



## Efficient Irrigation in Coconut Garden

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### Introduction

The average annual rainfall in Kerala is 3000mm. Despite this favourable total rain fall, water deficit exists for about six months in a year and palms suffer severe moisture stress during December to May. Extreme stress conditions are experienced during March - April, which affect the productivity of the coconut. The productivity is less in the northern districts of Malappuram, Kozhikode, Palakkad, Kannur and Kasargod due to prolonged drought from December to May. These districts receive negligible amounts of summer showers and pre-monsoon showers. In Kerala, the percentage of area under coconut receiving irrigation is only 17.8% (as per the record of 2005-06). Irrigation alone is capable of increasing the annual production per palm over to 70 nuts from the present average of 33 nuts. Tall cultivars under optimum management conditions with irrigation yield as high as 150 nuts/palm/year as against 35-40 nuts/palm/year under rainfed condition. Moisture stress is the most important factor responsible for low productivity.

Severe drought results in drooping of leaves, breaking of leaf petioles, high button shedding and even death of palms. Water stress also results in lower leaf production, less number of inflorescences and female flowers (Coomans, 1975). Shedding of buttons and young nuts

is a direct result of the preceding dry months (Abeyawarthena and Mathes, 1971). The study conducted at CPCRI, Kasaragod revealed that the coconut palms irrigated during dry season recorded 195 g copra/nut as against 153 g under rainfed conditions in the case of nuts harvested in November. Coconut palms provided with higher level of fertilizers with irrigation yielded 114.5 nuts compared to 28.4 nuts recorded on the palms which received the same dose of fertilizers but without irrigation. Once the crop is affected by water stress, it takes two to three years for regaining the normal vigor and yield. The experiment conducted in Nileswar Research Station in red sandy loam soil found that 74% increase in yield can be obtained compared to the rainfed crop. In a rainfed coconut palm, generally 7-8 bunches were harvested in a year while in irrigated palms the number increased to 12-13. Abortion of young inflorescences of coconut was traced to a drought effect from 15-16 months before the spathe opened. Under conditions of extreme moisture stress in the soil, the initiation of inflorescence primordium in the leaf axil gets impeded.

Irrigation is also conducive to enlarging the size of nuts. In Malaysia, in a field of dwarfs, palms provided with irrigation showed a tangible increase in the copra content of the nuts. After irrigation, the



number of nuts required per picul was only 457 to 531 as against 1925 to 1931 required before irrigation.

### Methods of irrigation in coconut garden

The conventional methods of irrigation adopted in coconut gardens are basin irrigation, channel irrigation and flooding.

**Channel irrigation:** When ground water table is high, farmers open a channel between two rows of coconut and water is retained in it. Water from the channels seeps laterally into the root zone of the crop.

**Flood irrigation:** If plenty of water is available from canal or river, farmers spread water to coconut garden and allows it to penetrate to greater depths.

**Basin irrigation:** This is the most common method of irrigation practised in Kerala. Farmers open circular basin of 1.8 to 2m radius around the palm and water is flooded in this basin. The water from the source is brought to the basin through small channels or hose pipe. The frequency of irrigation will depend on the type of soil and climatic features of the locality. The recommended schedule of irrigation for different soil types in Kerala is given below

Soil type	Quantity of water in lit/irrigation	Approximate irrigation interval (days)	
		Dec-Jan	March-April
Sandy	400	4	3
Sandy loam	600	6	4
Loam	850	8	6
Silty clay	1000	10	7

### Drip irrigation

It is imperative that timely provision of irrigation water is crucial for better productivity. But the availability of water is decreasing

day by day and hence judicious use of water is very much essential. In Kerala, because of water scarcity, high labour wages and scarcity of labour, most of the area under coconut is rain-fed. The surface irrigation methods, which are widely practised in coconut field, cause wastage of water to seepage, evaporation and deep percolation. Generally, under surface irrigation methods, less than one-half of the water released reaches the plants. The water use efficiency of such methods is between 30 to 40% only. Therefore judicious use of water is vital to achieve higher productivity in a sustainable manner. Good scientific water management involves adoption of right method of irrigation consistent with the topography of the field and type of soil to supply water to the crop at right time and in the required quantity. Drip irrigation can be considered as an efficient irrigation method, which is economically usable, technically feasible and socially acceptable. It provides highest yield per unit area with unit quantity of water. In this method, required quantity of water is supplied to each plant at highest point of its root zone through a net work of pipes. As the water is applied to the soil at a very slow rate through drippers or emitters, there is no loss due to percolation and the root zone could be kept near to field capacity.

