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# FY I ANNUAL REPORT (1976-1977)

USAID-IAV-UNIVERSITY OF MINNESOTA
PROJECT NE-C-1279
HIGHER AGRICULTURAL EDUCATION, PHASE II

MOROCCO

Edited by Pierre Ph. Antoine

Final Edition

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PERSONNEL EMPLOYED UNDER USAID-UNIVERSITY OF MINNESOTA PHASE II PROJECT

Period of October 1, 1976 - September 30, 1977

A. On-Campus

1. Director of International Agricultural Programs, Dean J.F. Tammen

2. Project Director, Dr. P.Ph. Antoine

3. Scientific Advisers

Agronomy - Dr. Herbert W. Johnson, Head, Agronomy

Horticulture - Dr. J.L. Ozbun, Head, Horticulture

Soil Science - Dr. W.P. Martin, Head, Soil Science

Range & Watershed Science - Dr. A.C. Mace, Head, Forest Resources

Plant Pathology - Dr. F.A. Wood & Dr. D.W. French, Heads, Plant Pathology

4. Secretarial

Senior Accountant - Mrs. J. Borris

Bilingual Secretary - Mrs. B. Harou

B. Regular Field Staff

1. Administrative Responsibilities (Field Chief of Party)

Dr. J.L. Caddel (until May 1977)

Dr. D.W. Sams (June 1977)

Dr. J.P. Vavra (July 1977 - present)

2. Scientific Assignments

Plant Breeding - Dr. J. L. Caddel (until May 1977)

Horticulture - Dr. H.W. Young (until October 1976) and Dr. A.M. Lasheen (June 1977 - present)

Horticulture - Dr. D.W. Sams (until July 1977)

Watershed Management - Dr. E.R. Berglund (June 1977 - present)

Range Management - Dr. J.T. O'Rourke (June 1977 - present)

Soil Conservation - Dr. J.P. Vavra (June 1977 - present)

C. Short Term Staff

Pedology - Dr. P. Ph. Antoine

Virology - Dr. B.E.L. Lockhart

Soil Microbiology - Dr. J.A.E. Molina

D. Consultants

Horticulture - Dr. S.E. Malo, University of Florida, Homestead

Range Management - Dr. J.E. Taylor, Montana State University

Watershed and Range Science - Dr. A.C. Mace, University of Minnesota

E. Local Hire

Administrative Assistants - Mrs. N. Handlin and J. Wood

# SUMMARY OF ACCOMPLISHMENTS OF THE PHASE I PROJECT

(AID/AFR/672)

SUMMARY OF ACCOMPLISHMENTS OF THE PHASE I PROJECT (AID/AFR/672)

I. DESIGN AND STAFFING OF THE PROJECT. OBJECTIVES OF UNIVERSITY OF MINNESOTA ADVISERS.

The USAID-University of Minnesota Phase I Project contract was signed in June, 1970. At the request of the Moroccan Ministry of Agriculture, USAID, through a contract with the University of Minnesota, agreed to provide technical advice and assistance to Morocco's Institute Hassan II of Agronomy and Veterinary Medicine (IAV) in planning its programs and in developing its teaching and research work in soil and plant sciences. Members of the University faculty joined the IAV in 1970 and 1971 to serve as advisers in soil biology-fertility, pedology, plant virology and cereals breeding. In 1973, an amendment of the contract resulted in an expansion of the project towards the fields of vegetable and fruit production. Two other University faculty members therefore joined the other four professors in 1974.

The central purpose of the in-country Phase I Project was to develop third cycle instruction programs in soil and plant sciences (fifth and sixth year of studies). However, since the Moroccan capacity to offer a full third cycle program was somewhat limited due to a lack of sufficient staff, Moroccan students spent their fifth year of studies in European or American institutions during the entire length of the Phase I Project. Consequently, the Minnesota field staff served primarily as advisers to sixth year students and as researchers, but members of the team with outstanding fluency in French also shared in some second cycle instruction.

The design of a technical assistance project for a professional school where the language is French and in an environment traditionally oriented towards European systems of education was an ambitious task. At the beginning of the project in 1970, Moroccan agricultural schools knew very little about the U. S. approach towards graduate teaching and were somewhat slow to realize the enormous potential offered by U. S. universities in the fields of agricultural education. At the same time, Morocco's proximity to Europe and availability of French and Belgian professors for long or short assignments made it unnecessary for them to try to give U. S. instructors major responsibilities in formal teaching programs (primarily first and second cycle of studies).

Consequently, the most valuable input by the U. S. was assistance at the third cycle or graduate level of instruction. Here it was possible to design an effective program combining the Moroccan requirement of a fifth year of study abroad (France, Belgium, or the U. S. A.) and sixth year work under the direction of a University of Minnesota professor in Morocco.

In another respect the project design was unique. Regular tenured members of the Minnesota faculty became directly involved in the program as scientific or technical advisers. For example, the activities of the two soil scientists, the two horticulturists and the two plant scientists (breeding and pathology) were directly supervised by a technical leader appointed for each of these three specialized areas. The three technical leaders all

provided the kinds of professional inputs available from senior University faculty members with long experience in teaching and research. They advised the resident staff on the design and methodologies for their research, advised on equipment specifications, on the selection of sixth year student research problems, and on the evaluation of student's work. At the University, they closely supervised the planning of study programs for Moroccan students in U. S. universities and advised on the selection of universities other than the University of Minnesota. In Morocco, where they spent a period of about one month each year, technical leaders advised field staff on the orientation to give to their teaching and research programs in light of local constraints and difficulties.

The combination of campus-based senior scientists and a resident team of specially appointed experts on long assignments resulted in a project that obtained high approval by Moroccan leaders.

The emphasis on graduate level programs at IAV gave the University of Minnesota professors the opportunity 1) to devote a major portion of their time to research programs tackling agricultural priorities of Morocco, and 2) to integrate Moroccan students on those programs. This integration of research activities into training programs is typical of the U. S. system of education. However, it was a somewhat new concept concerning the potential role of staff members at IAV in the early part of the project since most Moroccan

and European staff members on duty at IAV were clearly more involved in the traditional forms of teaching (classroom or field work) than in the development of research programs. (This of course can be explained by the heavy time requirements placed upon Moroccan and European staff for first and second cycle teaching.)

Research activities resulted in numerous publications and contracts with the international and local scientific community. They have been detailed in Phase I and IAV annual reports. A partial list of publications is also listed under "Achievements of Field Staff".

## II. PARTICIPANT TRAINING

Initially it was envisaged that potential members of the faculty at the Hassan II Institute would be sent to the U. S. for training that would lead faculty to a Ph.D. This was unrealistic for the first years of the project. The severe shortage of trained Moroccans and the availability of qualified Europeans to teach at the Institute caused the Government of Morocco to appoint many of the first graduates of the Institute to positions in agencies of the Ministry of Agriculture rather than designate them for further training as teachers.

