Soil Polymers For Turf Areas: A Technical Review

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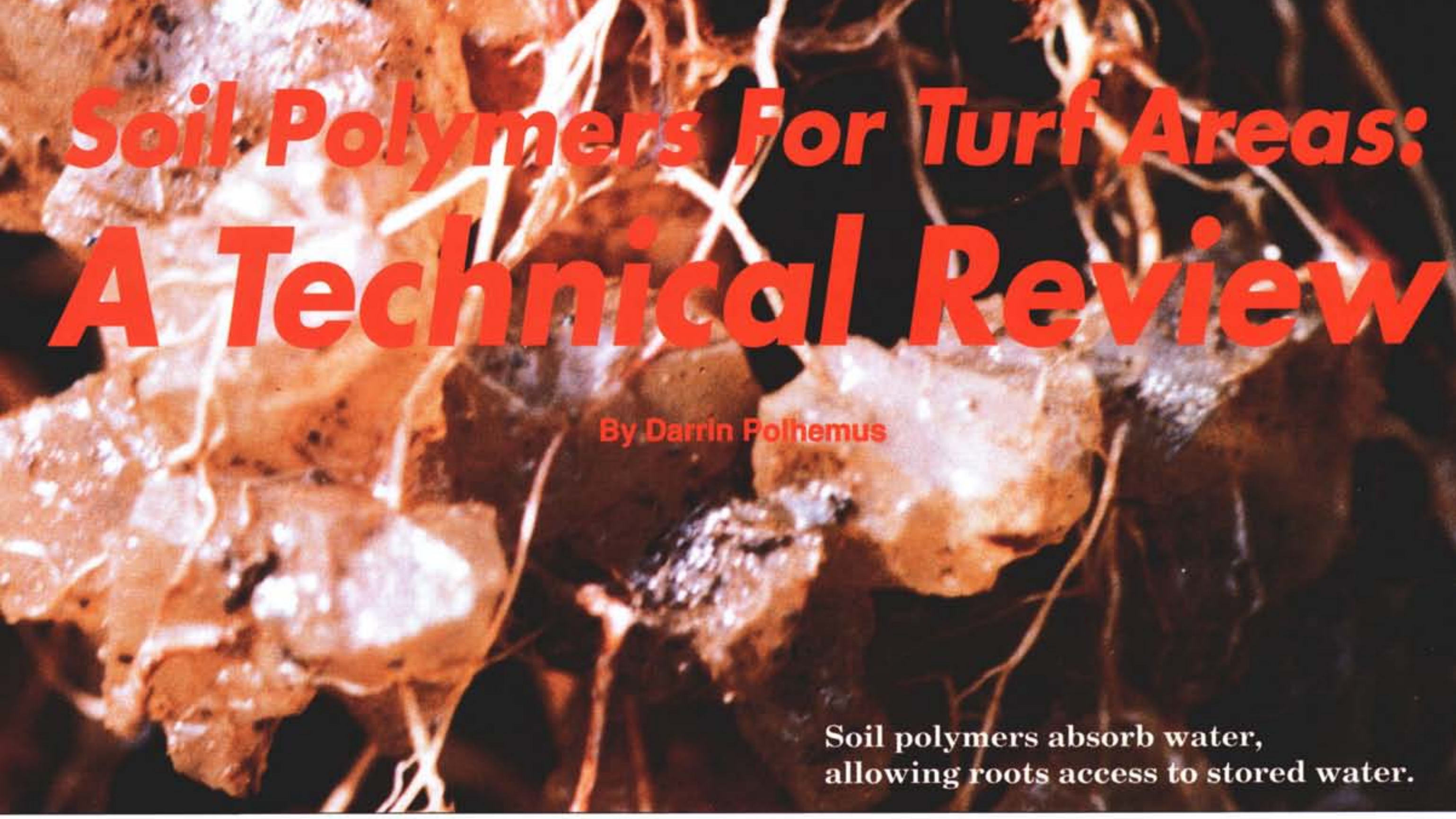

Soil polymers absorb water, allowing roots access to stored water.