### Factors favouring drip irrigation in Kerala

1. In surface irrigation, farmers give more water to the palms (in single irrigation) without knowing the ill effects of over irrigation like leaching of fertilizers, unequal distribution of water, water logging in low

level area and land becoming saline and alkaline in due course. The effect is low yield and lands becoming unproductive after some years. It also causes environmental and health problems. Whereas, in drip irrigation, loss due to conveyance, evaporation, interception, runoff and deep percolation are reduced considerably compared to other traditional irrigation systems. The use of drip irrigation in coconut garden has resulted in water savings ranging from 40 to 70 percent.

2. Drip irrigation offers the twin benefits of yield increase and water saving since root zone of the crop is always kept nearer to field capacity. In surface irrigation methods, water is applied once in 5 to 15 days and during the intervening period moisture/water stress will be noticed. In drip irrigation much water stress will not be experienced.
3. The cost of installation of drip irrigation for coconut palms is comparatively less as they are widely spaced. The usual cost is around Rs. 12,500/ha excluding the cost of pumpset, electrical fittings and installation charges. Government is giving 50% subsidy for the installation of the irrigation system.
4. High irrigation efficiency can be achieved by properly designed and well managed (use of carefully filtered water and periodical inspection of emitters to avoid clogging and non-uniform application) irrigation systems. Irrigation efficiencies in the range of 80 to 90% can be obtained.



5. In Kerala condition, labour is not only costly but is also scarce. Adoption of drip irrigation will help to save about 70% of labour cost compared to the conventional basin irrigation system.
6. The unique feature of Kerala agriculture is the open well-based homestead farms. Hence, the quality of water as regard to suspended materials is excellent. This helps to reduce the clogging problem in the irrigation system.
7. Since the average size of land holding in Kerala ranges from 0.01 to 0.025 ha, most of the farmers are wage seekers in some other trade or industry. Hence drip irrigation with less labour involvement and operational attention is easily more appropriate in the State.
8. As there is limited wetted area in drip irrigation, it inhibits weed growth and reduces disease incidence.
9. Since the soils of the state are characterized by high infiltration capacity, low water holding capacity and shallow top soil, heavy irrigation and bulk application of nutrients in the conventional method cause leaching of most of the nutrients to the deeper soil layers. In drip irrigation as water is applied to the soil at a very slow rate through drippers or emitters, there is no loss due to percolation and hence it facilitates effective utilization of water and nutrients and helps to avoid the contamination of ground water.
10. On hilly terrain, drip irrigation systems can operate with no

runoff and without much interference from the wind. The fields need not be leveled in this system. Hence in problem soils with intermixed texture and profiles and shallow soils that cannot be graded, can effectively be irrigated by drip irrigation system. Whereas in the case of surface irrigation, land leveling is a must, which may sometimes cause decrease in yield due to the removal of upper fertile soil.

11. Under surface irrigation, about 5 to 10 % of cultivable area is occupied by irrigation and drainage channels and the structures to store water. Since micro irrigation does not require field channels, it makes available this area for cultivation.

#### *Layout of drip irrigation system*

Irrigation systems are to be designed to provide high irrigation efficiency and uniform distribution of water and nutrients. If any existing source of water is not available, it is better to locate the source of water near the center of the design area. This gives least cost for main line pipe and for pumping. On sloping fields the well/ water source should be located uphill from the center to better balance up and downhill pressures and minimize the pipe sizes.

An adequate filtration process is an absolute requirement as rarely is natural water supply free of suspended or chemical materials. There are four types of filters namely, sand filter, screen filter, hydro-cyclone filter and disk filter. Filtration requirement depends on the quality of water and operating pressure of the drip system. Screen

filter is used in case of small system and if the source of water is a well. For large system, depending on water quality, different filters or combination of filters can be used.

Generally Rigid Poly Vinyl Chloride (PVC) or High-density polyethylene (HDPE) pipes are used as sub-main lines. Size of pipes depends on flow rate of water in the system. 40 mm to 110 mm diameter pipes with a pressure rating of 4 to 10 kg/cm<sup>2</sup> are recommended for main / sub-main lines. In order to ensure longer life period, PVC pipes should be laid underground (15 to 30cm below the soil surface). HDPE pipes can be laid on the soil surface since it can withstand UV rays. Hence in hilly areas and undulating topography, it is better to use HDPE pipe as main /sub-main pipe which helps to reduce the earth work.

