



Fertigation in Protected Cultivation

Rakesh Kumar Pattnaik

Dept. of Fruit Science and Horticulture Technology, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha (751 003), India.

Abstract

An approach for efficient utilisation of water and fertilisers is necessary for agriculture in the 21st century. As the use of conventional irrigation methods not only results in considerable loss of water but is also responsible for development of wide spread salinity, water logging and leaching of nutrients from the rhizosphere. Fertilisers supplied under traditional methods of irrigation are not effectively utilized by the crops. As an alternative, fertigation is gaining popularity all over the world. It was first started in the late 1960's in Israel with the development of drip irrigation and over 75% of the irrigated area is fertilized by fertigation.

Key words Protected cultivation, Green house, Fertigation, Irrigation.

Introduction

Fertigation is a method of fertilizer application in which fertilizer is incorporated within the irrigation water by the drip system. In this system fertilizer solution is distributed evenly in irrigation. The availability of nutrients is very high therefore the efficiency is more. In this method liquid fertilizer as well as water soluble fertilizers are used. By this method, fertilizer use efficiency is increased from 80 to 90 per cent.

Water and fertilizers are the two most important inputs in the crop production. Due to increasing pressure on both these resources, there is immediate need to increase the efficiency of these inputs. Fortunately, the technology of drip irrigation can be used effectively to enhance the efficiency of these resources. Application of fertilizers through drip/sprinkler is termed as 'fertigation'. Though fertigation technology is a boon to increase the fertilizer use efficiency, there is a great deal of science

to be understood before it becomes successful on the farmers' fields. Following sections describe this science in a nutshell.

Keywords in fertigation are as under

- Chemigation is an inclusive term referring to the application of a chemical into or through an irrigation system. It includes the application of fertilizers, acids, chlorine and pesticides.
- Fertigation is specifically the application of fertilizer (plant nutrients) through an irrigation system.
- Acidification is the introduction of an acid, such as phosphoric, sulfuric or hydrochloric acid into an irrigation system.
- Chlorination is the introduction of chlorine, such as liquid sodium hypochlorite (household bleach) or chlorine gas into an irrigation system

Advantages of fertigation

- **Eliminates manual application** Manual operation requires labour and time and is less efficient compared to the advanced fertigation methods. The fertigation eliminates this manual operation.
- **Uniformity in application** Since the drip or microsprinkler irrigates a limited area of active root zone and fertilizers are placed directly in this active root zone, there is very high uniformity in the application of fertilizers.
- **High efficiency and saving of fertilizer** In fertigation, fertilizers are applied in small quantities and more frequently. Fertilizers are directly placed in the active root zone. Hence, there is no loss of fertilizers through runoff, leaching or volatilization. It results into high efficiency of fertilizer application and saving of fertilizers to the tune of 30 to 40%.
- **Less fertilizer leaching and groundwater pollution** As controlled volume of water and fertilizer is applied in fertigation there is less (or negligible) leaching of fertilizers which results in less groundwater pollution.
- **Better penetration of P and K in the layers** Phosphatic fertilizers get fixed when applied in the soil. But in fertigation they are placed in the soluble form and hence can be placed in different layers where water percolates.

- **Improvement in nutrients availability and their uptake** In fertigation fertilizers can be given every day and the quantity given is based on the crop nutrient requirement. Hence, nutrients are available as and when the crop requires it.

Limitations of fertigation

- Possibility of clogging of emitters if the pH of irrigation water and fertilizer sources is not managed carefully.
- May result in possible contamination of the drinking water supply if devices are not used to prevent backflow of nutrients into the well or other water sources.
- Insoluble fertilizers are not suitable (e.g., super phosphate)
- Phosphate may get precipitated in the pipe line and dripper due to pH reaction.

Common fertilizers suitable for fertigation in protected cultivation

Chloride free fertilizers

These fertilizers are produced by using Urea, ammonium nitrate phosphate and potassium nitrate as basic ingredients and are useful for high value crops and crops which are more sensitive to the chloride injury. Ex: Tobacco, grapes, citrus, arecanut and vegetables.

Liquid fertilizers

Bulk fertilizers such as ammonium sulphate, ammonium nitrate, urea, ammonium phosphate, phosphoric acid, potassium nitrate, potassium chloride, potassium sulphate, etc. are primarily the raw materials used in the manufacture of liquid fertilizers. The liquid fertilizers do not precipitate and are pure. The liquid fertilizers are typically acidic (pH 5.5-6.5) and help to some degree to correct the soil pH and also help avoid the clogging of emitters. Liquid fertilizer with a neutral pH or even higher pH may be used for acidic soils.

