

# Drip Fertigation to Increase the Productivity of Coconut

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Coconut palm is widely grown in areas lying 20°N to 20°S of equator and it is concentrated more in coastal areas. More than 50 per cent of the coconut area is rainfed resulting in low production and productivity. In some of the newly introduced areas and in areas where proper management is practiced there is higher production of coconut which emphasize the need to practice agro techniques for coconut production. Among different agro techniques, supply of adequate water and nutrients play a key role in production. Therefore it is imperative to develop agro technologies which will optimize the use efficiency of both water and nutrients and maximize the crop yields per unit consumption of vital inputs.

Drip irrigation is an efficient method of providing irrigation water directly to the root zone of plants and it permits the irrigation to limit the watering closely to the crop as per the requirement of crops. The system applies water at low rate and under pressure to keep the soil moisture within the desired range for plant growth. The system has overall application efficiency around 90 per cent as compared to 25-30 per cent for surface irrigation.

Fertigation, which is widely adopted practice in Israel and other advanced countries, is an efficient method of fertilizer application through drip system. Drip fertigation increases the fertilizer use efficiency, saves fertilizer costs, reduce labour requirement, supply nutrients according to the crop demand during varying physiological stages, uniform, precise and direct application to root zone, correction of micronutrient deficiencies etc. Soluble fertilizers viz., urea, DAP and potassium chloride can be combined and supplied through drip

irrigation. The other possibility is to use liquid fertilizers which are highly soluble, hence no interference and no clogging except for the high cost. Application of nutrients like N increases morphological characters like leaf area and root length of the crops which are responsible for enhanced water use efficiency through improvement in water uptake, evaporation and transpiration. Extensive root proliferation occurs due to improved P supplies. The enhanced root activity explores soil volume to greater depths. Potassium plays a specific role in the mechanism of opening and closing of stomata and thus adequate potassium helps in reducing the water loss by transpiration.

## Fertilizer solubility

An essential pre-requisite for the solid fertilizer use in fertigation is its complete dissolution in the irrigation water. Highly soluble fertilizers appropriate for fertigation are : ammonium nitrate, potassium chloride, potassium nitrate, urea, ammonium monophosphate and potassium monophosphate. The solubility

of fertilizers depends on the temperature. DAP also has good solubility which is mainly used for supplying phosphorous and nitrogen.

## Practices of fertigation

To capitalize on fertigation benefits, particular care should be taken in selecting fertilizers and injection equipments as well in the management and maintenance of the system.

## Fertilizer injection methods

The three methods of injection are :

### Pressure differential (by-pass tank)

A pressure differential tank system is based on the principle of a pressure differential created by a valve, pressure regulation, elbows or pipe friction in the mainline. The pressure difference forces the water to enter through a by-pass pipe into a pressure tank which contain fertilizer and to go out again, carrying different quantities of dissolved fertilizer. The application of nutrients is quantitative and inaccurate, therefore is adapted for perennial crops like citrus, fruit trees and/or crops grown in heavy soil.

### Advantages

- Very simple to operate, the stock solution does not have to be pre-mixed
- Easy to install and requires very little maintenance
- Easy to change fertilizers

- Ideal for dry formulations
- No electricity or fuel is needed

#### Disadvantages

- Concentration of solution decreases as fertilizer dissolves
- Accuracy of application is limited
- Requires pressure loss in main irrigation line or a booster pump
- Proportional fertigation is not possible
- Limited capacity
- Not adapted for automation
- Inlet valve

#### Vacuum injection (Venturi)

This method uses a venturi device to cause a reduced pressure (vacuum) that sucks the fertilizer solution into the line.

#### Advantages

- Very simple to operate, no moving parts
- Easy to install and to maintain
- Suitable for both proportional and quantitative fertilization

#### Disadvantages

- Requires pressure loss in main irrigation line or a booster pump
- Quantitative fertigation is difficult
- Automation is difficult

#### Pump Injection

Pumps are used to inject the fertilizer solution from a supply tank into the line. Injection energy is provided by electric motors, hydraulic motors (diaphragm and piston).

#### Advantages

- Very accurate, for proportional fertigation
- No pressure loss in the line
- Easily adapted for automation

#### Disadvantages

- Expensive
- Complicated design including a number of moving parts, so wear and breakdown are more likely.

The major crops covered under fertigation are grapes, floriculture, pomegranate, banana, sugarcane, vegetables, coconut, mango etc., in descending order and crops covered under foliar application are vegetables, cotton, chillies, spices, paddy, citrus, mango, apples, pulses, oil seeds etc., in descending order.