Laterals are normally manufactured from LDPE. Recently, better quality LLDPE pipes (gives more protection against ultra violet rays, rats & other animals and longer life than LDPE) are being used as lateral lines. They are placed along the rows of the crop on which emitters are connected directly or through 8 mm micro tube to provide water to the emitters. The lateral pipe size of 12mm or 16 mm with wall thickness varying from 1 to 3 mm and a pressure rating of 4 kg/cm<sup>2</sup> is most common. These pipes are generally laid above ground.

Emitter is the most important part of a drip irrigation system through which water is delivered at desired rate to the plant and uniformity of water application is maintained all over the irrigated area. Therefore an emitter should match particular conditions existing at the field. Usually drippers having a discharge



rate of 2lit/hr and 4lit/hr is preferred in sandy soil, whereas, drippers having 4lit/hr and 8lit/hr are better for sandy loam soil. There are pressure compensating drippers and ordinary drippers. Pressure compensating drippers ensure constant discharge irrespective of pressure changes (from 1 kg/cm<sup>2</sup> to 4 kg/cm<sup>2</sup>) and hence they are preferred in hilly areas. Some drippers can be taken apart and manually cleaned. These types of drippers are preferable in plain land as they are cheaper than pressure compensating drippers. Tap type drippers are preferred in areas where clogging is a problem. The discharge rate of these drippers can be controlled manually. Flush out valves should be placed at the ends of main pipe, sub main pipe and laterals so that all portions of the pipe net work can be flushed out periodically for removing the fine particles that settle out near the ends of lines during operation.

Drip system can be introduced in coconut garden at any time but earlier the better because the total effect of better management from the beginning of planting can never be obtained when this is introduced at later stage. Among the farmers, there is a common doubt that, if drip irrigation is provided to coconut, the root development will get affected, thus in later stage the anchorage gets weakened. Since there is rain for six months and there is provision to change the position of drippers, the root development and the anchorage will not in any way be affected. Moreover, if correct number of drippers are selected and placed properly, whole effective root zone area of the coconut can be wetted properly.

While installing drip irrigation system, filter is to be fitted just after the pump set. The main or sub mains should be laid up and down predominant land slopes. It is preferable to lay laterals on the contour or across prominent land slopes. If the slope of the field is more than 3%, laterals should be used along the contours as far as possible. Running laterals down slope is often advantage, provided the slope is fairly constant and not too steep (<3%). If the average slopes of the field are less than 3 % in the direction of the lateral, it can be used at equal length on both sides of sub main pipe. Under down slope conditions, the difference in elevation between the two ends of the line results in gain in pressure head rather than a loss; therefore down slope laterals may be longer than similar laterals lay on level ground. Lateral pipes should be laid on the ground in straight line along the plant rows. Emitters are to be fixed on the lateral. They are placed at equal spacing so that plants get uniform amount of water.

Studies have indicated that if minimum of 15 to 20% of the active root zone is wetted, the palms can absorb the required quantity of water. The results obtained in the studies conducted at CPCRI and KAU revealed that four drippers are to be provided in the red sandy loam soil and laterite soil and six drippers are to be provided in sandy soil for getting better distribution efficiency (>80%). Studies on the coconut root absorption indicate that 0.75m to 1.25m away from the bole is the active absorption zone and hence it is recommended to place the emitter at 1m away from the bole. Water can be allowed to drip at about 30 cm

below the soil surface to eliminate the evaporation loss. This can be achieved by making a pit of 30 cm<sup>3</sup> and filling it with coir pith or locally available agricultural waste. A conduit pipe provided with number of holes is to be placed diagonally in this pit and the water is allowed to drip in that pipe. This will considerably reduce the evaporation loss and the weed growth, since the soil surface is not wetted by irrigation water.

It was observed that use of 12 mm lateral pipe is more economical for the drip irrigation of coconut garden. But if length of lateral is greater than 100m, it is better to use 16mm pipe for some length, and then 12mm pipe. Laterals can be laid at both sides of sub-main pipe.

Under Kerala condition, drip irrigation should start in December with 32 lit/day/palm and the quantity is to be increased in the succeeding months up to 50 lit/day/palm depending on the temperature and dryness of the atmosphere.