The presssure of instructional needs in the first four years of the six year program at the Institute were largely met by the use of European lecturers. Also the easy availability of study opportunities for advanced students in France and Belgium resulted

in slow development of third cycle programs at the Institute. Except for the Minnesota team, no Institute staff was appointed expressly to offer third cycle instruction.

In 1972 it was agreed that due to the limited number of Moroccan staff at IAV, Ph.D. training should be deferred but that U. S. training of fifth year students should begin. Interest in U. S. studies by Moroccan students was minimal at first. Only one fifth year student came to the U. S. for graduate level course work in 1972; however, with time and positive reports by returning Moroccan participants, the number of students increased regularly. Four came to the U. S. in 1973, six in 1974, eight in 1975 and nine in 1976. Students were trained at the University of Minnesota in soils, plant pathology and plant breeding, but other specializations involving extensive field work in arid and mediterranean ecosystems, or in irrigated regions led to admissions in other U. S. institutions (e.g., specializations in Range Management, Subtropical Horticulture, special crops, etc.).

Basically, Moroccan students coming to the U. S. completed a program of course work in an American university following a study plan jointly developed by Minnesota and the faculty at the Hassan II Institute. The student then returned to Morocco where, in the sixth year, a research project was completed and reported in a memoire or thesis, then defended in an oral examination. The Moroccan degree of Ingenieur Agronome was then granted to the student.

During the last year of the Phase I Project, arrangements were made for young members of the Institute faculty to have short periods of professional study in the U. S. as part of their preparation for the Moroccan doctorate. The first four such participants arrived in 1976. All had completed their "Ingénieur" degree after spending part of their third cycle programs in France.

## III. CONCLUSIONS

Phase I of the USAID-University of Minnesota Project in Morocco can best be described as a period during which the U. S. educational system was successfully integrated into the Moroccan system of higher agricultural education and during which Moroccan agriculturalists who had, for the most part, a limited knowledge of U. S. institutions could understand how the U. S. approach to training and problem solving in agriculture could clearly fit their national goals to strengthen Moroccan agriculture.

Most research that was significant and useful was produced by U. S. professors between 1970 and 1976. New research ideas and a new training approach were introduced. However, the initial assumption made before the beginning of the Project in 1970 concerning the number of faculty and third cycle students to be advised by U. S. professors or to be sent to U. S. institutions during Phase I were questionable in light of the limited number of Moroccan staff and students available between 1970 and 1976.

The 1970-1976 project clearly was the successful first phase of a long term project of faculty training and research development. It would have been presumptuous to consider it as an end in itself.

# ACCOMPLISHMENTS OF THE PHASE II PROJECT DURING FY I (10/1/76 - 9/30/77)

# ACCOMPLISHMENTS OF THE PHASE II PROJECT DURING FY I (10/1/76 - 9/30/77)

## I. PHASE II PROJECT GOALS AND OBJECTIVES. STAFFING AND ORGANIZATION OF THE PROJECT

### A. Objectives

The Government of the United States, which had been providing assistance to the Government of Morocco under USAID Project 088, from July 1, 1970 through September 31, 1976, agreed to continue that assistance under a new project (Phase II) planned to terminate in August, 1981.

The major goals of Phase II revolve essentially around the same themes as during Phase I, i.e., the training of Moroccan students at the graduate level in the fields of soil and plant sciences. However, there is more emphasis during Phase II on the training of Moroccan faculty to the Ph.D. level in the U. S. and this activity may eventually constitute the primary effort of the Project, perhaps starting as early as 1978 or 1979. A continuation of third cycle programs of study in the U. S. is also envisaged at least until 1979.

More emphasis is also placed during Phase II on agricultural activities in dry land farming areas, and the staffing of the Project by field team members reflects that change of emphasis.

In terms of the contract, the objectives of the Project were defined as:

(1) Developing indigenous teaching and research capability to train students in soil and plant sciences. (Bloc des Sciences du Milieu et des Productions Végétales including forestry and range management).

(2) Training needed manpower to increase food production and improve nutrition status of the population.

At the end of Phase I, Moroccan staff members were hired by the IAV in the fields of soil microbiology, pedology and virology. Consequently and due to an increasing emphasis by the Moroccan Ministry of Agriculture towards dry land agriculture, it was decided that Phase II would primarily focus on cooperative programs in the fields of agronomy, horticulture, plant pathology, watershed and range management and soil conservation. However, it was agreed that scientific and academic cooperation would continue in the fields of soil microbiology, pedology, and virology in order to continue the development of important programs initiated during Phase I.

The University of Minnesota was given full responsibility for adequate staffing to meet contract objectives and for providing the IAV with up to 30 man/years of professors in the fields of soil and plant sciences (Blocs des Sciences du Milieu et des Productions Végétales) mentioned in the above

paragraphs and 20 man/months of consultants in curriculum development and research, during the period October 1, 1976 and September 31, 1981.

B. Staffing and Organization of the Project

The project is placed under the overall responsibility of the Dean of the College of Agriculture, Director of International Programs, who delegates responsibilities for project operations to a Project Director. The latter is accountable for the Project's general administration, reports, work plans, preparation of budgets and participant training programs.

The in-country administration of the Project is placed under the responsibility of the Field Chief of Party, who is one of the Project field staff members. The Field Chief of Party serves as an in-country liaison officer between IAV, USAID, and the University. He is accountable for the general in-country administration of the Project.

Secretarial and Accounting services are provided both on campus and in Morocco.

The project is designed in such a way that it involves the contribution to different degrees of a wide variety of U. S. scientists: long term field staff, short term field staff, scientific advisers, and consultants.

The major responsibilities of University of Minnesota professors serving as Long Term Field Staff are to:

(1) Guide and supervise students in the planning and execution of research and thesis work;

(2) Develop in their respective areas of specialization appropriate graduate courses to be offered in Morocco, start-in 1979-1980 or before;

(3) Develop in their respective areas of specialization research programs supportive of their teaching or training activities;

(4) Assist in the selection and training of junior Moroccan faculty;

(5) Assist in the selection of students and faculty members for training in the U. S.; and

(6) Participate in undergraduate teaching and curriculum development.

Short Term Field Staff are professors having served as long term field staff in Morocco during Phase I. They remain active in the Project in order to maintain some scientific cooperation with their Moroccan counterparts at IAV. Their major role in the Project is, besides the completion of research activities started at IAV during Phase I, the guidance and supervision of doctoral programs of Moroccan counterparts. They assume their scientific role both on the campus of the University of Minnesota and at IAV during their visits to Morocco.

