Seed Priming and Pelleting: Tools for Stand Establishment

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Seeds are pelleted for ease of handling, singulation, precision placement, and the incorporation of beneficial chemicals, such as fungicides or microbials. Cereal seeds were the first seeds to be pelleted in Europe. Sugar beets were one of the first seeds to be pelleted in U.S. The outlawing of the short-handled hoe for the lettuce industry created demand for coated lettuce seed as the use of precision field seeders increased. As well, the expansion of greenhouse-transplant production created another arena where pelleted seed would be a labor-saving device, for both vegetables and flowers.

PELLETING

The objective of pelleting is to make the seed rounder, smoother, heavier, and more uniform than the raw seed.

Seed is pelleted when growers need a precision-sown crop and the raw seed is too small, too light, or too variable in size to be sown accurately. Precision seed is needed for production in cell trays in greenhouses, or when strict control for depth of placement and spacing is critical to achieve the highest possible yields. For example, pelleting allows the lettuce grower to precision-seed his crop with a high uniformly spaced population, allowing for the thinning operation to be faster, cheaper, and more accurate.

TYPES OF MATERIALS FOR PELLETING

Basically two types of materials exist, melt coat or split coat. The melt coating dissolves when wet and gradually washes away from the seed. Split coats initially retain their shape when wet, and as water is absorbed by capillary action to the seed, the seed begins to swell and the pellet splits open. The melt coatings were developed in the 1960s while the split-coat pellet was not introduced to the U.S. until the early 1980s.

The split pellet often requires less water during the germination process, allowing for oxygen to get to the seed more quickly. Melt coats on the other hand require enough water and time to wash the coating off of the seed. Because of their affinity to water they perform more reliably in the U.S. greenhouse systems and coastal field conditions, in what seem to be wetter and cooler atmospheres. Split coatings perform best when they are in drier conditions during the germination phase, such as field plantings in the southern portion of the U.S.

HOW IS SEED PELLETED?

The pharmaceutical industry developed technology which the seed coating industry relied upon in the beginning. Even today the candy industry employs similar techniques to produce some candies. Commercial seed pelleting is done by placing seed in a rotating pan, misting with water or other liquid, and gradually adding a fine inert powder. The wet seed becomes the center of the pellet, and as it tumbles in the pan the seed collects the fine powder, layer after layer. The pellets are rounded and smoothed by the tumbling action in the pan. The fine powder is compacted by compression from the weight of material in the pan.

Uniform size and uniform rate of increase in size are evaluated throughout the process with frequent hand screening. At intervals the seed is removed from the pan and screened. The smaller-sized pellets are then returned to the pan and the pelleting process continues until the pellets are the same size as the remainder of the lot.

After pelleting, the seeds are placed in forced-air dryers for a specified period of time. The seed is collected and screened once again. Pellet size is crucially measured with the standard tolerance at 0.4 mm, seed to seed. The seeds are then ready for packaging.

When the pelleting process began the goal was to have one seed in each pellet. Over the years as technology has advanced, flower growers have been asking for two to eight seeds per pellet depending on the species involved. Begonia growers only want two seeds per pellet because of the price of seed. Lobelia growers on the other hand wish to have six to ten seeds per pellet.

SEED QUALITY

This is a critical ingredient for producing a quality product for the grower. Junk in! Junk out! Measuring seed quality is an elusive piece of the puzzle, since there is no single test that will provide full seed quality information, and each species has its own unique challenges and solutions.

Every aspect of the seed's physiology is important in determining the best product form for the seed. Total germination, light requirements, and temperature thresholds give clues to the seed's requirements for optimal germination. In addition the environment in which the seed will be planted must also be taken into consideration. Various testing methods are applied to make the final determinations for which coating would be used for the grower's conditions. Germination tests may include testing under optimal conditions for the seed, stress conditions, soil tests, greenhouse tests, etc.

Lettuce, for example, has specific temperature thresholds and light requirements. Most types of lettuce go into thermodormancy when temperatures exceed 80F and some types of lettuce will not grow in the dark. Photodormancy is a particular obstacle when lettuce is to be pelleted. Germination of photodormant seed in a melt coat will only begin when enough of the pellet has been washed away to allow light to the seed, and in a split pellet where there is no light the seed will never germinate.

To compensate for these dormancies growers would put melt coatings on the photodormant seed and live with the irregular germination patterns. Seed grown in the desert with melt coatings were a particular challenge to the growers because of the extreme heat during the germination phase. Even watering 12 h on and 12 h off did not always bring the seed to a temperature where germination would occur.

