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Hydrogels

*Mane Priyanka
PhD Scholar, Dept. of Floriculture and Landscaping, Sri Konda Laxman Telangana State Horticultural University, Mulugu, India
*Corresponding Author's email: priyankamane210523@gmail.com

Hydrogels are hydrophilic polymeric network of three-dimensional cross-linked structures that absorb substantial amount of water. Cross linking facilitates insolubility in water because of ionic interaction and hydrogen bonding. It also provides required mechanical strength and physical integrity to the Hydrogels. Hydrogels have been successfully used as soil improvers to increase the water-holding capacity and nutrient retention of sandy soils, with a possible reduction of irrigation frequency, compaction tendency and water run-off.

Hydrogels found applications as slow-release fertilizers

- Addition of fertilizers salts generally implies a reduced hydration of polyacrylamide gels and affects physical properties of gel-amended media.

Features of hydrogel

- Highest absorption capacity
- Lowest soluble content & residual monomer.
- Highest durability & stability in the swelling.
- Highest biodegradability without formation of toxic species after degradation.
- pH neutrality after swelling in water.
- Colorlessness, odorless and absolute non- toxic.
- Photo stability.
- Re- wetting capability.
- High temperature resistance
- Low Cost of Labor
- Reduces leaching
- Hydrogels are characterized by negative and positive or neutral charge.
- Clay compounds of soil have negative charge, heavy metals have positive charge and other commonly found minerals in soil has positive, negative or neutral charges.
- Anionic hydrogel cannot directly bind to clay and may act as dispersants

Function- Osmosis

Polymers release 95% of the absorbed water into the soil when the soil dries out.

- Synthetic polymers are mechanically stronger and durable and can absorb more water. Therefore, they can be more efficient in agriculture as they hold more water and last longer.
- Eg : vinyl acetate, acrylamide, ethylene glycol and lactic acid.
- Natural polymers are biodegradable and often do not leave any bi-products so they are more environmentally friendly. Eg: collagen and polysaccharides like chitosan, dextran and alginate.
- The speed of water absorption depends on the type of the hydrogel.

Types of Hydrogels

1. Super Absorbent Polymers
2. Pusa Hydrogel
3. Potassium Polyacrylate
4.Water Retention Polymers

SUPER ABSORBENT POLYMER

- It can absorb and retain extremely large amounts of a liquid relative to their own mass.
- Water molecules are drawn into the network across a diffusion gradient - formed by the Sodium neutralization of the polymer backbone.
- Thus, the particles expand as water moves into the network.
- The water is held tightly in the network by Hydrogen-bonding.

BENEFITS

- It help to prevent water loss in the soil.
- In the cold region, it helps to arrest the freezing of water in or around the root.
- Improves the microflora of soil.
- It upgrades soil nutrient and organic carbon status.
- Suitable for: Medicinal plant, garden plant and nurseries.

PUSA HYDROGEL

- A semi-synthetic superabsorbent polymer which fulfils the basic requirements of Plants and is widely used in agriculture.
- It sticks to the roots of the trees.
- As the temperature rises soil moisture falls, thus the gel sheds water to nourish the crop.
- It is mixed with the soil on which the seeds are sown. The gel then absorbs water and expands to 300 of times its original size.

BENEFITS

- Reduces the frequency of watering required
- Reduces leaching of nutrients
- Cares about the growth of plants and trees
- Increases water retention in the ground and substrate
- Specifically retains water in the required layer or shape
- Reduces the cost of irrigation and fertilization
- It allows the growth of seedlings in extremely dry areas

POTASSIUM POLYACRYLATE IS APPLICABLE

- In seasonal crops.
- In transporting and Cut Flowers
- For bare root dipping
- Gardening

WATER RETENTION POLYMERS

- Useful in rainy and dry season for greater absorbency and retention power.
- A farmer can use this hydrogel to protect their crop from seasonal variability.
- It can maintain the high growth of crops in a changing environment.

Functions of Hydrogels

Increases water holding capacity of soil and water use efficiency

Enhance fertilizer efficiency

- Application of SAP at 15 kg/ha + only half the amount of conventional fertilizer – arid and semi-arid regions
- It reduces excessive nutrient loss from soil there by preventing pollution of agro ecosystem.
- Because of neutral pH, they do not affect nutrient availability, soil chemical composition, action of other agro chemicals (fertilizers, herbicides, fungicides &insecticides).
- Enhances soil permeability and infiltration rates.
- Reduce irrigation frequency.

- Reduce fertilizer leaching.
- Reduce compaction tendency of soil.
- Reduce soil erosion and water runoff.
- Reduces water stress of plants
- Decrease the insect attack by 10-30%
- Hydrogels are biodegradable

Bio degradability

- Hydrogels contain liable bonds either in polymer backbone or cross links.
- The liable bonds can be broken under physiological conditions either enzymatically or chemically over a period of time.
- End products after degradation are CO_2, water & ammonia.
- Polyacrylamide never reform its monomer. Hence there is no residual amount of it present in soil after degradation especially cellulose is used as a back bone.
- Pusa Hydrogel are 100% biodegradable in soil after 18 to 24 months of application. It was developed and patented by IARI-PUSA, an autonomous body under Government of India, New Delhi and is being manufactured by KCH India Private

Disadvantages

- Hydrogels are expensive
- Hydrogels have low mechanical strength
- Difficulty in handling
- Difficulty in loading

Conclusion

Hydrogel is ecofriendly, bio degradable and nontoxic product used for growth of plants.