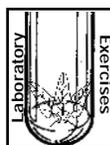


# Teaching Methods

## A Classroom Laboratory Exercise to Demonstrate Seed Priming

Sharon A. Duray<sup>1</sup> and Fred T. Davies Jr.<sup>2</sup>



**Additional index words.** education, germination, osmoconditioning

**Summary.** A laboratory exercise is outlined and discussed for seed priming, or osmoconditioning. The exercise was developed using an easily constructed and inexpensive seed-priming system. A variety of horticultural seeds can be used to give students experience and exposure to some of the benefits of seed priming. Seed germination data usually can be obtained within 6 to 8 days, depending on the species used. The laboratory may be modified to stress various features of seed priming, including priming agents, optimal concentrations, and ranges of germination temperatures.

Department of Horticultural Sciences, Texas A&M University, College Station, TX 77843-2133.

<sup>1</sup>Senior Research Associate.

<sup>2</sup>Professor.

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### Seed priming

Plant propagation instructors are challenged to develop laboratory exercises that demonstrate the theoretical aspects of seed germination. Seed priming, or osmoconditioning, is a relatively new technique that has been shown to improve seed performance in horticultural crops. Through the use of seed-priming agents, such as various salt solutions, polyethylene glycol, etc., the hydration of seeds is controlled to a level that permits pre-germinative metabolic activity to proceed, but prevents actual emergence of the radicle (Bradford, 1986). For many crops, seed priming has resulted in increased germination percentages

(Frett et al., 1991), improved germination uniformity (Brocklehurst and Dearman, 1983), and more-rapid germination (Smith and Cobb, 1991). This is particularly true when seeds are sown under adverse conditions, such as low temperature (Khan et al., 1983). Osmoconditioning also has been shown to be an effective tool in increasing seed longevity during high-temperature storage (Georghiou et al., 1987) and overcoming thermodormancy in lettuce (Valdes et al., 1985). Due to its increasing importance, seed priming can be a beneficial technique for inclusion in teaching laboratories.

### Equipment and procedures

An easily constructed seed-priming system was designed using a pair of 2-liter glass jars, two aquarium pumps, tubing, and air stones (Fig. 1). One jar was prepared by dissolving 18 g of  $\text{KH}_2\text{PO}_4$  in 1 liter of distilled water, having a final pH of 4.6, and osmotic potential of  $-0.476$  MPa. The other jar contained distilled water as a control. The aquarium pumps were connected, and tubing was placed in the containers to aerate the solutions. Seeds tested were counted and placed in coffee filters, securely folded, stapled, and marked with indelible markers. Seed number per treatment and number of replications can be modified depend-

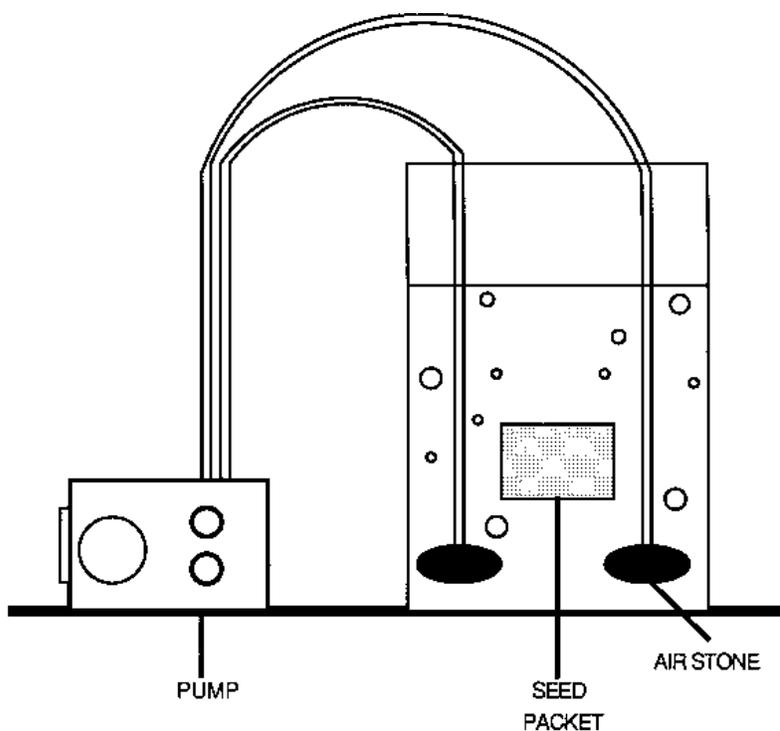


Fig. 1. Diagram of seed-priming system for classroom demonstration.

