Method of Germinating Segmented Beet Seed

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THE LARGE sample of beet seed received from the segmenting plant should be reduced by passing it through the Boerner sample divider.

Selecting the Sample.—When the original sample has been reduced to about 1/20 pound by passing it through the Boerner sampler it is to be placed on a 10-mesh sieve which has openings of about .075 inch and the small particles screened out. The screened sample is then to be returned to the Boerner sample divider for further reduction. One portion of the screened sample is saved from which 1/40 pound is to be weighed and counted. Multiply this number by 40 and record this as seedballs per pound.

The other portion of the screened sample is to be further reduced through the Boerner sampler. When the reduced sample has slightly over 400-seed particles it is passed through the sampler again and both portions saved. Each half is reduced once more making 4 portions of about 100-seed particles each. From each of these 4 portions 100-seed particles are to be counted without selection. This will make 4 germination tests of 100-seed particles for each sample of beet seed. Report the average germination of the 4 portions. The germination may be reduced to 2 portions of 100-seed particles for each sample when the number of samples become so great that the capacity of the germinator is not sufficient to hold all of them, or in case there is not sufficient time to process all of the samples if 4 germinations are made on each sample. However, when only 2 portions of 100-seed particles are germinated and they differ 10 percent or more in germination the sample is to be reset for a second germination.

Preparing the Sample for Germination.—When the sample has been reduced to 4 portions of approximately 100-seed particles, spread each portion out on some flat surface and count out without selection 100-seed particles from each. After the 4 lots of 100-seed particles have been secured place each in a separate small-screen basket of the Utah-Idaho seed washer and run tap-water through the seed washer for two hours. This will wash the seed in running water for 2 hours. At the end of the 2-hour washing period, remove the screen baskets from the seed washer and place them on a towel for a few minutes to remove the water film from the seed, then plant with no further treatment in folded wet blotters.

Mold Control.—When trouble is experienced with mold and cleaning-up and sun-drying the trays does not stop the condition, the following procedure is suggested.

After air-drying the seed somewhat in the small-screen baskets on the towel as stated above, place the baskets containing the seed in a shallow

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pan and soak the seed for 5 minutes in a solution of Lignasan containing 1 part Lignasan in 10,000 parts water. After the 5-minute soaking in the Lignasan solution, remove the basket from the solution and air-dry the seed in the basket a few minutes to remove the water film, then plant with no further treatment in folded wet blotters.

Preparing Blotters.—Place on each blotter your laboratory number with other necessary information before the blotter is wet. Use some suitable pencil for marking the blotters. Each 100-seed particle will require two blotters, one for the original 100-seed particle and one for the seed particles producing one sprout. Printed forms will be furnished for keeping other necessary information.

After the blotters are properly labeled soak in tap-water and then make 100 small round depressions in one-half of each blotter at one end of the blotter, by some suitable method. The depressions should be about one-half inch apart each way. Ten rows of ten holes each makes a good method for easy counting. After the depressions are made fold the other half of the blotter over as a cover. The blotters are now ready to receive the seed.

Placing Seed on the Blotters.—Place one seed particle in each depression making 100-seed particles per each blotter containing the original seed. The companion blotter which is to receive the seed particles which have developed one sprout is to be placed along side of the blotter containing the original seed particles but no seed will be placed on this blotter until after the first sprout count.

After the seed is placed in the depressions on one end of the blotter the other half is folded over the seed so that it is held firmly between the two halves of the blotter.

The seed is now ready for the germinator.

Preparing the Germinator.—The germinator should be so constructed that an even temperature can be maintained at all times inside the germinator. If the room temperature is held close to the required germinating temperature, there will be little difficulty in maintaining the proper temperature in the germinator. If the room temperature drops several degrees below the temperature to be held in the germinator some difficulty may be encountered unless proper insulation and heating facilities are provided. Some of the difficulties will be as follows:

1. Excess sweating of the inner walls of the germinator.
2. Dripping of water condensed on the upper part of the germinator onto the upper tray of blotters.
3. The uneven drying of the blotters in some locations in the germinator.
4. Difficulty of holding the proper temperature in the germinator.

