BRIEF PAPERS

LIGHT AS A FACTOR INFLUENCING THE DORMANCY OF LETTUCE SEEDS

Lettuce seeds of the highest vitality may fail to germinate when tested in a closed chamber germinator. Seed analysts have observed that germination may be induced in many of these dormant lettuce seeds by presoaking them in cold water for 2 hours. However, such increase in germination is due not to the soaking in water but to the action of light on the wet seeds.

Recent investigations by the writer show that it is even unnecessary to soak the seeds in cold water since the dormant condition can be broken merely by placing the seeds in an atmosphere saturated with water vapor and giving a longer exposure to light. Lettuce seeds of the Grand Rapids variety which were placed in a humid atmosphere and exposed to light for 10 hours and then placed on moist blotters at 20° C. in the dark germinated 98 per cent. A duplicate test which had received the same treatment but which was not exposed to light germinated only 8 per cent. The period of exposure to light can be shortened to 2 minutes or perhaps less by allowing the seeds to take up moisture from the air before exposing them to light. This germination response is of importance because it shows that water in the form of a film surrounding the seed is not essential to the breaking of the dormant condition by light.

Whether or not lettuce seeds in which the dormant condition has been broken by exposure to light will remain non-dormant when dried depends upon the physiological condition of the seed, the period of exposure to light, the temperature, and the manner in which the drying process is conducted. Lettuce seeds of the Big Boston variety which were placed in a humid atmosphere and exposed to light for a period of 24 hours at 23° C. and, without drying, placed on moist blotters at 20° C. in the dark, germinated 98 per cent. A similar lot of seeds which had received the same treatment but which was dried in the dark germinated 35 per cent. The failure of lettuce seeds to retain the non-dormant state when dried appears to be a characteristic response of lettuce seeds which require a temperature of 22° C. or lower for germination. It has been determined that if the seeds are set over water, exposed to light for 6 hours, and then placed in a refrigerator at a temperature of 6° C. for 10 days, they can then be dried and still retain the non-dormant state. Furthermore, it has been observed that

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exposure to light at the time of drying may have a marked influence on the percentage of dormant seeds. Moist Grand Rapids lettuce seeds which were exposed to light for 24 hours and then dried at room temperature in the dark germinated 92 per cent. at 20° C. A similar lot of seeds which were dried at the same temperature but in the light germinated only 5 per cent. The degree of dormancy originally existing in the seed appears to be the most important factor determining the necessary length of exposure to light and the germination response of the seed when dried.

The shorter wave lengths of the visible spectrum are more effective than daylight in producing a dormant condition in both presoaked and humified lettuce seeds when they are again dried in the presence of light. Grand Rapids lettuce seeds were placed over water, exposed to light for 24 hours, and then dried in the light, in the dark, and under plates of spectral glass. The seeds were dried for 24 hours and then placed to germinate on moist blotters at 20° C. in the dark (table I).

### TABLE I

**Influence of light and drying on the retention of the non-dormant state in Grand Rapids lettuce seeds**

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Checks, germination in darkness</th>
<th>Percentage of seeds germinating at 20° C. in dark when dried under the following light relations</th>
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In one of the representative tests the seeds dried in the dark germinated 89 per cent., while those dried in the light germinated 32 per cent. Similar lots which were dried while exposed to the individual colors of the spectrum germinated as follows: violet 12 per cent., indigo 5 per cent., blue 16 per cent., green 75 per cent., yellow 21 per cent., orange 24 per cent., and red 15 per cent.

