THE INFLUENCE OF THE pF OF SANDY SOIL AND CLAY SOIL ON LEAF GROWTH OF YOUNG BARLEY SEEDLINGS

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INTRODUCTION

Plants grown in pots with clay frequently differ in size, from those in pots with sand the plants grown on the clay soil being smaller and having smaller leaves. The same phenomenon can be found in the field. In climate rooms comparable differences occur on a sandy soil when different light intensities are applied; the plants, showing the clay type at the higher light intensities. In both cases these differences in growth seem to be caused by differences in the water balance of the plant. This assumption has been tested in the following experiment.

METHOD

The relation between soil moisture stress and water content of the sandy soil and the clay soil used in the experiments has been determined in the usual way (fig. 1). Portions

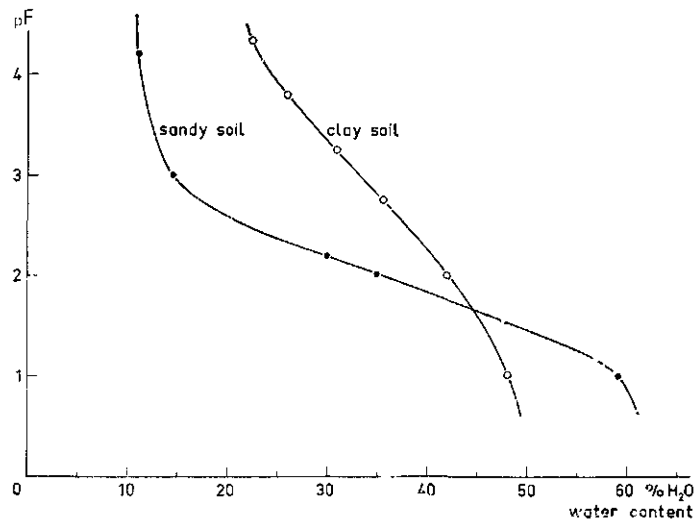

FIG. 1. The relation between pF and soil water content of the clay soil and the sandy soil used in the experiments.

of 100 gram dry soil were placed in small plastic containers. Thereafter the soil was brought at pF 2 and 5 grains of barley were sown in each container. The soil was covered with a 1.5 cm layer of fine gravel to prevent evaporation from the soil surface and was held at pF 2 until the emergence of the second leaf. At this moment the soil was thoroughly penetrated by the roots and some accumulation of roots at the bottom of the containers was found. Only those sets were used which showed a uniform growth of the first leaves. From the time the second leaf started its growth, part of the sets were wetted to pF 2 at the end of each 24 hour period whereas the other part was not re-wetted. From the transpiration losses and the graphs of figure 1 the mean daily pF could be calculated. At the same transpiration value the pF of clay soil increased more than the pF of the sandy soil (according to figure 1). Daily measurements of the increase in leaf length and of the transpiration were compared with the mean pF during the same day.

RESULTS AND DISCUSSION

In figure 2 an example of one of the experiments is shown. At time zero the second leaf of the barley seedlings could be measured for the first time. After this time the -H_2O sets got no more water whereas the daily rewetting of the +H_2O to pF 2 was

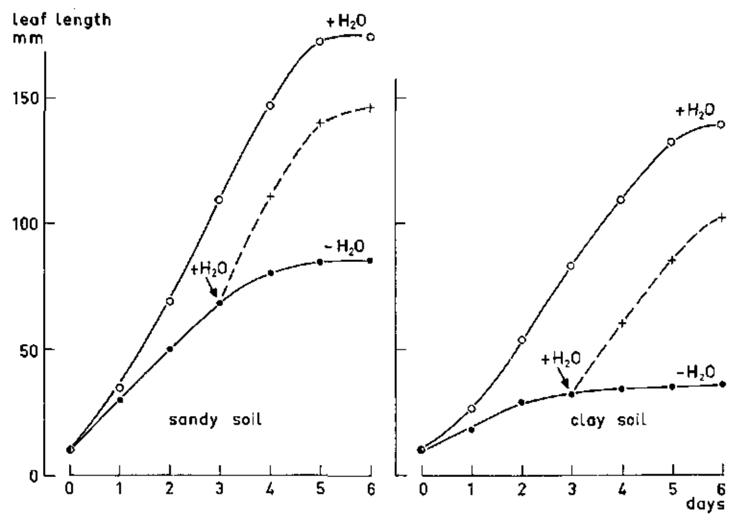

FIG. 2. The influence of drying out (-H_2O) of the soil on the leaf growth of barley seedlings.

continued. It can be seen that the leaf growth rate reacts immediately. This holds for both series. The reduction of the growth increases with increasing dryness of the soil. Rewetting on each moment resulted in an enhanced growth directly after watering. This is plotted for a water supply at the third day.

There is a great difference in growth rate between the two soil types, the sandy soil showing the most rapid growth.

In figure 3 the mean growth rate of the second leaves of 20 seedlings and the daily transpiration are plotted against the mean pF value. It is clear that the transpiration is less sensitive to an enhanced soil moisture stress than the growth. This fact can be found also if the suction tension of the root medium is raised osmotically (1). In that paper it is also shown that a short reduction of the growth is fully reversible as is the case here after an inhibition of the growth by a mechanical suction tension and this is in agreement with observations of WADLEIGH and GAUCH (3). The great difference between a sandy soil and a clay soil as appearing from fig. 2 seems to be much less pronounced if we are plotting the growth rates against pF as done in figure 3. This is much more clear if we are plotting the data for the growth rates on the same graph (fig. 4). We may conclude from this figure that there are no differences at all if we compare the relation between growth rate and pF for the both types of soil.

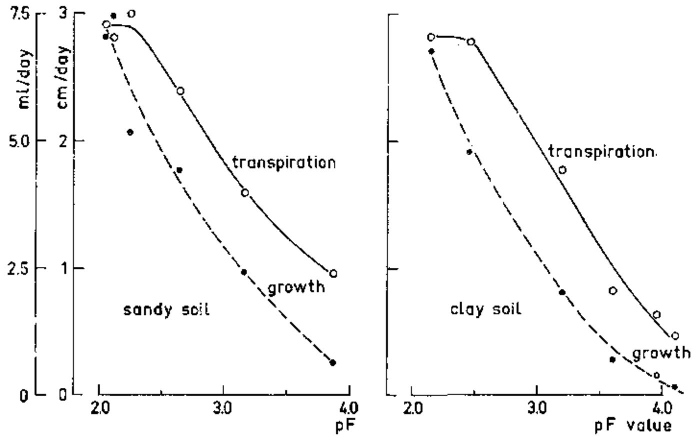

FIG. 3. The influence of the pF on leaf growth and transpiration of barley seedlings.

The differences in growth rate as shown in figure 2 seem to be due to the differences in the relation between soil moisture content and soil moisture stress as given in figure 1. This means that also at daily rewetting to field capacity (pF 2) differences between sandy soil and clay soil are very important because of the fact that at such a treatment

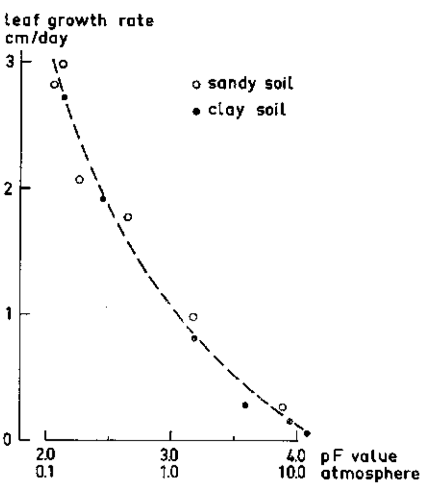

FIG. 4.
A comparison of the leaf growth rate of barley seedlings at various pF values of sandy soil and clay soil.

the mean pF of the clay soil is higher than the mean pF of the sandy soil. It is also clear from these experiments that the leaf growth is dependent on the soil moisture stress even at very small deviations from field capacity (2).

REFERENCES

1. BROUWER, R.: The influence of an osmotic suction tension in the root medium on leaf growth, DPD of the leaves and transpiration of bean plants *(in preparation)*.
2. HAYNES, J. L.: The effect of availability of soil moisture upon vegetative growth and water use in corn. *J. Am. Soc. Agron. 40 (1948)* 385–395.
3. WADLEIGH, C. H. and H. G. GAUCH: Rate of leaf elongation as affected by the intensity of the total soil moisture stress. *Pl. Phys. 23 (1948)* 485–495.

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