

Red Cotyledon of Lettuce

study of abnormality shows seedling growth not always retarded, calls for modified germination requirements

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Many lettuce seedlings with red cotyledons—seed leaves—produce normal plants, and their general classification as abnormal is not justified.

The high percentage of seedlings with red cotyledons constitutes a new problem for California lettuce seed growers and seedsmen. Because of the inflexible rules defining a normal seedling, seed analysts are forced to call reddening of the cotyledons symptoms of abnormality. As a result, many lots are rated low in germination even though most of the seedlings are normal except for the reddening of the cotyledons.

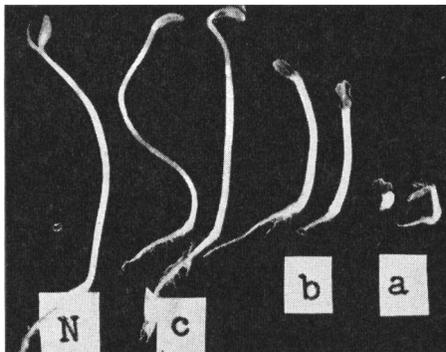
An investigation was undertaken to determine the effect of the red cotyledon condition on the production of lettuce plants. In addition to normal and dead seedlings, three categories of abnormal seedlings were tested. The categories were: *C* seedlings showing a slight reddening of the cotyledons, *B* seedlings having severe reddening and dead spots on the cotyledons, *A* seedlings having dead root tips as well as dead or severely deformed cotyledons.

A sample of Great Lakes lettuce showing a high percentage of red cotyledon was used in all tests with various samples showing no red cotyledon as checks. Before germination all lots of seed were soaked in Chlorox for one minute and then rinsed for one minute. The seed was germinated at 68° F using six replications of 50 seeds each.

Red cotyledon is apparently caused by neither a pathogenic organism nor by growing conditions or variety. The abnormality is found in seed from many growing areas and of all major lettuce varieties. As the symptoms increase with age, storage conditions might be responsible. An effort was made to induce red cotyledon by subjecting seed to severe storage conditions for varying periods.

The seed lots were stored at 90° F and 90% relative humidity. Newly harvested seed had as low as 25% normal seedlings after 16 days while older seeds showed a reduction of normal seedlings after only 24 hours. However, lots showing no red cotyledon at the beginning produced no red cotyledon seedlings as a result of the storage treatment. The seeds of such lots were either killed or root tip necrosis was the common abnormality produced.

The table below illustrates the effect of



Red cotyledon condition in lettuce seedlings. N is a normal seedling; c, b, and a are three categories of abnormal seedlings.

high temperature and high humidity storage on the lot containing red cotyledon seed. There was a rapid increase in severe red cotyledon abnormalities, and by the seventh day all seed were dead. In comparison with lots having no red cotyledon seed the deterioration was much more rapid indicating that seed with a high percentage of red cotyledon are less able

Effect of 90° F and 90% Relative Humidity for Varying Times on Seed Having the Red Cotyledon Abnormality in Laboratory Germination Tests.

Treatment	Per cent germinants				Normal
	Dead	A	B	C	
Check	7.5	6.5	17.5	55.5	13.0
12 hours	13.5	9.0	41.5	28.5	7.5
1 day	19.0	10.5	62.5	7.0	1.0
2 days	19.0	21.5	56.5	3.0	0.0
7 days	100.0	0.0	0.0	0.0	0.0

to withstand the unfavorable storage conditions of high humidity and high temperature.

During the time that laboratory germination tests were being made of the differently treated seed, other seed of the same lots were sown in soil-filled flats in the greenhouse. The second table shows the percentage of normal plants in each treatment after three weeks growth. Apparently most, if not all of the *C* abnormal and even many of the *B* abnormal

Effect of 90° F and 90% Relative Humidity for Varying Times on the Production of Normal Seedlings from Seed Having Red Cotyledon Abnormality in Soil Tests.

Treatment	Percentage of plants having four leaves after three weeks
Check	73.0
12 hours	64.6
1 day	51.6
2 days	14.0
7 days	0.0

must have produced normal plants. Evidently a slight reddening of the cotyledon is not serious enough to produce a weak plant as long as the roots are normal.

To further test the effect of red cotyledon on subsequent plant growth, transplants were made from the germination tests of normal, abnormal *C*, and abnormal *B* seedlings. There were three replications of each lot. After four weeks growth in flats in the greenhouse all plants appeared to be growing normally. Fresh weight determinations were made of each treatment. The results are shown in the following table. A slight but significant retardation of growth had occurred among the *B* seedlings.

Average Weight of Lots of Transplanted Seedlings after Four Weeks Growth in the Greenhouse.

Group	Average weight of each replicate of twenty seedlings (Grams)*
B	43.1
C	44.0
Normal	48.7

* Least significant difference 19:1—4.72.

When the reddened area is localized in the middle base of the cotyledon, the red cotyledon seedling produces normal plants. The remaining green parts of the cotyledon are able to grow and to photosynthesize. With growth the normal part of the cotyledon expands while the reddened area does not, producing a curled distorted effect. If the reddened portion of the cotyledon is more than one half the total area, the seedling becomes retarded in growth. If in addition there is root tip necrosis or the cotyledons do not emerge from the seed coat, severe retarding and death of the seedling results.

This study shows that many red cotyledon seedlings produce normal plants indicating the need for some modification of the decision to classify all red cotyledon seedlings as abnormal. Possibly some percentage of red cotyledon seedlings could be reported as normal or red cotyledon could be reported as a separate part of the total germination as is done with hard seeds in beans.

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