This may include controls and monitoring for:

- Tank levels
- EC
- pH
- Acid/base dosing equipment
- Water temperature
- Soil moisture levels
- Leaching rates (overdrain)
- Nutrient dosing equipment
- Pump controls
- Irrigation zone valves
- Line purging
- Recirculation management
- Water treatment equipment (filters, pasteurizers, ozone, UV, etc.)

REFERENCES:

McConnon, V. (2014) 'Guest Column: Top Technological Game-Changers for Cannabis Growers - Marijuana Business Daily.' Marijuana Business Daily. Available at: <http://mmjbusinessdaily.com/guest-column-top-technological-game-changers-for-cannabis-growers/> (Accessed: 13 March 2015).

Whitaker, B. (2015) The Marijuana Effect, CBS News. Available at: <http://www.cbsnews.com/news/colorado-pot-marijuana-60-minutes/> (Accessed: 17 March 2015).

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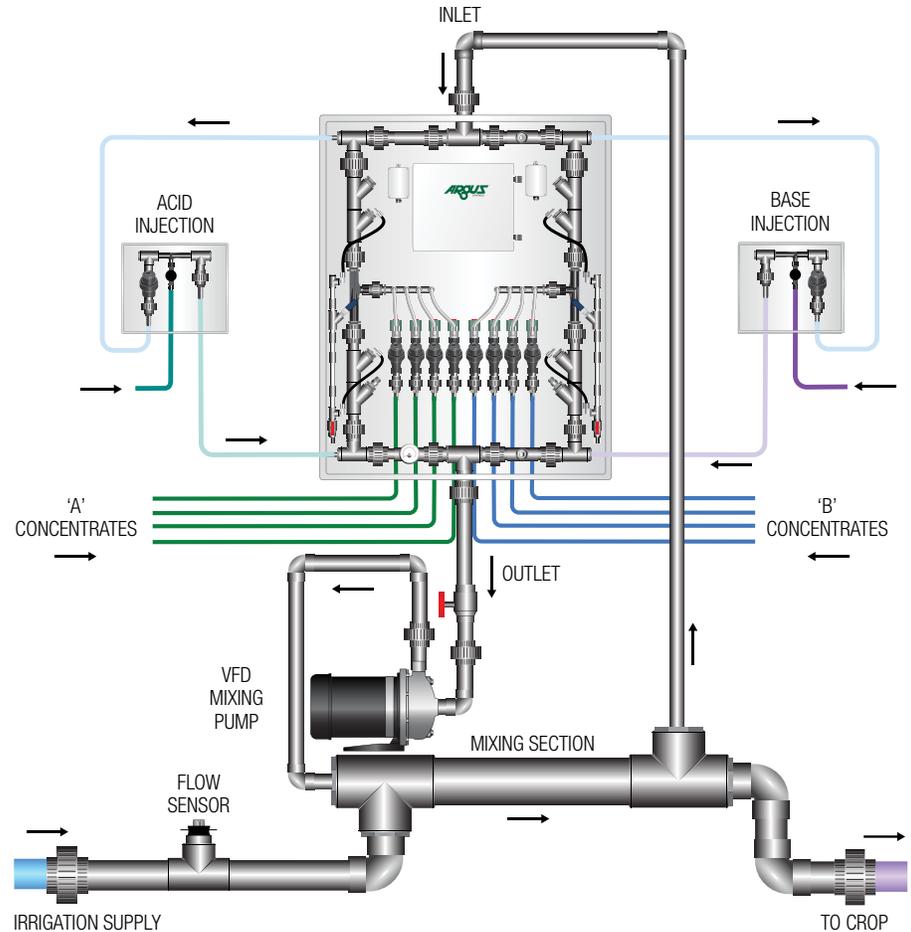
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Multi-Feed RM (rack mount) injectors are manufactured exclusively by Argus and feature some of the most advanced capabilities of any nutrient control device.

Depending on your requirements, a Multi-Feed system can provide anything from a single-tank formulation to many separate fertilizer recipes and feed strengths on the same irrigation system. Full single-element dosing options are available as well as standard A/B style stock tank applications. Programming and operations are managed seamlessly by the Argus fertigation management software.

KEY PRODUCT FEATURES

- Supports up to 64 recipes on a single irrigation system.
- Set target values in parts per million for each recipe element
- System locates the required elements, calculates the amounts to inject and automatically delivers each recipe 'on-the-fly'
- EC and pH targets for each recipe are tracked to ensure accuracy and provide a basis for automatic feed strength correction
- Precision dosing is achieved at all design flow rates.
- Simple venturi injectors are used to draw the fertilizer concentrates into the mixing line to achieve a desired concentration or recipe.
- Metering valves are used to provide precise amounts of concentrate for the current recipe and flow rate.



(Above) Multi-Feed Injector Panel and Flow Schematic

EASY TO INSTALL

- Drop-in units are ready for immediate use.
- Requires only in/out plumbing connections, a line voltage power connection, and a network connection to the Argus irrigation controller.

EASY TO OPERATE

- Feed-forward control intelligence for fast response and the highest dosing accuracy and safety.
- Custom configured to your specifications.
- **Fully supported by Argus.**

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Management System Certified to ISO 9001

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