#### Facts about drip irrigation for fertigation purpose

**Emitter/Micro tube placement in the coconut basin :** Coconut basin generally means 1.8 to 2 m radius from the centre of the bole all around the palm. Isotopic study on the coconut root indicates that 0.75 m to 1.25 m away from the bole is the active absorption zone and hence it is recommended to place the emitter/micro tubes in the centre of that area (1m away from bole) (*Fig. 1*). Suppose

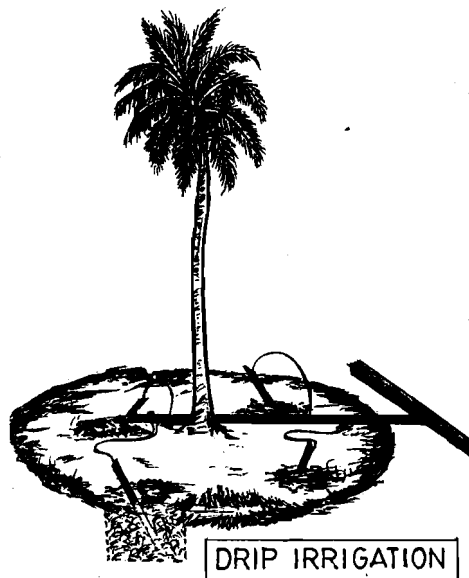


Fig. 1.

if the water is allowed to drip on the surface, it leads to evaporation losses where a good amount of water is lost. Therefore, it is advisable to allow the water to drip at 30 cm depth. This is achieved by making a pit of 30 cm<sup>3</sup>. A conduit pipe of 40 cm is placed diagonally and the water is allowed to drip in that pipe at 30 cm depth. The pit should be filled with locally available mulch preferably coir pith. The percent volume of active root zone wetted was 13.6 and 18.2 respectively in surface and subsurface placement of emitters. The subsurface placement wetted 35 per cent more volume than the surface placed emitters. (Dhanapal *et al.*, 1995).

#### Water spread

In trickle irrigation the soil water distribution for different soil is an important factor to be understood before initiation of irrigation as the volume of roots wetted has relationship with the quantities of water and nutrient uptake. Soil water distribution is determined by the soil properties and the way the water is added and withdrawn from the profile. Factors which generally differentiate the soil water regime for trickle from other irrigations systems are i) The flow regime is 2 or 3 dimensional rather than vertical only ii) The water is added at high frequency and iii) Soil water is maintained within a relatively narrow range. Previous studies indicated that at least 15-20 per cent of the active root zone should get wet.

A minimum of 15 to 20 per cent of the active root zone should be wet to absorb the water required by the palms. Results of the experiment conducted at CPCRI has shown (water spread from a single point source) that at least four emitters are required for the laterite and red sandy loam soil,

whereas for the sandy soil, six emitters are required to wet adequate volume of active root zone.

The reason for increasing the number of emitters for the sandy soil was the horizontal spread which was

Moisture distribution pattern in coconut basin under drip irrigation

Soil Type	Water spread		% Active root zone wetted*
	Horizontal (cm)	Vertical (cm)	
Laterite soil	60	100	28.8
Red sandy loam	61	115	31.0
Sandy soil	34	110	10.2 (15.1)**

\*For four emitters \*\*six emitters

only about 50 per cent of that of the laterite and red sandy loam soil and the wetted volume of active root was

only 10.2 per cent for four

emitters. The wetted volume

with six emitters was 15.1

per cent. Experimental

experience revealed that

having 4 emitters for the

littoral sandy soil did not

have impact on the

performance of the palms as

the water spread as well as

the water holding capacity

of the soil are less. Estimated

active root zone volume

wetted by four emitters is

given in Table, which

indicates that the red sandy loam soil

have more percentage wetting

compared to other soils probably due

to higher clay content in the soil

compared to others. (Dhanapal *et al.*

2000).

Under Kasaragod conditions 32-40 liters (66 per cent of open pan evaporation) of water/palm/day can be applied through drip irrigation based on the open pan evaporation. And actual irrigation should be started in

the month of November when the soil

moisture depletes to 50 per cent ASM.

In an year six times fertilizers can be

applied in equal splits depending on

the rain fall period. However fertilizers

should not be applied during heavy

rainfall season. Findings of CPCRI

indicated that 50 per cent of the

recommended dose of fertilizer when

applied through drip fertigation is

sufficient to produce an yield

equivalent to 100 per cent of the

recommended dose of fertilizer. The

fertilizers were applied through a by

pass tank to the palms (Fig.2.).

Fertilizers viz., 70 g Urea, 60 g DAP

and 170 g muriate of potash are

recommended for a single dose for one

palm. (Like this six doses are to be

given to the palms which are to be

applied from December to May at

monthly intervals for Kerala

conditions). For Phosphorus

application, commercial phosphoric

acid also can also be used. In areas

where the availability of soil

phosphorus is more than 20

ppm/ha, phosphorus

application can be skipped.

Here, Fertigation can be

practiced with urea

(nitrogen) and muriate of

potash alone (Potassium).

However phosphorus need

to be applied once in two

years or once the soil

phosphorus reaches less than

20 ppm.

Though Fertigation is

possibly by drip, sprinkler and

other irrigation methods, for

plantation crops like coconut, arecanut

etc. fertigation is most suitable/

economical by drip irrigation as these

crops are widely spaced. If Fertigation

is adopted by sprinkler irrigation, more

water and nutrients will be lost.



Fig. 2. Fertilizer by pass tank

applied in equal splits depending on

the rain fall period. However fertilizers

should not be applied during heavy

rainfall season. Findings of CPCRI

indicated that 50 per cent of the

recommended dose of fertilizer when

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-Editor