



The Benefits of using Hydrogel as a Soil Conditioner and Water Retainer in Agriculture

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DESCRIPTION

Water is a vital resource for agriculture, but it is becoming increasingly scarce and expensive due to climate change, population growth and environmental degradation. Irrigation accounts for about 70% of global freshwater use, but it also causes water losses through evaporation, runoff and leaching. Therefore, there is a need for innovative technologies that can enhance water use efficiency and reduce irrigation frequency and intensity [1]. Water scarcity is one of the major challenges facing agriculture in many regions of the world, especially in arid and semi-arid areas. Irrigation is essential for maintaining crop productivity and quality, but it also consumes a large amount of water and energy. Therefore, there is a need for innovative technologies that can improve water use efficiency and reduce irrigation frequency and intensity.

One of the promising technologies is hydrogel, which is a superabsorbent polymer that can absorb and retain large amounts of water and release it gradually to the soil when needed. Hydrogel can be applied to the soil as granules, pellets, powder or gel, or mixed with seeds or fertilizers. Hydrogel can also act as a carrier of nutrients and pesticides, enhancing their availability and effectiveness [2,3].

Hydrogel applications in agriculture

- Improving soil water-holding capacity and reducing evaporation, runoff and leaching losses
- Increasing water availability and uptake by plants, especially under drought stress
- Enhancing soil structure, porosity, aeration and biological activity
- Reducing soil erosion and compaction
- Improving crop growth, yield and quality
- Saving water, energy and labor costs

According to various studies, hydrogel can increase water use efficiency by up to 85% for sandy soils, reduce irrigation frequency by up to 50%, and increase crop yield by up to 40%.

Hydrogel can be used for different types of crops, such as cereals, vegetables, fruits, flowers and ornamentals. Hydrogel is made of cross-linked polymer chains that have hydrophilic groups that can bond with water molecules [4,5]. The most common hydrogel agriculture's ingredient is potassium polyacrylate or sodium polyacrylate. These polymers are insoluble in water and form a three-dimensional network that can swell up to several hundred times their original size when they come in contact with water. The amount of water absorbed by hydrogel depends on several factors, such as.

- The type, size, shape and concentration of hydrogel
- The soil type, texture, pH and salinity
- The water quality and quantity
- The climatic conditions, such as temperature, rainfall and humidity

Hydrogel can absorb water from different sources, such as rainwater, irrigation water or groundwater. When the soil dries up, the hydrogel releases the stored water back to the soil slowly and steadily. This creates a favorable moisture balance in the root zone of the plants and reduces the stress caused by water deficit. Hydrogel also prevents the formation of soil crusts and cracks that can hinder water infiltration and root penetration [6,7].

Hydrogel can also improve the nutrient status of the soil by acting as a slow-release fertilizer. Hydrogel can be loaded with different nutrients, such as nitrogen, phosphorus or potassium, or mixed with organic or inorganic fertilizers. Hydrogel can then release the nutrients to the soil along with the water according to the plant's demand. This can increase nutrient use efficiency and reduce nutrient losses through leaching or volatilization [8]. Hydrogel can also improve the pesticide performance of the soil by acting as a slow-release carrier. Hydrogel can be loaded with different pesticides, such as herbicides, insecticides or fungicides, or mixed with organic or synthetic pesticides. Hydrogel can then release the pesticides to the soil along with the water according to the pest's activity. This can increase pesticide efficacy and reduce pesticide runoff or drift.

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Hydrogel is a biodegradable and nontoxic material that does not harm the soil, plants or environment. However, some precautions need to be taken before applying hydrogel, such as: (1) Choosing the appropriate type and amount of hydrogel for the specific crop and soil; (2) Applying hydrogel uniformly and evenly to avoid uneven distribution of water and nutrients; (3) Avoiding over-application or under-application of hydrogel to prevent waterlogging or drought; (4) Monitoring the soil moisture content and adjusting the irrigation schedule accordingly. Hydrogel is a novel and effective technology that can help farmers cope with water scarcity and improve their agricultural productivity and profitability. However, more research is needed to optimize its application methods, rates and timings for different crops and soils [9,10].

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