Seed Priming

We all want two things from turfgrass — we want it to be beautiful, and we want it now. Selecting the right varieties helps to ensure beautiful turf, and seed priming can deliver germinated seed sooner than traditional methods.

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Unfortunately, our most desirable turf species are among the slowest to germinate. For example, Kentucky bluegrass is very slow to germinate, taking several months to fully establish. This gives weeds plenty of time to overtake the sluggish bluegrass seedlings. Likewise in turfgrass mixtures, more aggressive turf species can overcome the slower bluegrass. For example, in a mixture of Kentucky bluegrass and perennial ryegrass, the ryegrass often dominates the slow-to-establish bluegrass. To compensate for this, turf managers may plant 90 percent or more bluegrass in the seed mixture to obtain a 50:50 mix of plants. This can lead to clumping or segregating of the two species.

Turf scientists have tried for years to speed up turf seedlings. There are three methods used to enhance the germination of seeds:

- Presoaking seed in water,
- Presoaking seed in water and giberillic acid (GA), or
- Seed priming.

Presoaking means partially germinating seed before planting. Usually the procedure involves placing the seed in a 55-gallon drum containing water, using an aquarium pump and an air stone to aerate the seed for 48 hours or more, and then planting the seed wet.

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The most vigorous seed will usually germinate in the water — here, we define germination as the root and shoot breaking the seed coat. This presents a problem — seed must be planted wet, and wet seedlings are susceptible to physical damage. Furthermore, you must plant presoaked seed into a damp seedbed immediately after treatment or the seed is wasted. Planting into a dry seedbed results in severe desiccation to your most vigorous seed — those that have already germinated or are germinating. Adequate moisture has to be maintained after planting until the stand is established.

Presoaking in water and GA will result in more rapid and uniform germination. This works best with annual ryegrass and tall fescue. This method of presoaking is done by dissolving a very small quantity of giberillic acid in water — 1 ounce of

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giberillic acid in 75 gallons of water. The seed should be presoaked in this solution for 2 days at 77°F, while being aerated with an air stone and aquarium pump. Again, the seed must be planted wet, so you'll encounter the same problems you had with presoaking in water alone. The advantage of this method is that seed will germinate 3 days sooner than those soaked in just water.

Seed-priming

Scientists in the vegetable industry have developed a method called seed priming to deal with slow-to-germinate crops and weak seedlings. Seed priming or osmoconditioning is a seed pretreatment where moisture is controlled, allowing the seed to be brought through the germination process, just before root and shoot emergence. Nothing breaks the seed coat.

The difference between presoaking and priming is important to understand. In priming, the root and shoot do not break through the seed coat. You can plant the seed dry using traditional methods without any physical damage to the seed. Conversely, in presoaking roots and shoots have emerged from the seed coat in the more vigorous seed, and you must plant the seed wet using a hydraulic seeder.

In priming, the seed is soaked in a solution concentration that makes only a certain amount of water available to the seed. We use solutions containing polyethylene glycol (PEG 8000) or various salts (NaCl or table salt). PEG is a non-toxic thickener found in shampoos and soft drinks. The large molecular size of PEG prevents it from penetrating the seed coat. But, it is very expensive, so we also prime with various salts, such as table salt. Salts present some hazard because they penetrate the seed coat and may be toxic to the seed, as in the case of potassium nitrate.

Testing procedures

Our testing procedure to evaluate potential priming treatments uses petri dishes containing blotter paper, soaked with the experimental solutions. We place 50 seeds in the dishes where they prime in a germinator set at a constant temperature, (usually around 60 °F) for a set period. When priming is complete, we rinse the seed in running tap water and then dry them at 60 °F until they are surface dry. We then place them in petri dishes with blotters soaked in water where we germinate them and test them against untreated seed.

We do daily seed counts to monitor their progress. We also run germination tests in the field using 1 in.-diameter mini-plots, which we monitor daily. The field tests give the advantage of seeing how primed seed performs under natural conditions.

If we plan to store primed seed for any period, we store it in a refrigerator. Priming effects subside over time at room temperature. However, even old primed seed never performs worse than untreated seed. It may eventually equal untreated seed, but it never drops below it.

Various problems arise when we need to prime large amounts of seed using this petri-dish concept. This is because grass seed has several requirements that have to be met if the set is to germinate to its full potential.

- **Grass seed has a light requirement**. Grass seed is photosensitive. That is, it does not germinate as well in total darkness as it does with even a small amount of light. That is one of the reasons why you plant many seeds shallowly. Seeds have the same requirements during the priming process that they have during germination in the field.

- **Grass seed has a high oxygen requirement.** Water does not contain enough free oxygen to meet the needs of germinating grass seed. The seed realizes this and will go dormant in standing water. That's why we aerate the water, preferably with an oxygen supplement.

- **Grass seed excretes toxins that inhibit germination.** When seed *imbibes* (takes in) water, it excretes chemical toxins. In large quantities, these chemicals are harmful to the seed and can inhibit seed germination.

- **The germination rates of grass seed differ among species, varieties and seed lots.** We designed the experimental seed-priming apparatus to meet the needs of the grass seed and deal with the problems of priming large quantities of seed. The aquarium holds 18 clear testing columns, each containing priming solution and seed. A pump supplies a combination of air and pure oxygen through the bottom of the columns to aerate the solution. We fill the aquarium itself two-thirds full with water to create a waterbath, which we heat or cool to maintain a constant temperature. The seed gets adequate light, oxygen, the right temperature and the right water concentration. We change the priming solution every 24 hours to remove all excreted toxins.

Because germination rates differ among species of grass, among varieties within a species, and among seedlots within a variety, it's hard to know how long to prime a given batch of seed. If the seedlot has a long drawn-out germination, priming needs to run longer than if the seed germinates fairly rapidly. It is possible to end up with seed that hasn't primed sufficiently or seed that has primed too long and deteriorated.

Other research

Priming is very successful with other species of grass, such as bermudagrass. Bermudagrass seed has a very impervious seedcoat causing it to have a long, drawn-out germination rate. But, priming has a dramatic effect on bermudagrass. To quantify the germination rate, we used a germination index; the larger the number, the faster the seed germinates, and the more uniform the germination. Our testing showed that priming with an experimental salt was more successful than PEG.

The high germination index numbers we found also demonstrate another advantage of priming. Weaker seeds take so long to germinate that they become targets for fungus and bacteria; however, when we give these weak seeds a boost by priming, the weak seeds develop much faster and our final germination count is higher.

Priming can also aid a slow-to-establish species in competing with a more aggressive species when you plant a mixture. THis is the case with perennial ryegrass and Kentucky bluegrass. We compared Prelude perennial ryegrass with primed and untreated Baron Kentucky bluegrass to test this concept. The primed Kentucky bluegrass started to germinate on the same day as the perennial ryegrass, whereas the untreated bluegrass lagged behind.

To show what this edge can do for Kentucky bluegrass, we set another experiment using Prelude in a mixture with untreated Baron Kentucky bluegrass. After 3 months when the stand was fully established, there was twice as much Kentucky bluegrass in primed lots than in the untreated Kentucky bluegrass plots.

Credit: Hole Notes, July '93