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HYDROGELS AS AUXIN CARRIERS FOR ROOT REGENERATION

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Starch-based polymers, commonly referred to as hydrogels (hydrophilic gels), water-absorbing polymers, transplant gels, or super-absorbents, are being used in a variety of ways in the production of numerous horticultural crops. These products, under such trade names as Terra-Sorb, Agrosoke, Water Grabber, Hydra-Soil, Viterra Gelscape, Aqua Lox, Stasorb, Liqua-Gel, StaWet, Moisture Mizer, and others, are purported to hold up to several hundred times their weight in water, and then to subsequently release water under drying conditions, thereby decreasing the need for irrigation. Gels are also reported to improve field soil and container media aeration, to reduce fertilizer leaching, and to promote ion exchange.

HYDROGEL USES

Hydrogels, not to be confused with wetting agents which are designed to improve water penetration (not retention) into potting media and field soils (16), are advertised by their manufacturers for many uses. These uses range from dipping transplant roots, coating seeds and fluid drilling pregerminated seeds to incorporation into potting media, and landscape planting holes and beds. Other water retaining/extending recommended uses include hydroseeding and sodding, and cut flower holding.

Research using hydrogels has yielded mixed results, sometimes showing considerable benefit (5), and other times showing no benefit from their use (4,9). Most negative reports have centered around a decrease in medium aeration when hydrogels are incorporated (8).

Under my test conditions I have seen no benefit from their use when incorporated into greenhouse pot plant media for reducing water use or watering frequency, and have found no benefit using them as a root dip when transplanting bareroot Christmas tree seedlings, or as a slurry added to the planting hole when transplanting container-grown nursery stock. I have also used them both as an incorporated dry powder and as a slurry in the soil within the in-ground fabric containers in hopes of reducing the need for field irrigation, and even under severe drought conditions have again seen no benefit that justifies the cost of their use, at least in the conditions under which I tested them.

AUXIN CARRIERS AND APPLICATION METHODS

The auxins or rooting hormones used in plant propagation are applied in a number of ways depending in great part upon the inert carriers used. Auxins in solvents such as water, acetone, glycerol, DMF, DMSO and various alcohols may be used directly as concentrated quick-dips, dilute long soaks, drenches, sprays, and injections, and indirectly when toothpicks, string, and other physical carriers are soaked in them. Powders such as talc and pastes such as lanolin and wheat flour are also used as carriers and application methods.

It has been reported that hydrogels can be used not only for water retention, but also as carriers for numerous horticultural chemicals including fertilizers, herbicides, fungicides, insecticides and nematicides (11). At least one hydrogel/fertilizer product is now being marketed (SoilMoist Plus, JRM Holdings, Inc., Hudson, Ohio 44236), and reports exist of others that are forthcoming (2,11).

Several researchers have and are investigating the use of hydrogels as carriers for auxins or rooting hormones, both for root development on cuttings, and for root regeneration on larger bareroot transplant stock (1, 13, 14, 17, 18). Increased root regeneration on bareroot trees has been obtained using spray applications, and on balled and burlap trees using a soil drench. Trees successfully tested include magnolia (15), oaks (6, 13), Colorado spruce (7), linden (20), and crabapple (20). Successes with other means of application have also been reported (19).

Regarding auxin incorporation into hydrogels, again, as with their general use, mixed results have been obtained. I reported encouraging results after an initial year's testing, with significant increased root regeneration on 2-0 white pine seedlings and 2 to 3 ft. dogwood (3). In two subsequent years' experiments, however, one using plants for which root regeneration is easy (silver maple), moderate (dogwood), and difficult (sourgum), and one using dogwood under low and high volumes of applied irrigation (data unpublished to date), results were very inconsistent.

Having obtained mixed results, the only conclusion I have reached relative to the use of hydrogels for use as auxin carriers appears to be the fact that, as with the other uses, their efficacy varies greatly depending on media (or field soil) moisture levels. In addition, there exists the possibility of a negative chemical interaction between the hydrogel and the potassium of the K-IBA auxin used in this work. Dissolved salts in tap water and fertilizer have been reported to adversely effect gel hydration significantly (12), which conflicts with reports of effective incorporation of fertilizer into gels (11).

Aitken (1) reported no significant improvement in root development on rooted cuttings of 'Coral Bell' azalea when either hydrogel/IBA or hydrogel/IBA/nutrient combinations were used. Root development was significantly improved only when using just a hydrogel/nutrient combination. Starbuck and Preczewski reported statistically significant increases in the number of new roots on bareroot 1-year old dwarf peach trees treated with a hydrogel/IBA combination (18), but later Starbuck reported that a hydrogel/IBA combination did not significantly increase the number of new roots on bareroot, potted roses, and may have caused a reduction in shoot growth, although the gel did not counteract the root promoting effect of an alternative IBA source, K-IBA (17).

One important characteristic of auxins that should be kept in mind when evaluating rooting experiments is the fact that while auxins promote root initiation, they can inhibit root elongation (10), and also shoot growth (17). With rootless cuttings, root initiation may be considered most important, while with nursery stock being transplanted with a portion of its root system already existing, root elongation may be as much or more important than additional root initiation or regeneration, depending upon the percent of the plant's root system that is harvested. A clear advantage to universally using hydrogels as carriers for auxins for root regeneration has yet to be satisfactorily demonstrated.

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