Normal fertilizers

These are produced by using ammonium nitrate, urea, ammonium phosphate, ammonium sulphate, phosphoric acid, potassium chloride etc.

Table 1: Nutrient (N, P₂O₅, K₂O) content of common fertilizers in their solid and saturated liquid forms

Nutrient	Fertilizer	N: P ₂ O ₅ :K ₂ O	
		Under solid form	Under saturated liquid form (pH 5.5-6.5)
Nitrogen	Urea	46:0:0	21:0:0
	Ammonium nitrate	33:0:0	21:0:0
	Ammonium Sulphate	21:0:0	10:0:0
Phosphorus	Phosphoric acid	—	0:61:0
	Monoammonium Phosphate	12:61:0	4:18:0
	Diammonium Phosphate	18:46:0	7:25:0
Potassium	Potassium Chloride	0:0:60	0:0:15
	Potassium Nitrate	13:0:46	4:0:12
	Potassium Sulphate	0:0:50	0:0:6
	Mono-Potassium	0:52:34	0:10:7

Forms of inorganic fertilizers

Slow-release fertilizer and liquid fertilizer are commonly used in green houses.

Slow-release fertilizer

They release the nutrient into the medium over a period of several months. These fertilizer granules are coated with porous plastic. When the granules become moistened the fertilizer inside is released slowly into the root medium. An important thing to be kept in mind regarding these fertilizers is that, they should never be added to the soil media before steaming or heating of media. Heating melts the plastic coating and releases all the fertilizer into the root medium at once. The high acidity would burn the root zone.

Liquid fertilizer

These are 100 per cent water soluble. These comes in powdered form. This can be either single nutrient or complete fertilizer. They have to be dissolved in warm water.

Fertilizer Application Methods

• Constant feed

Low concentration at every irrigation is much better. This provides continuous supply of nutrient to plant growth and results in steady growth of the plant. Fertilization with each watering is referred as fertigation.

• Intermittent application

Liquid fertilizer is applied in regular intervals of weekly, biweekly or even monthly. The problem with this is wide variability in the availability of fertilizer in the root zone. At the time of application, high concentration of fertilizer will be available in the root zone and the plant immediately starts absorbing it. By the time next application is made there will be low or non-existent. This fluctuation results in uneven plant growth rates, even stress and poor-quality crop.

Fertilizer used in fertigation

- Urea, potash and highly water-soluble fertilizers are available for applying through fertigation.
- Application of super phosphorus through fertigation must be avoided as it makes precipitation of phosphate salts. Thus, phosphoric acid is more suitable for fertigation as it is available in liquid form.
- Special fertilisers like mono ammonium phosphate (Nitrogen and Phosphorus), poly feed (Nitrogen, Phosphorus and Potassium), Multi K (Nitrogen and Potassium), Potassium sulphate (Potassium and Sulphur) are highly suitable for fertigation as they are highly soluble in water. Fe, Mn, Zn, Cu, B, Mo are also supplied along with special fertilisers.

N fertigation

Urea is well suited for injection in micro irrigation system. It is highly soluble and dissolves in non-ionic form, so that it does not react with other substances in the water. Also, urea does not cause precipitation problems. Urea, ammonium nitrate, ammonium sulphate, calcium ammonium sulphate, calcium ammonium nitrate are used as nitrogenous fertilizers in drip fertigation.

P fertigation

Application of phosphorus to irrigation water may cause precipitation of phosphate salts. Phosphoric acid and mono ammonium phosphate appear to be more suitable for fertigation.



K fertigation

Application of K fertilizer does not cause any precipitation of salts. Potassium nitrate, Potassium chloride, Potassium sulphate and mono potassium phosphate are used in drip fertigation.

Micro nutrients

Fe, Mn, Zn, Cu, B, Mo could be used as micro nutrients in drip fertigation.

Conclusion

Fertigation is a precise, controlled and tested method of applying fertilisers, nutrients and other water-soluble products through drip lines and sometimes by micro sprinkler irrigation systems as per crop requirements, its stage, canopy size, soil or season, etc. which increase the fertilizer use efficiency and stimulate the crop growth effectively.

References

Gaikwad, D.J., Maitra, S. and Shankar, T., 2020. Irrigation and Fertigation in Protected Cultivation. *In: Protected Cultivation and Smart Agriculture, New Delhi Publishers, New Delhi: (pp. 40-54).*

ISBN: 978-81-948993-2-7, DOI: 10.30954/NDP-PCSA.2020.5

<https://ncert.nic.in/vocational/pdf/kepc104.pdf>

<https://sites.google.com/site/greenworldcropcult/green-home/drip-irrigation-and-fertigation-systems-in-greenhouse-cultivation>