

AUTOMATED FERTIGATION

Choosing the right system

Fertigation is the process of delivering plants nutrients and water to produce a quality crop with higher yields. Employing an automated fertigation system can help growers make informed decisions that can significantly impact water and nutrient usage as well as contribute to reducing disease.

The methodology behind the technology is pretty straightforward. Sensors measure the moisture in the soil, if it gets too dry, the crop is automatically irrigated. Timely irrigation decisions translate into better nutrient management results. Most notable, the reduction of fertilizer leaching can lead to direct fertilizer savings as well as minimize the environmental footprint of runoff from herbicide, fungicide, and systematic pesticide applications. Also, for growers using controlled release fertilizers, there is great potential to monitor EC and determine how temperature and other environmental factors impact release rate (Burnett et al., 2014). As environmental regulations continue to get more strict, and consumer concern over the use of agrochemicals increase, adopting this type of technology allows growers to evolve their standard practices and benefit from the improved crop outcomes.

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

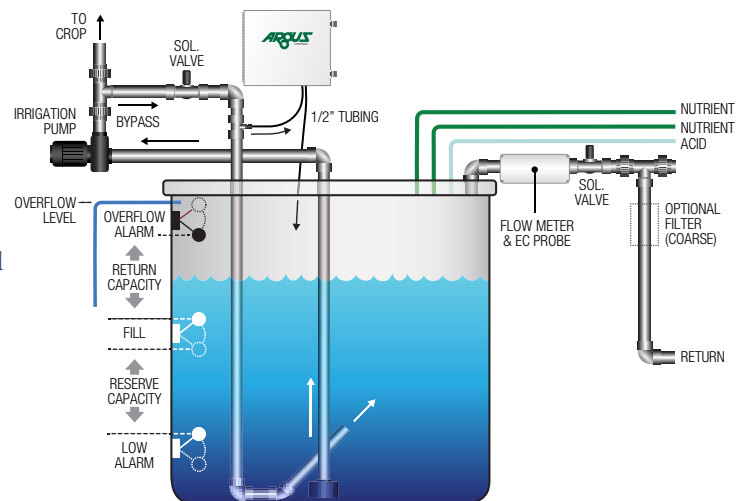
DILUTE TANK CONTROL:

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 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.

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

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



Single-element nutrient dosing system

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.

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.

Some automated systems only manage the nutrient dosing equipment while other systems are capable of integrating irrigation scheduling with nutrient dosing activities.

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 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.

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.

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- 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.

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:

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



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

REFERENCES:

Burnett, S., Van Iersel, M., Ferrarezi, R. S., Kang, J. G. and Dove, S. (2014) Gain greater control of fertilizer with automated Fertigation. Available at: <http://www.greenhousegrower.com/production/crop-inputs/gain-greater-control-of-fertilizer-with-automated-fertigation/> (Accessed: 1 December 2015).

Flood, D. (2013) Nutrient Dosing. Available at: <http://www.gpnmag.com/nutrient-dosing> (Accessed: 15 March 2015).

Ling, P. (2013) Commercial Greenhouse Production: Component and System Development - OHIO STATE UNIVERSITY. Available at: <http://www.reeis.usda.gov/web/crisprojectpages/0217279-commercial-greenhouse-production-component-and-system-development.html> (Accessed: 17 March 2015).

Van Iersel, M., Burnett, S. and Lea-Cox, J. (2014) Precision irrigation: How and why?. Available at: <http://www.greenhousegrower.com/structures-equipment/precision-irrigation-how-and-why/> (Accessed: 1 December 2015).

For more information, contact argus@arguscontrols.com

TOTAL FERTIGATION MANAGEMENT

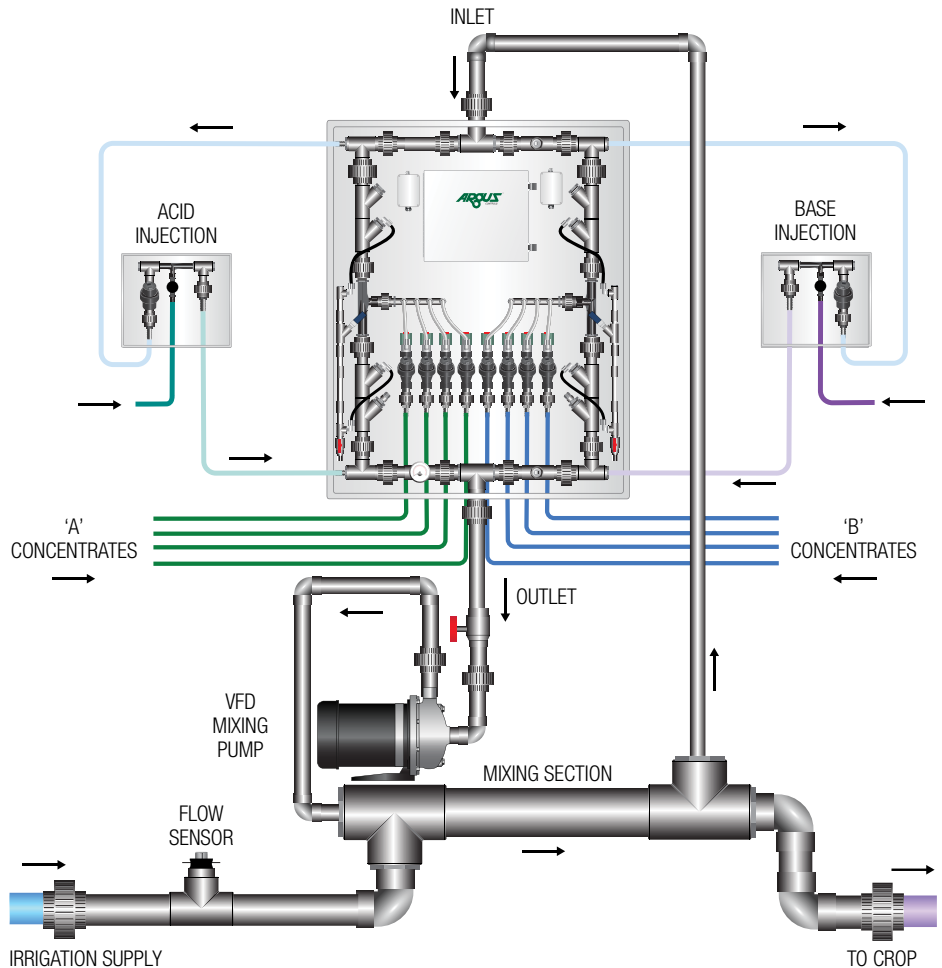
Designed to fit the way you manage your crops

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.**