

Hydrogel: A boon for dryland agriculture

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Introduction

In India, more than 60% of the net cultivated area is under dry land conditions and also more than 30% of the area faces the problem of insufficient rainfall. Under such dry land, agriculture hydrogel may prove a convenient and economically feasible option to achieve the goal of agricultural productivity in almost all crops like cereals, vegetables, oilseeds, flowers, spices, etc. It also helps improve the quality of agricultural produce in terms of plant biomass, fruit and flower size and colour. Agricultural hydrogels are eco-friendly because they are naturally degradable over some time without leaving any toxic residue in the soil and crop products. Hence, the application of hydrogel will be a fruitful option for increasing agricultural production with sustainability in a water-stressed environment.

What is hydrogel?

Hydrogels are cross-linked polymers with a hydrophilic group that can absorb large quantities of water without dissolving in water. Water absorption capacity arises from the hydrophilic functional groups attached to the polymer backbone while their resistance to dissolution arises from cross-links between network chains. Polyacrylamide (C₃H₅NO)_n is widely used as a synthetic hydrogel which is non-toxic and highly water-absorbent and forms a soft gel when hydrated. Cross-linked variants of polyacrylamide have shown greater resistance to degradation hence, they are more stable for longer periods (2–5 years).

Uses of hydrogel in agriculture

- 1) They improve the ability of soil to absorb water (400 times of their dry weight) and release gradually according to specific requirements of the plant under semi-arid and arid regions.
- 2) They can perform well at high temperatures (40–50 °C) by withholding water in the root zone of the crop leads to reduced leaching of nutrients in the soil.
- 3) Because of their neutral pH, they do not affect nutrient availability, soil chemical composition

and action of other agrochemicals viz., fertilizers, herbicides, fungicides, and insecticides.

- 4) Hydrogels are neutral pH found to improve the physical properties of soils (viz. porosity, bulk density, water holding capacity, soil permeability and infiltration rate) without affecting nutrient availability, soil chemical composition, and action of other agrochemicals viz., fertilizers, herbicides, fungicides and insecticides.
- 5) An increase in porosity results in improvement in seed germination and rate of seedling emergence, root growth and density, and reduced soil erosion due to reduction in soil compaction.
- 6) It also increases biological/microbial activities in the soil, which increases oxygen/air availability in root zone of the plant.
- 7) Hydrogel help plant to withstand extended moisture stress by delaying the onset of permanent wilting point and reducing irrigation requirements of crops due to reduced water loss through evaporation.
- 8) Application of 5 kg/ha of hydrogel significantly increases soil moisture content at different depths of soil (viz. 0–15, 15–30 and 30–45 cm) at all stages of crop growth.
- 9) Different enzymatic activities (acid phosphatase, alkaline phosphatase, dehydrogenase, protease and urease) which are indicators of microbial population in the soil are increased with the application of hydrogel in sandy soils.

How to apply, when to apply and how much to apply

Agricultural hydrogel can be used for all crops and all soil types. Its benefits are most easily noticed in nurseries and seedling beds, crops sensitive to moisture stress, crops requiring large quantities of water and container gardens. Rate of application of agricultural hydrogel depends upon the texture of soil

for clay soil is 2.5 kg/ha (at the soil depth of 6–8 inches) and for sandy soil can be applied up to 5.0 kg/ha (at the soil depth of 4 inches).

Table1. Some of agricultural hydrogel products available in India

Trade name	Manufacturing company
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

- 1) **For field crops:** Prepare an admixture of hydrogel and fine dry soil in 1:10 ratio and apply along with the seeds/fertilizers or in the opened furrows before sowing. For best results, hydrogel should be close to seeds.
- 2) **In nursery bed for transplants:** Apply 2 g/m² (or according to recommended rate) of nursery bed mix of hydrogel uniformly in the top 2 inches of the nursery bed. In pot culture, mix 3–5 g/kg of soil before planting.
- 3) **While transplanting:** Thoroughly mix 2g (or according to recommended rate) of hydrogel

per litre of water to prepare a free-flowing solution and allow it to settle for half an hour. Dip the roots of the plant in the solution and then transplant in the field.

Conclusion

Understanding the advantages, it is concluded that hydrogels are practically convenient and economically feasible option in water-stressed areas for increasing agricultural productivity with environmental sustainability.

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