

# Implication of Superabsorbent Hydrogel (SH) in Agriculture: A Review

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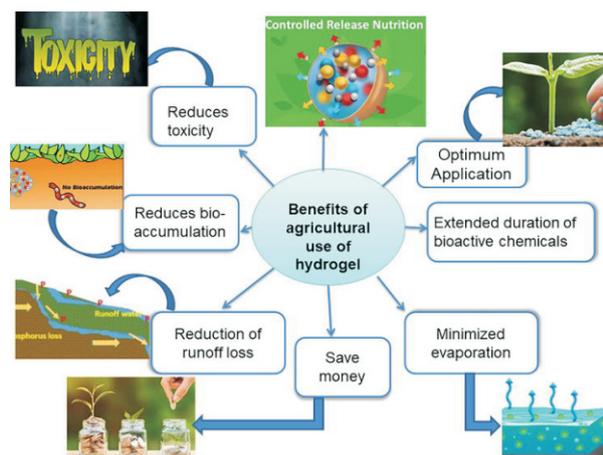
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**KEYWORDS .:** Hydrogel, Water management, Moisture conservation, Superabsorbent hydrogels, Plant-nutrient carriers

## SUMMARY

Global water demand by 2030 is probable to be 50% higher than today. Nowadays water management is considered one of the major challenges for all countries in arid and semi-arid regions. Superabsorbent Hydrogels are a promising management option to increase the water use efficiency in agriculture. Research evidence suggests that when the soil is treated with water hydrogel composite the water volumetric content of the soil increases significantly and when the surrounding soil dries, the stored water is released back slowly into the soil.

## INTRODUCTION

The increasing global demand for water, with the combined effects of climate change, is exerting tremendous strain on water resources, resulting in water shortages in arid, semi-arid, and several other regions of the world. Food security is increasingly threatened by rising food consumption and diminishing water supplies, among other factors. Additionally, there is competition for the limited amount of available water from different sectors, such as urban demands, the industrial sector, and the agricultural sector, which account for more than two-thirds of global freshwater use. Superabsorbent hydrogel (SH) or Super Absorbent Polymers (SAP) are cross-linked polymeric three-dimensional networks that can accommodate a significant fraction of aqueous solvents and biological fluids within their structures. In the early 1980's water absorbing polymers were introduced for agricultural use. The major SAPs used in agriculture are formed by polymerization of acrylic acid using Potassium as a cross linking agent. Thus forms 'polyacrylates' which are biodegradable over a period of time and nontoxic too. The agricultural sector accounts for the most significant water consumption in the United States, with more than 85% of overall freshwater consumption in the country expended on agriculture. In fact, there are other hydrogel groups such as Polyacrylamide which are quite toxic to environment after degradation.

## Types of Hydrogels

Hydrogels are crosslinked hydrophilic water-soluble polymers capable of absorbing a large amount of water without dissolving, up to a hundred times the dry weight of the polymer, and desorbing that water when subjected to mechanical stress. There are two broad classes of polyacrylamide (PAM) hydrogel, soluble (linear) and insoluble (crossed-linked). Linear PAM dissolves in water and has been successfully used in irrigation induced erosion in agricultural field. Cross-linked PAM are insoluble in nature and marked as Super Absorbent Polymers (SAP) or Superabsorbent hydrogel (SH). Instead of dissolving, these gels absorb water, swell many times of their original size. As they dry water is slowly released into the soil.

## Application Prospect of Hydrogel in Agriculture

In view of the excellent characteristics of water absorption, biodegradability, water retention and slow-release capacity, SH occupies a dominant position in the slow-release fertilizers (SRFs) market. The agricultural application of SH in double coated SRFs and nutrients carriers is also noticed.

In arid and semiarid regions, more efficient use of water is essential in the field of agriculture. Application of SH to maintain soil moisture and increasing water holding capacity is considered as one of the ways to save water

Somatic embryoids have been

encapsulated in alginate hydrogels and used as artificial seeds, with the design and functionality of such "synseeds" representing an alternative pathway to forming plants with a higher resistance to desiccation.

## Application Methods

**(a) For field crops:** An admixture of hydrogel and fine dry soil in 1:10 ratio should apply along with the seeds/fertilizers or in the opened furrows before sowing. For best results, hydrogel should be close to seeds.

**(b) In nursery bed for transplants:** 2 g/m<sup>2</sup> (or according to recommended rate) of hydrogel should be applied in nursery bed at the top 2 inches of the nursery bed. In pot culture, need to mix 3-5 g/kg of soil before planting.

**(c) While transplanting:** Plant root should be dipped in a free-flowing solution consisting of 2g (or according to recommended rate) hydrogel per litre of water.

## Benefits of Hydrogel

- Increases water holding capacity of soil particularly for arid regions / deserts, which is perhaps the most noble benefit of using Agricultural Hydrogels.

**Academic editor-** Dr. Sandeep Singh, PhD, Kanpur, (208021) Uttar Pradesh.

- Conserves water and prevents water loss due to evaporation and runoff consequently reduces irrigation frequency, power consumption, labour etc.
- It increases soil permeability and improve germinate rate as soil moisture is critical for every successful germination. The benefits of improved soil structure go in addition.
- Enhances fertilizers and herbicide use efficiency. In fact, they reduce the fertilizer usage by 15-30%.
- Agricultural Hydrogels absorb the excess water to prevent water runoff followed by soil erosion.
- Has stability on soil and gradually biodegrades into nontoxic materials.

**CONCLUSION**

A wide range of technological advancements have encouraged the usage of polysaccharide hydrogels due to their

conservation, in addition to protecting the health of living organisms and conserving the environment via sustainable crop production practices. Hydrogel based natural agents, such as growth regulators, moisture attractants, plant essential oils, biopesticides, and microorganisms have demonstrated positive results for seed and plant protection without compromising soil fertility, water consumption, or nutrient loss.

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**Citation:** Ghosh and Ghosh (2022). Implication of Superabsorbent Hydrogel (SH) in Agriculture: A Review. *Frontiers in Food & Nutrition Research*, 8(1), 1-2.



**FIGURE 1.** Potassium Polyacrylate, for Agriculture



**FIGURE 2.** Hydrogel in plant root

Trade Name	Introduced By
Pusa Hydrogel	IARI, New Delhi
Waterlock 93N	Acuro Organics Ltd, New Delhi
Agro-forestry water absorbent polymer	Technocare Products, Ahmedabad
Super absorbent polymer	Gel Frost Packs Kalyani Enterprises, Chennai
Hydrogel	Chemtex Speciality Ltd, Mumbai
Rain drops	M5 Exotic Lifestyle Concepts, Chennai

**TABLE .1** Hydrogel Products Available in India.

numerous advantages. Hydrogels have been effectively employed in moisture conservation, soil protection and improvement of plant performance in the face of various adverse environmental conditions. This article has emphasized on the critical nature of hydrogels, their application methods and benefits with in order to maximize production efficiency, seed protection, nutrients and water

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