Scientific Advisers are regular staff members of the University of Minnesota who provide the necessary scientific link between the concerned academic departments (disciplines) at the University of Minnesota and the Project field staff members at IAV and as such are considered to be essential to the attainment of Project goals:

(1) They serve as resource persons on a person-to-person basis to field team members to offer advice and counsel on plans of work, curriculum development course preparation, concept and conduct of researchers and the guidance of graduate study. These activities are critically important to the activities of field team members who are externally recruited and/or are at the beginning of their scientific careers.

(2) They take the scientific responsibility for Moroccan participants training in the U. S. and coordinate this training with their Moroccan field team counterparts.

(3) They carry out field team research activities which cannot be handled in Morocco (analyses, manuscript review, provision of specific research materials such as seed, etc.).

The role of scientific advisers is essentially an on-campus activity.

Consultants are scientists from the University of Minnesota or other U. S. institutions who join the Project on a

short term assignment in Morocco at the request of the University of Minnesota field staff in Morocco and IAV. They are called upon when some activities critical to Project goals, like curriculum development, guidance of graduate study, research activities, etc., require the temporary help of experts who are not available in Morocco.

## II. OVERVIEW OF THE PERIOD PHASE II, FY I (10/1/76-9/30/77)

### A. Staffing of the Project

The period October 1976 - September 1977 constituted a period of transition between Phase I and Phase II projects as far as staffing and programs are concerned.

P. P. Antoine (Pedology), B. E. L. Lockhart (Virology) and J. A. E. Molina (Soil Biology-Fertility) returned to the University of Minnesota during the summer 1976 and H. W. Young (Fruit Production) terminated his two year contract in October 1976 and returned to the U. S. In May and July 1977, J. L. Caddel (Plant Breeding) and D. W. Sams (Vegetable Production), respectively, also completed their assignments and left Morocco.

A major part of the academic year 1976-1977 was spent interviewing candidates for the field team positions in Morocco because no regular staff member of the University could free himself from his on-campus duties for a period of two years or more. The University does not have any

position officially allocated to international work and this makes long term in-country international commitment of regular staff a somewhat difficult task.

Due to a shift in the emphasis of the Phase II Project towards dry land agriculture and to the fact that Moroccan staff members have been hired by the IAV in the fields of Pedology, Virology, and Soil Biology-Fertility, outstanding new U. S. professors were employed in Soil Conservation (J. P. Vavra), Range Management (J. T. O'Rourke), and Watershed Management (E. R. Berglund), three areas not covered under the Phase I Project. In addition, A. M. Lasheen joined the Project replacing H. W. Young as a professor in Fruit Production.

Those individuals (curricula vitae in Appendix III) began their employment on April 1, 1977 and spent eleven weeks at the University of Minnesota studying French intensively before going to Morocco at the end of June in order to complete their French training program in a French oriented professional environment and integrating at the same time into the Hassan II Institute. The entire French training program is presented and discussed in Section V. The summer was then spent by field staff members developing research and training programs in each area of specialization. Reports of their accomplishments and activities are given in Section III of this unit.

In order to bring some continuity from the Phase I Project and reinforce academic and scientific cooperation between the University of Minnesota and young Moroccan staff members of the IAV at the beginning of their professional career, three former field staff members of Phase I visited the Project as short term staff. P. Antoine, B. Lockhart, and J. Molina (curricula vitae in Appendix III) spent a few weeks in Morocco during FY I, concentrating on research activities which had not been completed during Phase I or working jointly with their Moroccan counterparts at the development of a doctoral program. Reports of their accomplishments and activities are included in Section III.

At the request of IAV and field staff in Horticulture, Range Management and Watershed Management, three consultants (curricula vitae in Appendix III) visited the Project during the summer 1977. S. Malo of Fruit Production at the University of Florida (Homestead) surveyed Morocco for its production possibilities of tropical and subtropical fruit, evaluated Morocco's present academic status and needs for horticultural manpower training and attended the memoire presentation of M. Hallatou, a Moroccan participant who had spent his third cycle in Homestead. J. Taylor, Professor of Range Management at Montana State University, advised H. Narjisse, an Instructor at the E. N. A. Meknes, in establishing a range research program leading to a doctoral dissertation. A. Mace, Professor of Watershed Management and Head,

Department of Forest Resources at the University of Minnesota, consulted with E. R. Berglund and J. T. O'Rourke on the development of their research and instruction programs at IAV. Reports of their accomplishments are included in Appendix II.

B. Participant Training and Faculty Development

A total of 26 third cycle Moroccan students and four staff members spent the entire year or part of FY I studying in U. S. universities. Names, fields of specialization and programs are discussed in Section IV.A. The 26 third cycle students can be divided into three groups:

(1) Six of the eight third cycle students who had arrived in August, 1975 spent part of the academic year 1976-1977 concentrating on research activities to be part of their sixth year thesis program. Details of the programs are included in Section IV.A, Part B.

(2) The nine third cycle students having arrived in the U. S. in August, 1976 spent the entire FY I period concentrating on course work and on field programs in various U. S. universities. Fields of specialization selected by these nine students were as follows: three in Plant Pathology, three in Horticulture, two in Range Management, and one in Watershed Management. Details of the programs are included in Section IV.A, Part C.

(3) In August 1977, eleven new fifth year students arrived in the U. S. in order to participate in an intensive English training program and start an academic program at the University of Minnesota. These eleven students selected majors as follows: two in Watershed Management, two in Forestry, one in Dryland Farming Agriculture, one in Soil Fertility, one in Soil Physics, one in Range Management, one in Plant Breeding, one in Horticulture and one in Plant Pathology. Details of the programs are included in Section IV.A, Part D.

In addition, four staff members of the Higher Agricultural Education System concentrated on academic work essential to the Doctoral programs in various U. S. universities. Two staff members spent five months studying Soil Physics and Range Management respectively, at the Universities of California, Davis, and Montana. Another faculty member spent the whole academic year 1976-1977 studying Pedology at the University of Arizona. The last faculty member started a two year program leading to a M.S. at the University of Syracuse, New York. Details of their programs are included in Section IV.A, Part A.

## C. Evaluation of the Progress During FY II

In July 1977, several meetings took place in Rabat between official representatives of the IAV, USAID, and the University

of Minnesota. A review of the achievements of University personnel during FY I took place at the same time as an analysis of academic results of Moroccan participants in the U. S.

The conversations during those meetings focused primarily on four areas of mutual concern and on the recommendations expressed by USAID auditors during the spring 1977.

