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HYDROGEL: A CONSERVATIVE APPROACH IN AGRICULTURE

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The increasing extent of desertification and scarcity of water are serious problems in various parts of country because of compromise agriculture farming. Desertification is the degradation of land in arid, semiarid and dry areas resulting from various factors including climatic variations, but primarily due to anthropogenic activities. The solution of this problem is by the use of synthetic materials with good water absorption and retention capacities under high pressure or temperature. Systems of this type are the Super Absorbent Polymers (SAPs). The most essential components of these applications are water absorbency and water retention. The present research work is aimed to using hydrogel technology for sustainable agricultural farming.

How Agricultural Hydrogels are Made

Hydrogel polymers are made from petroleum based products, but recent research has enable their manufacture using soy oil. These hydrogels are more biodegradable and therefore kinder to the environment. Agricultural hydrogels are referred to as water retention granules because they swell to many times their original size when they come in contact with water. Hydrogels are polymers that are physically or chemically cross linked and can absorb large amounts of water while retaining their shape. They also do not dissolve with the ingress of water and the large swelling due to the water does not affect the mechanical properties of the hydrogel. Hydrogels can hold an amount of water that is many times its own weight .This characteristic helps it to store water which can include nutrients. This water is then released slowly negating the evaporation process. This is especially useful in arid lands.

Hydrogels commonly used in agriculture can absorb between 400 and 1500 grams of water for every gram of hydrogel. So using these hydrogels in places where post plantation irrigation has its limitations, the hydrogels can store large quantities of water and make it available to the plantation so that it has time to establish itself. Hydrogels can be natural polymers, semi synthetic or synthetic polymers. The polymers used for agricultural purposes are the synthetic variety which consists of polyvinyl alcohols and polyacrryl amides. The advantage of synthetic polymers is that they are less biodegradable and would last for a longer time.

Classes of hydrogels

Two broad classes of hydrogels are-

Soluble variety-It is used to reduce irrigation erosion in fields by dissolving in water.

Insoluble variety– It is used in gardens, nurseries and landscapes to reduce frequency of watering. Instead of dissolving they absorbed water and swell many times of their original size. As they dry water slowly released in soil.

Potential uses in agriculture

- Hydrogels of different kinds could be useful in agriculture, reducing drought stress in plants, making better use of irrigation water and fertilizer.
- The hydroge**l** absorbs rainwater until full saturation of its crystals and in the dry season it constantly gives the plants through the roots. At the same time keeps the surface of the ground walkable and braced against the ground without hydrogel humidity to withdraw the ground and holds it firmly in its structure.
- Hydrogel increases the volume of water in the soil (1 kg hydrogel remain at about 250-300 liters of water), then the plant does not suffer from stress and constantly draws moisture and nutrients contained therein. Hydrogel is ideal for the dry season and dry area, it ensures the supply of moisture to the roots and where the plants are usually successful.
- Hydrogel reduces the frequency of watering by up to 70 % , thus saving water and your time, hydrogel reduces nutrient leaching to groundwater, and keeps them where they are needed , thus directly at the roots in water solution. This also saves the cost of fertilizer and irrigation.
- Superabsorbent hydrogel polymers can in principle influence soil permeability, density, structure, texture, evaporation and infiltration rates of water through soils.
- Allow pesticides to be released slowly over a long period, increasing effectiveness and reducing side-effects such as pesticide runoff. There has therefore been considerable research interest into the possible use of hydrogels in agriculture. For example, a hydrogel based on gum tragacanth increases the water content of clay soil by up to 5.35% and of sandy loam by up to 5.5%; it could also be used to release calcium chloride slowly over a prolonged period.
- Superabsorbent polymers can be used to release phosphate fertiliser slowly, by making an ester bond between polyvinyl alcohol and phosphoric acid. Agricultural hydrogels are synthetic polymers generally made from petroleum products. They absorb many times their weight in water, and can be distributed into dry regions in order to improve the soil's ability to absorb water. Learn how they're made and how they can be used.

Agricultural hydrogels can change the physical properties of soils by

- Increasing their capacity to hold water
- Reducing erosion and runoff
- Reduce frequency of irrigation
- Increase the efficiency of the water being used
- Increase soil permeability and infiltration
- Reduce the tendency of the soil to get compacted
- Help plant performance

Uses of hydrogel in field

Application procedure

- Field crops: Make a mixture 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.
- Nursery bed: Apply 2 g/m^2 (or according to recommended rate) of nursery bed mix of hydrogel uniformly in the top 2 inches of the nursery bed.
- Transplanting: Thoroughly mix 2 g (or according to recommended rate) of hydrogel per litre of water to prepare a free-flowing solution; allow it to settle for half an hour. Dip the roots of the plant in the solution and then transplant in the field.

Hydrogel in India

In 2015, The Indian Agriculture Research Institute (IARI) reported the development of a novel hydrogel for agricultural use. It was intended to help farmers to cope with drought, making efficient use of water in arid and semi-arid regions of India. Pusa hydrogel, a granular product developed and patented by Indian Agriculture Research Institute, New Delhi and being promoted by ICAR as well as Ministry of Agriculture & Science & Technolgy, Govt of India. It can save water as well as water soluble nutrients up to 40 to 60% in any crops and would be best for

1. Field Crops.
2. All cash crops like exotic vegetables, Indian vegetables, potato, and sugarcane.
3. Indoor Plants
4. Grass Lawns, Golf Courses, Cricket Stadiums etc
5. Plantation Crops like Tea estates, Coffee Estates, Coconut, Cashew, Rubber, Timber and forestry plantations
6. Green House, Shade net and other Hi tech cultivation practices.
7. Landscaping sites, Terrace Gardens
8. Field Crop Nursery, Garden Nursery and Plantation nursery.
9. Urban Farming, Kitchen Garden, Flower pots at Home, Hotel Restaurants etc

Advantages of Pusa hydrogel

- Can save irrigation water & nutrients up to 40 to 60%.
- Improve soil fertility and soil texture.
- Can perform well even at a temperature of 50-60 ^{0}C soil temperature.
- Helps in better germination about 20% increase performance.

- Yield increase reported from 10-30%.
- Healthy Plants / crop reported 40% better with use of Pusa Hydrogel in Poppy crop in MP.
- Pusa Hydrogel is very well effective for one year in the soil and then decomposes in soil.

Constraints

The high cost of these hydrogels has been an inhibiting factor that has drastically affected their universal use. Unless costs are brought down, its use will get limited to government and other well funded organizations, leaving out the private farmers and agriculturists who can benefit from its use.

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