

21. MICRO IRRIGATION

Micro irrigation is a modern method of irrigation; by this method water is irrigated through drippers, sprinklers, foggers and by other emitters on surface or subsurface of the land. Major components of a micro irrigation system is as follows.

Water source, pumping devices (motor and pump), ball valves, fertigation equipments, filters, control valves, PVC joining accessories (Main and sub main) and emitters. In this system water is applied drop by drop nearer the root zone area of the crop. The drippers are fixed based on the spacing of crop. Many different types of emitters are available in the market. They are classified as Inline drippers, on line drippers, Micro tubes, Pressure compensated drippers.

Drip irrigation is most suitable for wider spacing crops. Micro sprinkler irrigation system is mostly followed in sandy or loamy soils. This system is most suitable to horticultural crops and small grasses. In this method water is sprinkled in a lower height at various directions.

Portable micro sprinklers are also available. They distribute slightly more water than drippers and micro sprinklers. They spray water in not more than one meter. It is used for preparing nursery and lawns in soils with low water holding capacity.

Advantages of drip irrigation system

- Water saving and higher yield
- High quality and increased fruit size
- Suitable for all types of soil
- Easy method of fertigation and chemigation
- Saving in labour and field preparation cost

Disadvantage of drip irrigation system

- High initial investment
- Clogging of emitters
- Possible damage of system components due to animals, etc.,

Investment cost mostly differs based on spacing of the crops

- Generally, the reasons for clogging are solid particles (sand, rust), soft dirt (organic matter, algae, micro organism, salt), sediments (salt in the fertilizers).
- Filtration is the main key factor to the success or failure of the system. The aim of filtration is to stop dirt particles which damage any components of the system.
- To remove salt encrustation, 30 per cent commercial Hydrochloric acid can be used at the rate of one liter per one m³ of system discharge.

- To remove algae and fungal clogging 5 to 500 ppm sodium hydrochloride (10 per cent chlorine) can be used.

Maintenance of drip system

- Back washing and sand filters has to be cleaned
- Frequent cleaning of emitters and drippers
- Flushing at every irrigation
- Cleaning of sub main and main pipes
- Cleaning of PVC pipes and laterals and acid or chlorine may be used to remove clogging.

Water used and yield of crops in micro and conventional irrigation methods

Crop	Methods of irrigation	Water requirement (cm)	% water saving	Yield kg ha ⁻¹	% increase in yield	Water use efficiency (kg ha mm ⁻¹)
Banana	Drip	97.00	45.00	87500	52.00	90.20
	Surface	176.00	-	57500	-	32.67
Sugarcane	Drip	94.00	56.00	170000	33.00	180.85
	Furrow	215.00	-	128000	-	59.53
Grapes	Drip	27.80	48.00	32500	23.00	116.90
	Surface	53.20	-	26400	-	49.62
Aerobic rice	Conventional aerobic rice	74.30	38.10	4747	-	6.39
	Surface drip	61.90	48.40	5940	14.20	9.60
	Sub-surface drip	61.90	48.40	6227	19.80	9.74
	Conventional transplanted	120.00	-	5200	-	4.33
Cotton	Drip	28.00	66.27	3250	25.00	116.10
	Furrow	83.00	-	2600	-	31.33
Beetroot	Drip	17.70	79.34	887	55.34	50.11
	Surface	85.70	-	571	-	6.66
Radish	Drip	10.80	75.72	1186	13.49	109.80
	Surface	46.40	-	1045	-	22.52

Crop	Methods of irrigation	Water requirement (cm)	% water saving	Yield kg ha ⁻¹	% increase in yield	Water use efficiency (kg ha mm ⁻¹)
Papaya	Drip	73.88	67.89	23490	69.47	0.32
	Surface	225.80	-	13860	-	0.06
Mulberry	Drip	20.00	60.00	71400	3.03	3570
	Surface	50.00	-	69300	-	1386
Tomato	Drip	18.40	39.00	48000	50.00	260.86
	Surface	30.00	-	32000	-	106.66

(WTC Annual Reports 1985-2003)

Affordable micro irrigation systems

Affordable micro irrigation system is mostly suitable to kitchen garden, nursery and ornamental crops.

1. Bucket kit system

Bucket kit system is designed for kitchen garden suitable for women, marginal and small farmers. It consists of a bucket (15 lit.) 10 metre long lateral (12mm) fitted with drippers (4 LPH), which can irrigate about 100 plants in approximately 15 m² area. The bucket is placed at a height of 1m (3 feet) and water is filled for 4 to 5 times daily.

2. Drum kit system

This system is ideally suitable to kitchen garden and small commercial vegetable growers. The drum is having 200 liter capacity which would supply water approximately 500 plants by filling the drum twice daily. It consists of lateral (16mm and 12mm). One number of 16mm lateral and five 12mm laterals are used. This system could cover an area of 120 m² (3 cents).

3. Micro sprinkler system

Micro sprinkler kit is suitable for farmers with access to pressurised water. It is very useful for groundnut, vegetables, nurseries home gardens, and lawns etc. It can be connected with a tap from an overhead tank or a domestic water pump. It consists of 15 micro sprinklers with pipes irrigating an area of 250 m² (6 cents). Fertigation can also be done through this method.

