

Drip Irrigation for Saline Water Usage in India

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Introduction

The immense demand of water resources by industrial and agricultural sector for has reduced the availability of fresh water for crop production. Out of total accessible water in the world, only 1% is fresh water, of which 70% is used for agriculture. Therefore, depleting water resources, declining land quality and decreasing resource productivity are matters of great concern. Availability of irrigation water is the most limiting factor for crop production in arid and semi-arid regions. Major cause of water scarcity in such regions is unfavourable conditions such as erratic rainfall and high evaporative demand constrains agricultural productivity. These regions are majorly underlain with poor quality groundwater or saline water which can be used in agriculture for irrigation purpose to sustainably increase the crop yield. Therefore, if saline water can be used as a resource, this can greatly reduce the amount of fresh water used by agriculture and decrease water stress in many areas.

Saline water as alternate irrigation source

Under rain fed conditions, saline water resources could be used as irrigation to bridge dry-spells for agricultural crops. Use of saline water irrigation instead of freshwater incurs a yield reduction, but it allows allocation of freshwater to other purposes. The greatest risk of using saline water as irrigation is soil salinization, which lead to crop failure and deterioration of soil condition. Therefore, careful and efficient management of such system is required for more sustainable crop production. In North-West India, around 41-84% of groundwater is brackish or poor quality in nature. An estimated 8.5 Mha of agricultural land is salt affected area in India due to imbalanced fertilization techniques, poor use of saline water and presence of excessive salts in groundwater. Thus, we need pioneering water saving technologies as well as techniques that would allow appropriate usage of poor quality water. This would play important role in achieving twin objective of efficiently utilizing saline water and conserving

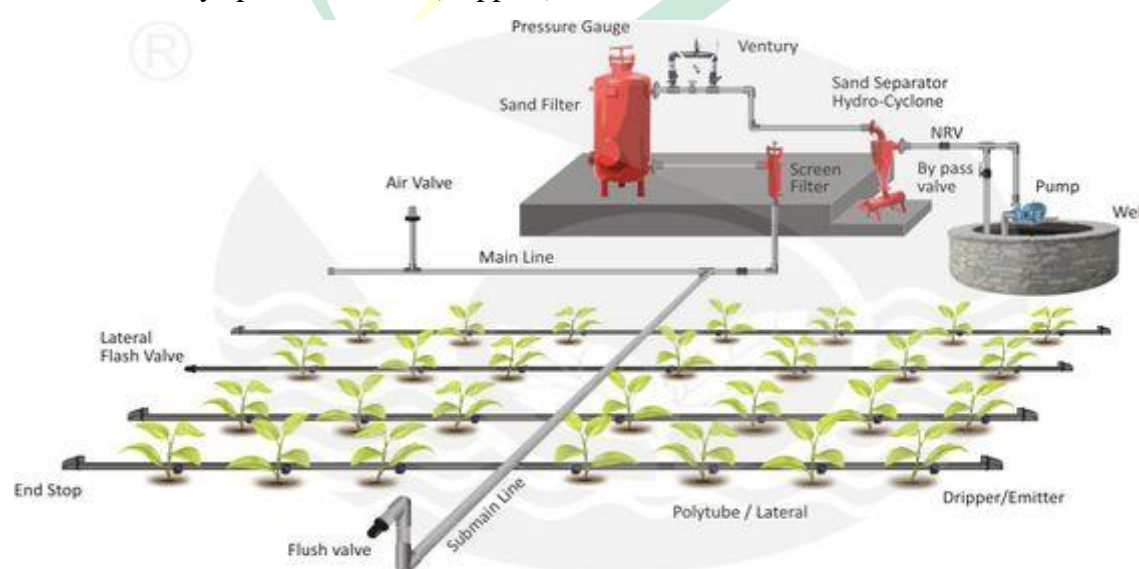
fresh water resources. Drip irrigation is the most viable irrigation method for water conservation and managing saline environment.

Effects of Stalination on crop growth

Use of saline water as irrigation source may cause soil salinity development and leads to reduce transpiration and growth, subsequently reductions in yield. Accumulation of excessive salts in soil profile results in higher osmotic potential, thus adsorbing water molecules more strongly to soil particles and limiting the plant water uptake. Therefore, growth reductions are described as an osmotic or ion toxicity effect. This salinity effect may be reduced with drip system where small amount of irrigation is applied at minimal rate as per the crop requirement. The low rate and high frequent irrigation applications of drip irrigation system, over a long period of time, can maintain high soil matric potential in root zone, compensating for the decrease of osmotic potential introduced by the saline water irrigation, and constant high water potential can be maintained for the crop growth.

Drip irrigation under saline groundwater areas

As per reports of 2019-2020, approximately 0.55 Mha area is currently under drip irrigation in India against potential of 27 Mha. Drip irrigation is widely adopted for agricultural and horticultural crops under various agro-climatic regions. Drip irrigation system supplies water near the roots of each plant as per the required quantity of water to the crop on a daily or periodic basis. Drip irrigation delivers water through pipes (PVC) and a series of closely spaced emitters (drippers).



The application of poor quality water through drippers may give better crop yields due to an ability to maintain high soil moisture levels and replenish the water lost by evapotranspiration on a daily basis. In literature, it is well cited that drip irrigation has proved to be a more successful irrigation method than conventional (furrow or flood) methods in terms of water saving and crop productivity per unit of applied water. Drip irrigation maintains the optimum moisture condition which is favourable to the plant growth. It reduces the water consumption while minimising salt build up in root zone and thereby reducing the adverse effects of salts on crop growth and yield.

Advantage of drip irrigation over conventional method

- Water through drippers is applied in the vicinity of root to provide a better soil moisture condition and has the potential to increase crop production with limited available water as compared to furrow or flood irrigation
- Drip irrigation under saline environments it offers favourable conditions in the root zone with lower salt accumulation
- Frequent irrigation on crop demand basis maintains a soil moisture level that does not fluctuate appreciably between wet and dry extremes. This residual moisture which remains in the soil between irrigation cycles keeps salts in a dilute solution, making it possible to use saline water
- Irrigation of saline water through conventional method resulted in higher accumulation of salts in soil due to high evaporation of during the periods between the respective irrigations which poses harm to plant growth. The effect of salts on physiological process of plant results from lowering of soil water potential and toxicity of specific ions