Available online at
www.agrospheresmagazine.vitalbiotech.org

ISSN (E): 2582 – 7022

Agrospheres:e- Newsletter, (2023) *4*(1), 1-3

Article ID: 455

Bio-Drainage

Mohd Shah Alam[1*], Jay Nath Patel[1], Vinod Kumar[2] Anupam Kumar[3] Shatruhan Jaiswal[4]

Assistant Professor,
[1]Department of Agronomy,
[2]Department of entomology,
[3]Department of Pathology,
[4]Department of Agriculture Engineering
Abhilashi University, Mandi, Himachal Pradesh

Open Access

*Corresponding Author
Mohd Shah Alam*

Article History
Received: 23. 12.2022
Revised: 3. 01.2023
Accepted: 8. 01.2023

INTRODUCTION

Conventional engineering -based techniques most commonly used to drain excess water from land are: surface drainage, sub-surface drainage and vertical sub-surface drainage (pumped well drainage). In natural environments, components of hydrological system, i.e., rainfall, evapotranspiration, change in soil-water storage and drainage, are in balance. Bio-drainage is an alternative to waterlogging and salinity that are persistent problems in both irrigated and non-irrigated areas. In irrigated agriculture command areas, subsurface drainage is frequently required to prevent waterlogging and soil salinization. Gafni is credited with coining the term "bio drainage" for the first time (1994). Heuperman (1992) coined the term "bio pumping" to describe the use of trees to control the water table before that date. Excavation of surplus soil moisture using bio-energy through deep-rooted vegetative cover with a rapid percentage of transpiration is one definition of bio drainage. Fast-growing trees and shrubs absorb moisture from the pore spaces, which are situated just above groundwater level in the bio drainage system. The absorbed water is actively transported to various parts of the plant, with over 98% of it being transpired into the air with the help of stomata. Bio-drainage could also be defined as the absorption, translocation, and transpiration of surplus groundwater into the atmosphere by underground vegetation. Eucalyptus species consumes a huge amount of water when there is a lot of moisture in the soil, are suited for bio drainage.

Concept of Bio-drainage

Bio-drainage may be defined as "pumping of excess soil water using bio-energy through deep-rooted vegetation with high rate of transpiration." The bio-drainage system consists of fast growing tree species, which absorb water from the capillary fringe located above the ground water table. Absorbed water is translocated to different parts of plants and finally more than 98% of the absorbed water is transpired into the atmosphere mainly through the stomata.

ISSN (E): 2582 – 7022

This combined process of absorption, translocation and transpiration of excess ground water into the atmosphere by the deep rooted vegetation conceptualizes bio-drainage. Fast growing Eucalyptus species known for luxurious water consumption under excess soil moisture condition are suitable for bio-drainage. These species can be planted in blocks in the form of farm forestry or along the field boundary in the form of agroforestry. Other suitable species for block plantations are *Casuarina glauca, Terminalia arjuna, Pongamia pinnata and Syzygium cuminii* etc.

Bio-drainage is a viable alternate option for the reclamation and management of waterlogged saline soils in canal command areas. Situations where conventional surface and sub-surface drainage is not feasible and is costly, bio-drainage alone and in combination with drainage should be practiced. This approach of integrating trees like Eucalyptus having high transpiration rate as apart of farming in rising ground water areas in canal commands has tremendous scope to reclaim and, improve productivity, increase forest cover, earn carbon credit for farmers and clean environment. Now there is a strong case for developing policy guidelines for promotion of bio-drainage for generating livelihood security and poverty alleviation of farmers in irrigated arid and semi-arid regions.

Bio-Drainage trees species

Eucalyptus species are generally considered to be effective for bio-drainage purpose. Eucalyptus allows more rainfall reaching the ground and the water use efficiency of Eucalyptus is also better compared to other trees. To produce one gram of dry matter, Eucalyptus use only 1.41 ml of water while it was 8.87 ml for pines, 3.04 ml for poplars and 2.59 ml for rosewood (Vinayarai 1988). *Acacia nilotica, Dalbergia sissoo, Tecomella undulate* and *Ziziphus mauritiana* are other species that have performed quite well in plantations along leaking canals in arid conditions. Species suitable for non-irrigated conditions are *Acacia tortilis, Prosopis cineraria, Prosopis juliflora* and *Parkinsonia.* Suitable Eucalyptus species for different areas of India are given below:

Region	Promising species
Lateritic soils of south India	E. globosus, E. teretimaizeis, E. eugenoides
Red chalka soils	E. camaldulensis
Black soils with low rainfall	E. hybrid
Ravine lands of Yamuna	E. teretimaizeis
Ravine lands of Chambal	E. teretimaizeis, E. hybrid, E. camaldulensis
Ravine lands of Mahi	E. camaldulensis
Semi-waterlogged soils	E. teretimaizeis, E. Robusta, E. grandis

Advantages of Bio-drainage

1. Economical consideration

- Requires small initial investment,
- Plants use their bio energy to drain excess ground water into the atmosphere, so there are no operational costs,
- Low maintenance cost and economic return in terms of fodder, fuel wood and timber,
- Instead of depreciation, value increases with age.

2. Environmental Consideration

- Reduce carbon footprints by reducing emissions of greenhouse gases and absorbing CO2.
- Aids in the reclamation of land,
- By perspiration, it reduces the surrounding temperature and provides defence against heat, cold, and frost.
- More land can be farmed due to less waterlogging and soil salinity.
- Improved nutrient use efficiency, higher crop yield decreases the effects

ISSN (E): 2582 – 7022

of climate change and helps increase forest cover

Limitations of Bio-Drainage

Bio-drainage can be practiced with certain limitations.

1. As groundwater salinity rises, plants' ability to transpire leaves gradually decreases. Eucalyptus trees may transpire only half as much water as they do under non-saline conditions when the groundwater salinity is around 8 dS m^{-1}.
2. Long term sustainability of non-irrigated bio-drainage tree plantations growing in shallow saline water table areas may be questionable. At some point throughout their commercial lives, rising root-zone salinity may have an impact on how well they grow. The accumulated salts in the root zone will rise to the surface by capillary when the trees are cut down and affect subsequent land usage if there is no subsurface drainage to maintain salt balance.
3. Without proper salt balance, no biological system is able to survive. Before bio-drainage can be commercialized as an effective drainage management solution, salt balance is one of the most crucial concerns that must be resolved.
4. Planting large areas of new crops, especially tree crops, will have significant impact on regional economies and social structures
5. Release of toxic chemicals from leaf, stem and roots extracts of Eucalyptus may inhibit the germination and seedling growth of some crops, and
6. Bio-drainage occupies potentially valuable land thereby decreasing the availability for commercial/ food crops.

CONCLUSIONS

In India, bio-drainage is a novel invention for land reclamation, and it needs to have its viability thoroughly studied. Bio-drainage is economically appealing because it only needs a little initial investment to plant the vegetation, and once it is in place, the system may provide income through the production of fodder, fuel wood, and timber. As an alternative to the tried-and-true traditional methods of drainage and land reclamation, there is bio-drainage. If successful, land reclamation using bio-drainage would be far less expensive and environmentally hazardous than adopting a traditional horizontal sub-surface drainage system and the risks entailed.