Sl. No.	Item	Selling Cost/Unit	Area covered by the kits
1.	Bucket Kit (Drip system)	Rs.225	20 m ² (0.5 cent)
2.	Drum Kit (Drip system)	Rs.600 (Excluding Drum Cost)	120 m ² (3.0 cents)
3.	Micro sprinkler kit	Rs.900	240 m ² (6.0 cents)

Fertigation

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.

Fertilizer efficiencies of various application methods

Nutrient	Fertilizer use efficiency (%)	
	Soil application	Fertigation
Nitrogen	30-50	95
Phosphorous	20	45
Potassium	50	80

Advantages of fertigation

- Nutrients and water are supplied near the active root zone through fertigation which results in greater absorption by the crops.
- As water and fertilizer are supplied evenly to all the crops through fertigation there is possibility for getting 25-50 per cent higher yield.
- Fertilizer use efficiency through fertigation ranges between 80-90 per cent, which helps to save a minimum of 25 per cent of nutrients.
- By this way, along with less amount of water and saving of fertilizer, time, labour and energy use is also reduced substantially.

Water saving, yield and profit under drip and drip fertigation systems

Crops	Water Saving (%)	Yield (t/ha)			Profit (Rs/ha)		
		Conventional	Drip	Drip+ Fertgn	Conventional	Drip	Drip + Fertgn
Banana	35	26	30	37	81000	98000	120000
Sugarcane	29	120	160	207	30000	47000	68000
Tomato	32	45	56	65	56000	77000	95000
Aerobic rice	48	4.75	5.58	6.23	47470	55760	62270

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.

Fertilizers commonly used in fertigation

Name	N – P ₂ O ₅ – K ₂ O content	Solubility (g/l) at 20° C
Ammonium nitrate	34-0-0	1830
Ammonium sulphate	21-0-0	760
Urea	46-0-0	1100
Monoammonium phosphate	12-61-0	282
Diammonium phosphate	18-46-0	575
Potassium chloride	0-0-60	347
Potassium nitrate	13-0-44	316
Potassium sulphate	0-0-50	110
Monopotassium phosphate	0-52-34	230
Phosphoric acid	0-52-0	457

Special water soluble fertilizers

Name	N %	P ₂ O ₅ %	K ₂ O %
Polyfeed	19	19	19
Polyfeed	20	20	20
Polyfeed	11	42	11
Polyfeed	16	8	24
Polyfeed	19	19	19
Polyfeed	15	15	30
MAP	12	61	0
Multi-K	13	0	46
MKP	0	52	34
SOP	0	0	50

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 appears 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.

Fertigation equipments

Three main groups of equipments used in drip system are :

- Ventury
- Fertilizer tank
- Fertilizer pump

Ventury

Constriction in the main water flow pipe causes a pressure difference (Vacuum) which is sufficient to suck fertilizer solution from an open container into the water flow. It is very easy to handle and it is affordable even by small farmers. This equipment is most suitable for smaller area.

Fertilizer tank

A tank containing fertilizer solution is connected to the irrigation pipe at the supply point. Part of the irrigation water is diverted through the tank diluting the nutrient solution and returning to the main supply pipe. The concentration of fertilizer in the tank thus becomes gradually reduced.

Fertilizer pump

The fertilizer pump is a standard component of the control head. The fertilizer solution is held in non-pressurised tank and it can be injected into the irrigation water at any desired ratio. Therefore the fertilizer availability to each plants is maintained properly.

Cost of fertigation equipments

Sl.No.	Fertigation devices	Cost (Rs.)
1.	Ventury type	1200
2.	Fertilizer Tank	3000
3.	Injectors	12000

Economics of drip irrigation system

The initial investment in drip irrigation system is mainly depends upon the spacing of crops. The initial cost will be almost 75 - 85 thousand rupees per hectare for wider spacing crops such as coconut, mango, grapes and for orchard crops. The initial cost is approximately 1 - 1.25 lakh rupees per hectare for close spacing crops such as sugarcane, banana, papaya, mulberry, turmeric, tapioca, vegetables and flower crops.

Drip fertigation technology for aerobic rice Surface drip fertigation

Under aerobic rice conditions, provision of surface drip fertigation (with 0.8 m lateral spacing provided with drippers at 0.3 m distance) scheduled at 125 % Pan Evaporation value for clay soil / 150 % open Pan Evaporation value for sandy soil + STCR based NPK fertigation + biofertigation of *Azophosmet* @ 500 mL ha⁻¹ during panicle initiation and flag leaf stages is recommended.

Sub Surface drip biogation

Under aerobic rice conditions, provision of sub-surface drip fertigation (10 cm depth with 0.8 m lateral spacing provided with drippers at 0.3 m distance) scheduled at 125 % Pan Evaporation value for clay soil / 150 % open Pan Evaporation value for sandy soil + STCR based NPK fertigation + biofertigation of *Azophosmet* and seaweed extract each @ 500 mL ha⁻¹ during panicle initiation and flag leaf stages is recommended.