To: Faculty of Agronomia, U.C.O.
From: R.W. Arnold, Convenio UCO-MOP
Re: Soil Research in the Quibor Basin

During the past year I have tried to encourage efforts in some type of mission-oriented research. I proposed that more cooperative work be done at Quibor because of the need to better understand potential impacts from the water to be supplied by the Dos Cerritos dam and eventually from Yacambu. Someday there may be an abundance of water for the Quibor basin. Will we have sufficient data and observations to answer a number of questions related to the agricultural development of the region? For example, is salinity likely to become more seriuos — where in the basin — how much worse — can the excess salt be leached — where — with how much water — how long will it take — how often may leeding be needed? This implies an adequate understanding of irrigation demands and needs for crops likely to be grown, the more efficient methods of managing and levelling, water distribution systems, crop rotations and the numerous associated management practices for economic crop production. If some crops are to be processed locally what are the water requirements, will there be effluents to dispose of, how much, where, is it potentially harmful? How many people can or should the area anticipate — does this create new demands on our skills as agricultural scientist? The questions can generate more questions and so on — and eventually we should try to integrate the findings of agricultural research.

It is relatively easy to incorporate so-called basic research in with the applied work needed to provide alternative solutions to the practical problems facing the people in the region. For example, bulk density of soil is one parameter often used to make corrections of, or correlations with, available water in a soil. It is well established that matrix potential is affected by, or related to, the bulk density of a soil. It is also reasonably well known that bulk density measurements are variable. Just how variable are they — how many samples are necesary to reduce the errors of natural variations?

In an attempt to answer these questions I decided to measure the bulk density distribution in two extensive soils in the basin. One soil is a fine textured soil of a cubeta, Unit Nº 20; the other is a medium textured soil of a napa, Unit Nº 16. To more precisely locate changes of bulk density we used small steel cores about 1 cm deep and 3 cm in diameter — these are much smaller than the standard Uhland samples. The error is likely larger because of the small volume, so we took 5 replicates in one soil, and 10 in the other so that we could evaluate the amount of error.

At each site we dug a calicata and took replicated samples of each 5-cm layer to depth of 140 to 150 cm. When we obtain the statistical analysis it should be possible to estimate the number of samples needed to be within any given limit about the mean value and at any selected probability level. In general we hope to obtain results that are plus or minus 10% of the mean value at a 95% probability level. For some situations it may require 15-20 samples and for others 3-5 samples may be sufficient.

We hope that this information can be related to other observations on moisture retention, permeability or conductivity, and tension, to better extrapolate from one measurement to another. In addition we hope to look at the salinity of these profiles for other useful relationships.

But there is another facet of this simple set of measurement. Quantitative evaluation of soil genesis is based on assumptions about the original state of soil materials. One must decide if there are lithologic or sedimentological strata present in a soil profile. If so the inherited properties must be estimated before satisfactory budgets of changes resulting from soil forming processes can be calculated. It is important to have a bulk density values as accurate as is reasonable to obtain for the effort expended. The soils in Quibor afford the unique opportunity to study relatively undisturbed bulk densities because of the lack of water percolating through the soils. In general the upper 30-40 cm reflect prior cultivation and penetration of rainfall but below this it appears that very little has happened since the drying out of the original sediments.

By analyzing salt contents and kinds we think it will be possible to make calculations that reasonably explain the amount of presently observed soil development. After that it is possible to develop a series of models to predict changes under specified conditions. One important set of conditions would be that associated with kind and amount of irrigation water supplied to these profiles.

Thus it is possible to work on both practical aspects of soil management and theoretical models of soil genesis at the same time. A number of simple student-oriented research problems could be designed to increase their awareness and participate in research as well as extend our capability to obtain desired information.

I realize that this effort in a research problem is small indeed, however, if each of us did several small things and were able to pool our knowledge I am sure we will be making more progress than we imagine is possible. I feel that cooperation is easy to achieve, but a coordinated program to integrate and extend our individual observations will require more attention, assistance, and motivation.

RWA/ldeh

Barqto. Dec. 3, 1972