THE EFFECT OF SOIL MOISTURE ON THE COMPOSITION OF CEREAL PLANTS

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Introduction.—Much scientific interest is being shown at the present time in the nutritive value of cereal grasses. One development in this field is the practise of cutting young grass before it starts to form shoots, drying by special processes and selling it for both human and animal consumption. Just before the formation of the flowering shoot, there is a stage of great vegetative physiological activity in the plant and at this time the tissue contains significant quantities of vitamins and other growth factors. In addition to these substances, the value of cereal grass as a food, especially when used by animals, depends partly on the protein content. The present paper is a preliminary note on the effect of varying amounts of soil moisture on this component of cereal grass.

Numerous data from field and experimental plots indicate that the moisture content of the soil has a significant influence upon the percentage of protein in crops. When one considers that soil structure, moisture, temperature, supply of nutrients, microorganisms, soil reaction and climate may affect plant growth in many ways, it is not difficult to understand why any effort to study a single factor such as soil moisture becomes very complicated.

Much of the early work on soil moisture in relation to plant growth was done in Germany. Hellriegel in 1883 published an account of his researches on the quantitative relationship between varying levels of moisture and the yield in dry matter of green plants. As a consequence of this work, Mayer in 1892 conducted researches on the influence of moisture on the composition of cereal crops. His results are shown in Figure 1. These results are what might be expected except for the rather high percentage of protein under conditions of low levels of moisture. Further study on this problem, done in both Germany and the United States, confirmed the fact that the usual consequence of increasing the soil moisture was to decrease the percentage of protein in the green plant. Greaves and Carter obtained the results shown in Figure 2 on irrigation studies conducted at the Utah Agricultural Experiment Station.

Despite the fact that numerous investigators have shown that increasing amounts of soil moisture decrease the percentage of protein in grasses, it appears that under some conditions, increasing percentages of protein are obtained with increasing water content in the soil. The explanation of the causes which call forth these apparent exceptions is of great theoretical interest to the plant physiologist as well as the agriculturist.

Experimental. — In the laboratory of Plant Physiology at the University of Illi-

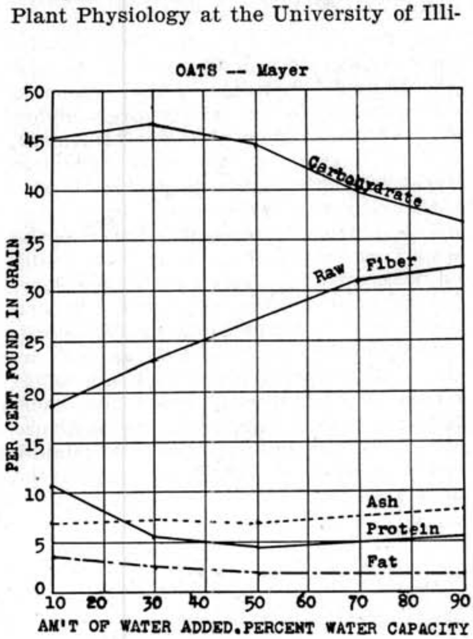

Fig. 1.

TABLE 1—THE EFFECTS OF SOIL MOISTURE ON THE NITROGENOUS COMPONENTS OF THE SOIL

Soil moisture in %	14.43	21.64	28.85	36.06	43.28
Nitrate	p.p.m.	p.p.m.	p.p.m.	p.p.m.	p.p.m.
April 1, 1940	142	140	127	103	88
April 21, 1940	135	134	174	140	117
Ammonia					
April 1, 1940	7.5	7.1	8.0	8.2	8.6
April 21, 1940	8.2	8.1	13.1	11.0	11.0
Total Nitrogen					
April 1, 1940	236	220	215	227	213

nois, two varieties of oats, Marion and Columbia, are being grown on a fertile black silt loam under varying levels of moisture. The water-holding capacity of the soil was 72%. The moisture was adjusted so that five levels of soil moisture are being maintained, at 20, 30, 40, 50, and 60% of the water-holding capacity or 14.43, 21.64, 28.85, 36.06, and 43.28% water based on the dry weight of soil. Ten pots of each variety are maintained at the indicated moisture levels by weighing every other day and adding water lost by transpiration and soil evaporation. A complete chemical analysis of the soil as well as the pH, base-exchange capacity and organic base-exchange capacity was made on the soil before the moisture levels were adjusted. Every two weeks a similar analysis is made on an unseeded control pot at each of the five moisture levels.

At the present time the data are incomplete but certain changes in the soil are already indicated. The ammonia content of the soil is progressively higher as the water content of the soil is raised, and an analysis on the same soils two weeks later, the ammonia content is also higher under every moisture level. The nitrate content of the soil is lower as the water content of the soil is raised, and on successive analysis the nitrate level doesn't vary greatly. The total nitrogen does not vary significantly under the different moisture levels. Cations such as Ca^{++}, Mg^{++}, K^{+} and Na^{+}, which are determined as exchangeable bases give some indication of increasing as the moisture content of the soil is raised. A detailed report will be published as soon as the data are complete.

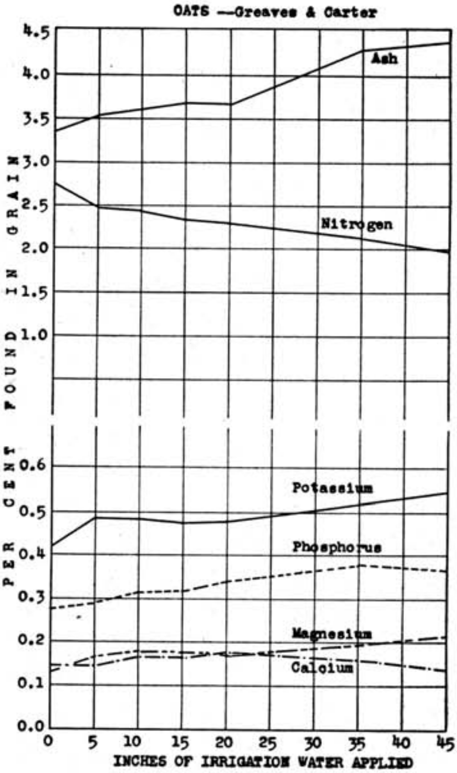

Fig. 2

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2. Mayer, A. Über den Einfluss kleiner oder grösser Mengen von Wasser auf die Entwickelung einiger Kulturpflanzen. Jour. für Landw. *46:* 167-184. (1892).