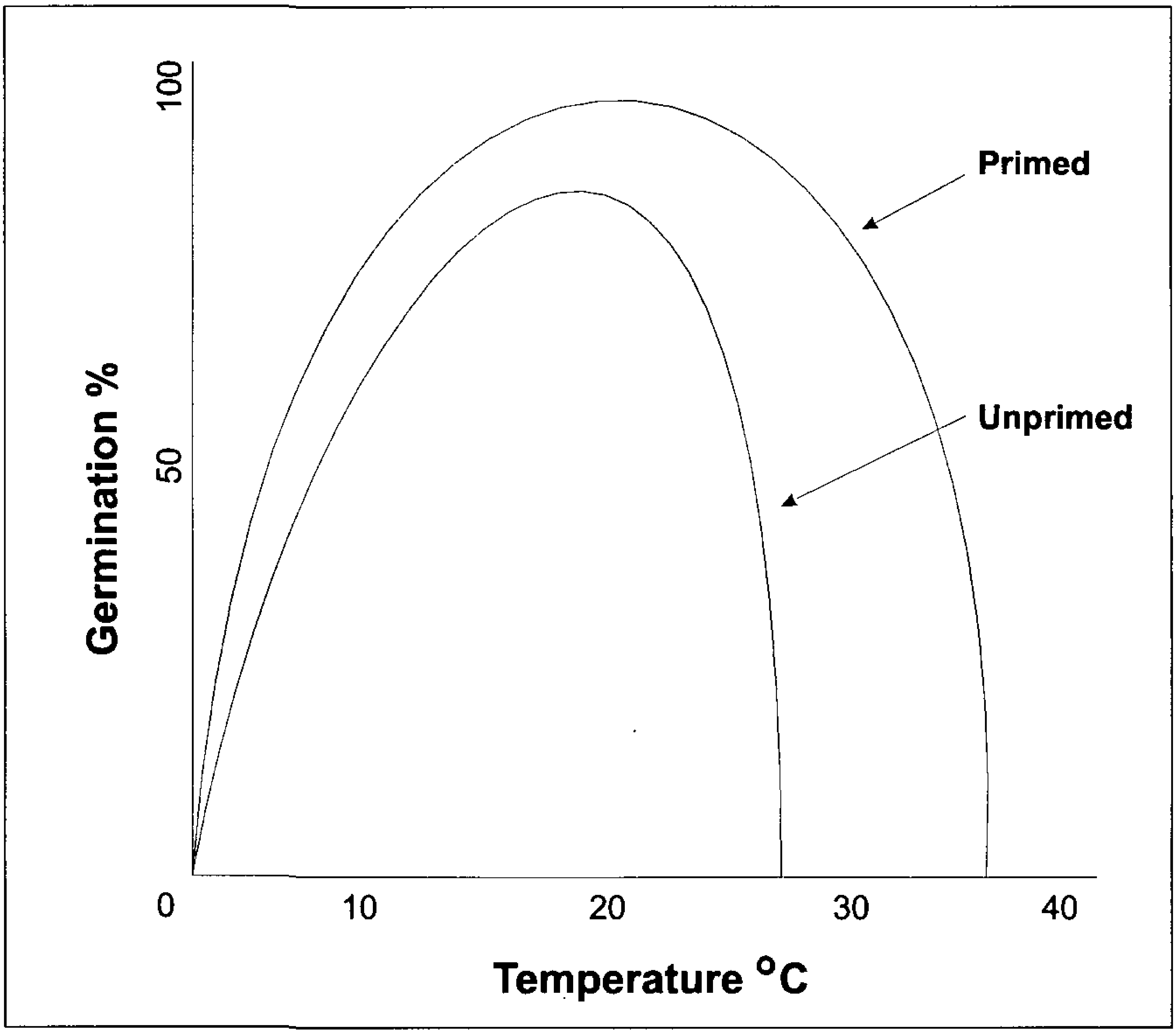

Figure 1. Germination percentages at various temperatures for primed and unprimed seeds.

SEED ENHANCEMENT

There are many different methods to enhance seeds such as milling, fungicide application, biological application, and seed priming. The purpose of these techniques is to increase total germination, and/or to have faster and more uniform germination under a wider range of temperatures, and to break dormancy. This discussion will focus on seed priming in lettuce for desert conditions.

There are various ways to prime seed, three of the more common are osmotic, drum, and matrix priming methods. Each has its own approach to enhance the germination process. Osmotic priming places the seed in an osmotic solution with air, drum priming places the seed in a drum with air, and matrix priming uses a solid medium with the seed with air.

Thermodormancy in lettuce is an important issue for growers, especially those in the southwest trying to establish stands under tremendous temperature stress, where temperatures can exceed 110F in the soil. Commercial priming of lettuce is offered to assist the grower during the germination phase for a better chance at optimal stand establishment. The combination of his watering practices and seed priming allow the seed to be at temperatures that are optimum for germination. When the temperature rises above the acceptable threshold, germination will stop, and will not begin again until the temperatures are again lowered. This stopping and starting causes irregularities in the stand, which translates to irregularities in the harvest.

Figure 1 shows the differences between primed and unprimed lettuce seed at two extreme temperature ranges. The raw unprimed seed stops germination at 28C while the primed seed continues up to 36C and moves back into a dormant state at temperatures which exceed 36C. With this process growers in the southwest are able to obtain reasonable lettuce stands under their extreme conditions.

Today more than 30,000 acres of lettuce are planted with a primed and pelleted product. That translates into 10,000 raw pounds of seed. Real advancements in pelleting and seed priming have been made and more will follow. Use of this technology combined with advanced genetics allows growers to become more successful and cost efficient.

LITERATURE CITED

Kaufman, G. 1991. Seed coating: A tool for stand establishment; a stimulus to seed quality. HortTechnology 1(1):98-102.