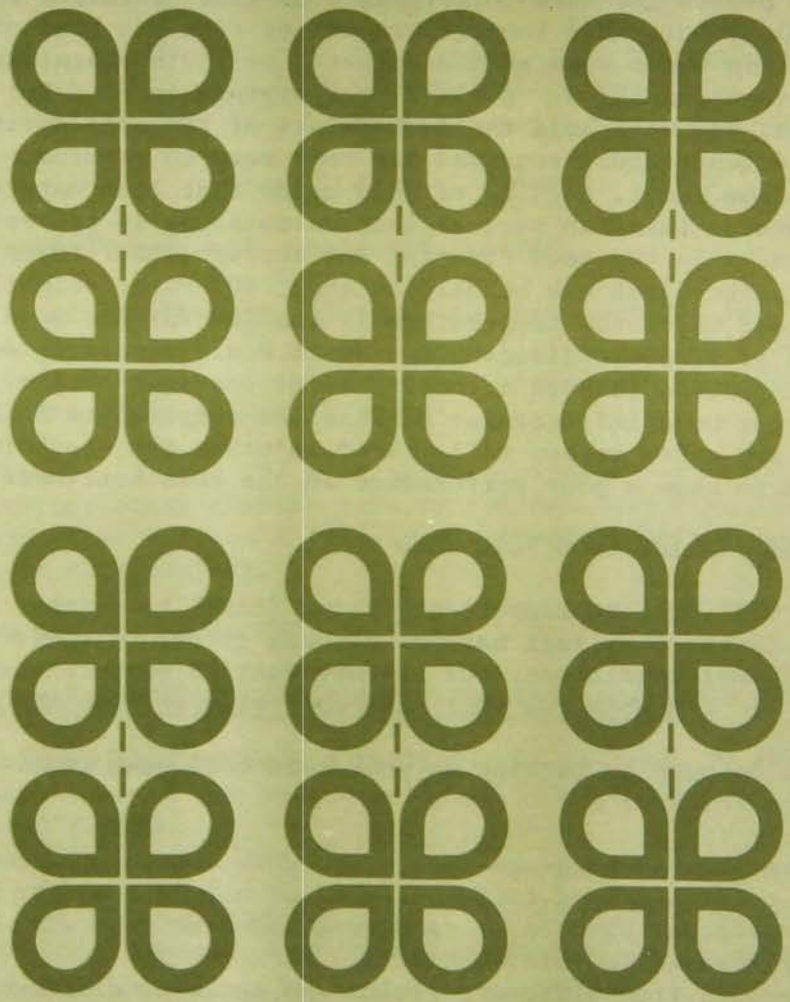
4-H M-143 Revised 1973

Plant Pathology

COLD SOIL SEED TEST



4-H Members Manual

AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

COLD SOIL SEED TEST

INTRODUCTION AND WHAT YOU WILL LEARN

This is another phase of an interesting 4-H project--"Plant Pathology, a Study of Plant Diseases." The test that you will be making in this phase--the cold soil seed test--is used to find out quality of seed and effectiveness of seed treatment materials. You will learn that cold, wet conditions that are not good for seed to germinate and grow will be produced in your own laboratory (your own home).

You may be familiar with the common seed germination test which is used to find out percentage of live seed. The cold soil seed test is similar to the seed germination test; however, it is more severe. It will give you a good idea of the likely performance of seed under cold, wet conditions. Nearly every spring, cold, wet conditions occur in our fields before seeding, and at times prevent seed from germinating or cause loss of the young tender plants.

The soil temperature needed for seed to germinate or grow is called the threshold temperature for seed germination. This temperature varies from one kind of seed to another. For example, most small-grain seeds such as wheat, oats, or barley germinate at about 40° F. (Fahrenheit), while corn requires 49° F. A 40° F. temperature is good for testing most seed. In the cold soil seed test, you will hold the temperature of the soil during the first part of the test lower than the temperature required for most seed to germinate. Why is this done? Because it is known that some fungi, such as certain molds that live naturally in the soil, can grow at lower temperatures than the seed as long as moisture is present. Fungi often enter the seed through cracks in the seed covering and through other injuries. So if the temperature of the soil in your test can be held at about 40° F. or slightly lower, the fungi can grow and attack the seed while the temperature is too low for the seed to germinate and grow. This puts the seed at a severe disadvantage which would result in death of all the seed if it were allowed to remain in such a condition for too long a time. The test is usually run for about 4 days in your home refrigerator at this low temperature followed by room temperature until plants are a few inches tall. Seed injuries are one form of seed weakness that will cause weak seed to show a poor performance in the cold soil seed test.

