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## HYDROGEL – AN UPCOMING STORYLINE OF AGRICULTURE

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<sup>1</sup>Barsha Mansingh\* and <sup>2</sup>Prerana Priyadarsini Choudhury

[barsamansingh5480@gmail.com](mailto:barsamansingh5480@gmail.com)

<sup>1</sup>Department of Agronomy, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar, India

<sup>2</sup>Department of Agronomy, Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar, Odisha, India

**W**orldly agriculture always requires large amount of water, so it generate a few provocations to restrict water usage. Natural polymers have been used in agriculture because they are high-quality and environment friendly. Based on their structure, natural polymers can be classified into 3 major classes 1) Polyesters, 2) Proteins, 3) Polysaccharides. Derivatives of polysaccharides with combination of other synthetic polymer get together to produce agricultural polysaccharide hydrogel. This hydrogel is basically used in arid and semiarid regions under rainfed condition. Hydrogel is water absorbing and cross linked to absorb aqueous solutions by joining the water molecules. Actually, it's the new proposal of water management under aridity condition to secure the soil water in mobile rooting zone, decreasing the water losses of the crop due to evaporation, percolation and runoff losses. When agricultural hydrogels come in contact with water it swells for some period and it's a water conserving powder which have ability to suck up the large amount of water under plentiful rainfall and water availability period. It's freeing the water to the soil for alleviating crop water requirement under lack of water condition. It has remarkable property like biophysical, hydro-physical and soil physical properties. Contemporary decrease the water supply frequency and increases the water use efficiency, nutrient use efficiency and also gives huge amount of quality produce from the plants, ornamentals and vegetable crops. These granules don't cause any hazards to the environment, plant and soil system.

Water scarcity is seen globally in arid and semiarid climates, and irregular rainfall threatens agricultural sustainability. There is also competition for water in various sectors such as agriculture, industry, and the urban sector. Under moisture stress conditions, various physiological changes have been noted, including decrease in water potential, stomatal closure, decrease in photosynthetic rate, decrease in

morphological rate, and a reduction in decile yield and quality of the plant by restricting overall plant growth. The modern method of water-saving, deficit irrigation technologies is regarded as a crucial element in conditions of restricted water availability to provide favorable soil moisture balance in the root zone with higher water use efficiency without compromising crop yield and quality. At this time, the development of contemporary micro-irrigation technologies, such as low-pressure micro-sprinkler and drip irrigation systems with ideal irrigation scheduling combined with plastic mulching, can solve the problems by drastically reducing the consumption of irrigation water and improving water use efficiency. Recent years have seen a significant increase in the usage of hydrogel polymer technology in agriculture as a soil conditioner due to its multifunctional capabilities in superior water absorption and water retention. By preventing evaporation loss, deep water percolation, and nutrient leaching in arid and semiarid areas around the world, the polymers maintain a very high water swelling and moisture-releasing capacity under water deficit situations, enhancing plant growth and crop productivity.

Amorphous quasi solid-phase substance hydrogel is often referred to as "root watering crystal," "water retention granules," or "raindrops." With precisely engineered absorbency and biodegradability, it has three-dimensional networks of loosely held cross-linked flexible hydrophilic macromolecules joined by covalent bonds or physical interactions. When in contact with freely available water, these organic polymers have the unusual capacity to absorb a significant amount of moisture in their extremely absorbent structure in a short length of time. When the soil dries up, these materials uniformly release the trapped moisture to the surrounding soil and rhizosphere zones over time. When there is a moisture shortage, having more water available in the soil helps to prevent water stress. Hydrogels is the main component in urban farming for plant growth medium. Hydrogels are used in agriculture for increase water use efficiency, water holding capacity, nutrient mobilizer when it's used. Hydrogel has been applied different type of soil in different dosages. Its ability to absorb water 400 times of their dry weight. it has three dimensional networks interconnected by covalent bonds. These are the polymers which absorb the large amount of water in their super absorbent structure within short period of time when it contacts with freely available water. These materials vanish the stored water to the surrounding soil on rhizosphere zone during the soil drying process uniform manner over a extend period. This type of hydrogels can be classified on several polymeric composition, material origin source, configuration, cross linking type.

## **Hydrogel**

Hydrogel is a soft, fashionable, water loving substance with three-dimensional nature. It has an ability to sup a considerable amount of water or any liquid substance without liquefying its own structure. Hydrogel is quirky and mainly formed from polymers. It can be

classified as natural and artificial. There are some polymers which leads to form hydrogels and these natural hydrogel forming polymers encompasses proteins like collagen and gelatin. Again, they contain polysaccharides like alginate and agarose. Chemical polymerization methods are followed for preparation of artificial hydrogel. Hydro means water and gel is the state of matter which is not fully solid or fully liquid. As hydrogel lies between two different states of matter such as solid and liquid stage it shows some peculiar characters such as drastic volume change with respect to foreign stimuli like temperature, electrical conductivity and pH *etc.* Agricultural hydrogels are mainly synthetically prepared from petroleum products. Main feature of hydrogel is the potential to hold liquid substance such as water and water-soluble nutrients hence can be broadly used in agriculture for mitigating the water stress.

### Characteristics of Hydrogel

- It can absorb water 400 times more than its original volume hence it has maximum absorption capacity so called as Super Absorbent Polymer (SAP).
- For a long period of time *i.e.* at least 1 year it can be there in the field without degradation as it has strong stability.
- It acts as a miniature water reservoir in the soil hence provide water to the root zone.
- Hydrogel can be used in saline soils as it is least affected by salty condition.
- It is neutral in pH.
- Hydrogel directly enhances the physical properties of soil such as bulk density, particle density, porosity *etc.*
- It is not too much costly for the beginners.

### Role of Hydrogel in Agriculture Sector

- Hydrogel helps in reducing water stress of plant at drought condition.
- Enhances the nutrient use efficiency as well as water use efficiency.
- Plays a vital role in agricultural land conservation.

### Advantages of Hydrogel

- As hydrogel is neutral in nature and helps in increasing the physical properties of soil hence seed germination, seedling establishment, root growth, flowering, fruiting of a plant is enhanced.

- Water absorption power of hydrogel is high hence it is used in arid and semiarid as well as in dry spell conditions for diminishing water stress in plants.
- It also releases water and dissolve nutrient in a controlled manner gradually so helps the crop to extract nutrient through out the crop growth period.
- Reduces surface runoff, which leads to decrease in soil as well as water erosion.
- Hydrogel helps in increasing aeration so that enhances microbial activity of that particular region.

### **Disadvantages of Hydrogel**

- Preparation of hydrogel always needs a good mechanical strength but unfortunately somewhat world is lacking this mechanical strength.
- Handling of hydrogel is difficult.
- Mostly synthetic hydrogels are nonbiodegradable in nature hence may be toxic.

### **Future Prospective of Hydrogel**

- Hydrogel can be used for pest management if it will be loaded with different liquid pesticides.
- It can be used for seed coating to shield the seed from pathogens, salinity, acidity, alkalinity and drought *etc.*

### **Conclusion**

Population pressure as well as urbanization is increasing in a rocketing rate in the same manner water usage is also shooting up to meet the demand of population. But as water is incredible for crop-growth we need to save water and we have to adopt the technologies which will enable to produce more production per unit of water use. For fulfilling this dream hydrogel is the premier way.

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