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Original Research Article

Plant Polysaccharide Gels – Some Properties and Applications in Irrigation Systems, Horticulture and Soil Protection

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Gels are formed when certain plant polysaccharides come in contact with water. Many of these polysaccharides exhibit uptake of water in high quantities (factors up to 300-times the weight of the polysaccharide powder). Layers consisting of these gels have remarkable properties: they act as a barrier for water, e.g. seawater. In addition, during air-drying of mixtures with soil or sand, they can glue together these particles. When dry, they can form crusts that stabilize the ground and reduce erosion. Polysaccharide gels, when placed below the surface of garden soil, act as water depots for the roots of plants, and they are nutrients for microorganisms.

Keywords: Plant polysaccharide gels, water barrier, irrigation systems, soil stabilization, water depots, nutrients for microorganisms

INTRODUCTION

Many plant polysaccharide gels are formed when polysaccharide powder comes in contact with water. These gels have various remarkable properties: gel layers act as barrier for water, e.g. seawater; during drying, they can “glue together” soil particles when mixed into the soil; when dry, they can form crusts, stabilize the ground and reduce erosion; they can act as water depots for the roots of plants when placed in the soil, and they can be nutrients for microorganism, thus improving soil quality.

In standard textbooks on polysaccharide applications (e.g. M.A. El-Nokaly and H.A. Soini, 1999) these properties and the specific applications mentioned above are not treated at all or only scarcely described; in handbooks on water management (e.g. Publication by Lenntech BV) they are not considered. This is the reason why I describe several selected kinds of application of polysaccharide gels, especially those which are related to irrigation (barrier function, irrigation in locations very close to the sea), soil protection (problem of erosion), and horticulture (water depot). Our first presentations of our findings took place in the year 2000 at the EXPO.

RESULTS AND DISCUSSION

During a stay on the island of Djerba, Tunisia, I observed many dead palm trees in the hotel garden located in the immediate vicinity to the sea shore. I was told that the trees suffered from the salt load in the groundwater. Actually the ground water was, in fact, seawater. The hotel management had decided not to apply specific kinds of adequate irrigation, but to replace the dead palms by new palms and palm shoots. After all, the plant material and the manpower for the replacement were less expensive than an adequate irrigation system.

This was also the reason why they were no longer interested in conventional systems such as lowering the ground water level by drainage, and in a system described by me which uses the barrier function of polysaccharide gels as a barrier. The idea was as follows: the dead palms are removed; the bottom and the lower parts of the hole which was created by the removal of the dead palms is then covered by a thick layer of polysaccharide gel; the surface of the gel layer is covered by a layer of shredded plant material whereby the small plant pieces (stem material of dead palms) were covered by polysaccharide gel; The shredded plant material is then covered by a layer of soil; the new palm or palm shoot is then placed into the hole, the soil is added, and the whole site around the stem of the new palm is surrounded by a water ditch as usual, and the site is extensively watered from time to time.

The benefit: The barrier function of the polysaccharide gel prevents that sea water is transported, by capillary forces, to the surface; after all, no freshwater from irrigation comes into contact with seawater due to the barrier function of the gel. Capillary effects are avoided. Additional benefit: the depot function of the buried gel reduces the amount of water needed

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for irrigation; the location of the gel inside the soil avoids evaporation of the water depot. An application was now introduced by some dealers who had studied our system presented during the EXPO 2000 (s. above, Introduction): they sell plant polysaccharide powder (e.g. Guar Gum, a polysaccharide mainly common in the food industry; a technical grade is available) in arid zones.

It is used at sites where a perfect lawn should be created. This is done as follows: the site is made free of any plants and treated in such a way that it is flat and level; polysaccharide powder is evenly distributed on the ground, followed by a layer of soil. Now the whole site is carefully watered; this causes formation of a polysaccharide gel below the thin soil layer. In a final step, either grass seeds are carefully distributed as usual, or ready-to-use lawn is spread out as usual. Benefit: the polysaccharide gel is a water depot; less watering is needed. The roots of the grass penetrate the gel and get their water from the gel. The water loss of the gel is compensated by watering; in addition the gel is a source of nutrients for microorganisms.

At sites in arid areas where erosion by wind and water is a real problem, plant polysaccharide gels can be used for soil stabilization, thus preventing loss of soil. Application of plant polysaccharides can be done by mixing the powder into the soil layers close to the surface of the ground with subsequent natural watering or controlled irrigation. As an alternative, the polysaccharide powder can be mixed with loose soil, and the mixture can be blown directly onto the surface of the ground, followed by gentle watering. Thus, the polysaccharide – soil mixture will form a kind of wet gel consisting of polysaccharide and soil particles. After drying, the uppermost layer of the mixture will form a dry crust, preventing loss of soil by strong winds. Erosion by water can be reduced due to a certain stability of the crust.

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