Following are the basic observations and recommendations made during the evaluation meetings:

(1) Creating a Research Capability at the Institute

It was felt that even though the Contractor's staff had carried out some valuable research since the beginning of the overall project in 1976, there was a limited effort by the Institute to carry on the research programs. Difficulties are due to the limited budget allocated to research at IAV and to the fact that many IAV staff members have limited experience or time to carry on research started by U. S. professors during preceding years. (In most cases, Moroccan staff members were studying abroad at the end of Phase I and, therefore, were not very involved in research programs taking place at that time.) However, it was agreed that preparation of the joint work plans for academic year 1977-1978 would provide the best means of focusing on research plans. These research plans would include a budget (including IAV's

contribution) and would be prepared and submitted to USAID for approval before the second half of December 1977.

(2) Student Selection

Since the beginning of the participant training program in 1972, one of the major difficulties lies in the late selection of Moroccan participants for U. S. training programs. Admission in many U. S. universities is very difficult to obtain less than three months before the beginning of the programs. On the other hand, emphasis on the study of the English language is often minimal for many students before a decision is made concerning their area of specialization. It was agreed that the IAV would help make earlier selections and would provide the University of Minnesota with a list of potential participants no later than the month of March each year. This will help to secure admission more easily in U. S. universities and enable IAV to reinforce its English training program during the period March-July for students selected for U. S. studies.

The length of time of participant programs in the U. S. was also debated and it was agreed that subject to the recommendation of the University of Minnesota, trainees would be allowed to continue their studies in the U. S. until they had completed the courses normally required for competency in their field of specialization.

(3) Faculty Development

The major objective of the Project is the graduate training of faculty of IAV and related institutions. Much concern has been expressed during the preceding years over the limited number of Moroccan trainees being hired for staff positions at the IAV and related institutions. However, in light of the recent assignments for faculty positions made during 1977, it seems that Project goals are reasonably achieved in that area. Out of a total of 19 participants in U. S. programs, nine Moroccan graduates are presently employed as staff members in Higher Agricultural Education. Moreover, all field staff members of the University of Minnesota have now a Moroccan counterpart at the IAV.

During the review of the Project, IAV officials also agreed that Moroccan "ingénieurs" who have returned from the U. S. and now hold faculty appointments, be sent for additional study in the U. S. as part of their doctoral studies. However, doctoral programs in the U. S. will not take place before Moroccan staff have acquired at least one or two years of work experience at IAV and have a clear picture of the orientation of their professional career.

(4) Development of Third Cycle Curriculum at the IAV

The initial Project Paper assumed that a full third cycle curriculum could be offered at the IAV in soil and plant sciences starting in 1979. This assumption, however, is

somewhat unrealistic. Third cycle courses will be developed by 1979 in certain fields, but not in all of them. It was decided that the resolution of this specific problem would take place at a later date.

## III. ACCOMPLISHMENTS OF FIELD STAFF, SHORT TERM STAFF AND CONSULTANTS AND DEVELOPMENT OF PROGRAMS DURING PHASE II, FY I

### A. Agronomy (Plant Breeding) - Dr. J. L. Caddel

#### 1. Summary of Activities During 1975-1976

##### (a) Teaching Activities

Most of the teaching activities were devoted to the third cycle research programs. Miss Fouzia Baniaameur was the only third cycle student in Plant Breeding this year. The title of her memoire is "La Relation de la Grosseur des Grains et la Vigueur des Plants d'Orge". (English translation: "The Relationship Between Grain Size and Plant Growth of Barley")

Another teaching activity was the initiation of a weekly seminar for the staff and sixth year students of the Bloc des Productions Végétales.

In addition to these teaching activities, Dr. Caddel also helped sixth year students with their research projects in cereal production and fourth year students from the Ecole Nationale d'Agriculture

at Meknes in cereal pathology and agronomy and served on advisory committees for 15 students from the Institute and Meknes.

A long term continuing teaching responsibility is the formulation and development of a complete third cycle program at the Institute. A report entitled "L'Organisation d'un III Cycle" was written jointly by the staff in plant breeding and agronomy. This report outlines a possible way to offer a complete third cycle program in Morocco in these two areas of study. Lists of courses to be offered by the Bloc des Productions Végétales and other Blocs were presented.

(b) Research Activities

"Barley Kernel Size in Relation to Seedling Vigor, Yield and Yield Components" was the subject of Miss Fouzia Baniaameur's memoire research. The effects of kernel size were highly significant with larger kernels producing the most vigorous seedlings among both the hulled and hulless cultivars. The effect of cultivars on seedling vigor was also highly significant but there was no interaction between cultivar and kernel size. Kernel weight was the only yield component that was significantly affected by kernel size. Yield was significantly

affected by the cultivar but not by kernel size. There was no significant effect of nitrogen on seedling vigor and none of the interactions was significant.

Both preliminary and intermediate barley yield trials were conducted for promising new barley lines. Fifteen of the 100 lines in intermediate yield trials appeared to be very promising and were given to the Cereal Breeding Section of the DRA. The DRA is now responsible for multiplication of the seed and final nationwide yield trials. Fifty of the 100 lines in preliminary yield tests performed very well and will be advanced to intermediate yield trials in 1976-1977.

The material that was in the intermediate yield trials came to Morocco from various collections around the world - primarily lines from the University of Minnesota's barley breeding program and the U. S. D. A. World Barley Collection. Material from these sources as well as material resulting from selections among crosses made in the program at the Institute were included in the preliminary yield trials.

The 1975-1976 nationwide yield trials conducted by the DRA include four barley cultivars from the

breeding program at the Institute. Three of these four were among the four best yielding cultivars in their trials which included 40 barley cultivars.

2. Accomplishments During FY I (1976-1977)

(a) Staffing of the Plant Breeding Unit During FY I

Dr. J. Caddel completed his project assignment at the end of May, 1977 and returned to the U. S. Mr. A. Zahour, student of Dr. Caddel, who graduated in July, 1977 was employed as a faculty member in the Plant Breeding Unit of IAV. He began this assignment in September, 1977.

(b) Teaching Activities

Like the preceding years, most of the teaching activities were devoted to third cycle programs and to the weekly participation of a seminar for the staff and sixth year students of the "Bloc des Productions Végétales".

The only major second cycle activity was a field trip to an experiment station to show students examples of plant breeding activities.

(c) Research Activities

Four students did their memoires in plant breeding under the direction of Dr. Caddel.

Mr. Ahmed Zahour, a sixth year student, studied the protein content of cereals in Morocco and analyzed cereals from commercial fields in order to describe the level of proteins in this important part of the Moroccan diet. He also analyzed the protein content of wheats and barleys from yield trials to determine whether any of the promising materials had improved levels of protein, and described the relative role played by the genotype and the environment in determining the protein content of cereals.