VARIATIONS THAT MAY BE USED IN THE COLD SOIL SEED TEST

In this project you will want to compare one thing (test) to another (test). You may, for example, want to see if two different batches of seed differ in their ability to sprout and grow under these cool, wet conditions. Or you may want to compare chemically treated seed with seed that is not. Remember you must make some kind of comparison.

Many comparisons can be used in setting up your cold soil seed test. Some ideas that you may want to use are as follows:

(1) Seed of different crops--corn and flax often show some of the most striking effects in the cold soil seed test, but seed of any crop can be used.
(2) Seed quality--different batches of seed from the same crop will often show quite different results in this test.
(3) Source of soil--soil from different fields and soils of different textures; for example, clay vs. sandy or loam vs. clay may give quite different results. Just remember--when a good source of soil has been found, a supply should be obtained and stored for future use. Since this is mainly a winter project, soil should be collected in the fall and stored for winter use. You will need about 2 quarts of soil for each test that you run.

(4) As mentioned before, 40° F. is best for most early test work, but this can be varied to change the results. You could run your test at either a lower or a higher temperature than this, but the important thing is know the temperature that you are using. You can find out the temperature by putting a common thermometer beside your test dishes.

(5) Amount of soil moisture--you may want to compare dry soil vs. wet soil in this test. A cupful of water per quart of "air-dry" soil is a good starting point, but other amounts can be tried. See item 1 under procedure which tells you how to "air-dry" soil. Remember the soil should be uniformly moist, but no water should be standing in the bottom of the container.

(6) Time at low temperature--it was mentioned earlier that 4 days is commonly used. However, you may choose either a longer or a shorter period of time. Compare your time with 4 days at cold temperature.

(7) Chemical seed treatment--certain chemicals are commonly used for control of seedling diseases caused by fungi. These chemicals are called fungicides. This cold soil seed test will give a good demonstration of the effectiveness of these fungicides. The following fungicides are satisfactory for treating a large variety of seeds and should be used for your tests:

Common name	Some trade names you may find in a store
captan	Captan, Orthocide
chloranil	Spergon
dichlone	Phygon
thiram	Arasan, Panoram, Thiram

Compare treated seeds with seeds not treated.

(8) Injury of seed--deliberate injury to the seed reduces the vigor or strength of the seed and therefore its quality. An electric grinder is useful for making a notch in corn kernels. A notch can be chipped out of a seed with a knife or other tool. Compare these to healthy seed.

(9) Combinations of (7) and (8) will often provide a very good demonstration. You may wish to use other combinations or you may have some ideas that are not included in the above list and would like to use these. There is a lot of room for your own ideas in this project.

MATERIALS NEEDED FOR THE COLD SOIL SEED TEST

You will need the following materials for the cold soil seed test:

(1) Field or garden soil of medium texture. A loam soil is best. Generally the soil should be mixed one part of soil to one part of sand unless the soil is sandy to begin with.
(2) Low dishes with covers (see figure 1).
(3) Measuring cup and quart jar.
(4) Seed--corn and flax are generally best for demonstration but any seed can be used. Obtain seed from several sources and start testing. You may come up with some very surprising results. Certain lots of seed may give you very good or very poor results. These may then be used as standards for comparison with other batches. Try to obtain enough seed of each batch to run several tests. You may become an expert on checking seed quality.
(5) Cold storage--about 40° F. is best. A household refrigerator is good for keeping this temperature steady.
(6) A common outdoor thermometer for determining the temperature in your refrigerator.

(7) Chemical fungicides. (see item 7, page 3)
(8) Markers for dishes.
(9) 1/4-inch mesh screen.

PROCEDURE

(1) First, prepare the soil. If the soil is very heavy and clayey, you may have to mix it with sand. You will want to end up with a good medium-textured or sandy loam soil. Sieve the soil through a 1/4-inch mesh screen.

Spread out the soil in a 1/2- to 1-inch thick layer for 2 to 3 days (see figure 2) to "air-dry." After it is air-dried, store the soil in a container. It is necessary to air-dry this soil in order that the soil moisture is uniform for the test. Fill each of the test containers with about 3/4 quart of "air-dried" soil. Remaining soil is for covering seed.

(2) Obtain the seed for the test. Remember, always use two sets of seed that differ in some way, such as: treated with fungicides compared to seed that hasn't been treated; discolored seed compared to bright seed; sound seed compared with seed from a source that has been intentionally injured; injured seed that has been treated with a fungicide vs. injured seed that has not been treated. This is where you will use your own ideas or some of the ideas given to you under the section titled VARIATIONS THAT MAY BE USED IN THE COLD SOIL SEED TEST. Figure 3 shows a test being set up using injured seed vs. normal seed.

