



## Soil Temperatures Affect Seed Germination

By Dawn Pettinelli, UConn Home & Garden Education Center

A much-asked question every spring is when can I plant my seeds? The seed packages of many cool season vegetables state that seeds can be planted as soon as the ground can be worked. One can tell if the soil is workable by taking a handful of it and squeezing it into a ball. If it crumbles easily with just a little press, it is workable. If the soil remains in a ball with just an indentation, it is too wet to work and needs more time to dry out. Working soil when it is too wet will cause it to become compacted which limits water and air movement and plant growth.

While soil workability gives one a rough estimate of whether or not it is time to plant seeds, the actual soil temperature gives a much better indication. Soil temperature is critical for seed germination. Also, if the soil temperature when the seed is germinating is too hot or too cold, subsequent plant growth will likely be adversely affected.

The soil warms up slowly and is not determined by the air temperature. As the sun's rays strike the earth, some of the sun's warmth is conducted slowly downwards through the soil. This slow movement means it takes the soil a lot longer to warm up than the air. For instance, the peak temperature that occurs at a 2-inch soil depth will occur about an hour after the peak temperature at the soil surface. Also, it will be on average about 30% less. While it takes soil a while to warm up, it also takes soil a while to cool down which is a good thing. Any heat stored in the soil as the days grow warmer will be retained longer.

Soil moisture also affects soil temperature. The wetter the soil, the longer it takes to warm up because water can absorb a fair amount of heat without its temperature changing.

Different plant species germinate at different temperatures. Each type of seed has an optimum temperature for germination at which the greatest percentage of seeds would germinate. It also has minimum and maximum temperatures where germination could occur but it would be at a lower rate. The majority of common vegetable and flower seeds would prefer a germination temperature of between 65 to 75°F.

A common misconception is that cool season vegetables like lettuce, radishes, peas, carrots, kale and turnips like to germinate in cool soils. The truth is they can germinate in cool 40 to 50°F soils but the percentage of seeds that do germinate will be less than when the soil temperature is higher. For us anxious gardeners, a 70% germination rate, which is often associated with sowing at lower soil temperatures, is usually fine. When these seeds are direct sown in late summer for a fall crop, they germinate much more rapidly because of the warm soil temperatures.

For general guidelines, plants lettuce, kale, peas and spinach when the soil warms up to 40°F, onions, leeks, chard and turnips when it reaches 50°F, cole crops, beans, beets and carrots when it hits 60°F and warm season crops like tomatoes, eggplants, cucurbits and peppers when 70°F is reached. Several online sources have more specific optimum and minimum temperatures for various vegetables.

A soil thermometer is a useful and inexpensive garden tool that can be had at larger garden centers, agricultural supply stores or purchased online. They are often under \$10.00. The metal probe is inserted into the soil and the temperature read after several minutes.

Two things to note. First, the thermometer should be pushed into the soil at the recommended planting depth for the seeds you want to sow, usually 1 to 3" deep. If the soil is hard, use a screwdriver or other tool to make a pilot hole before inserting the thermometer.

Secondly, it is wise to take the soil temperature for at least 3 consecutive days before planting. Usually it is taken in the early morning. Pick a time, say 8 a.m., and measure it at that time for 3 days at least and then average the temperature readings. Before planting, check the extended weather forecast. Just because the soil is warm enough to plant, does not necessarily mean that the danger of frost is over.

What can you do as a gardener to see that your soil warms as early as possible? Locate your beds in full sun and facing south if sited on sloped land. Raised beds will warm up faster because they usually drain better. Row coverings or plastic mulches will help raise the soil temperature by several degrees. If your soil is not drying out quick enough, a light tilling of the surface may promote better drainage and drying.

As gardeners it is important to realize the dependence of seed germination as well as transplant survival on soil temperature. It is a quick and easy measurement to make and guarantees greater success in your garden.

For more information on soil temperatures and germination or any other gardening query, call the UConn Home & Garden Education Center (toll-free) at (877) 486-6271, visit [www.ladybug.uconn.edu](http://www.ladybug.uconn.edu), or get in touch with your local Cooperative Extension Center.

Images by Dawn Pettinelli