If the dormant state has been broken to such an extent that the seeds remain non-dormant when dried in the dark, then only a small percentage...
of the seeds revert into dormancy when dried while exposed to the green rays, whereas if they are dried while exposed to either the red or the blue rays, a high percentage of the seeds become dormant. The violet, indigo, and blue rays are more effective in producing dormancy than the longer red rays since a semi-stable condition can frequently be produced in non-light-sensitive seeds by drying the moist seeds while exposed to the shorter wave lengths of light. The main factor influencing the germination response of seeds when dried while exposed to the different colors of the spectrum appears to be the degree to which dormancy has been broken, which state in turn is influenced by the temperature and the period of exposure to light. In order to duplicate these results it is suggested that the moist lettuce seeds be given an exposure to light for a period of 24 to 48 hours, since an exposure for only a few hours may not be sufficient to break the stable condition in the embryo while a prolonged storage over water will cause an increase of dormancy and finally deterioration of the seeds.

The influence of light on the germination of lettuce seeds has been studied by FLINT, who has found that the longer wave lengths of the visible spectrum promote germination while the shorter wave lengths are not only ineffective in promoting germination but may inhibit it. Since the red rays are effective in breaking the dormant condition and promoting germination while the blue rays cause the formation of a semi-stable condition, it appears that there may be an intermediate region of the spectrum which has no appreciable influence on certain physiological processes in the embryo associated with the dormant state. That there is a region of the spectrum between the blue and the red rays which has less influence on the embryo than the rays on either side is suggested by the germination response of lettuce seeds after they are dried while exposed to the green rays. These observations have been made upon Grand Rapids lettuce seeds which usually exist in a dormant condition which makes them particularly sensitive to light. A corresponding semi-stable condition may or may not be present to such an extent in other varieties of lettuce seeds, and this fact must be taken into consideration when studying the response of different lots of seeds to light.

Lettuce seeds are continually changing organisms which show different degrees of dormancy depending on the age or physiological condition of the seeds. The seeds often exist in a dormant condition in which certain of the life processes necessary for germination appear to be in a state of delicate equilibrium. This condition can be broken by exposing the moist seeds to light. A similar unstable condition can be formed again by drying the seeds in daylight or by exposing them to the shorter wave lengths of the light.

spectrum. These transformations can be made in the light and without the presence of water in the form of a film surrounding the seed. It appears that under these conditions light does not facilitate the passage of any substance from the seed but causes certain unknown photochemical changes within the seed.—A. L. SHUCK, New York State Agricultural Experiment Station.

A CASE OF CHANGE OF TROPIC RESPONSE

(WITH ONE FIGURE)

During a recent trip into the northern woods of Minnesota the peculiar formation seen in the accompanying illustration (fig. 1) was encountered. This specimen of the black spruce was found near the shore of Lake Hole-in-the-wall, a small lake which is located about six or seven miles southeast of Marcel. The two lateral branches had each made a three-quarter turn and then grew almost directly upward. The upper portions of these two branches if seen alone would appear much like the top of the main axis of the tree, with laterals extending outward and somewhat drooping.

Since the lateral branches of the black spruce normally grow nearly at right angles to the vertical main axis and perpendicular to the force of gravity, they may be said to exhibit plagiotropic response. No attempt, however, was made to determine the specific influence or influences responsible for this position. After making the turn the branches apparently became definitely negatively geotropic like the main trunk.

The writer is not certain as to the cause of this abnormal formation but thinks that it might have been caused by the mistletoe, Arceuthobium pusillum, which is known to attack the black spruce in Minnesota and produces abnormal development. At the time of the visit to this region he was unaware of the occurrence of this mistletoe and failed to look for its presence on this individual tree which was the only one seen which seemed to be abnormal. These two branches, however, are thickened at the curvature and resemble mistletoe injury as reported by colleagues who are familiar with its pathogenic symptoms.

Aside from the peculiar unique formation, is the fact that these branches are seemingly unaffected in their subsequent growth and have later responded to growth forces in such a manner as to resemble the main axis of the tree, illustrating quite definitely a change of tropic response. Just what forces were brought into play to cause the branches to grow in such a way as to form the circle it is difficult to say. The parasite must have stimulated growth on the upper and outer sides of the curve and then, after the growing tip had passed the half circle mark, left the elongating portion unaffected. After that, the end of the branch completed the turn until it