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Applications of Hydrogel in Their Practical Form for the Purpose of Irrigation in Dry Areas

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Abstract

Water is the most vital and basic resource for crop production, yet it is always in short supply. Water scarcity affects photosynthesis, translocation, respiration, mineral consumption, and cell division. Due to water scarcity, many draught-prone areas, and irregular rainfall in India, it is critical to reduce water losses and boost water efficiency for increased crop and vegetation productivity. India could get a lot more water if they used hydrogel and other polymers that can soak up a lot of water.A hydrogel is a cross-linked polymer structure. It may absorb 30–40 times its weight in pure water before becoming gel granules. It improves water retention, water efficiency, and permeability. It aids in lowering irrigation frequency, dry density, and water runoff. Both living and non-living environmental influences can destroy it. As a result, the practical deployment of hydrogel is critical in drought-prone locations.

Keywords: *Hydrogel, Water deficiency, Crop productivity, Soil properties.*

INTRODUCTION

Water is the most vital and basic resource for crop production, yet it is always in short supply. Water scarcity affects photosynthesis, translocation, respiration, mineral consumption, and cell division. Due to water scarcity, many draught-prone areas, and irregular rainfall in India, it is critical to reduce water losses and boost water efficiency for increased crop and vegetation productivity. India could get a lot more water if they used hydrogel and

other polymers that can soak up a lot of water.A hydrogel is a cross-linked polymer structure. It may absorb 30–40 times its weight in pure water before becoming gel granules. It improves water retention, water efficiency, and permeability. It aids in lowering irrigation frequency, dry density, and water runoff. Both living and non-living environmental influences can destroy it. As a result, the practical deployment of hydrogel is critical in drought-prone locations.

Application of Hydrogel

There are numerous applications for hydrogels in pharmaceutical and chemical engineering (1). Hydrogels are used in the manufacture of contact lenses, hygiene products, and wound dressings (3). Its application in agriculture and irrigation appears to be a new field of application. The hydrogel polymer has the potential to hold excess water in the soil, allowing crops to use the water for an extended length of time.

A hydrogel (super absorbent polymer) is a water-retaining, cross-linked, hydrophilic, biodegradable amorphous polymer that can absorb and retain water 400 times its initial weight and make at least 95% of stored water available for crop absorption. When polymer is mixed with soil, it creates an amorphous gelatinous material that is capable of absorption and desorption over a long period of time, acting as a slow-release source of water in the soil. The hydrogel particles can be thought of as "miniature water reservoirs" in the soil, with water being withdrawn from these reservoirs in response to root need via osmotic pressure differential.

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Fig 1: Application of Hydrogel in Crop

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Advantages

1. Increase in water holding capacity of soil.
2. Increase in water use efficiency.
3. Enhance the soil permeability and infiltration rates.
4. Reduction in irrigation frequency.
5. Reduction in compaction tendency.
6. Reduction erosion and water run-off.
7. Increase in plant performance.

Limitations

1. Complexity of application and poor distribution in soil.
2. Absorption of water is time dependent process for hydrogel.

Case Study

The maize plant requires a lot of water and thrives best in temperatures ranging from 12°C to 30°C. For the study, the environmental parameters essential for crop growth were studied and recorded.The maize crop was grown in two distinct pots in the identical environmental circumstances as in the current case study. A hydrogel mixed soil sample was used in one pot, while no hydrogel mixed soil sample was used in the other. For this investigation, clayey soil that was locally available was used. Water was applied to the crops in both pots at the same time, and a record of the amount of water used was kept. The amount of water was determined by the soil's ideal moisture level at the time.

Fig 2 (a): Hydrogel mixed soil sample

Fig 2 (b): Without Hydrogelmixed soil sample

Table 1: Observation of Water Quantity

Sr.No.	Watering	Volumeofwater(Lit)	
		Naturalsoil	Hydrogelmixedsoil
1	First	2.5	2.5
2	Second	2.5	2.0
3	Third	2.5	1.5
4	Fourth	2.0	0

RESULT AND DISCUSSION

The maize plant requires a lot of water and thrives best in temperatures ranging from 12°C to 30°C. For the study, the environmental parameters essential for crop growth were studied and recorded.The maize crop was grown in two distinct pots in the identical environmental circumstances as in the current case study. A hydrogel mixed soil sample was used in one pot, while no hydrogel mixed soil sample was used in the other. For this investigation, clayey soil that was locally available was used. Water was applied to the crops in both pots at the same time, and a record of the amount of water used was kept. The amount of water was determined by the soil's ideal moisture level at the time.

CONCLUSION

The use of hydrogel was discovered to be very cost-effective and favourable to the growth of the crop under consideration. According to the findings of this investigation, hydrogel mixed soil samples required less water than non-hydrogel mixed soil samples. Similar research can

be conducted for different crops under varying environmental and soil conditions. These results can justify the use of hydrogel in water-stressed areas.

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