Mr. Azzouz Ibnelmouata, another sixth year student, was scheduled to write his memoire with Mr. Mohamed Aourik, fourth year student of the School of Meknes on the genetics of height and lodging in barley, and on estimating the yield losses due to lodging of cereals in Morocco. A study of the resistance to lodging and some other morphological characters was also planned. Unfortunately, Mr. Ibnelmouata could not complete his study during the year 1976-1977 due to health problems and will graduate in 1977-1978.

Mr. Hsain Aoussaff studied the relationship between seed size and seedling vigor and their relationship to yield and yield components.

The non-student research focused primarily on the completion of research activities initiated during previous years. Work was also performed on preliminary and intermediate yield tests of promising barley lines and varieties, on the screening segregating material from crosses among the most promising barleys that had been previously tested, and on the screening of the world collection of naked barleys.

3. Proposed Long Term Plant Breeding Program at the Institut Agronomique et Vétérinaire Hassan II

(The following constitutes a recommendation for a program in plant breeding. It was developed by Dr. J. L. Caddel at the end of his assignment in Morocco.)

Introduction and History

The Plant Breeding Program at the Institute began in August 1971, as a program of integrated research and teaching. The long term objectives of every activity within the program has been to give the students in the plant breeding option at the Institute personal experience in applied and fundamental aspects of plant breeding and genetics. The general nature of the program should maintain this spirit because training people in these important areas is necessary if Morocco is to feed itself.

The program has been limited almost exclusively to studies of barley and to a much lesser extent, the wheats. Barley was chosen as the main species to be studied because of its important place in relation to other cultivated species in Morocco (about 2 million ha) and the fact that barley is a good species for students since its genetic mechanism is easily manipulated by students. If work on several species was attempted, all of the studies would be very superficial, and in the end, no progress on any would be achieved.

The specific overall objectives of this program are the following: (a) to identify problems that limit the quality and quantity of barley produced in Morocco; (b) to choose from among the factors that limit either quality or quantity of barley, problems appropriate for sixth year "Mémoire de fin d'Etude"; and (c) to use the solutions to these problems to develop germ plasm that can be eventually used by Moroccan farmers.

The principal problems limiting barley production in Morocco and the apparent potential yields have been recently reported by researchers of this laboratory and their associates (6,7). We concluded that yields of about 50 q/ha are obtainable when certain yield limiting factors were not important.

The major factors limiting barley yields in Morocco are lodging and certain fungus diseases, such as net blotch, powdery mildew, rusts, barley scald, barley stripe and smuts.

We have observed that many introduced varieties have small seeds which produce seedlings that are sometimes unable to grow well under adverse conditions. Mr. Maamar (12) reported that barley varieties with large seeds appear to be better able to emerge as strong seedlings capable of producing vigorous plants than varieties with small seeds.

Drought resistance or tolerance is always an important area for research in regions like Morocco where insufficient water is often the limiting factor controling yield.

Studies involving factors concerning quality have only just begun. Mr. Collier has shown that acceptable techniques necessary to search for barley varieties with high protein content are available and functioning at the Institute (9). In general, he has found that the protein content is low in the barleys that he tested.

A second quality factor involves the possible production of naked barleys. This is a characteristic that is controlled genetically in which the envelopes do not

adhere to the seed. When barley is used for human and animal consumption there are several advantages to naked barleys, such as the fibrous envelope is not eaten and does not have to be removed before milling. We have already identified several problems associated with naked barleys - primarily poor seedling emergence and vigor (11,12).

## Plant Breeding Research Proposals

The same sorts of studies as mentioned above should be the principal types that should be followed in the future of the Plant Breeding Program at the Institute. Summaries of five research proposals are outlined below. These five studies have been identified as the most probable from the points of view of importance, laboratory facilities, probable personnel planning and general practicality in relation to the central theme, "the education of students". Included in the proposals are lists of necessary staffing at the Institute, collaborators from other organizations, and general estimates of cost. Obviously, if these necessities are not met, it will be impossible to carry out the proposed research and teaching.

## Proposal I: Investigations of Naked Barley for Morocco

Naked barleys might have an important place in

Morocco in the future. The germ plasm that has been used in barley breeding has almost always originated in programs concerned with malting barleys. The malting barleys traditionally have had envelopes which adhere to the seed. In countries like Morocco an almost unique situation exists in which a very small portion of the barley produced is used in the manufacture of beer.

We have already advanced in the development of naked barleys. Crosses were made and lines have been identified among the segregating progeny with productive spikes and large grains. Some of this material is in the stage of preliminary yield tests now. It is, however, doubtful that any new lines with all of the desired characteristics will be identified. The best new lines will be crossed to high yielding, well-adapted varieties, and another cycle of selection will be carried to identify superior types.

The varieties of naked barleys that we have tested so far yield poorly. At least a part of the poor yield is due to poor plant population in the field. For some reason naked seeds germinate poorly, produce many abnormal seedlings and grow slowly.

We propose to study the relationship between seed size and seedling vigor and seed shape and seedling

vigor among naked barleys. We have evidence that large seeds grow faster as seedlings, but also have more abnormal seedlings. Perhaps the fact that the germ is exposed to mechnical injury explains why these grains are so susceptible to abnormalities. Wheat and sorguhm normally have naked seeds but the germs are somewhat protected from mechanical injury by the endosperm which nearly surrounds them. We know that the shape and degree of protection provided by the endosperms of naked barley seeds vary greatly, but an objective means of classification must be developed to judge the shape of the seeds. Then trials could be conducted to test the theory that the seeds with protected germs are injured less during threshing and cleaning, and these seeds produce fewer abnormal seedlings.

We plan to screen large parts of the World Barley Collection (up to 10,000 varieties) to find diverse sources of naked barleys in addition to those that we have already tested. In order to incorporate the genes for naked kernels into Moroccan varieties and to study the inheritance of these genes and their relation to seedling vigor, we plan to make crosses among some of the best naked varieties in the world and Moroccan varieties. We will probably have to make several backcrosses to the Moroccan varieties to permit us to select new, stable, high yielding lines.

We should thresh naked barley samples in various manners to determine if seed damage can be reduced by changing the threshing methods.

We plan to investigate the existence and usefulness of genetic variability for seed size, seed shape, and seedling vigor within what we normally call pure lines, and if there is genetic variability and to make selection for good types of naked barleys.

We propose to analyze naked barleys to determine if their nutritional value is superior to covered barleys. This will be done by using chemical analysis of the grain as well as animal feeding trials.

After naked material has been identified that appears to be promising for Morocco, we propose to conduct yield tests to see if the naked varieties have the yield potential comparable to covered ones.