If the temperature of the room, over the week end be allowed to fall below 20° centigrade for fuel economy sake, some provision should be made

to control the temperature of the outside walls of the germinator. A good insulation method might be used. One good system, as used at Longmont, is to build a complete housing, with space between, around the germinator and control the temperature in the space slightly below the temperature in the germinator by using a bank of lights controlled by a thermostat.

It is well to place a wet towel on the top tray for moisture control and not use the top tray for germinating blotters.

In order to force a proper circulation of the hot air and to prevent the trays directly over the heating unit from becoming too warm, the lowest tray should be completely covered with some poor heat-conducting material such as asbestos. A shallow pan filled with water may have to be placed on this covered tray in order to prevent the blotters from drying too rapidly.

Temperature of the Germinator.—The temperature of the germinator should be held as near 30° centigrade as possible, but not to go above this point. The minimum temperature will be determined by the range in temperature you are able to maintain. If the room in which the germinator is placed is properly heated or the germinator is insulated and heated on the out side you should be able to hold the temperature about 27° to 30° centigrade without any difficulty. If the temperature of the room reaches a point above 30° centigrade for any length of time, you will not be able to hold the germinator at 30 degrees. If the room temperature falls too low the temperature in the germinator may drop to a point where the light bulbs or other heating device will not be able to hold the germinator at the required temperature.

Arrangements must be made to have the room where the germinator is located heated at all times, especially over the week end and early in the Spring, when normally temperatures are allowed to drop in the factory laboratory.

The temperature of the germinator should be regulated before the seed is placed in it.

Placing the Seed in the Germinator.—When the germinator temperature has been regulated, the blotters containing the seed are placed on the trays and the latter placed in the germinator. At the same time the blotters for the single-germ particles may be placed on the same tray so they will be ready when needed after the first count.

Germinator Space.—If the number of samples at any one time become so great that the germinator will not hold them, the blotters may be placed two deep on the tray. If this is done the position of the blotters should be changed each time an examination is made, the one on the top being placed underneath and the one underneath being placed on top.

Securing Germination Data.—After the seed has been placed in the germinator all future operations will consist of securing the following data and keeping the blotters moistened.

1. Number of germinating seed particles.
2. Number of seed particles producing only one normal sprout.
3. Number of seed particles producing two or more normal sprouts.

From the above information other calculations are made.

In securing these data proceed as follows: The first examination should be made the second day after the seed is placed in the germinator, not more than 48 hours after the seed is placed in the germinator. If the first examination is delayed too long some sprouts may have become too far advanced making accurate observations impossible.

After the first examination all samples must be examined every day. This means a 7-day-a-week job.

Moisture in Blotters.—Water must be added from time to time to hold the moisture content of the blotters at the proper level. The only measure of the moisture content of the blotters we have found practical is their color. The blotters should be moist enough at all times to maintain the same dark color as when the blotters are saturated. Excess free water on the blotters should be avoided.

First Examination.—In making the first examination proceed as follows: At this point all of the 100-seed particles will be on one blotter. Each particle that shows a sprout must be examined carefully. First you must determine whether or not the sprout is normal. If the sprout is normal the root will appear first. Normal roots will be tapering and ending in a rounded point. As development of the root advances the root hairs will develop making the root appear somewhat like a round brush with no bristles for a short distance back from the end. These root hairs do not always develop.

The following will be designated as abnormal sprouts:

1. Where the cotyledons (seed leaves) appear first.
2. Where the cotyledons and root appear at the same time.
3. Where the tip of the root and the cotyledons remain fixed in the seed particle and the stem shows as a loop extending out of the seed particle.
4. If the root appears first but has the end broken off. In such cases the root will be minus the tapering, rounded point and will present an extremity which is straight across instead of rounded.

