FERTIGATION SYSTEMS EXPLAINED

with Don May, Guest Writer for Ferti-Ject.

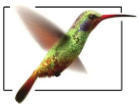
Introduction

Fertigation is a term used to describe the practice of applying fertiliser in a liquid form to a crop via the irrigation system. Using the irrigation system to apply fertiliser make a lot of sense as it reduces the need to use on-field mechanical fertiliser applications and sometimes eliminate these altogether.

In this article we talk with global Irrigation Technology Guru, Don May as he shares some insights into the art of Fertigation.

Fertigation when combined with an efficient irrigation system allows for both nutrients and water to be manipulated and managed in order to obtain the maximum possible yield whilst delivering savings in water usage and cost savings in fertiliser, labour and energy.

"Now-days, greater numbers of annual crop fertiliser requirements are being applied via a range of fertigation methods, to the point where some agricultural sectors we see as much as 90 to100 percentage uptake of this technology over traditional fertiliser application methods."



The Pros and Cons

In precision agriculture, fertigation is typically used to address fertiliser deficiency which inhibits plant growth and will improve labour and operational efficiencies.

Fertigation has many advantages and disadvantages.

The advantages include:

- Fertiliser can be applied directly to the root zone optimising plant growth.
- Nutrients can be applied any time during the growing season based on the needs of the crops.
- Even highly mobile nutrients such as nitrogen can be successfully managed to ensure rapid crop uptake.
- Fertiliser can be applied quickly and accurately to address any deficiency issues.
- Minimal crop damage as no machinery is required.
- Tractor operations are reduced, saving fuel, wear and labour.
- Well-designed injection systems are simple to use and suitable for use with automation.
- Smaller amounts of fertiliser are applied reducing runoff and contamination issues.
- Reduced loss of fertiliser due to unseasonal weather.

"There are many benefits for this type of technology including greater uptake of nutrients by the plant, less run off and leaching of the fertiliser into the environment, and less compaction and pollution due to the decrease in the usage of tractor applied fertilizer."

Some of the disadvantages of fertigation can include:

- Accuracy is heavily reliant on the efficiency of the irrigation systems distribution uniformity.
- Accuracy is heavily reliant of overall irrigation infrastructure design / layout depending on injection point.
- There can be potential issues during wet weather events.

Things to consider when choosing a fertigation system.

- How and where to mix the fertiliser before injecting – will it be done at the shed or in the paddock?
- Is the right handling, mixing, storage and transport equipment in place – is a bunded area required, is a spill kit and first-aid kit on-site?
- Are the occupational health and safety (OH&S) requirements in place – are the Material Data Sheets accessible.?
- Good calibration is essential for economical application.
- Does the injection system have a anti-backflow check valve to prevent injected fertilisers from siphoning into the water source?
- Install an in-line check valve at the point of injection into the main line to prevent flow of water from the irrigation system back into the mixing tank – and avoid overflow of fertiliser.
- Fertigation should only commence injection after the host irrigation system is pressurised ready for normal operation.

System Design Guidelines

Generally, there are four methods of injection which can be used and the best suited to your application will mostly depend on the type of irrigation system used, Don May gives another insight.

For fixed irrigation systems such as drip, micro and overhead sprays, positive displacement systems are also generally thought to be the best, but other types of fertigation systems such as venturi injection, suction injection and pressure differential systems are also often used with good results.

"For most mechanised irrigation systems such as centre pivot and lateral move irrigators and also indoor farming applications or hydroponics, positive displacement (pressure) pumps are widely recognised as the best choice due to their accuracy."

Venturi injection

Venturi injectors come in several sizes and can be operated under different pressure conditions. Venturi injectors are only usable on closed pipe systems as they are set up in a shunt pipeline parallel to the main irrigation pipeline.

Requiring at least a 20 per cent pressure differential to work properly, irrigation water from the main pump is passed through the venturi unit, creating a pressure differential between the water bypassing the unit and the fertiliser solution in the tank.

This pressure differential causes the solution to be drawn up into the mainline. The gate valves and flow rate control the rate of the fertiliser solution applied. The venturi draws all the fertiliser until the tank is empty.

Venturi injectors do not require external power to operate but some units utilise a small booster pump in the shunt pipeline to produce a differential pressure. Injection rates of 10 to 20,000 litres per hour can be achieved.

The advantages of Venturi Injection systems can include:

- No moving parts – typically manufactured from corrosion resistant plastic.
- Requires little maintenance.
- Gate valves control fertiliser injection rates with some accuracy.

Disadvantages of Venturi injection systems include:

- Requires a closed pipe system.
- Requires pressure loss in main irrigation line (can be up to 33 per cent).
- Automation is difficult but not impossible.

Positive displacement

The most common and accurate method of injection of fertiliser into irrigation system. The systems most commonly available are motor driven injection pumps, piston-activated pumps and diaphragm activated pumps.

Piston activated and diaphragm activated pumps are both hydraulically driven injection pumps. Motor driven injection pumps include single or multiple pistons, diaphragm, gear and roller pumps.

Piston-activated pumps

- Uses a piston or diaphragm to inject fertiliser into the main line from a storage tank.
- Pumps are driven by electricity, petrol or water.
- Irrigation water operates a hydraulic motor that pumps the fertiliser solution into the system.

Since the pump's maximum rate of injection is proportional to the pressure in the mainline, the required injection rate is easily adjusted by throttling the injection line by means of a valve fitted to the water main, and as the injection rate per pulse is known, the exact application of nutrients can be readily calculated.

For high injection rates, two or more units can be operated in parallel. Injection rates of over 320 litres/hour are possible.