## Proposal II: Investigation of Lodging Resistant Barley for Productive Environments of Morocco.

Lodging resistance is an extremely important characteristic that is lacking in local barleys. In order to produce high yields, good cultural practices must be used along with good varieties. The present local barleys lodge severely when grown under favorable conditions. In

effect, this produces a ceiling of about 30 q/ha, and encourages farmers to use little fertilizer on barley. If lodging resistant varieties were utilized by Moroccan farmers, they could apply more fertilizer and achieve higher yields.

Our studies on lodging resistance have been rather limited. In searching for a good method to select for lodging resistance we found that there was no correlation between lodging resistance and height (4).

A problem that we have encountered in our search for lodging resistance is that the varieties that serve as our best sources of lodging resistance are very susceptible to stripe rust. Crosses must be made between lodging resistant varieties and lines that are resistant to stripe rust in order to identify lines that are resistant to both.

We have screened a large part of the World Barley Collection for lodging resistant materials and intend to screen more material. Some of the material identified might be adapted to Moroccan conditions. If not, it must be crossed to local varieties and selections must be made for resistant lines.

We propose to make crosses and grow the $F_1$ plants during the summer, harvest the $F_2$ seed from the $F_1$ plants and plant them. No observations can be made concerning lodging in the $F_1$ or $F_2$ generation. We will plant $F_3$ generations in $F_2$ head-rows and make observations on height and lodging. The seed from the $F_3$ plants will be used to plant replicated $F_4$ plots coming from each $F_2$ plant. The height and lodging observation in the $F_4$ generation should permit us to determine the inheritance of height, lodging resistance, and the correlation between height and lodging. We will conduct genetic studies of other characters to enable us to obtain information about the linkage between lodging resistance and other characters (see Proposal V). If linkage is found to be strong, selection can be made for the other character which will be easier to measure than lodging resistance.

Selected lines from the $F_4$ can be backcrossed to the local parent and reselected until a well adapted line is identified.

All of the good sources of lodging resistance that we have identified are susceptible to stripe rust. We need to study the relationship between this disease and lodging.

After suitable material has been identified, tests for their reaction to fertilizer should be made to find out what are the maxims, minimum and optimum rates of fertilizer of lodging resistant material.

## Proposal III: High Protein Content in Moroccan Barley for Animal and Human Consumption

Protein content in barley in Morocco is low possibly because of the introduction of malting varieties from other countries. Malting barleys must be low in protein in order to make good beer. Therefore, a breeding program should be started in which selections are made for high protein which would improve the health of the people and animals that eat barley and barley products.

To identify sources of high protein we propose to analyze the varieties and lines presently in the program and to screen several thousand lines from the World Collection.

After identifying high protein lines, we will make crosses between these lines and local barleys. We can study the inheritance of high protein content and select lines that produce high protein.

We also intend to study the relationship between seedling vigor and protein content in the seed. It has

been reported that lines with high protein produce more vigorous seedlings than low protein lines.

We intend to incorporate high protein into naked barleys. This will increase the nutritional values of barleys and perhaps improve vigor.

When high protein lines are identified that have good yield potential they will be put into yield trials. We hope to be able to increase the protein production per hectare, but traditionally there has been a problem of increasing yield and protein simultaneously. These two characters are usually negatively correlated.

## Proposal IV: Investigations of Disease Resistance in Barley

Even though each barley disease must be studied independently using parallel projects, we will describe our proposed studies together. The techniques of inoculation, time of observation and symptom notation vary, but the classical disease breeding methods are proposed. The specific diseases that we propose to study are barley stripe, stripe rust, powdery mildew and net blotch.

BARLEY STRIPE caused by *Drechslera graminea* (or *Helminthosporium graminium*) is a serious disease in Morocco, reducing yields up to 15% (10) in some cases

and often more than 5% (6). This disease is systemic and seed borne. It kills some seedlings before germination but kills most plants after heading. In the latter case, no seed is formed in the spike.

Several methods of inoculation have been tried by Mr. Boulif and were found to be neither reliable nor efficient (1). Recently he has tried a new method that shows much promise in screening for varieties that are resistant to this fungus (2).

YELLOW RUST caused by Puccina striiformis is not normally an important disease in Morocco, but as mentioned above, causes problems in our lodging resistance program. Several hundred lines and varieties have been tested in Morocco, using natural epidemics (5), and many were found to be resistant. An efficient, reliable method of artificial inoculation needs to be developed. If this were possible, we could efficiently select resistant lines in our lodging resistant program.

POWDERY MILDEW caused by Erysiphi graminis is a disease found in almost every barley field in Morocco. No real evaluation of loss due to this disease has been made. We screened 10,420 varieties from the U. S. D. A. World Barley Collection and found many barleys that have some potential in Morocco that are resistant to

powdery mildew (3). Many of these lines are in yield test this year.

NET BLOTCH caused by Pyrenophora teres is often cited as the most severe disease problem of barley in Morocco. We screened 2,680 barley lines from the U. S. D. A. World Barley Collection and found 80 lines that were resistant to net blotch, many other diseases and lodging (8).

Two sixth year students, M. Mohamed Tourkmani and Mohamed Boulif worked separately on trying to develop reliable screening techniques for net blotch, but neither was successful (1,13).

Traditionally one needs to identify a source or sources of resistance and incorporate the genes for resistance into locally adapted material. To find sources of resistance, we propose to use the existing material in the laboratory and large parts of the World Collection of Barley. Many crosses have already been made resistant varieties and local barley. We need to find techniques to identify the resistant progeny. Then the progeny can be backcrossed to the local parent and selected again until high yielding material 's identified.

After appropriate artificial inoculation methods have been identified we propose to study the inheritance of the resistance to each of these diseases. With the knowledge of the inheritance of the resistance our selection methods can be more efficiently made. For example, if resistance to stripe rust in Morocco is controlled by three pairs of genes, we would not want to use the backcross method with small populations because the probability of identifying resistant lines is very low.

## Proposal V: Investigation of the Inheritance of Morphological Characters in Barley

Genetic studies of morphological characteristics such as spike shape, leaf shape, leaf angle, make good genetics problems for students. Changes in these characteristics sometimes lead to improved yields by contributing to the knowledge of how to make selections in barley more efficiently.

There is an endless number of characters that can be studied. We propose that these studies always be linked with studies of important factors such as naked grains, lodging resistance, protein content or disease resistance. Often insignificant morphological characters are linked with important factors related to yield such

as disease resistance, light interception, lodging resistance, etc.

Within the species of barley we have two different types of spikes. They are two-row and six-row spikes. Barley in Morocco is usually six-row. Often we find that two-row varieties have some desirable factors which need to be incorporated into the six-row type. One example is that the six-row Moroccan barleys are susceptible to powdery mildew, whereas Carlsberg, a two-row European barley, is resistant.