ing on student number and the most-efficient use of the germination area. Individual seed packets included 1-, 3-, and 5-day treatments for the priming solution and distilled water treatment. A nontreated control also was included. Five-day treatments were placed in the solutions 6 days before the laboratory exercise was conducted, and 3- and 1-day treatments were submerged 4 and 2 days prior, respectively. One day before the laboratory exercise, seed packets were removed, placed in a strainer, and rinsed well with distilled water. The control treatment also was rinsed with distilled water. Seed packets were opened, spread on paper towels, and allowed to air-dry at room temperature until no longer damp ( $\approx 24$  h) before sowing. Students placed seed treatments in labeled petri dishes containing moist filter paper and placed them on a light rack with a 16-h day length, PPF of 45  $\text{mmol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ , and average temperatures of 23C for optimal germination. Students observed the seeds daily for percent and rate of germination based on radicle emergence and elongation. Median germination time (time in which 50% of a seed lot germinates) was determined by students. The experiment usually was concluded after 6 to 8 days, depending on the species used.

### Student evaluation of results

Many horticultural species are

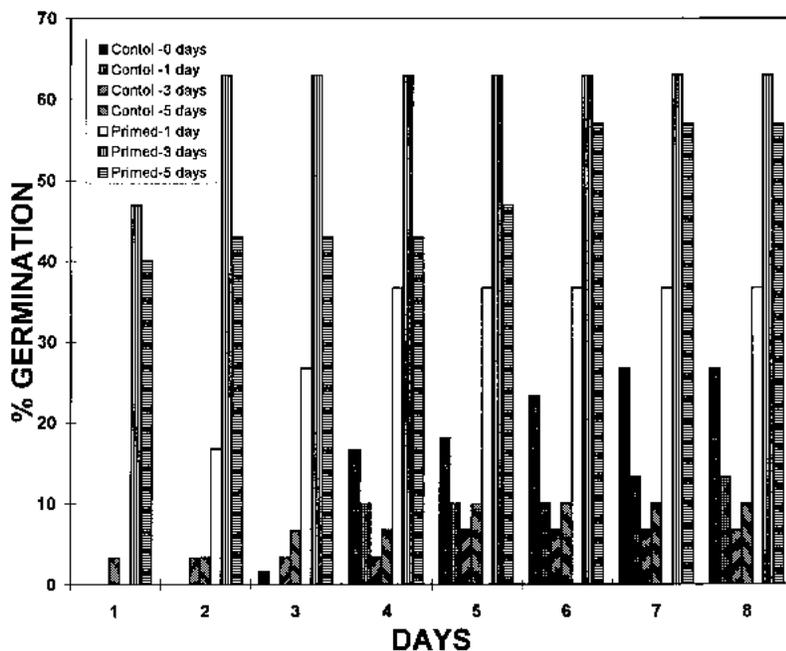


Fig. 2. Germination percentage of *Vinca* (*Catharanthus roseus*) seed primed for 1, 3, or 5 days with  $\text{KH}_2\text{PO}_4$  or with water control.

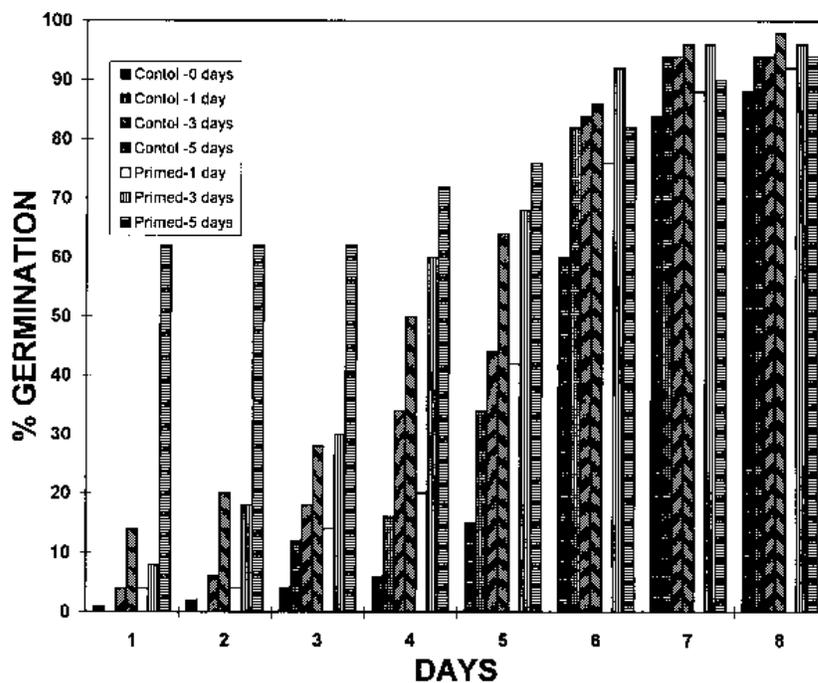


Fig. 3. Germination percentage of jalapeño pepper (*Capsicum annuum* 'TAM Mild') seed primed for 1, 3, or 5 days with  $\text{KH}_2\text{PO}_4$  or with water control.

