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MANAGEMENT REPORT
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The use of symbiotic biodiversity to enhance plant tolerance to environmental stresses

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1) Scientific Summary:

This project set as its aim the isolation and characterization of symbiotic N_2-fixing associations in desert areas of Uzbekistan. A considerable number of N-fixing nodules were isolated and some 25 remarkable salt-tolerant isolates were further characterized. Studies were also carried out on the regulation of germination of a few selected species of leguminos shrubs with a potential to serve as animal forrage. Experiments were undertaken to study the capacity of the isolates selected to reinfect native leguminous species and also leguminous crops to follow possible changes in their drought and salinity tolerance under controlled and field conditions. Results are now being assesed and will be presented in the final report of this project

2) Scientific Issue:

During the first phases of this project, studies similar to those carried out with native leguminous plants of the Kizyl Kum desert were carried out with local cultivars of alfalfa (Tashkent-1728 and Khorezm-2), to study the salt tolerance of both the host plant and the N-fixing bacteria of the alfalfa symbiotic N_2-fixing nodules. These studies were carried out partially in Uzbekistan and complemented with studies in Sede Boqer by Drs. Shakirov and Khakimov in cooperation with scientist of the Blaustein Institute for Desert Research. As observed many years ago in Sede Boqer, added NO_3^- fertilization to alfalfa under salinity conditions, greatly enhanced vegetative growth of the plants over controled plants under traditional fertilization levels.

Nodulation of alflalfa plants under all growth conditions was stimulated by salinity up to 80-100 mM NaCl. Further increase of salinity inhibited nodulation. NaCl concentration for survavility of alfalfa plants was 200 mM NaCl and 80-100 mM NaCl was the turning-point for growth and development. The nodulating ability of salt-resistant rhizobia on alfalfa plants was maintained even at higher salt concentrations: in the "Khorezm-2" variety even at 200 mM NaCl, whereas in "Tashkent-1728" only up to 140 mM.

The last stage of this project is testing the feasibility of enhancing N_2-fixation under saline conditions using some of the salt-tolerant nitrogen fixers isolated from wild species and reported previously. Some encouraging preliminary results have been obtained with peanut and beans. The new equipment purchased by the Uzbek PIs during their stay in Israel has greatly improved the quality and overall activity not only of their lab but also of many other scientists of the Institute of Microbiology of Tashkent.

Unfortunatelly, many activities under way and planed for the last stage of this project (experiments, travel of scientist for advanced work in Israel, purchase of chemicals, etc.) have been either slowed down to a minimum or cancelled altogether due to the freeze on the use of funds imposed on this project, in spite our efforts to continue work using scarce alternative funds.

Research achievements

Nodulation studies

The desert leguminous species selected for study in the project show very few nodules after 2-3 years of growth in their natural ecosystems. Means to increase nodulation have been investigated, including testing various types of planting substrates and of diferent levels of soil humidity. For each bacterial strain-plant species combination the highest number of nodules was observed in a substrate consisting of sand and vermiculite at a ratio of 3:1 v:v. Nodules developed within 3 weeks, and their numbers varied from 3 to 5 in *A. connollyi* and *A. Saligna*, and between 10 and 30 in *A. villossimus* and *A. unifoliolatus*. Detailed studies on the effects of soil moisture and salinity on plant nodulation are in progress.

Plant growth and development as affected by salinity

Plants of *Amodendron connollyi*, *Astragalus unifoliolatus* and *Astragalus vilosissimus* were grown in pots and irrigated with nutrient solutions containing 1 mM NH_4NO_3 or without nitrogen, and in the presence of up to 500 mM NaCl. These experiments were conducted in Tashkent and in Sede Boqer, however, the results obtained by the two groups differ somewhat and the matter is under investigation.

Influence of drought on the growth and development of the plants

Desert plants grow in their natural ecosystems with an annual average rainfall of 60-80 mm. The effect of drought on plant development was studied during a 2.5 months-long experiment in a greenhouse, under a controlled gradient of soil moisture. Plants of *Amodendron connollyi*, *Astragalus unifoliolatus* and *Astragalus vilosissimus* were inoculated with their corresponding nodule bacteria, and an initial

environmentally friendly biohumus may be a more promising method of enhancing phytoremediation than the addition of artificial metal-chelators such as EDTA.

The effects of the simmultaneous use of biohumus and arbuscular mycorrhizal fungi on plant growth and heavy metal-accumulation were being studied and will be renewed upon the reactivation of funds supply in this project.

Studies have been carried out also to study the correlation between growth rate and heavy metal accumulation by plants and some of the basic biochemical mechanisms directly related to the capacity of hyperaccumulators to remove heavy metals from soils and water.

3) Managerial Issue:
Freezing the use of funds in this grant was a curious but damaging way which achieved stopping the activity of the investigators – not clear for what purpose. Otherwise, no outstanding problems.

4) Special Concerns: None, besides a promissing technology to remove heavy metals from soils and water bodies in the drylands of Kazakhstan.

5) Collaboration, Travel, Training and Publications:
Dr. Alikulov and his coworkers are frequent visitors to the Sede Boqer laboratories to make use of facilities not yet available in Astana and the cooperation of Israeli scientists and students in the cooperative research projects. Dr. Alikulov has already three AID/CDR/CAR projects, one accepted and others in preparation. Publications are at the preparation stage and should become available in 2003.

6) Request for American Embassy Tel Aviv or A.I.D. Actions: