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**PORTUGAL UNIVERSITY
INSTITUTES
DEVELOPMENT PROJECT**

(Contract AID/NE-C-1701)

**REPORT ON
SHORT-TERM STAFF ASSIGNMENT**

**Submitted by
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Lubbock, Texas**

April 15 - June 1, 1983

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SHORT-TERM STAFF ASSIGNMENT
at the
Universidade de Evora
Evora, Portugal

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This document is the final report of Dr. Howard Taylor of Texas Tech University, Lubbock, Texas, who served as a crop science short-term advisor at Evora University under the terms of an Agency for International Development contract administered through Purdue University, West Lafayette, Indiana.

The Portuguese counterpart was Maria do Rosario Oliveira but the advisor was also asked to facilitate the research of Eng. Mario de Carvalho, Eng. Tech. Agr. Antonio Manuel Calado and Professor Carlos A.M. Portas.

The problem to be addressed was that limited water conditions in the Alentejo complicate forage production for livestock feed. The consultant was asked to bring knowledge and experience derived in other Mediterranean-type climates to suggest means for reducing plant water stress through modifying plant rooting in Alentejo soils.

The advisor was asked to:

- 1) Direct Maria do Rosario Oliveira in her attempts to measure root system development as affected by particular soil characteristics in the Alentejo.

- 2) Assist the counterpart researcher in identifying how varying soil conditions have affected rooting patterns in other Mediterranean-type climates.

3) Recommend methods that will enable the researcher to more rapidly measure root growth and to increase the number of such measurements taken in a given period of time.

4) Make specific recommendations as to the required materials, equipment, manpower, training or other requirements needed to enable this technology to most rapidly be transferred to practical usage.

5) Attempt to locate such materials and instruct in their installation and usage.

6) Examine the research in detail and suggest means that will improve overall results, increase accuracy obtained and decrease the time required for completing the experiments.

7) Help improve the research-extension ties of the University of Evora with the Regional Director of Agriculture and the PNUD program.

8) Work with other members of the Crop Science Department and give an intellectual stimulus through seminars.

9) Present a final report with specific research-extension suggestions for the University of Evora and other Alentejo institutions where relevant.

This report will now discuss the advisor's response to these nine work areas.

1) The advisor and the Portuguese counterpart discussed in considerable detail on several occasions the effects of various soil biological, chemical and physical properties on plant root growth and function and the properties of several soil profiles that contained various levels of these soil properties.

2) The advisor and the counterpart examined several soil profiles containing roots of different crop species and identified the probable

constraints to root growth in each soil profile.

3) The advisor and the counterpart discussed the advisability of reducing the number of soil and crop treatments in which rooting patterns are closely examined and also discussed the Letcombe Laboratory method of obtaining an index of plant root behavior through counting the number of roots that can be seen from a broken core of soil at a specific depth. This broken core technique is a means of speeding up the root measuring procedure without sacrificing too much accuracy.

4) The advisor recommended the use of a glass-box technique to help isolate the probable causes of unsatisfactory plant rooting in Alentejo soils. In this technique, soil physical condition is maintained in an "ideal" state during short-term experiments to determine if some chemical or biological condition is also limiting root growth.

5) The advisor discussed with Mario de Carvalho use of the soil core breaking technique. Dr. R. Scott Russell, the retired director of the Letcombe Laboratory, Wantage, England worked closely with Mario de Carvalho on the equipment needed for this technique. Dr. Russell was at Mitra during part of the advisor's tenure there.

6) The counterpart's research was examined in detail and a number of modifications were suggested to her and her supervisor, Professor Carlos A. M. Portas.

7) The advisor asked various people at Mitra about the possibility of meeting with Ministry of Agriculture personnel at Evora. He always was assured that such a meeting would not be profitable, from both his and the Ministry people's standpoint. The advisor did spend part of one day with the soil research group of the Ministry of Agriculture at Oeiras (Estacao Agronomica Nacional) and part of two days with personnel

of the Plant Breeding Station at Elvas. He also spent part of one day with the PNUD personnel.

8) The advisor gave 3 seminars: one on the role of soil characteristics in controlling root system development to the Agronomy faculty at the University of Lisbon and a seminar on modifying the root systems of plants to reduce their water stress to the agronomy faculty at the University of Lisbon and also to staff at the University of Evora.

This report now covers some general impressions based on traveling through parts of Alentejo during weekends or on results of questioning various Portuguese contacts.

First, the farmers traditionally have moldboard plowed most Alentejo soils 30 to 40 cm deep when they are to be planted to annual crops. The most frequent reason given was to make weed control easier but other reasons, such as to increase water storage, to increase root penetration, to aid drainage, to increase soil aeration, and to bury crop trash, were also given. This moldboard plowing is very expensive. Carefully controled, replicated experiments should be conducted on various soils to evaluate reduced (minimum) tillage, scarification and no-tillage technologies for their usefulness in the Alentejo. The advisor saw some soil profiles where scarification with chisels (tines) probably will increase crop yields but deep tillage of any type should not be done unless it will correct some obvious defect. This evidence is not available for the Alentejo. The reduced tillage systems should be less costly than the traditional moldboard system.