(3) Count out equal numbers of two sets of seed (usually 50 or 100 seeds for each dish). The important thing to remember is that the number must be equal for each of the two sets (see figure 3).

(4) If you are going to use a chemical seed treatment using one of the fungicides listed on page 3, then you will want to treat one set of seeds at this point. Place the seeds and the chemical inside an envelope and shake.

You might use the end of a toothpick for measuring out the necessary chemical. Just a small amount of chemical is needed. Use care in handling them. Seed should be uniformly covered, and excess chemical should be screened off.

(5) Plant seeds with one set in each container. Cover with 1/4 to 1/2 inch of soil. Small seeds should be very lightly covered with soil. (see figure4)

(6) Add water to the soil. All seeds as well as fungi need water to grow. Add the water carefully so as to not disturb the soil and seed. The ratio of soil to water is very important, and it must be uniform. For average loam soils, 1 cupful of water to 1 quart of air-dried soil is about right. Within a half hour after the water has been added to the dry soil, the soil should be uniformly moist. If you are planning to test normal soil with overly wet soil, this would be the point at which you would add excess water to one of your containers.

(7) Cover the containers. If a container has its own cover, this can be used, or a plastic cover can be put over the top and tied, or the container can be placed inside a plastic bag (see figures 5 and 6).

(8) Next, place the containers at low temperature (about 40° F.) for 4 days. A household refrigerator is suitable, or a cold storage cellar may be used. If you plan to vary the temperature or the time of exposure, this can be done at this point. To vary temperature, place the pans at different places in the refrigerator.

Temperatures are lower near the freezing unit. To vary time, place one pan in the refrigerator before another but remove them at the same time. Record the time and temperatures used. Light is not necessary at this stage.

(9) After this cold treatment has been completed, take the containers out of the refrigerator or cold storage cellar and put them at room temperature (about 70° F.). After plants have emerged, put the containers near a window so that the plants will have light. Remove the covers.

(10) When the plants are from 1 to 4 inches tall, make some final notes and counts. The height will vary depending upon the crop. Count the total number of plants that have come up. Also grade the plants according to whether they are tall or short. The tall normal plants will be considered healthy and the others weak. Report your results in your record as percentage of total emergence and percentage of healthy plants. To find percentage of total emergence, divide the number of plants that came up by the total number of seeds planted. To find the percentage of healthy plants, divide number of healthy plants by total number that came up.

(11) Photographs could be taken to make this project more meaningful.

(12) Complete the project record.

(13) Start out with single dishes or two dishes for each test. After you become more proficient or when some good differences in seed performances are found, you may wish to expand your tests to include Replicated Trials. Replicated trials mean several dishes of each treatment. This gives greater certainty of results.

(14) To see the true effect of the cold soil test, a "warm test" may be run at the same time as your cold test. This "warm test" is set up the same way as the cold test, but without the low temperature exposure in the refrigerator. The purpose of it is to demonstrate to you the actual effect of the cold test. How is it done? Set up your "warm test" the same as you did the cold test. Set it up the day before the dishes of the cold test are to come out of the low temperature treatment or, in other words, the day before they come out of the refrigerator. Keep this container at room temperature and the next day place the cold test dishes beside it. Observe the differences in these dishes from the time plants come up until they are quite tall.

If you follow these directions very carefully, I am sure that you will find this phase of the Plant Pathology Project to be a very challenging one. There are many possible combinations which can be tested by use of the cold soil seed test. You are encouraged to use your own ideas in setting up tests which may not be included in this project bulletin.

