Water for Profit

METHODS OF FERTIGATION

WATERFORPROFIT

Fertigation systems should be able to regulate the quantity and duration of applications, proportion of fertilisers and the starting and finishing time.

Strategies for fertigation management

Continuous application - fertiliser is applied at a constant rate from irrigation start to finish. The total amount is injected regardless of water discharge rate.

Three-stage application - irrigation starts without fertilisers. Injection begins when the ground is wet and cuts out before the irrigation cycle is completed. Remainder of the irrigation cycle allows the fertiliser to be flushed out of the system.

Proportional application - the injection rate is proportional to the water discharge rate, e.g. 1 L of solution to 1000 L of irrigation water. This method has the advantage of being extremely simple and allows for increased fertigation during periods of high water demand when most nutrients are required.

Quantitative application - nutrient solution is applied in a calculated amount to each irrigation block, e.g. 20 L to block A, 40 L to block B. This method is suited to automation and allows the placement of the nutrients to be accurately controlled.

Injection Methods and Equipment

The selection of the correct injection equipment is just as important as the selection of the correct nutrient. Incorrect selection of equipment can damage parts of the irrigation equipment, affect the efficient operation of your irrigation system or reduce the effectiveness of the nutrients. The three usual methods of injection are:

- suction injection
- pressure differential injection
- pump injection.

Suction injection

Suction of fertiliser through the intake of the pump is a common method of application and is the simplest method. The pumping unit develops a negative pressure in its suction pipe (unless the suction is flooded). This negative pressure can be used to draw fertiliser solutions into the pump. A pipe or hose delivers the fertiliser solution from an open supply tank to the suction pipe. The rate of delivery is controlled by a valve. This connection must be tight to prevent air entry into the pump.

Another hose or pipe connected to the discharge side of the pump can fill the supply tank with water. A high-pressure float valve can be used to regulate this inflow into the tank. If necessary the system can be automated with a direct-acting solenoid valve. For multiple block usage, two or more tanks can be set up in series and operated when required.

Advantages

- Very simple to operate, a stock solution does not have to be premixed.
- Easy to install and requires little maintenance.
- Ideal for dry formulations.

Disadvantages

- Concentration of solution decreases as fertiliser dissolves, placing most of the nutrients below the effective root zone if tank is operated when irrigation is commenced.
- Proportional fertigation is not possible unless several tanks are used.
- Limited capacity.
- Danger of suction air entering the pump unless all fittings are airtight.
- Risk of corrosion of pump bowl. Flushing the system is necessary.
- Risk of contamination of water supply if chemicals flow back down suction pipe when pumping unit stops. A check valve is necessary.

Pressure differential injection

A pressure differential tank system is based on the principle of a pressure differential being created by a valve, pressure regulation, elbows or pipe friction in the mainline, forcing water through a bypass pipe into a pressure tank and out again, carrying a varying amount of dissolved fertiliser.

Advantages

- Very simple to operate; a stock solution does not have to be premixed.
- Easy to install and requires little maintenance. Changing fertiliser is easy.
- Ideal for dry formulations.

Disadvantages

- Concentration of solution decreases as fertiliser dissolves, leading to poor placement of nutrients. Requires pressure loss in main irrigation line.
- Tank must be able to withstand irrigation line pressure.
- Proportional fertigation not possible.
- Limited capacity.
- Accuracy of application is limited and determined by volume rather than by proportion.

A pressure differential venturi system can be installed as a bypass or inline. The venturi causes a rapid change in velocity producing a reduced pressure (vacuum) which draws the fertiliser solution into the line. Injection rates of 2 L - 3000 L per hour can be achieved.

Advantages

- Simple in design with no moving parts.
- Easy to install, requiring little maintenance.
- Fertiliser rates can be controlled with some accuracy.
- Low labour, as a month's supply of stock can be mixed in an inexpensive tank.
- Low cost.

Disadvantages

- Quantitative fertigation is difficult.
- Requires pressure loss in main irrigation line (can be 33%).
- Automation is difficult.

Pump injection

This is the most common method of injection of fertiliser into irrigation systems. Injection energy is provided by electric motors, impeller-driven power units and water-driven hydraulic motors. The pumps are usually rotary, gear, piston or diaphragm-type which deliver fertiliser solution from the supply tank into the pressurised mainline. This method can be very accurate. Pumps are generally not simple in design and can include a number of moving parts, so wear and breakdown are more likely.

The three systems available are electric injection pumps, piston-activated pumps and diaphragm-activated pumps. Piston-activated and diaphragm- activated pumps are both hydraulic injection pumps and dominate the fertigation market at present.

Electric injection pumps include single or multiple piston, diaphragm, gear and roller pumps. These can be regulated to achieve the desired rate by:

- adjusting the length of the stroke of piston pumps
- selecting the appropriate pulley diameter
- using a variable-speed motor
- semi-automation to adapt pump to receive electrical impulses from a water meter which can then be used to apply precise amounts of fertiliser.

A Growcom project conducted in collaboration with the Department of Primary Industries and the National Centre for Engineering in Agriculture with funding provided by the Queensland Government's Rural Water Use Efficiency Initiative.

Advantages

- Simple and effective.
- Relatively easy to install and maintain.
- Either proportional or quantitative fertigation is possible.
- No pressure loss in the main irrigation line. Suitable for high head systems.
- Automation is relatively easy.

Disadvantages

- Pumps must develop a minimum mainline pressure to operate.
- Need electric power source to operate.
- Injection rate not easily adjusted.

Piston-activated pumps - 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 adjusted by throttling the injection line via a valve fitted to the water main. 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 up to 320 L/hour are possible.

Diaphragm-activated pumps - water pumped into the lower chamber activates a rubber diaphragm in the drive unit which forces the diaphragm and drive rod up, pushing the fertiliser out of the injector into the irrigation system. 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 L - 1200 L/ hour are possible. There is an upper limit to the pressure available and they may not operate on high head systems.

Advantages

- Very simple to operate, install and maintain. Either proportional or quantitative fertigation is possible.
- Rate of injection is easily adjustable.
- System is easily portable between paddocks.
- No pressure loss in main irrigation line.
- Automation is very easy.
- Not labour intensive.

Disadvantages

- Large number of working components.
- Sensitive to air pockets and needs a continuous water discharge to operate the piston or diaphragm. Pumps require a minimum line pressure.
- Spent 'drive water' is lost and discharged from the system.

The information contained on this sheet was obtained from the New South Wales Department of Agriculture Agnote 100-9 and is gratefully acknowledged.

For more details contact the Growcom members access line on 07 3620 3844.

Queensland Government NCEA growcom