The increasing pressure to conserve water on irrigated landscapes forces sports turf managers to explore methods of getting the most out of each irrigation. One alternative being explored is soil polymers.

Soil polymers have been around for about 40 years. Recently, they have undergone some improvements. They are acknowledged to increase the water holding capacity of soils and, therefore, extend irrigation intervals.

There have been sporadic studies and data collection on the benefits and disadvantages of using polymers as a soil amendment. The main focus of this article will be to explore the use of polymers in large turf irrigation management programs.

There are five main types of soil polymers being commercially produced and distributed. The most commonly used polymer is the cross-linked polyacrylamide.

*Starch-grafted copolymers,

*Polyacrylates,

*Cross-linked polyacrylamides (gel-forming),

*Non-cross-linked polyacrylamides (water soluble), and

*Polyacrylontrile.

Copolymers, or combined polymers, are also possible and contain mixtures of different polymer types. Each has a slightly different mechanism for absorbing water with the potential for absorption being based on the types of polymer used.

Water-Absorbing Ability

The absorbency of polymers depends on several factors. Under laboratory conditions, soil polymers can absorb hundreds of times their weight in water. However, there are several factors that influence this absorbency in the real world.

First, consider the type and quality of the polymer. A fair amount of variation can be found between different brand names and types of polymers.

A second factor is that all polymers drastically decrease in absorption ability when the water being absorbed contains salts. (Johnson, 1984). Most polymers absorb water in an attempt to dissolve. In the case of gel-forming polymers, they are held together by cross-links or some other form of chemical bonding between the polymer chains.

Many polymers also contain chemical groups that make them salt-like, placing them in a class of materials called polyelectrolytes. The ionic charges cause the polymer chains to stretch out in solution because the charged portions of the polymer tend to repel each other (Harwood, 1991). This effect causes cross-linked polymers that are in the polyelectrolyte class to swell much more than uncharged polymers with the same amount of cross linking. Whenever salts are present, the reactions between the charged portions are reduced considerably (Harwood, 1991).

In typical irrigation water, the absorption of a common cross-linked polyacrylamide will be around 80 to 200 times its weight in water. This is compared to laboratory test results showing an absorption of 600 times its weight of water when deionized water is used (Allied Colloids).

Product Lifetime

Another property of soil polymers that varies by type is life span once the product is incorporated into the soil. Starch-grafted copolymers have the shortest life span, with a typical range of one month to one year. Their absorption rate slows down after installation, but the rate of reduction depends upon the soil and microbial activity. Such rapid decay of the starch-grafted copolymers is a result of the starch chains that make up its structure being easily digested by soil microbes.

Typical life spans quoted for cross-linked polyacrylamides are five to 10 years. Polyacrylates and associated copolymers are thought to last from two to five years. The life spans mentioned are approximations and depend on soil conditions.

Both cross-linked polyacrylamides and polyacrylate copolymers maintain most of their water absorption ability until a period shortly before the end of their life when they begin to decay rapidly.

Benefits of Polymers

When polymers are incorporated into a soil, they increase the effective water holding capacity of the root zone. They do this by acting like miniature reservoirs that plants can draw from as they need water for transpiration.

You can view the addition of polymers as having the same effect as increasing a plant's root zone depth. It is this increase in available water to the plant that allows you to extend the interval between irrigations. (Note that the amount of water the plant uses does not change.)

Polymers can be helpful when dealing with potted plants (indoors or outdoors) or when establishing street trees where the expense of hand watering is significant. In these installations, there may be no automatic irrigation system and labor costs dominate the expense of keeping the plant watered.

In such cases, being able to irrigate half as many times per year is a true labor savings. However, for general landscape applications, automatic controllers turn irrigation systems on and off. In such cases, the water cost itself is the issue.