Other Projects

We do not want to try to make a complete list of studies that might be carried out in the future of the Institute's Plant Breeding Program, however, below is a list of projects of varying importance that have been started and might be continued.

Yield is obviously the most important measure of the value of a barley variety. We think that we can improve barley yields in Morocco if we can solve the individual genetic problems that limit yield. Poor yields are primarily due to poor cultural practices. After varieties have been identified that have improved genetic potentials, they must be extensively tested throughout the country during several years.

We plan to attack neither the problems of improving cultural practices nor extensive variety testing. We do plan to conduct preliminary yield tests on selected new lines coming from our program. If the lines produce good yields in our tests, we will provide the DRA with breeders seed and they can conduct the necessary extensive testing.

We started studying the effects of seed size several years ago, and we have good evidence that barleys which are to be grown in Morocco must have large grains. Large seeded types produce vigorous seedlings that grow rapidly and can withstand the severe conditions of drought, poor seed bed preparation, sand storms, etc. In addition, kernel size is one of the important yield components and plays, therefore, a double role in the barley breeding program.

Drought resistance is a subject of great interest in many parts of the world but working with this subject is often very difficult. Probably the most feasible solution to this problem in Morocco is escape, i.e., varieties that need a shorter period of time to grow and produce a good yield. They can be sown later than the barleys presently used and they will mature earlier. We have identified many lines that have very short growing seasons, and one of these lines in particular

produced 40 q/ha at Merchouch in 1974-1975 when it was sown in February.

Perhaps the varieties that require less time to mature can avoid or escape dry periods early in the season, i.e., November, December and January, and/or late in the season, i.e., May and June. Obviously, this will not solve the problems of mid-season, i.e., February, March and April. Drought resistance during the middle of the season is a more physiological problem and cannot be resolved by a plant bred alone.

Personnel Needs

If these proposals are to be conducted at the Institute, there must be at least one experienced researcher who has a doctorate and at least one Ingenieur. These professional people will direct the teaching and research studies as well as give courses in plant breeding to second and third cycle students.

These proposals include a large amount of routine work such as counting and weighing seeds, planting plots, harvesting plots, numbering packets and stakes, etc. For this type of work there must be at least one "adjoint technique", who can organize the routine lab and field work and two "agents techniques" who can work with the "adjoint technique" as well as the professional people.

In addition one full-time secretary and one full-time "garçon de laboratoire" is necessary.

Financial Needs (1976 prices)

In addition to the salaries of the personnel listed above there must be an annual budget of 35,000.00 D. H. ($8,000.00) per year. Listed below is the general way that this quantity of money should be spent.

| | D.H. | $ |
|---|---|---|
| Laboratories supplies* | 4,000.00 | 900.00 |
| Office supplies | 2,000.00 | 450.00 |
| Maintenance of equipment | 3,000.00 | 700.00 |
| New equipment | 5,000.00 | 1,130.00 |
| Mis. labor | 3,000.00 | 700.00 |
| Vehicle (Purchase price every 5 years plus operating expenses) | 8,000.00 | 1,820.00 |
| | 25,000.00 | $5,700.00 |

*An active program of protein analysis requires about 2 D. H. ($.45) per sample for chemicals - therefore for 5,000 samples we need 10,000 D. H. ($2,300) in addition to the 4,000 D. H. listed for lab supplies.

| | | |
|---|---|---|
| Total Financial Needs | 35,000.00 | $8,000.00 |

In reality the more important proposals cost more than the less important ones. The genetics studies cost the least and are the least important for the improvement of cereal production in Morocco. The only real cost other than salaries will be that for packets, pencils, staples and tablets.

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COOPERATING AGENCIES

At the Institut:

Bloc des Productions Végétales

Section of Agronomy

Section of Phytopathology

Bloc of Human Nutrition

At the Ecole Nationale d'Agriculture de Meknès:

Département de Phytopathologie

Département d'Agronomie

At the Direction de la Recherche Agronomique:

Experiment Stations

Service de Contrôle et de Multiplication des Semences

Section de Phytopathologie

Section d'Amélioration des Céréales

In France:

Institut National de la Recherche Agronomique

In U.S.A.:

University of Minnesota

Department of Agronomy and Plant Genetics

Department of Plant Pathology

United States Department of Agriculture ( U.S.D.A. )

B. Forest Resources

Section A. Watershed Management - by Dr. E. L. Berglund

1. Introduction

Morocco's future is keyed to its range and agricultural resources. Over 40% of the export and 30% of the domestic products result from these practices. Furthermore, over 85% of this commercial output is produced on only 15% of the total arable land. This small fraction of the land is the rich, fertile, high rainfall areas and new water-intensive irrigation perimeters.[1] Non-cultivated land constitutes 81% of the country. Forests (15%), rangeland (24%), and desert and unproductive zones (42%) are all utilized for animal production.[2] Agricultural and forage production is dependent on both water and soil resources of the country. Thus, water and soil become of paramount importance to food and fiber production to sustain Morocco's ever-increasing population of 3% per year.

Water resources of Morocco are spatially and temporally diverse. Precipitation and streamflow

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[1] Anonymous. 1977. Moroccan-American economic development cooperation. U. S. Agency for International Development, Mission to Morocco. 18p.

[2] Walpole, Norman C. et. al. 1965. Area handbook for Morocco. The American University, Foreign Areas Studies Division. DA Pam 550-49. 461p.

are closely related to the topographic variability. Major water producing areas include the Rif and the Moyen Atlas Mountains while deficits are common along the coastal plains and in the Haut Atlas Mountains. Precipitation results from a Mediterranean-type climate where most of the rainfall occurs from November to March. Urban and irrigated areas are becoming more dependent upon reservoirs to distribute dependable water supplies throughout the year. Range and agricultural practices in non-irrigated areas emphasize dry land production techniques.

Soils are equally variable. Those having potential productivity are cultivated with some fields on slopes exceeding 100%. "Badlands" often result from severe erosion of subsistent practices The remaining rocky, thin soils are used for range purposes. Extensive overuse and abuse of soils produce serious erosion problems coupled with enormous quantities of sediment. This sediment coupled with the necessity for reservoirs yields an overwhelming watershed management dilemma.

Watershed management teaching and research can provide an applied, coordinated thrust to resolve these dilemmas. Teaching will provide the long

term foundations to problem definition while research will offer practical solutions to specific problems. To date, unrelated studies have not produced a coordinated watershed management program.

2. Program Development

Instruction

A graduate program involves both formal and informal instruction. Sixth year students who have been to the U. S. will have completed much of their formal graduate studies at the University of Minnesota. Additional graduate course work will enhance the student's backgrounds and provide an opportunity for other students to broaden their knowledge.

