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Fertigation: An Innovative Fertilizer Application Method

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Abstract
It is important to emphasise how important fertigation is for increasing productivity, cutting back on fertiliser and water use, and almost completely eliminating pollution. In modern farming systems, fertigation is frequently used as a low-cost and efficient method of applying soluble nutrients to crops. Efficiency, sufficiency, and uniformity are important fertigation performance evaluation criteria. A composite measurement known as "fertigation uniformity" comprises indicators for irrigation and fertiliser application uniformity. Since it was first used in horticultural cropping systems, fertigation in conjunction with micro-irrigation has become more popular. Combining these elements offers a technical solution that enables precise fertiliser and water delivery to the crop, leading to great nutrient usage efficiency. For precise plant nutrition and excellent nutrient usage efficiency, fertigation cropping systems require accurate calculations of crop nutrient and water needs. When compared to surface irrigation, this approach can reduce irrigation water use by up to 50% while also increasing crop yields and quality. To get the most out of drip irrigation, certain soil properties, like as infiltration rate, soil texture, and water quality of both surface and well water, must be taken into account in system design and administration.

Keywords: nutrients, fertilizer, water, drip irrigation, plant.

Fertigation
Fertigation is a fertiliser application method that uses a drip irrigation system to dissolve fertiliser in irrigation water. In this system, the fertiliser solution is evenly distributed through irrigation. The efficiency is higher because nutrients are readily available. In this case, liquid fertilisers and water-soluble fertilisers are used. By employing this strategy, fertiliser use efficiency increases from 80 to 90%. Fertigation is a relatively new cultural approach in which nutrients are mixed with irrigation water and applied via drip irrigation to increase fertiliser efficiency while also increasing crop yields. Nutrient and water-soluble fertiliser solutions are injected into irrigation water using the appropriate injection equipment. Fertigation directs necessary elements to the active roots zone, reducing costly nutrient losses while increasing productivity and quality parameters of the produced product and lowering the risk of contamination. The purpose of this article is to provide insight into the various aspects of fertigation technology.

Importance of Fertigation
Fertilisers are recommended in the agronomic field to achieve good crop production and quality, especially when the soil in which the crop is grown lacks sufficient resources to meet the crop's needs. Fertilisers increase the depth to which roots grow and assist the plant in absorbing nutrients in low-fertility soils. Given that 20-40% of applied fertiliser is assimilated by crops and the remaining is lost through various mechanisms, optimising the use of

nutrients applied to the plant is required to achieve this increase in crop yield and quality. According to data from the International Fertilizer Association (IFA), the amount of fertilisers used in agriculture was around 187 million tonnes in 2018, with forecasts stating that this amount will rise to 1914.4 million tonnes in 2020. So the challenge of today's agriculture is to optimise fertilisers and use irrigation water responsibly and efficiently. There is fertigation, a technique that allows the simultaneous application of water and fertilisers through the irrigation system, optimising their responsible and efficient use, to achieve maximum efficiency of water and fertilisers with no losses of any kind.

Advantages

- Increased assimilation of nutrients by plants
- Accurate nutrient placement, where the water travels, the nutrient goes as well
- Micro-dose capability, feeding just enough nutrients to plants so that there is no unnecessary wastage of nutrients via washing down due to a heavy rainstorm
- The decrease in the usage of water, synthetic fertilizers, and the use of other chemicals that might compromise the integrity of the soil
- Reduction in water consumption due to the ability of the plant root mass to trap and hold water
- The rate of application of nutrients in terms of time and quantity can be controlled more efficiently
- The risk of the roots contracting soil-borne diseases is minimised
- Increased chances of avoiding soil erosion as the nutrients are passed via water dripping system

Disadvantages

- Poor equipment selection may lead to poor nutrient placement
- As the fertilizer dissolves, there's a chance that the concentration of the solution may decrease
- The main irrigation line may suffer from a loss of pressure
- The whole process depends on the water supply. If the water supply is compromised, so will the fertigation process.

Methods of Fertigation

It is not only more efficient for fertilizer usage, but can also be for maximizing nutrient uptake in plants like cotton. Drip irrigation using fertigation can also increase the yield and quality of fruit and flowers, especially in subsurface drip systems rather than above-surface drip tape.

Nutrients can be applied at any time during the season and according to plant requirements:

- Placement of mobile nutrients such as nitrogen can be regulated in the soil profile by the amount of water applied.
- Applied nutrients are readily available for rapid plant uptake.
- Nutrients are applied uniformly over the field.
- Crop damage during fertilizer application is minimized (FAO, 2005)

Four systems are generally used:

1. Continuous application: Fertiliser is applied at a constant rate from irrigation start to finish. The total amount is injected regardless of the water discharge rate.

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

3. Proportional application: The injection rate is proportional to the water discharge rate, e.g. one l of solution to 1000 l of irrigation water. Fertiliser recommendation can also be expressed in terms of kg ha^{-1} day^{-1} (or week). 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.

4. Quantitative application: Nutrient solution is applied in calculated amount to each irrigation block. It can also be expressed in terms of concentration (g m^{-3} = ppm). This method is suited to automation and allows the placement of the nutrients to be accurately controlled.

List of fertilizers used in fertigation:

- Urea
- Anhydrous ammonia
- Aqua ammonia
- Ammonium phosphate
- Ammonium nitrate
- Calcium nitrate
- Potassium chloride or MOP
- Potassium sulphate
- Potassium magnesium sulphate

Precautions and Back flow prevention

Backflow, whether from back siphonage or back pressure, must be avoided in order to safeguard drinking water supplies and groundwater from chemical pollution. The primary backflow prevention tools utilised during chemigation. Cross connections between a water source and an irrigation system can cause backflow in a system. For instance, if the water is shut off but the chemical injection unit is still operating, the water source may get contaminated.

Back siphonage, which occurs when there is negative pressure (vacuum or partial vacuum) in the supplying pipe, is the reversal of the usual system flow. Low pressure in the water supply is the cause of back siphonage. For instance, the irrigation system's mainline source pipe could burst below it, or a failed supply pump could cause a significant drop in pressure. Installing check valves, vacuum relief valves, or vacuum breaker valves can help to prevent such situations.

Back pressure is the reversal of normal system flow due to downstream pressure increasing above supply pressure. Backpressure may occur if a system operates at higher pressures than its water supply, perhaps due to use of booster pumps or interconnection of a water source to other water systems. Such situations can be avoided by installing double check valves or special valves that combine check valves with reduced pressure zones commonly known as reduced pressure principle backflow prevention valves.

Conclusion

Fertigation is a low-cost method of providing plant nutrients to field crops. Increased crop production and quality, resource conservation, environment protection, operational flexibility, efficient weed management, and successful crop cultivation on uneven topography are just a few benefits that users can enjoy when using fertilisation. As a result of its ability to stop the leakage of nutrients, notably N-NO3, it is regarded as environmentally beneficial. Various fertigation techniques may be used for various circumstances. The type of crop and irrigation system will determine which fertilisation equipment is best for you. The best fertilisers for fertigation are those that dissolve in water or are liquid fertilisers. Depending on the phenological stage of the plant, several fertilisation strategies can be developed and applied in minute amounts at the ideal time. Because the nutrients are concentrated in the root zone, the

fertilisers work more quickly and efficiently. distribution that is simultaneous and homogeneous See the compatibility chart before combining two or more fertilisers. Compared to conventional fertilisation techniques, the initial cost of installing a fertigation system is higher, but over time it will be more cost-effective because it decreases the cost of cultivation by lowering fertiliser requirements and boosts farm income through enhanced production.

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