Polymers only extend the interval between irrigations and have only a minor effect on the total quantity of water required (Nus, 1990), resulting in negligible change in the annual cost of irrigation. Therefore, polymers tend to have fewer cost benefits in general landscape use. However, they can provide several types of appearance, soil structure and safety benefits.

One area where the use of polymers may be beneficial is in the treatment of dry spots, which are caused by areas where the soil has extremely low water-holding capacity. An example would be a turf site that has mostly a silty or clay soil with spots of an extremely sandy soil. In this case, a polymer application to the sandy area may bring the water-holding capacity of the sandy area up to or close to that of the adjacent heavy textured area. This would allow irrigation frequency to be based on the larger percentage of the turf area and might improve the appearance of the sandy area.

You could possibly justify general application of soil polymers under a set

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of multiple circumstances. If the soil of the area you are treating is extremely sandy and the number of days per week available for irrigation is severely restricted, then polymers may provide a viable solution. They will provide a larger *gas tank* for storing irrigation water.

However, polymers used for large areas may be costly (approximately $2,000 to $5,000 per acre when installation is included) if you apply them in sufficient quantity to significantly increase the water holding capacity within the turf root zone.

Another possible benefit of soil polymers is the appearance of turf in treated areas. It has been reported that areas of turf seem to hold a better appearance for a longer period of time and tend to show fewer signs of stress than untreated areas (Nus, 1991). This does not have any relation to the amount of water plants use.

Polymers and Soil Structure

Another possible benefit is the effect polymers have on soil structure. The expansion and contraction of the polymer while in the soil has been reported to cause greater soil fracturing and possible reduction in compaction (Ellefson, 1990). A study by Dr. Tony Koski of Colorado State University indicated that polymers have an effect on the compaction of the soil. This could possibly increase root mass and organic material within the soils (Wofford, 1989).

Subsurface polymer planter in action. Photo courtesy Ken Harrison, Hydrosource.

Polymer Elasticity

In a study at Kansas State University, Dr. Jeff Nus investigated the effect of polymers in turf as a way of reducing sport injuries. A hydrated soil polymer has a consistency like a super strong jello. It will give a lot and does not burst or rip when pressure is applied. When mixed into the soil, polymers may add some shock absorbing ability to the soil. This extra shock absorption could be easier on athletes' knees, helping to prevent certain injuries that occur during turf sports (Nus, 1990).

Possible Savings With Polymers

In a study to determine the allowable days between irrigations at different polymer application rates (Nus, 1990), it was found that 80 pounds per acre was required before any increase in water stored in the soil is noticed. However, applications this light are not recommended.

A *substantial* increase in water stored in the soil was achieved only when the application rate was raised to 320 pounds per acre. This amounts to approximately 7.5 pounds per 1,000 square feet. At this rate, the polymer increased the soil-water holding capacity by 0.25 inch of water. During a typical hot day in Southern California, a turf area could use 0.2 inch of water in one day. Therefore, a soil polymer applied at 320 pounds per acre will only extend the time between irrigations by about one day in the summer.

In general, there is not sufficient information to determine optimum polymer application rates based on soil type, root zone depth or irrigation water quality. The information provided concerning the amount of possible water absorption usually ignores the effects of salts in fertilizers, soils and irrigation water. Although it is generally recognized that salts reduce the water absorption of polymers, the question is how much the absorption is reduced in actual field use. This lack of knowledge has hindered the ability of landscape contractors to predict the actual economic performance of a certain polymer application rate at a specific site with a given water quality, soil texture and fertilization.

Although soil polymers increase the water holding capacity of soils and extend the possible time interval between irrigations, they do not significantly change the fundamental variables affecting plants' irrigation water requirements. The total water required per year is about the same. The amount of water applied can be reduced if there is overirrigation.

When you consider soil polymers for turf sites with automatic irrigation systems, evaluate polymer use on the basis of being able to reduce compaction, help prevent sports injuries, improve turf appearance in specific *hot spot* areas, and increase irrigation scheduling flexibility. ❑

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