The influence of some external factors on growth and phosphate uptake of maize plants of different salt conditions
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SUMMARY.

It has long been known that the supply of ions has an influence on the growth of the plant, in the sense that with a deficiency of ions the growth is hampered. The connection between absorption and growth has, in this treatise, been more closely investigated with plants of different salt percentages by comparing the rates of absorption and growth and by studying the influence on these of some external factors.

In order to obtain the material suitable for these experiments seed plants of Zea mais L. were cultivated on a Hoagland nutrient solution of half strength, supplemented with A-Z solution. Phosphate and iron were alternately administered, by which chlorosis could be avoided. By placing part of the plants on tap water some time before the experiment, and regularly providing others with fresh nutrient solution, plants with a low percentage of salt (low-salt plants) were obtained in the former case, and plants with a high percentage of salt (high-salt plants) in the latter.

Some experiments were made with an arrangement for continuous flow; in the other cases the absorption was determined from solutions without a continuous flow. Advantages and disadvantages of the method of continuous flow have been fully discussed in Chapter II. In every case, the absorption was determined by analysis of the outer solution.

From the results it appeared that with both kinds of plants the absorption can continue for several days. With the high-salt plants, the rate of absorption remains the same under constant conditions; with the low-salt plants it shows an increase during the first two or three days of the experiment, and only afterwards does it become constant. As a rule, the rate of absorption with low-salt plants is greater than with high-salt plants, but these differences are dependent on the external conditions during the cultivation.

Also with regard to the connection between absorption and concentration there are evidently considerable differences between low-salt and high-salt plants. This connection, it is true, has in both cases been shown by a saturation curve which is in accordance with what other writers have found in this respect, but the concentration at which the maximal rate of absorption is reached is much lower for high-salt plants than for low-salt ones.

Also with regard to the factor light there are differences between the two categories of plants. In darkness the absorption comes to a standstill with the high-salt plants and, in most cases, even passes into an exosmosis; low-salt plants, however, continue to absorb phosphate in darkness.

In certain experiments, in addition to the rate of absorption, the connection between absorption and growth was investigated. From the experiments with constant conditions. Here, the connection is not entirely parallel to the curve of absorption. As expected, with the low-salt plants also the rate of growth increased, whereas with the high-salt plants the connection proves also to exist. With high-salt plants growth stops whereas in the other case there was growth as well as an increase in absorption between the two categories of plants, clearly connected with different ion concentrations.

In accordance with experimental results it can be surmised that with low-salt plants the concentration of phosphate is considerably higher than with high-salt plants, and in growth under constant conditions increased metabolism is taking place.

From the experiments conducted, it was found in these experiments the growth of the shoot on the absorption by high-salt plants is less than that, with high-salt plants also, the root in the xylem are carried on when the consumption by the shoot. This is in accordance with observations of his co-workers, who have shown that gases may pass through the phloem.

Finally, it was found in some experiments that the absorption of phosphate by low-salt plants, independent of the factors light, increased metabolism, independent of the concentration of ions, can be bound by the plasma membrane and thus affect the metabolism. This is in agreement with other writers who have shown that for a definite ion, in the same environment isoforms or a chemically close
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In certain experiments the rate of growth was determined in addition to the rate of absorption. There always proved to be a close connection between absorption and growth. This is clearly shown from the experiments with high-salt and low-salt material under constant conditions. Here, in both cases, the growth curves run entirely parallel to the curves showing the rate of absorption i.e. with the low-salt plants also the rate of growth shows at first an increase, whereas with the high-salt plants this rate of growth remains on the same level during the whole length of the experiment. This connection proves also to exist with regard to the absorption in darkness. With high-salt plants both absorption and growth come to a stop whereas in an experiment with low-salt plants in darkness there was growth as well as absorption of phosphate. The differences in absorption between the two kinds of material are, therefore, clearly connected with differences in growth.

In accordance with experiments by Hoagland and Broyer the percentage of carbo-hydrates in the roots of low-salt plants proved to be considerably higher than that in the roots of high-salt plants. I surmise that with low-salt plants, the initial increase in absorption and in growth under constant conditions must be connected with increased metabolism in the roots of the low-salt plants.

From the experiments concerning the influence of light and that of the concentration on the absorption it may be deduced that in these experiments the growth of the shoot is determinative for the absorption with high-salt plants. This regulating influence of the shoot on the absorption by the root is explained by the hypothesis that, with high-salt plants a part of the ions which are secreted by the root in the xylem are carried back to the root by the phloem when the consumption by the shoot is smaller than the supply by the root. This is in accordance with the experiments by Mason and his co-workers, who have demonstrated a downward transport of ions through the phloem.

Finally, it was found in some experiments of short duration that the absorption of phosphate is, with both high-salt and low-salt plants, independent of the other anions in the culture solution. In agreement with other writers I assumed that the actively absorbed ions play a part in metabolism, and that the amount to which ions can be bound by the plasm (binding capacity of the plasm) is dependent on the metabolism. This binding is considered to be specific for a definite ion, in the sense that it can only be replaced by an isotope or a chemically closely related ion.