



Fertigation - Design

Sprinkler and Micro irrigation Systems

Factors for Fertigation Design

- I. estimation of available nutrients in soil,
- II. estimation of amount of fertilizer required,
- III. frequency of fertigation,
- IV. fertilizer tank capacity,
- V. irrigation water requirement,
- VI. capacity of drip system,
- VII. injection duration,
- VIII. estimation of concentration of nutrients in irrigation water and
- IX. injection rate.

Estimation of Fertilizer Requirement

- Requirement of fertilizers changes according to the stage of plant growth.
- The amount of nutrients to be applied during fertigation and the total amount to be applied during active crop production season depend on the frequency of fertigation, soil type, nutrient requirements of the crop and its availability in the soil.
- Required amount of fertilizer may be estimated by using the following equation

$$F_n = (R - A_n) \times F_{cf}$$

Where,

- F_n = nutrient requirement, kg ha⁻¹
- R = recommended dose of fertilizer for the crop, kg ha⁻¹
- A_n = available fertilizer in the soil, kg ha⁻¹
- F_{cf} = fertilizer correction factor (based on factors modifying nutrient requirements i.e. manure, pre-crop residue incorporation, irrigation etc.)

Estimation of Fertilizer Requirement

- To determine the quantity of fertilizer to be injected into the system for each setting, the area irrigated in each setting of the lateral line is obtained by multiplying the length of the lateral coverage and the move of the lateral. The quantity of fertilizer to be injected is calculated using the following equation

$$D_f = \frac{D_s \times D_e \times N_s \times W_f}{10000}$$

Where,

- D_f = amount of fertilizer per setting, kg.
- D_s = distance between sprinklers, m
- D_e = distance between laterals, m
- N_s = number of sprinklers, and
- W_f = recommended fertilizer dose, kg ha⁻¹

Frequency of Fertigation, Duration and Capacity of Fertilizer Tank

a) Frequency of fertigation

- Fertilizers can be injected into the irrigation system at various frequencies once a day or once in every two days or once in a week. The frequency depends on system design, irrigation scheduling, soil type, nutrients requirement of the crop and the farmer's preference.

b) Injection Duration in Fertigation

- The maximum injection duration depends soil type and nutrient and water requirements of the crop. A maximum duration of 45 to 60 minutes (Clark et al., 1990) is generally recommended with enough time for flushing of fertilizer residues from the lines before shutting the pump off.

Frequency of Fertigation, Duration and Capacity of Fertilizer Tank

C) Fertilizer Concentration

The actual concentration of nutrients needed in the irrigation water depends on the type of crop. Many systems will have flowing water with a requirement to maintain a desired concentration of a chemical in the system. This requires injecting a supply mixture at proper rate to maintain the desired concentration level.

According to Howell et al. (1980) fertilizer concentration in the irrigation water is estimated by

$$C_f = \frac{100 F_r}{T_r \times I_d}$$

Where,

C_f = concentration of nutrients in irrigation water, ppm

T_r = ratio between fertilization time and irrigation time

I_d = gross irrigation depth, mm

F_r = rate of fertilizing irrigation cycle, kg ha⁻¹

Frequency of Fertigation, Duration and Capacity of Fertilizer Tank

d) Fertilizer Injection Rate

The fertilizer injection rate into the system depends on the concentration of the liquid fertilizer and the desired quantity of nutrients to be applied during irrigation.

The following equation is used to determine the fertilizer injection rate. The injection rate may be predetermined by the capacity of the injector or the flow rate of the irrigation system.

The desired injection rate can also be calculated by using the following formula if all the parameters are known.

Where,

$$q_{fi} = \text{injection rate of liquid fertilizer} \quad q_{fi} = \frac{F_r \times A}{c \times t_r \times I_t} \quad \text{stem, L h}^{-1}$$

F_r = rate of fertilizing (quantity of nutrient per irrigation cycle, kg ha⁻¹)

A = area irrigated (ha) in time, I_t

c = concentration of nutrient in liquid fertilizer, kg L⁻¹

t_r = ratio between fertilization time and irrigation time

I_t = duration of irrigation, h.

Injection time should be limited to prevent over-application of water that will leach chemicals.

Frequency of Fertigation, Duration and Capacity of Fertilizer Tank

e) Fertilizer Tank Capacity

- The size of the fertilizer tank will depend on the volume of chemical mixture to be injected, which in turn will depend on either the total amount or volume of chemicals to be applied or on the length of the injection period.
- Low cost tanks are practical where an injection pump or venturi is used. A large tank provides a good place to store fertilizer tank ranges from 30 to 600 L.
- This is not enough, because some fertilizers need larger, the capacity varies from 300 to 600 L.

Frequency of Fertigation, Duration and Capacity of Fertilizer Tank

- The stock solution is prepared based on the solubility of the fertilizers used. Normally highest concentration is not desirable and it is recommended that stock solution is prepared with slightly lesser concentration.
- The fertilizer tank capacity is computed by using following equation

$$C_t = \frac{F_r \times A}{c}$$

where

C_t = capacity of fertilizer tank, L

F_r = rate of fertilizing per irrigation cycle, kg ha⁻¹

A = area irrigated (ha) in time, I_t

c = concentration of nutrient in liquid fertilizer, kg L⁻¹.

!!!-Thank you-!!!

