It is suggested that an increase in H ions probably blocks out the higher centers ordinarily involved in the arc. On the other hand OH ions probably aid in facilitating the conduction of the nerve impulse.

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Aspects of Mineral Nutrient Balance as Related to Sap Hydrion Concentration.

W. F. LOEHWING.

From the Department of Botany, State University of Iowa.

Fluctuations in amounts of mineral nutrients found in plants is known to exert a profound effect on their metabolism. Results of recent experiments with grain plants grown on a number of acidic, humus soils deficient in potash disclose striking effects of certain mineral nutrients.

The accompanying chart (Fig. 1), typical of conditions in a number of grains, depicts schematically the chemical analyses of 3 oat crops *(Avena sativa)* grown on a soil variously treated with mineral

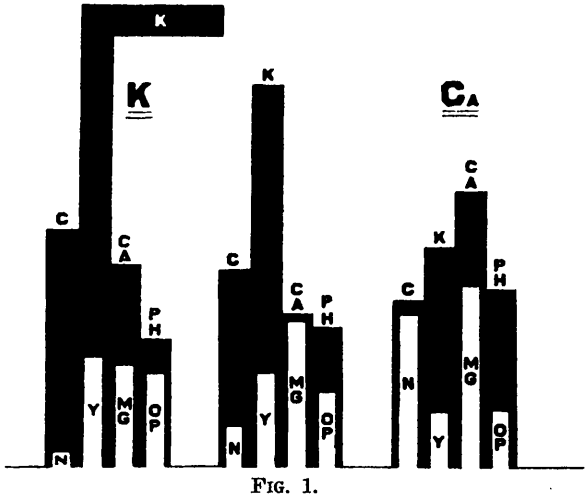

FIG. 1.

Analyses of entire oat plants grown in a potash deficient, acid humus following treatment with nutrients as follows: Left group (K), 400 p.p.m. of powdered KCl; center group, untreated (check) soil; right group (Ca), 4000 p.p.m. $CaCO_3$. c, total hydrolyzable carbohydrates; n, nitrate nitrogen; k, potassium; y, yield as dry weight; ca, calcium; mg, magnesium; all given as percentage of plant dry weight. ph, sap acidity in pH units; OP, osmotic pressure of expressed sap in atmospheres.

fertilizers. Variation in the amount of potassium is readily apparent. Correlated with decreases in potash is a fall, often greater than 3 pH units, in a sap hydrion concentration, a variation of sufficient magnitude to distinctly alter the solubility and, hence, also the mobility of essential nutrients in plants. The effects of impaired translocation are thus apt to be superimposed upon those of potassium insufficiency. External symptoms of injury and the results of tissue analyses support this view.

Potash starvation is known to interfere with carbohydrate storage, a process of fundamental significance in plants. Concomitant with decreases in potassium there was observed a decrease in hydrolyzable carbohydrates and an increase in nitrates. The great increase in soluble nitrates during potash starvation suggests a carbohydrate insufficiency severe enough to impede protein synthesis. This is true even though allowance is made for nitrates which accumulate in soils in the presence of lime. Consideration of this phenomenon is especially pertinent because lime was abundant in soils and tissues low in potash. In fact, the data (Fig. 1) show that potassium on the one hand is rather delicately balanced by calcium and magnesium on the other, an increase in the former entailing a diminution in the latter and vice versa.

Effects of potash insufficiency were accentuated by depressed iron mobility in plants whose sap had a low hydrogen-ion concentration. Inability to translocate insoluble forms of iron from roots to foliage interferes with the photosynthetic mechanism of the plant by impairing chlorophyll formation. Although analyses disclosed little variation in iron content of entire plants, iron was found massed in roots of specimens whose sap pH was near 7 while foliage of these same plants suffered from iron chlorosis. Plants from acid soils had their iron more evenly distributed between roots and tops.

Diminutions in potassium content were coupled with a fall in osmotic pressure of extracted cell sap due primarily to a decrease in the total soluble mineral content. Thus it appears that the mobility of inorganic solutes in general as well as of iron in particular is diminished by a fall in sap hydrion concentration.

Extreme variations in the ratio of the above nutrients to one another were often associated with characteristic external symptoms of injury. The severity of injury, however, appears to be a function not only of the balance among essential nutrients but also of their absolute amounts. Only when some constituent fell below a critical minimum did injury become apparent in plants. A falling off in dry weight yield due to lack of nutrient balance usually precedes the appearance of other symptoms of injury.