Some sprouts which at first appear to be abnormal may, on further development, become normal. The loop stem sprouts are left for another day after they emerge to see if the root tip will come out and make normal sprouts.

Some authorities on beet-seed germination believe the blunt root-tip sprouts will make healthy plants. The sprouts with the blunt root tip are left in the seed particles for another day and if they develop normally they are counted as normal sprouts.

The next step is to remove these sprouts completely from the seed particles. This can best be done with a needle or fine-pointed tweezers.

If only one normal sprout has appeared the seed particle should be placed on the blotters prepared for single-sprout seed particles. If the sprout is abnormal the seed particle should be returned to the blotter from which it was taken. All seed particles which produce nothing but abnormal sprouts, or no sprouts at all, shall be termed non-germinating. Should two sprouts appear from one seed particle at the same time and one is abnormal this seed particle will be placed on the blotter prepared for singles. If both sprouts are normal the seed particle shall be discarded and a record kept of the same on a form provided for reporting the germination results.

At the end of the first examination you will have some seed particles still remaining on the first blotter, some on the blotter designated singles, and a record of the number of seed particles producing two or more sprouts. The sum of the three should add up to 100.

Second Examination.—The second examination should be made the day following the first one. In examining the blotters on which the original sample was placed, proceed as in the first examination. All the seed particles on the blotter designated as "singles" will be examined next. If any normal sprouts have developed on the blotters designated as singles, discard the particle or particles producing them and increase the record of particles producing multiple sprouts. Also reduce your record of the number of particles producing single sprouts by the same amount. By this method your total number of seed particles in the three groups will always be 100, that is those remaining on the original blotter plus those on the blotter designated as singles, plus the number of seed particles discarded as producing two or more sprouts. This information is kept on a printed form provided for the purpose.

Subsequent Examination.—After the second examination proceed as in this examination in making all subsequent examinations.

The final examination will be made on the 11th day including the day the seed is placed in the germinator. This means there will be 9 sprout counts made in 9 consecutive days.

The Record.—When the final examination is made the following record shall be made:

1. *Percentage germinating seed particles.* This is the sum of the seed particles showing single and multiple sprouts divided by the total number of seed particles placed on the original blotters. That is, if 400-seed particles were used, divide the total germinating seed particles by 400 and multiply the result by 100. Example: if each of the 100-seed particles placed on the original 4 blotters germinated as follows: 85, 80, 78 and 86, there would be a total of 329 seed particles that sprouted. 400 seeds were used so $\frac{329 \times 100}{400} = 82.82$ percent germination.

In the event only 200 seed particles are used for the germination the 400 in the equation becomes 200.

The number of germinating seed particles must equal 100 minus the number of seed particles remaining on the blotter which held the original 100-seed particles. We have found that this double check on the germination prevents errors which easily occur.

2. *Percentage singles.* This is the number of seed particles remaining on the blotter designated "singles" (or shown by your report) expressed in percentage of the total number of germinating seed particles. That is the number of seed particles showing singles times 100 and divided by the total seed particles which have produced normal sprouts.

3. *Number of germinating seed particles per pound.*—This is the product of the number of seed particles per pound and the percentage germination.

In reporting the germination you will use the forms which have been provided for the purpose, giving all required information called for on the forms.

Summary

The screening of the sample is to remove the small particles which should not be counted as seed particles. It is the intention that all particles remaining on the screen should be counted as seed particles.

Mold seldom bothers to any great extent. When it is severe the germination may be lowered considerably. Cleaning up the germinator and exposing the trays to direct sun light for several hours may remedy the cause. A Lignasan solution of 1 part Lignasan to 10,000 parts water in which the seed is soaked for 5 minutes just before germinating, seems to control mold without injury to the sprouts. The seed may be germinated without using depressions in the blotters however, the depressions help hold the seed particles in place and tend to reduce uncertainty in indentifying the seed particles from which some of the sprouts come.