### Fertigation

Fertilizers can be injected into the drip irrigation system by selecting appropriate equipment. In order to facilitate fertigation, fertilizer tank, fertilizer injector or venture should be fitted in the irrigation system after sand filter and before screen filter.

Heavy irrigation and bulk application of nutrients in the conventional method cause leaching of most of the nutrients to the deeper soil layers. Many places are facing the problem of ground water contamination with nitrates and iron ions. Drip irrigation offers an opportunity for precise application of soluble fertilizers and other nutrients to the soil at appropriate



time with the desired concentration. In drip irrigation, since nutrients are applied along with irrigation water, the plants can utilize it more effectively. Optimum moisture content maintained in the root zone of the plants makes the nutrients in available form to the crop. This improves fertilizer use efficiency (40 to 50% can be saved) and also reduces pollution of ground waters.

Urea and urea-ammonium nitrate mixtures are highly soluble and usually do not cause pH shifts and hence these chemicals can be used as nitrogen fertilizers. Generally, injection of phosphatic fertilizer through drip system has not been recommended since most of the phosphatic fertilizers react and cause chemical or physical precipitation problems leading to clogging of the system. But with low pH water, if phosphorous is applied in the form of phosphoric acid, which is soluble in water, clogging problem does not develop. However, it is common practice to apply the phosphate fertilizer separately (once in a year). No adverse chemical reaction is expected with common potassium fertilizers. It can be applied as potassium sulphate, potassium chloride and potassium nitrate. These potassium sources are soluble in water and have no precipitation problems.

Care should be taken to distribute the fertilizers uniformly throughout the field. The chemicals should be completely soluble to avoid clogging. Fertilizers can be injected into the micro irrigation system by selecting appropriate equipment. Fertilizer injection through drip and micro tube should not begin until all lines are filled with water and the

emitters are running. Applying fertilizer into partially filled system will result in poor fertilizer distribution. After the application of fertilizer, the system should work for sufficient time so as to flush it from any toxic effects of the fertilizer solution.

### Maintenance

Ideally, maintenance of the system should start from the time it is installed. Thereafter timely maintenance and repair of the system is essential for its successful functioning. Care should be taken so that dirt, sand etc. does not enter into pipes while making connections. For the system to function properly, all the filters must be kept clean. Back flushing with automatic or manual control valves will keep both sand and some screen filters clean. Other screen filters are to be cleaned by removing the screen from its housing and rinsing off the accumulated dirt materials. Rubber seals are to be taken out and cleaned from both the sides. Care must be taken to see that before opening the lid of screen filter for cleaning, choke valve should be opened and all the water in the screen filter removed.

Backwashing of sand filter allows the backwater to come out through the lid. Stir the sand in the filter bed up to filter candle without damaging them. Whatever dirt is accumulated deep inside the sand bed will get free and will go out with the water through the lid. Seventy five percent part of sand filter should be filled with sand. If the sand level is low, it should be filled with sand up to the required level. Sand filter should be opened and cleaned once in a week. After one year, it is better to replace the sand in the filter with new sand.

Sometimes silt escapes through the filters and settles in submains and laterals. Similarly, algae and bacteria lead to the formation of slimes/pastes in the submains and laterals. In order to remove the settled silt and slimes and also to drive out the air entrapped in the system, submain should be flushed by opening the flush valves and the lateral lines are to be flushed by removing the end caps. Flushing of pipes should be done once in two weeks. This will help to remove the traces of accumulated salts. Flushing should be stopped once the water coming out from each emitter is clean. Due to improper maintenance, sometimes emitter may get clogged. Under such conditions emitters can be taken out from the laterals and should be cleaned manually. After that, emitter has to be refitted in the system. If the clogging is severe, the emitters have to be soaked in 2% solution of HCL/H<sub>2</sub>SO<sub>4</sub> for 24 hours.

### Conclusion

Even though this method of irrigation has numerous advantages, the acceptance among the farmers is not encouraging. This is due to the lack of knowledge in installation and maintenance of the system and also due to clogging of emitters and high initial investment. Any user of drip irrigation should recognize that the success of the system depends on timely maintenance. A properly designed, installed and maintained system can be used effectively for 10 to 15 years. Government of India and State Government are giving subsidy at 40 % and 10% respectively for the installation of micro irrigation. One farmer/family is eligible for getting subsidy for 5 ha of land.