Second, the Crop Science Department has constructed a rhizotron (a root observation facility). A definite decision should be made

whether this rhizotron will be useful for the University. If the answer is yes, the windows should be redesigned so a smooth surface is next to the soil volume. In addition, the other walls of each compartment should be waterproofed. If the answer is no, then the adjoining building should be converted to some other use.

Third, the agricultural scientists are not sure of the fertility requirements in the Alentejo soils. Well-replicated experiments should be conducted to identify yield responses of major crops to all of the mineral elements--a soil fertility program to increase crop yield.

Fourth, there seems to be considerable doubt in the minds of scientists here in the Alentejo about the annual water balance. Data are needed about soil water content (water retention and about water content) conductivity relations. These data are needed for evaluating the need for drainage, for designing irrigation systems and for determining where rainfed farming will result in the most economical crop production.

Fifth, if the research called for in items 3 and 4 is to be conducted in conjunction with Evora University, the soil physics and soil fertility equipment already here at Mitra should be placed into service rapidly. The scientists concerned with these projects also must be responsible for the laboratory tests and should not be required to rely on tests conducted at some other location by someone not particularly interested in the project.

Sixth, the advisor observed considerable amounts of soil erosion especially on hillsides where moldboard plowing had occurred. The reduced tillage systems suggested in item number 1 not only should be less expensive but should help control this soil erosion.

Finally, the advisor has been in many countries during the past 30 years. He often had the opportunity to contrast the attitudes of

farmers and extension service personnel toward research results both where the research was directed toward identifying and solving problems or toward accumulating basic knowledge. He did not have the opportunity to talk with farmers or extension workers in Portugal so can only assume that acceptance of university research results is low. If this analysis is correct, acceptance will be substantially increased when, and only when, the research is directed toward reducing farmer's costs or increasing crop yields. There are many interesting scientific questions to be answered even though the research is directed toward solving a practical problem.

ADDENDUM TO REPORT

Howard Taylor

Accommodation and amenities at Mitra, for the most part, were adequate for short-term advisors during the five working days of the week. A problem occurred when we arrived back at Mitra from a field trip too late to eat at the "refeitorio." When this happened, we did not have food until the next morning. An even more serious problem occurred each Saturday and Sunday. During the weekend, the amenities are not satisfactory. The noon and evening meals were supplied very erratically not only to me but to the other two short-term advisors (Dr. Scott Russell and Dr. Edward Carter). This situation should not be tolerated, especially because transport to Evora is limited on weekends in amount and consistency.

I solved my problem about meals and transportation by renting an automobile at my personal expense and stocking a supply of food goods in my room at the Convent.

Personal laundry also is a problem at Mitra. Sometimes, it can be washed and returned in less than one week but sometimes it is more than two weeks in returning. The short-term advisors do not expect this slow laundry situation so we do not bring enough clothes to last this period of laundry delay. Because there is no laundry service available in the city of Evora, the local laundry situation should be straightened out.

Finally, someone should be assigned to discuss with each short-term advisor the facilities which are actually available at Mitra, where these facilities are located, when they can be used and who to contact about their use.

DAILY DIARY - HOWARD TAYLOR

- April 14, 1983 - Travelled from Lubbock Texas toward Lisbon, Portugal.
- April 15, 1983 - Arrived at Lisbon, cleared immigration and was driven to Évora by Maria do Rosário Gamito de Oliveira. On the way to Évora, she explained the olive and wheat culture system.
- April 16, 1983 - Maria do Rosário Oliveira and her husband, a Ministry of Agriculture official drove me through the countryside to the Barragem do Divor and also explained the land distribution and reserve system in the Alentejo.
- April 17, 1983 - Professor Carlos A.M. Portas and his wife hosted us at Elvas for the day. We saw the dairy farm of Senhor Pereira on the Caia River and also saw a private collection of pre-1920 farm tools on the farm of Senhor Gonçalves.
- April 18, 1983 - Spent day in conference with Maria do Rosário Oliveira and with Professor Carlos A.M. Portas on my duties here at Évora University and being briefed Rosario's research program.
- April 19, 1983 - Spent day with Dr. R. Scott Russell and Mário de Carvalho on a drainage experiment being conducted by Professor António dos Santos Júnior as a part of the PNUD program in Portugal.
- April 20, 1983 - Spent day with Dr. R. Scott Russell, Mário de Carvalho and Maria do Rosário Oliveira examining soil pits on various experimental sites.
- April 21, 1983 - Continued the examination of soil pits to determine probable effects of soil characteristics on the rooting patterns of crop plants.
- April 22, 1983 - Spent day looking at agricultural systems in the Évora, Borba, Vila Viçosa and Elvas area.
- April 23-25, 1983- Drove from Évora to Sevilla, Cordoba and Cadiz Spain and returned to Évora. This trip allowed me to see the irrigation areas around Badajoz and Cordoba Spain in order to compare these areas with development of the agricultural areas irrigated in the Alentejo part of Portugal.