adaptable for use in such an exercise. Some species responded favorably, others negatively, while some did not respond to priming at all. The experiment usually consisted of more than one species (different species were assigned to lab sections), and replications were completed by groups within a lab section. At the termination of the

experiment, results from all lab groups and lab sections were tabulated, and pooled data were given to students for analysis. This ensured that students would observe and report on effectiveness of osmoconditioning with several species. Results over the past 3 years have demonstrated consistently the concept that seed priming enhances germination. A good test species for this exercise is *Vinca* or Madagasgar Periwinkle (*Catharanthus roseus*), which typically has a poor germination percentage and rate. Seed priming for 3 and 5 days significantly enhanced both germination percentage and rate in *Catharanthus* (Fig. 2). Jalapeño pepper (*Capsicum annuum*) 'TAM Mild' also responded favorably to priming (Fig. 3). Germination was inhibited in geranium (*Pelargonium × hortorum*) seeds primed with  $\text{KH}_2\text{PO}_4$ , whereas pansy (*Viola × Wittrockiana*) and tomato (*Lycopersicon esculentum*) responded favorably. The species used generally had large seed size, allowing easy handling and viewing without magnification. Seeds used represent common ornamental and vegetable species that are available through seed catalogs and are relatively inexpensive.

### Teaching benefits

This simple demonstration exposes the students to the technique and benefits of osmoconditioning. The

laboratory can be modified easily to examine the effects of other specific priming salts, salt concentrations, priming temperatures, and duration of priming on seed germination.

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## In the Eye of the Beholder: The Case of the Minnetonka Lawn Ordinance

Anne M. Hanchek<sup>1</sup>

**Additional index words.** decision case, naturalized landscape, people-plant interaction, city government, turf management, urban conflict issues

**Summary.** In 1991, a suburban city in Minnesota found its lawn and nuisance weed ordinance the center of controversy as a citizen sought to develop a naturalized landscape that contrasted greatly with her neighbors' mowed lawns. This decision case study presents that situation as faced by the city policymakers and, when presented in a class setting, provides an opportunity to explore real options in a real issue of today. The case objectives are to prepare policymakers to deal with similar issues, and to broaden the outlook of students based in plant and environmental sciences to include the social factors of people-plant interactions. Group problem-solving skills also can be enhanced by this exercise. The abridged teaching note provides guidance for classroom and extension use.

### The case

Bill Hise fought his way through the downtown Minneapolis rush hour traffic, avoiding the potholes of April as best he could, but he hardly noticed. He was concentrating on another potential battle coming that evening. Bill was a member of the Minnetonka City Council, which was in the process of

*Department of Horticultural Science, University of Minnesota, St. Paul, MN 55108.*

<sup>1</sup>Assistant Professor.

*Many thanks to Desyl Peterson, Minnetonka City Attorney, for inviting me to participate in the development of the new ordinance, and for sharing with me her files and her insight on the process. Thanks also to D.W. Davis for his help in the preparation of this decision case for publication. The cost of publishing this paper was defrayed in part by the payment of page charges. Under postal regulations, this paper therefore must be hereby marked advertisement solely to indicate this fact.*

reviewing a proposed revision of the lawn and nuisance weed ordinance. A situation with a local resident had sparked a great deal of controversy over the existing ordinance, and led to the proposal the Council would be considering that night. Looking back, Bill thought that no single issue in his 11 years of tenure had taken as much staff and council time. Tonight, after a year and a half of work, the Council would review the second draft of the ordinance in an open work session and would decide if it was ready to send it forward for an official council vote. "What additional issues will be raised?" he wondered. "What have we missed?"

Bill knew that Minnetonka had first struggled with a lawn and nuisance weed ordinance in 1987 in response to citizen concerns about neglected yards (Exhibit 1). Residents wanted the city to take action against grass that was unmowed. There was an apparent increase in the number of houses going through foreclosure, with homes left unoccupied and untended. Some believed that the unkempt appearance decreased the value of their nearby properties and the enjoyment of their neighborhoods. Generally, the ordinance had been effective in answering those concerns. For example, in 1991, the Community Development Dept. responded to and resolved almost 50 complaints about yard neglect. (Enforcement was only in response to written complaints filed by neighbors directly affected; areas were never sought out and cited by inspectors. This method of "enforcement on demand" had been upheld in court as a just means of allocating city resources that otherwise would have to be spent on a full-time inspection program.)

The Minnetonka Council in 1991 governed a city with a rich variety of landscapes and land usage patterns that presented almost every possible situation, from natural area to city park to farmland to manicured suburbia. In fact, many people in Minnetonka still kept horses, pastured within the city limits, and the Minnetonka Horsemen's Assn. was a well-organized group that promoted owning horses as companion animals. In July 1991, however, one situation raised significant controversy and demanded official attention when a landowner was cited after complaints from her neighbors (Exhibit 2).

Marjie Kline appeared before the