A Method for Measuring the Effects of Soil Salinity on Seed Germination with Observations on Several Crop Plants

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There is considerable evidence that many crop plants are particularly sensitive to soil salinity during germination and seedling growth. Crops growing on soils subject to salinization are frequently interspersed with numerous barren areas. That is, there may be a sharp demarcation between fair growth of plants and no plants at all. These barren spots often delimit the areas where soil salinity was sufficiently high at planting time to prevent seed germination. It is especially important, therefore, that the level of salinity in the soil be below the limit of tolerance of a crop during the time of germination and seedling growth. Information on the salt tolerance of various crops during this phase of growth is very meager even though it may be a primary consideration in production on saline soil. Uhvits has recently reviewed the literature on this subject in connection with her studies on the effect of osmotic pressure of the substrate moisture on water absorption and germination of alfalfa seeds.

It is difficult, if not impossible, to evaluate adequately the level of salinity conditioning the germination of seeds under field conditions. The amount of soil moisture and the salt concentrations adjacent to the seed are continually changing through the influence of evaporation, capillary transmission, rainfall, or irrigation. Although information is needed as to the effect of the variations in soil moisture and salt content upon germination, it is first necessary to ascertain the effect of varying levels of salinity on germination when all other factors are held constant or as uniform as possible.

A technic is being used at this Laboratory which appears to evaluate satisfactorily the influence of a given level of soil salinity on seed germination with a minimum of complication by other variables.

METHOD

Soil which has passed through 1/2-inch mesh screen is adjusted to a specified salt content and then moistened to a degree intermediate between the wilting percentage and field capacity. The soil is spread in a thin layer over a rubberized sheet and portions of the calculated quantity of water required are sprayed on the layer of soil. After each addition of water the soil is mixed carefully with a spatula. It is important that the amount of water be insufficient to cause the formation of large sodden lumps of soil. The salts to be added may be incorporated into the soil before the water is applied, or they may be dissolved and added in the water. The moistened and salinized soil is then placed in a closed container and allowed to stay in a constant temperature room at 70° C for about 2 weeks. Frequent rotation of the container mixes the soil and permits the attainment of equilibrium in moisture and salinity content through the soil mass.

When the adjusted soils are deemed ready for use, weighed amounts are placed in large culture dishes and planted with a definite number of seeds. Eight-inch culture dishes containing 1,400 grams of moistened soil have proved satisfactory. The covered cultures are maintained in a constant temperature room to prevent moisture distillation and condensation which would occur under varying temperatures. Emergence of the seedlings is determined by daily counts. Fig. 1 shows a view of culture dishes and the relative emergence of barley seedlings salinized with 0, 0.1, 0.15, 0.2, 0.25, and 0.30% NaCl, dry soil basis. Twenty seeds were planted in each culture.

The moisture content of the soil and the salt content of the extract from the saturated soil is determined at the time of planting. These data permit calculation of the osmotic pressure of the soil solution existing within the germination culture. If the relation holds

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1 Contribution from the U. S. Regional Salinity and Rubidoux Laboratories, Bureau of Plant Industry, Soils and Agricultural Engineering, Agricultural Research Administration, U. S. Dept. of Agriculture, Riverside, Calif., in cooperation with the 11 Western States and the Territory of Hawaii.

2 Chemist and Director, respectively.


4 U. S. Regional Salinity Laboratory. Diagnosis and improvement of saline and alkali soils. Laboratory Staff. L. A. Richards, Editor. Multilithed. 157 pp., illus. 1947.