

## SUMMARY OF THE SESSION

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Arid and semi-arid zones have their own specific problems which are linked essentially to the fact that the rains are concentrated on a very short period never exceeding 3-6 months and which, in typical arid conditions, is but a few days long. Arid and semi-arid climates are thus characterized by a long period of water shortage, which has many implications in various fields.

### **Biological Consequences of the Water Regime in Semi-Arid and Arid Soils**

During the dry periods to which they are submitted, the soils undergo desiccation; the pF increases then to more than 5.5 - 5.6 (i.e., the moisture stress is more than 400 bars). Desiccation induces physical, chemical, and biological changes.

One of the most important of those last types of changes is a sharp decrease of microorganism density in the soil: often more than 90% of the micropopulation is killed by the drought. Professor Sasson clearly stressed the interest shown by the study of adaptation and selection of drought-tolerant microorganisms in these soils.

Very important, from a practical point of view, is the problem of the stimulation of biological activity, especially the stimulation of organic matter mineralization, which appears when desiccated soils are rehumidified either by rain or by irrigation. This stimulation is very intense when, in a year, there are numerous cycles of wetting and drying: that is the case of arid and semi-arid soils, especially irrigated and sandy ones (the protecting effect of clays is then absent). In many countries (Northern Africa, Egypt, Senegal, for instance), the soil low organic matter content resulting from active biodegradation is the cause of the low productivity and of the ineffi-

ciency of the chemical fertilization. To improve this situation, the idea is to add to the soil organic materials which give humic substances as refractory as possible to biodegradation. Dr. Abd-el-Malek has obtained very encouraging results by adding to sandy soils sawdust and Dr. Taha by adding muds and different composts; these investigators have thus been able to reclaim former absolutely unproductive lands.

### **Biological Consequences of the Composition of Water in Arid and Semi-Arid Soils**

The fact that these soils are often irrigated with saline waters may have important implications on the activity of the soil microflora. A good example of the influence of salinity concerns a so-called lucerne "disease" that had been observed by agronomists in Tunisian soils irrigated with water containing sulphates; this "disease" which is generally lethal appears: (a) in plots water-logged by excessive irrigation and (b) after major changes in sunlight intensity. The explanation of the phenomenon is that this change of light intensity stimulates the exudation of lucerne roots; the accumulation of exudates in the rhizosphere induces an explosive multiplication of the sulfate reducing bacteria which find then in this habitat an ideal environment: absence of  $O_2$  due to waterlogging, presence of sulfates in the irrigation water, and presence of organic substrates in the exudates. The  $H_2S$  which is produced by the bacteria in the rhizosphere kills the plants.

### **Biological Consequences of the Large Fluctuations of Temperature in Arid and Semi-Arid Soils**

The large fluctuations of temperature in arid and semi-arid soils must have important effects on the biological activity of the soil microflora. But this specific aspect of the arid and semi-arid soil biology has not yet received much attention. There has been, however, some studies on the thermo-tolerance of soil microorganisms (Prof. Sasson) and it has been shown that arid and semi-arid strains of soil microorganisms were more thermo-tolerant than strains of the same species but isolated from humid tropic soils.

### **Utilization of Legumes in the Arid and Semi-Arid Zone**

Legume inoculation raises some specific problems such as the one of the resistance of *Rhizobia* strains to desiccation. Some strains are very sensitive,

others are resistant; it is strongly advised to select and use resistant strains for inoculation in these countries.

A very important question at the agronomic level is that of grass-legume associations. In a very careful study conducted in dry tropical Kenya soils, Dr. Birch has shown that grass could benefit from the increased amount of nitrogen mineralized under certain but not all legumes, this beneficial effect being restricted to certain periods. Dr. Birch's findings explain certain discrepancies between the results published by the different authors on the grass-legume associations.

### **Control of Plant Pathogens in Arid and Semi-Arid Soils**

In arid and semi-arid soils many plants suffer from diseases because they often grow at the limits of their ecological area. The problem of the protection of the crops against root pathogens is a very acute one; but it has not yet been given enough attention. However, investigators such as Prof. Naqvi are engaged in fundamental research on root diseases in arid zones, and papers like the one he has presented open the way to the discovery of the mechanisms of infection and parasitism. On the other hand, one may hope with Prof. Meyer that practical methods of biological control will enable us to modify the biological equilibrium of the soil in the rhizosphere so as to eliminate pathogens; some promising results have already been obtained in that field by Dénarié in Madagascar. But much more work remains to be done before the essential rules of biological control are established and we are able to give proper technical advice to agriculturists.

### **Problems of Public Health**

We have just mentioned some of the specific problems concerning agriculture. But arid and semi-arid zones are faced with many tremendous problems in other fields such as public health. One of the major difficulties that is met in those regions is that of obtaining a good diagnosis of the different diseases. That is why research, such as Prof. Masseyeff's, is specially useful; this searcher working in collaboration with Dr. Mattern has elaborated an original and very reliable method of biological diagnosis of two diseases, trypanosomiasis and primary liver cancer, which are very frequent in dry tropical regions of Africa.