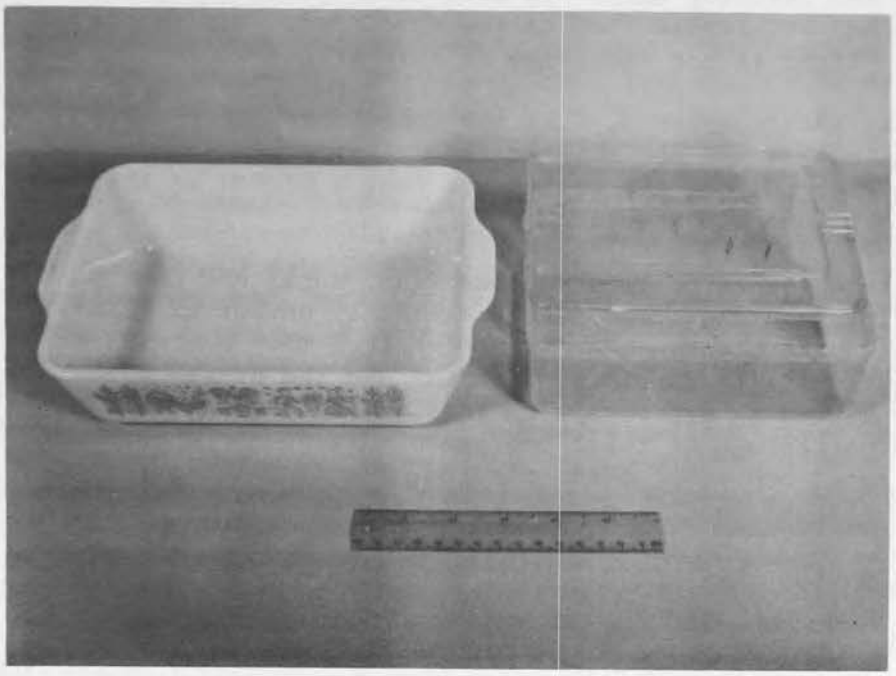
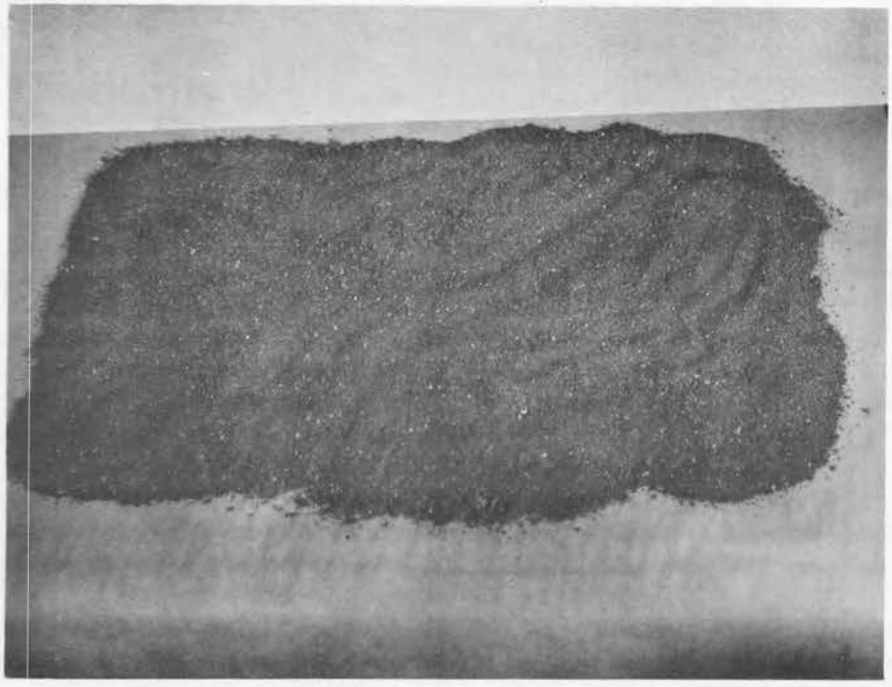


Figure 1. Two containers that are suitable for cold soil seed testing; 50 corn seeds or 100 flax seeds can be planted in such dishes.

Figure 2. Soil mixed with sand and put through a 1/4-inch screen is spread out to air dry.



