Some Effects of Elevated Atmospheric Pressures on Growth of Wheat Plants

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SYNOPSIS. Seedling wheat plants were grown at air pressures up to 9 atmospheres. At the higher pressures plants were chlorotic and grew to 3 to 4 cm. in length after which elongation practically ceased.

In recent years many experiments have been conducted to clarify the influences of various environmental factors on plant growth. The role of total pressure, however, has received relatively little attention.

Some effects of increased total pressure on yeast were reported by Lieske and Hoffman (6). They found that fermentation in a pressure chamber ceased when the partial pressure of CO$_2$ reached 38 to 40 atm. or the concentration of alcohol reached 40 g. per liter. When they used an initial inert pressure of 90 atm. no retardation of fermentation was evident, but at 150 atm. a distinct retardation was evident. At 1000 atm. initial inert pressure the quantity of CO$_2$ and alcohol produced was halved, but fermentation otherwise seemed normal.

Some effects of lowered atmospheric pressures were evaluated using seedlings of Cajanus and Helianthus (3). At 360 mm. Hg., growth rate of Cajanus was appreciably diminished, and at 260 mm. growth ceased. The growth of Helianthus seedlings remained unaffected at 360 mm. but was appreciably decreased at 260 mm. Hg. When the partial pressure of O$_2$ was maintained equal to that in normal atmosphere, growth of both Cajanus and Helianthus remained unaffected even though the total pressure was reduced to 260 mm. Hg.

In a study of carbon dioxide, oxygen, and atmospheric pressure as growth factors, Janert (5) found that the abnormal plant growth associated with reduced atmospheric pressure was not to be ascribed directly to a decrease in atmospheric pressure but solely to a decrease of those component parts of the air which influenced plant growth. Conversely, in a test over a 4½-month period, marked fluctuations in root growth were found by Niemann (8) to be associated with fluctuations in atmospheric pressure. Higher rates of root growth of cress were associated with high atmospheric pressures. When an experimental modification of atmospheric pressure did not have the same effect, Niemann concluded that atmospheric pressure and root growth were related to a third growth factor, probably atmospheric electricity.

In a study of the biological reactions of several kinds of microorganisms, Bortels (1) found that reactions became more pronounced on approaching or intensifying high pressures. It has been shown that high hydrostatic pressures are more pronounced on approaching or intensifying high pressures and less marked on approaching or intensifying low pressures. It has been shown that high hydrostatic pressures will affect cell division (7), increase germination of microorganisms, and inactivate tobacco virus (4).

It seems evident that results of using elevated pressures have been inconclusive. This paper reports results of an experiment designed to test effects of pressure on growth.

EQUIPMENT AND PROCEDURE

Five plant growth chambers were constructed of plastic sheets and tubes. The chambers consisted (figure 1): a cylindrical center section, A, clamped between rectangular end pieces, B and C, by 4 steel bolts, D, near the corners of the end pieces. The end pieces were made of sheets 1½ inches in thickness. Three center sections, 12 inches in height, were constructed for pressures to 10 atmospheres, from 4-inch inside diameter acrylic tubing with a wall thickness of 3/4 inch. Two center sections, 12 inches in height, were made from 3½-inch inside diameter tubing with 1/8-inch wall thickness. End pieces were cut from hard rubber gasket material.

Air inlet E and outlet F were made by tapping connections into opposite edges of part B. From the tap hole, a 1/8-inch hole was drilled to connect with a 1/8-inch hole drilled vertically from inside the pressure control tubing, with an outside diameter of 3/8 inch, (G), sufficient to reach within 1 inch of the soil surface. The vertical portion of the air inlet hole, Valves were placed on the base plate, C, of each chamber and covered with 66 g. of water.