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Role of Hydrogel in Fruit Crops

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Introduction

When placed in an aqueous environment, hydrogels are water swollen polymer chains with the ability to absorb water. Raindrop or agrosorb are two commercially available forms. It's a soil conditioner that can keep water and plant nutrients in the soil. Because of the unique physical and chemical characteristics of hydrogels, such as hydrophilicity, swellability, and modifiability, there is a growing interest in the development and application of new hydrogels in fruit crops. Its adsorptive removal of a wide range of aquatic contaminants, including heavy metals, nutrients, and poisonous dyes, has proven to be better. Adsorption kinetics, operating pH range, interference, and hydrogel recovery are all major issues that are investigated. Hydrogel helps trees grow healthier by retaining water in the soil and reducing the frequency with which they must be watered. It is beneficial for nearly all forms of agriculture, horticulture, and gardening, including fields, orchards, and vineyards, because horticulture's primary requirement is water and using the hydrogel increases both water and nutrient use efficiency.

Mode of action for polymer hydrogel

It aids in long-term absorption and desorption of water in the soil by forming an amorphous gelatine-like material when combined with the soil. The hydrogel particles act as “miniature water reservoirs” in the soil, and water is drawn out by the root via osmotic pressure differential. Because hydrogel shrinks as water is delivered to the plant, it generates more pore space in the soil for air and water penetration, storage, and root development. So the hydrogel polymer acted as a gradual release base for water and dissolved nutrients in the soil. It is beneficial in short-term droughts and reduces losses in the institution phase. Once

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polymers are mixed into soil, they preserve vast quantities of water and nutrients, reaching up to hundred times their original weight and conserve approximately ninety-five percent of keep water available for plant absorption and which are released as required by the plant, so plant growth was enhanced with limited water supply, however, in rainfall region.

General Characteristics

Polymers are high-molecular-weight compounds that may be formed from a variety of monomers. The materials that arise might be hydrophobic or hydrophylic. Swellable starch, crosslinked acrylamide: potassium polyacrylates, starch: Acrylate copolymers and acrylonitrile are all included in these hydrophylic polymers. Polymer crosslinking appears to increase plant-available water storage while also acting as a physical barrier to water evaporation from the gel. Particle size and distribution, salinity response, and cost all affect the total amount of water absorbed per gramme of material. Polymers may absorb up to 1000 times their weight in distilled water since most water sources are salinized, but in field applications, hydration seldom exceeds 400-500 times their weight. As the ion concentration in water rises, the polymer loses hydration. Particle sizes vary from 5m to 2mm inside a polymer and between polymer kinds. The majority of horticultural polymers are intended to increase soil water-holding capacity, pore size/number, transplant survival, germination, and lessen or eliminate the impacts of soil compaction on plant growth. To reduce plant toxicity, many manufacturers have substituted potassium for salt (often included in disposable baby diapers). Polymer breakdown rate has been studied in the field in few, if any, long-term investigations. Polymers lose 10–15 percent of their activity per year, according to controlled degradation testing. Polymer degradation appears to be mediated by microorganisms, physical structural changes, and chemical breakdown.

Key characteristics

- Exhibits absorbency at high temperatures (40-50°C), making it suitable for semi-arid and arid regions.
- Absorbs a minimum of 350 times its dry weight in pure water and gradually releases it.
- Low rate of application (1-1.5 kg/acre)
- Effective in soil for at least one crop season.
- Less affected by the presence of salts in its immediate environment.

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- Improves seed germination and seedling emergence.
- Improves root development and density.
- Helps plants tolerate prolonged moisture stress.
- Reduces nursery establishment time.
- Reduces crop irrigation and fertigation needs.
- Delays the beginning of permanent wilting.

Role in fruit crops

The lower tree mortality in freshly established orchards and continued active development in established orchards under stress situations, according to various research findings. Several injection devices have been built in the western United States as a result of the interest in injecting hydrated polymers in orchards. The application equipment has been built to apply dry polymer at four or more different sites around the drip line of trees, in addition to applying polymers in the hydrated condition. Initial reports from equipment developers suggested that the equipment and the application of the polymer in the drip-line area were both successful. However, tree size, tree species, location, soil type, and rainfall volumes and dispersion patterns should all be considered when determining the rate of polymer application at each location.

Application methods

Because of the modest rate of application (1-1.5 kg/acre) and the variety of agricultural circumstances, the product's application procedures have been standardised. It can be placed just below the root or seed, or in its immediate area, using a need-based application approach. The use of an admixture of hydrogel and soil in the furrows at the time of sowing, root dipping, nursery application, and other methods are all important.

Application equipment

Several companies have recently started to sell polymer injection equipment around the United States. Gene Seifert (Condor Industries Inc., Ogden, Utah) invented the Aqua-Life Tree Injector, which can inject dry or hydrated polymers. The system works by breaking up the soil near the tree stem with an air compressor before injecting the polymer into the soil with the injector. The injector has been used in orchards, street tree plantings, parks, and along roadsides to establish plants and bushes. IAS (Cerritos, Calif.) will market three types of polymer injectors: one for orchards and vineyards, another for grass, and third for

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landscaping and home yards. To inject the dry polymer, all of these IAS injectors use high-pressure water injection (3000 psi) and a Venturi chamber. A vacuum formed by the Venturi chamber draws dry polymer from the polymer hopper into the stream of water. The injectors can place the polymer anywhere from 4 to 20 inches (10 to 50 cm) beneath the soil surface, depending on the crop. Both polymer injectors aerate the soil while also injecting the polymer. Aeration of the soil can be just as beneficial to the plant as the polymer application.

Status of Commercialization

Pusa Hydrogel has been licensed to six companies for commercialization. It has become one of the key technologies of IARI having the potential to become a leading component in second green revolution.

Licensee companies

1. Earth intenational (p) Ltd, Delhi (product vaaridhar gi)
2. M/s carborundum universal (p) Ltd., Bangalore (product: kauvery)
3. Kch India Pvt Ltd Tamil Nadu/Chennai Jalnidhi pusa hydrogel
4. M/s huntin organics (p) Ltd., Faridabad (product: anmol)
5. M/s nagarjuna fertilizers (i') Ltd, Hyderabad
6. The sarpanch samaj, Delhi
7. M/s madhusudan and company (t) Ltd., Jaipur
8. *Reliance industries* limited

of the six licensees, three have launched their products. Much of the initial efforts of the licensees have been to undertake demonstrations in fanners' fields to establish a consumer base across the country. The initial cost of the product has been kept in the range of Rs 1000-1400 kg.

Conclusion

Hydrogel treatment improved soil physical qualities such as water holding capacity and soil water retention, as well as water usage efficiency and fruit crop growth and development. Because of its potential for water retention, soil conditioning, and nutrient transporters, hydrogel might be employed as an absorbent in the horticulture industry, based on its chemical and physical properties.