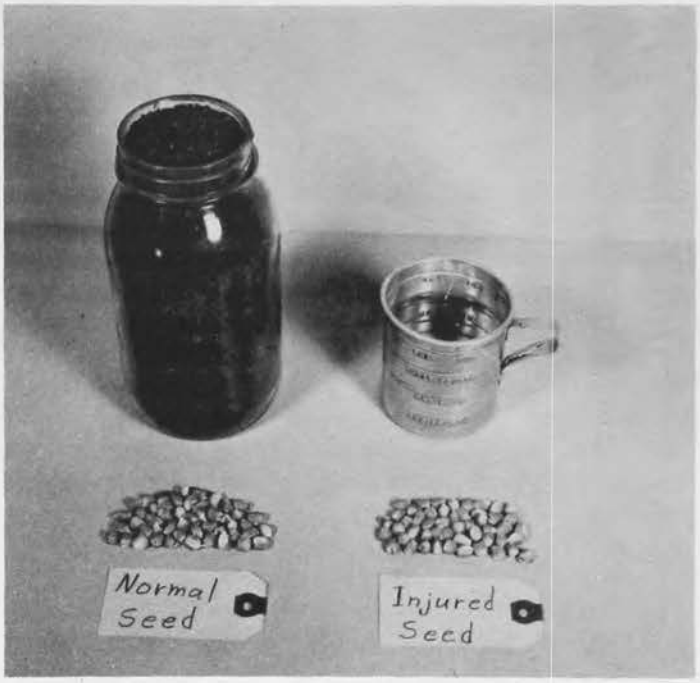
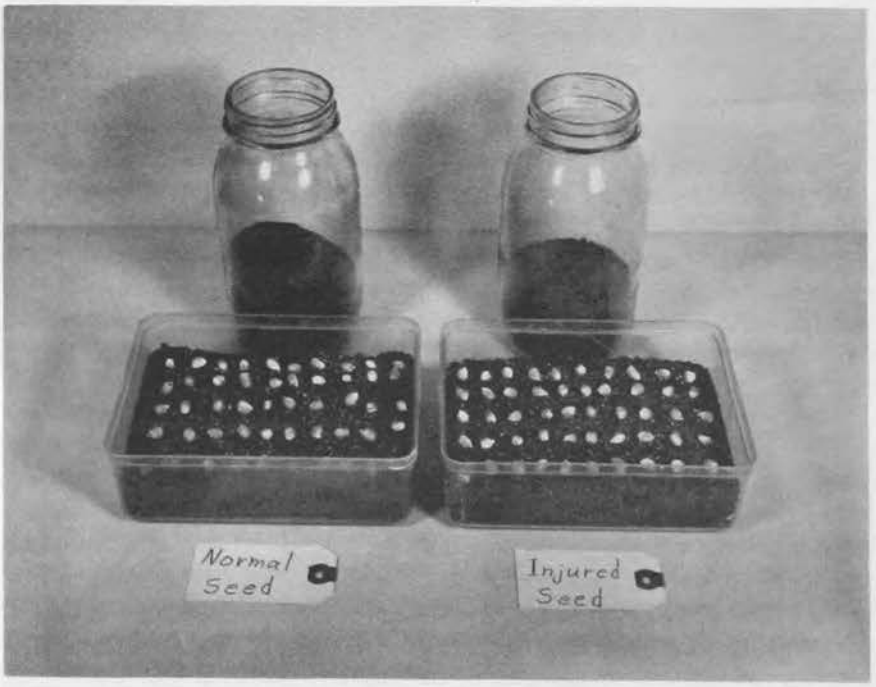


Figure 3. Corn seed, air dried soil, and water ready for a test. The injured seed has a notch on each kernel made with an electric grinder. There are equal numbers of seed in each pile.

Figure 4. Corn seed spaced out on soil and ready to be covered with remaining one-fourth of soil. Note that there are 50 corn seeds in each container.



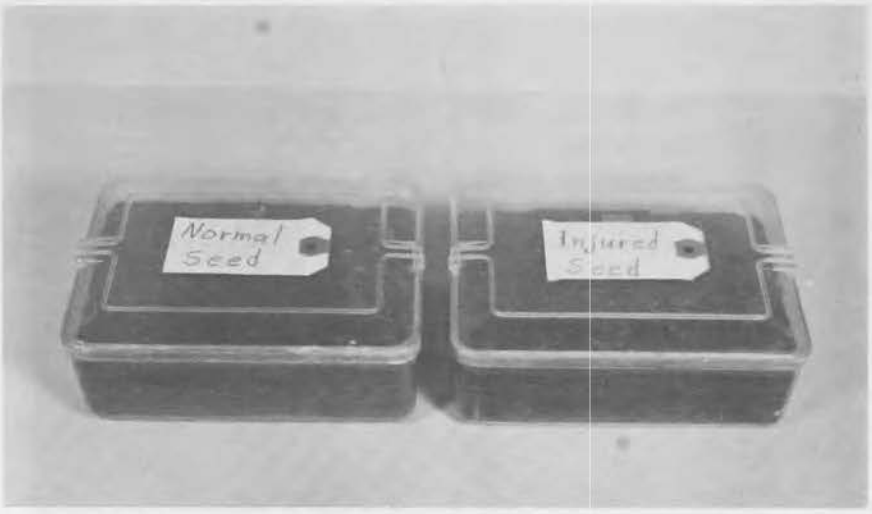


Figure 5. Seed planted, watered, covered and ready to be put at 40° F. for 4 days.

Figure 6. A dish in a plastic bag. The dish contains 1 quart of soil. Such a dish can be used instead of containers shown in figure 5.