Diaphragm-activated pumps

How they work

- Water pumped into the lower chamber activates a rubber diaphragm in the drive unit which forces the diaphragm up, and in doing so forces the fertiliser out of the injector into the irrigation system via a drive rod.
- On the return stroke the spent drive water is discharged from the lower chamber of the drive unit while simultaneously fertiliser solution is drawn into the injector. The cycle is automatically repeated.
- Injection rates from 3 litres to 1200 litres per hour are possible. There is an upper limit to the pressure available and these pumps might not operate on high head systems.
- Electric injection pumps include single or multiple pistons, diaphragm, gear and roller pumps.

Diaphragm-activated pumps (cont..,)
This type of pump can be regulated to achieve the desired injection rate by the following:

- Adjusting the length of the stroke of piston pumps.
- Selecting the appropriate pulley diameter.
- Using a variable-speed motor.
- Using semi-automation to adapt the pump to receive electrical impulses from a water meter which can then be used to apply precise amounts of fertiliser.
- Adjusting the length of the stroke of piston pumps.
- Metering flow.
- Manipulating pump speed at the pulley.
- Using a variable-speed motor.
- Semi-automation via electronic pulse water meters.

Advantages of diaphragm activated pump can include:

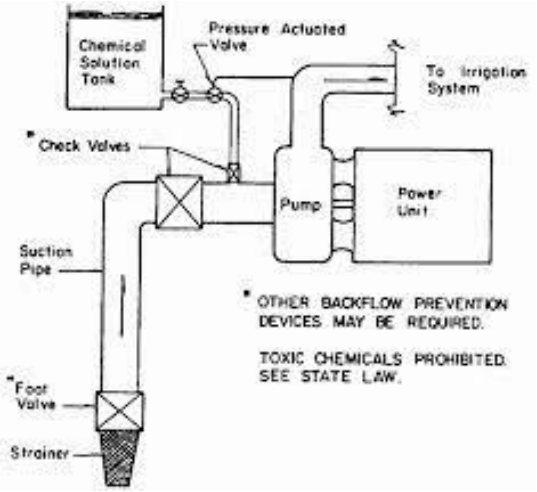
- Simple and effective.
- Relatively easy to install.
- No pressure loss in the main irrigation line.
- Automation is relatively easy.

Disadvantages of a diaphragm activated pump can include:

- Pumps must develop a minimum mainline pressure to operate.
- Potentially need electric power source to operate.
- Require a certain level of maintenance.
- Selected pump must be stainless steel and/or have a bronze impellor.
- There are a large number of working components.
- The pumps are sensitive to air pockets and need a continuous water discharge to operate the piston or diaphragm.
- The spent 'drive water' is lost and discharged from the system.

Suction Injection Method

- This injection method utilises the irrigation pump suction capacity to draw fertiliser from an open tank, typically of variable size (200ltr drum to 20,000 ltr molasses tank).
- the Large tanks enable large quantities of fertiliser to become suspended in solution and to be readily injected. Using a large tank provides a known fertiliser : water ratio.
- Small tanks / drums typically require water to be continuously added during fertigation event to ensure all the fertiliser in the drum becomes suspended and thus injected.



Suction Injection Method (cont…,)

Disadvantages

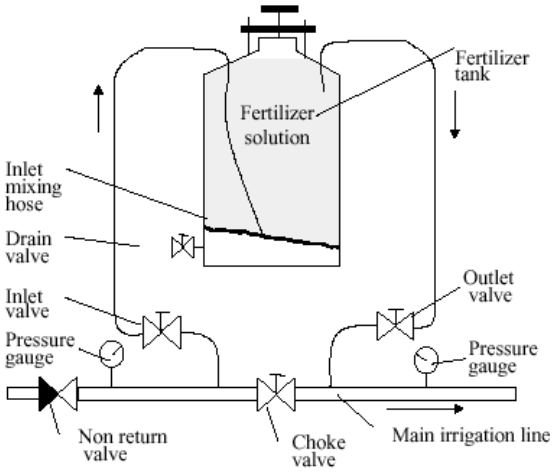
- Risks of air entering system, pump corrosion, contamination pump should be stainless steel and or fitted with a bronze impeller.
- Flushing the system is very important.

Advantages

- Very simple to operate.
- A stock solution does not have to be premixed.
- Easy to install and requires little maintenance.

Pressure Differential

Pressure differential tanks are closed tank systems that require a minimum of 35 kPa pressure difference from inlet to outlet to operate correctly.



Normally used in the field near filter banks, these tanks are prefilled with the required quantity of fertiliser for the block in question, filled with water, closed and then pressurised via the mainline.

In most cases around 6-8 tank volumes of water are required to pass through the tank to ensure all fertiliser has been injected.

Disadvantages of PD and Suction systems

- Injection rate is important due to the decreasing concentration of solution over the course of the fertigation period.
- Limited capacity.
- Danger of suction air entering the system unless all fittings are airtight.
- Risk of contamination of water supply if chemicals flow back down the suction pipe when the pumping unit stops.
- A check valve is necessary.

In conclusion

Of all the systems we have examined above, the industry consensus is that Positive Injection Systems will deliver the best results across a wide range of applications.

Positive injection Systems allow for greater control of dosage rates improving the accuracy of the systems and gives the option of using liquid nutrients or soluble nutrients. It is also easily automated which can allow for clean water flushing.

"It's true, Positive Injection Systems do come at a higher cost, but when you consider the savings in the cost of fertiliser and the increased productivity of the crop being treated. this is quickly paid back".

Don May is a guest writer of articles for Ferti-Ject and is not otherwise affiliated.