- April 26, 1983 - Worked with Mário de Carvalho on a soil bulk density core sampler and with Maria do Rosário Oliveira on soil pH values and their possible consequences on forage production.
- April 27, 1983 - Sorted slides for Lisbon University seminar in A.M. In P.M. spent some time with Almeida Alves, the PROCALFER coordinator for Portugal on lime and fertilizer trials sponsored by USDA and INIA.
- April 28, 1983 - Spent day at Mitra examining and photographing soil pits and designing a root box experiment to test the possibility that aluminium toxicity, associated with low soil pH, might reduce root exploration of Mitra soils.
- April 29, 1983 - Spent day in library at Mitra and Évora reading details on rooting experiments for alfalfa, white clover, subterranean clover, perennial ryegrass and tall fescue, the forage species used by Maria do Rosário Oliveira in her experiments.
- April 30, 1983 - Spent day in Lisbon
Met Dr. T.H. Gunter at Hotel Diplomático.
- May 1, 1983 - Spent day in Lisbon.
- May 2, 1983 - Spent day at Soil Science Department of the National Station of Agronomy at Oeiras, Lisbon. Visited with Dr. A. J. da Silva Teixeira, Eng^o Agr^o Antunes da Silva and Dr. E. Menezes de Sequeira.
- May 3, 1983 - Gave seminar at School of Agriculture, Lisbon on "The effects of soil characteristics on plant rooting". Talked with Drs. Gomes and Garcia on the soils program there. Returned to Évora.
- May 4, 1983 - Spent day with Maria do Rosário Oliveira on glass fronted box experiment to test the hypothesis that aluminium toxicity might affect rooting of plants in Alentejo soils.
- May 5, 1983 - Spent morning with Dr. T. Gunter defining my role as short term advisor. Spent afternoon on glass fronted box experiment.
- May 6, 1983 - Spent day at Elvas Plant Breeding Station. Was supposed to

- meet Dr. Silas Pego but he had come to Évora this day.
- May 7, 1983 - Spent day observing farming practices in Alentejo - Évora, Monsaraz, Beja, Évora.
- May 8, 1983 - Spent day driving to Portalegre and Castelo de Vide examining farming practices in this part of Portugal. Saw many examples on deep plowing with questionable results.
- May 9, 1983 - Spent day washing out and photographing root systems washed out from walls of soil pits.
- May 10, 1983 - Went to Lisbon and met with José Luis Pinheiro of USAID mission. Gave seminar "Modifying Root Systems to Reduce Crop Stress" to about 50 people at Superior Institute of Agronomy, Lisbon University. Returned to Mitra.
- May 11, 1983 - Spent day with Maria do Rosário Oliveira on possible future kinds of research and also on working with the glass-front box experiment.
- May 12, 1983 - Reading literature on aluminium toxicity.
- May 13, 1983 - Spent most of day with Mário de Carvalho discussing tillage and nitrogen experiments. Spent some time calibrating a force ring for a penetrometer with Maria do Rosário Oliveira.
- May 14, 1983 - Drove to Vila Viçosa with Professor Janick. We discussed ecology, soils and horticultural crops.
- May 15, 1983 - Drove to Viana do Alentejo examining the ecology of pine eucalypt and oak forests and the tillage practices under tree canopies.
- May 16, 1983 - Wrote part of final report.
- May 17, 1983 - Mario de Carvalho and I drove to Beja experimental fields of Évora University. We examined 5 soil pits on clay soils. In no case did I see justification for deep moldboard plowing.
- May 18, 1983 - Drove to Elvas Plant Breeding Station. Discussed the plant breeding programs with Eng. Agrº Manuel das Torres Barradas

and Dr. Silas Pego.

- May 19, 1983 - Drove to Coimbra and visited the Superior School of Agriculture, a Polytechnic School at Coimbra. Professor Albuquerque was my host.
- May 20, 1983 - Went to the Mondego research station with Prof. J. Albuquerque, Eng. Flavio Ferreira and other project members.
- May 21, 1983 - Visited tourist sites with Prof. J. Albuquerque.
- May 22, 1983 - Drove from Coimbra to Mitra.
- May 23, 1983 - Gave seminar on "Modifying Root Systems to Reduce Crop Stress" at Mitra.
P.M. met with Vice-Rector António Gonçalves Santos Júnior about the drainage experiment at Barrocal. Other participants were Ricardo Serralheiro, Lino Lúcio and Mercês de Mello.
- May 24, 1983 - Visited soil pits with Mário de Carvalho then lunch with Vice-Rector Santos Júnior then the AID office in Évora.
- May 25, 1983 - Worked with Maria do Rosário Oliveira on future experimental plans. Worked on final report.
- May 26, 1983 - Visited eucalypt plant rooting project at Rio Maior. Met with João Santos Pereira.
- May 27, 1983 - Visited with PNUD project personnel at Évora.
- May 28-29, 1983 - Weekend visit with Professor Carlos A.M. Portas for final discussions on my advisory trip to Portugal.
- May 30, 1983 - Final discussion with Maria do Rosário Oliveira and Mário de Carvalho on their research programs.
- June 1, 1983 - Return to U.S.A.