SEEDLING HEALTH FROM AN AGRONOMIC POINT OF VIEW

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Abstract

There are many above and below ground non pathogenic factors that influence stand establishment. Temperature is the most important. Others include soil pH, soil insecticides and herbicides, tillage, soil moisture, seed vigor, rain, hail, soil cursting, organic matter, salinity, compaction, pop-up fertilizers, fertilizer placement, wind, blowing sand and chemical sprays. Cotton can over come much adversity if soil and air temperatures are sufficient for good growth.

Text

There are many above and below ground factors that influence seedling health not related to pathogenetic bacteria, fungi or nematodes. The impact of these influences are impossible to predict and fully measure due to the constant changing micro climate of the seedling.

Below ground factors include such things as the planting depth, soil temperature, soil texture, surface crusting, seed quality, herbicides and herbicide placement, soil aeriation, soil moisture, seed vigor, insecticide and fungicide toxicity both in furrow and applied to the seed, pop-up fertilizers that might be applied in the seed furrow, salinity, soil pH, organic matter, overall fertility and soil compaction. Above ground factors include such things as blowing sand, wind, air temperature, foliar fertilizer and PGRs, rain, hail, soil crusting as well as insects.

Of all the factors mentioned, I believe the most overriding and important one is temperature. Since cotton is a tropical plant, that evolved under warm desert conditions, it is not suppose to grow under cold conditions. In an effort to beat the short season, insects or drying soil, we push the planting date as early as possible and subject the seedling to less than optimum condition -- which creates stress and delayed development.

The optimum temperature for seed germination is 85° F. Most researchers set the minimum temperature for cell activity, or cell division or growth around 60°F. Below 60°F, cell division basically stops. Plant tissue however, continues to respire and use energy. Cell walls do not mature and harden as rapidly as they should and as a result cell walls leak cell contents, normal cell activity is disrupted and the seedling begins to stress.

There is much research related to proper timing of when to plant. Dr. Wanjura in Lubbock determined that it required more than 100 hours above 64°F at the seed level to obtain a 50% stand. Planting studies at Lubbock Experiment Station where cold temperatures are always a problem in the early spring resulted in the following recommendation. Before planting, a 10 day average soil temperature of 65°F at the 8" level should be reached, realizing that during the day with warm sunshine soil temperature increase and then cool off again at night. Some people have suggested the minimum soil temperature in the morning at the seed depth should be about 55° before planting. Hopefully, soil temperature will not stay at that temperature but will increase as the radiant energy warms up the soil.

Dr. Tom Kerby from his research, said it requires about 100 heat units or minimum of 10 heat units per day in order to get a stand, in about 10 days. Others suggestions also include the 5-day forecast realizing weather predictions are not always accurate, but what is? When the 5-day forecasts predicts less than 25DD 60s in 5 days, planting should be delayed. Another indicator is when the forecast is below 50°, wait until temperatures are above 60° before planting. Those of us that have been around cotton for a long time know that no matter how much we watch the weather, how seemingly late we wait in spring time to plant, there's always one more cold front. Cold temperature stop growth and stunt seedlings.

I have some practical cotton planting suggestions that I learned from my father as well as others in the cotton industries:

Many times we get a little anxious, to hurry up and get the seed in the ground and see the new year begin. But one practical suggestion is the first time you get the planting fever go take a cold shower to cool off. The second time it gets warm you need to go out and plant 10 acres with no seed to set the planter. The third time that it warms up it's getting close to time to think about planning.

The following are farmer proven techniques. One is, early in the morning when you're out in the field where nobody can see you and kick the top of the bed off and sit down on top of the bed bare bottomed. If you can sit there for about 10 minutes without freezing, then it is time to plant cotton. Other techniques for Texans is to wait until the mesquite trees are budding. When the mesquite are all budded out, it's time to plant cotton. Generally mesquites are late budding trees and require more accumulated heat units than other plants. My father said wait until the buds of a pecan tree are the size of a squirrel's foot. Pecans, also being a tree that buds late, is a good indicator of enough heat units accumulated. The last one of course, is when

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your neighbor starts planting you know you are behind, so hurry up and get out there and get with it.

The next two factors are critically important, planting depth and moisture. Often we plant too deep to reach sufficient moisture for adequate germination. The following from Dr. Wanjura's research shows that as planting depth increases the likelihood of getting a good seed stand decreases very rapidly. Seed quality and seed vigor are also very important in getting a stand. The standard germination test run by most state agriculture department determines how many seed will sprout under the best conditions. Of course, there is no indication of how much vigor lot of seed has in the event of cold weather. A better test is to use a cool warm vigor index which takes the germination at a low temperature at 5 days added to the traditional germination test.

The next agronomic factor is what I'll lump together as soil factor. Moisture without adequate soil moisture the seed cannot imbibe enough water to germinate and maintain growth. I believe the importance of early fertility is overrated. Very little fertility is needed during the seedling stage. Phosphorus is important for raid root growth, but fertility will not compensate for cold temperature and poor planting conditions. Many test over the years evaluated pop-up fertilizers. Some sprayed liquid fertilizer behind the planter and included their herbicides with phosphorous and a small amount of nitrogen to get the plant off to an early start. That particular practice may work well in areas that can count on rain as a way of incorporating the fertilizer and herbicide. In areas where its dry, the practice of adding pop-up fertilizers to the seed furrow often cause reduced stands even under good conditions. Placing fertilizer two to three inches below and two to three inches to the side of the seed is the safest and most efficient placement.

Soil compaction is important particularly when knife openers were popular several years ago. Knife openers slice through the soil and if the soil was a too moist it would seal the soil. If the soils where high in clay, it would be very difficult for roots to penetrate the sealed slice. I have seen cotton planted with an knife openers where the root of the seedling may be 4 to 5 inches long running along the bottom of the seed furrow before finding a hole to get through the compacted zone cause by the knife openers.

Soil crusting on the soil surface is also a problem when heavy rains packs the surface soil. As the soil drys, seedlings have a hard time pushing their way through. Dr. Norman Hopper, Seed Physiologist at Texas Tech in Lubbock has done research on the process of emergence. A condition that we call big shank is caused when the seedling is trying to break the soil crust. When the soil crust is so strong that the seedling cannot push its way up, cells grow side ways rather than elongating, causing a fat shank. After a short period a time the cells begin to harden and cotyledon leaves can not emerge from the surface. Replanting is then necessary. The next factor under soil factors relates to amount of oxygen. When living organisms respire, oxygen is burned to use carbohydrates. Without sufficient soil oxygen, root growth is greatly reduce. This condition normally occurs under flooded conditions.

Soil pH should be in the optimum ranges.

Salinity is another soil factor that causes reduced stand. Salt competes with roots for water -- by pulling water out of seedlings, thereby desiccating them.

Lack of organic matter will cause problems with crusting in both fine textured soils and sands.

Another category in below ground factors is pesticides. In our efforts to provide the most ideal conditions for the seed, we are encouraged to use more and more ag chemicals to the germination and establishment zone. Pesticides include herbicides for weed control, insecticides both on the seed and added in the seed furrow for early season insect control, and fungicides. Under stressful condition, of to much or not enough soil moisture, cold temperatures or poor seed germination and vigor, pesticides can have a major impact on whether not a stand is obtained.

And finally are PGR's, or Plant Growth Regulators. Several companies now have products to enhance cell metabolism and many of these are sold along with low amounts of plant nutrients. Any of these materials alone generally will not cause a reduction in seedling growth however, when three, four or more chemicals are added to the seed furrow, there can be a toxic effect from each one being slightly additive to the other. I don't think we will ever be able to answer how much is too much or not enough because of variable planting conditions.

Above ground, again my personal feeling is that temperature is the overriding factor for seedling establishment. The longer a seedling sits without much development, the greater the likelihood of detrimental environmental factors to cause a stand reduction. Wind whipping a seedling back and forth can cause greatly reduce plant growth. A prime example of that is in the Lubbock region where many growers are now using a killed stand of wheat as wind protection for young seedlings. The abrasion caused by blowing soil particles is very detrimental to above ground plants. Shortly after a rain, the soil crusts, and sand will remain on top of the soil surface. As the winds begin to blow, sand can cause enough abrasion to young seedlings to either cut them off or allow disease organism to enter. Of course, rain and hail can cause enough physical damage to seedlings or to plants to break the plant off.

In short, its tough to get a good stand. We should be surprised when we get a good rather than expecting it. Again the most important factor is temperature.