The outline of two formal courses to be presented in 1977-1978 was developed: Climatology, (20 lecture hours and six laboratory hours), and a Seminar on Soils and Water (one weekly meeting during one quarter).

Research

Well-supported applied research in watershed management of natural resources is fundamental to effective graduate education in watershed management and to resolving problems of national significance.

A new research program must be organized so as to sustain itself in the future. The proposed efforts will stress current student research, personal research related to a long term program and will involve other staff members of the IAV working in the same area of specialization.

Project I: Relative Infiltration Rates in Forest and Range Cover Types of the Tleta Basin, Morocco

Duration: Fall 1977 to Summer 1978

The objective of this project is to compare relative infiltration rates in reforested and natural brushlands and to obtain relative infiltration rates within other major natural cover types.

Soil erosion is one of the most important watershed problems in Morocco. A crucial element to the erosion process is the disposition of water at the soil surface. High infiltration rates minimize surface water runoff whereas low infiltration rates concentrate water on the surface and greatly increase potential erosion. New watershed rehabilitation projects will benefit by identifying the sites having greatest surface runoff potential. The study will be in the Tleta basin between Tanger and Tetouan.

A soon-to-be completed dam and reservoir will provide water to the city of Tanger. Attention is now being focused on a FAO plan to curb the immense sedimentation problem. Implementation of the plan will begin in 1978.

Project II: Surface Erosion in the Tleta Basin

The objective of this project is to attain an approximation of annual surface soil loss from the doum cover-type and to evaluate the applicability of the erosion pin technique.

Considerable surface erosion and gully development is evident in the heavily grazed doum cover-type. Sizable deposits of new sediment exists in the small headwater channels as a result of early autumn storms. An estimate of soil losses will assist land managers in understanding the basin erosion activity. Furthermore, if the inexpensive technique is successful, a student could apply it on a much larger scale next year.

Project III: Surface Runoff and Erosion in the Rif and Moyen Atlas Mountains

The objective of this project is to develop reliable monitoring systems on two small watersheds in each of the Rif and Moyen Atlas mountains; and

to evaluate surface runoff and sediment yield throughout the following year.

Surface runoff and sediment transport are active processes in the primary water producing regions of Morocco - namely the Rif and Moyen Atlas mountains. These areas are the backbone to Moroccan development yet virtually no quantitative knowledge exists as to the yield and timing of runoff and sediment. Needless to say, natural resource management implications are nonexistent. The commencement of precipitation runoff-erosion/sediment studies is fundamental to the structuring of a watershed research program. Short term compartmentalized studies will mesh with longer term projects by the IAV watershed faculty. Within the scope of this basic project, numerous interrelated graduate student projects will develop that emphasize current and future erosion control techniques, in addition to hydrologic process studies. This project will help resolve the complexities involving future water requirements and land productivity concerns in relation to natural resources. A doctorate research program for M. Tayaa will develop from this study in addition to two third cycle memoire project by next year's returning students.

3. Consultant Activities

Dr. Arnett C. Mace, Jr., Professor and Head, Department of Forest Resources, College of Forestry, University of Minnesota, spent the period August 28, 1977 to September 14, 1977 in Morocco. The basic purpose of the trip was to consult with E. L. Berglund and J. T. O'Rourke, Watershed and Range Management Specialists, respectively.

This consultation focused on development of their research and instruction program as part of the University of Minnesota Contract with USAID for training and development of an indigenous faculty at the Moroccan Hassan II Institute of Agriculture and Veterinary Medicine (IAV).

This report contains basic recommendations regarding further training and research activities in these two fields with the major emphasis in watershed management. Also, general observations regarding operation of the project are contained.

Approximately one week was spent traveling in the field and the remainder in the vicinity of Rabat meeting with team members, IAV staff and various AID and Moroccan officials. The remainder of the field trip was designed to introduce E. L. Berglund

to two areas in which previous hydrologic investigations have been conducted by FAO and Forest Research Station scientists.

The consultant report of Dr. A. C. Mace is presented in Appendix II.C.

Section B. Range Management - by Dr. J. O'Rourke

1. Evaluation of the Range Management Problem in Morocco

In the private ownership sector of land tenure, there is said to be 2,100,000 hectares of grazing land. Since such land lies generally within the farming areas, their future may well be tied more closely to programs connected with improved pastures. About 5.3 million hectares of the collective lands consist of grazing land, primarily used for production of sheep and goats. The range is badly overgrazed, with the result that its production of livestock forage is much below its potential yield. Overgrazing also means that the range is soon exhausted after the growing season, and the animals go through a long period of very scarce fodder in late summer and fall until the range improves again.

Livestock in terms of meat, dairy products, eggs, wool and skins and other animal products account for 49% of the agricultural production of

Morocco. In turn, 95% of the livestock and its products are produced by the traditional sector of the population. Seventy percent of the population is concerned at one time or another with the production of livestock.

Within the country the need for cooperation in range management studies is primarily between range livestock interests and Eaux et Forets. Today, just as was the case 11 years ago, "there is a curious lack of appreciation of the role range management can play in the conservation of soil or watershed protection. The results of this view show up in land treatment measures either applied or planned. In some cases, trees are being planted where they are not ecologically adapted, nor economically rewarding. (Where this is done on cultivatable land, the result is to force cultivation to steeper slopes.) In some areas, terraces and other higher cost conservation works are being developed on non-farm land where a grass cover would do the job as well and more cheaply. Stream bank stabilization is being recommended where its value and duration is questionable as long as the watershed is left untreated. Range management properly applied and administered is a relatively low cost effective

measure that can be expected to protect and improve the resource. This is not to deny the enormous and complicated land tenure and transhumance problems connected with the rangelands, but these are real problems and must be faced."

2. Program Development

Based on the observations made during the summer of 1977, the range management program will be oriented as follows:

Instruction

The emphasis during the 1977-1978 academic year will be on guiding student research, curriculum development and various other activities as listed later in this report. There is an obvious need for more depth in range management education, if students are to be expected to specialize in range management in the third cycle and thereafter function as professional range people. After four years at the Institute, a student currently receives roughly one-third of the number of contact hours in range management as compared to a student receiving a B. S. degree in range management in the U. S. This U. S. student is minimally certified to work as a professional range manager. The situation is even further impaired when a student from the

Institute then attempts to obtain a graduate degree in range management after only one additional semester of course work in a U. S. university.

Discussions will be held and attempts will be made throughout the year to add more depth to the curriculum in range management.

Courses presently being taught are as follows:

| Instructor | Subject | Hours |
|---|---|---|
| Mr. Berkat | Toxic Range Plants | 10 |
| Mr. Berkat | Range Management | 20 |
| Mr. Berkat and Mr. Hammoumi | The Environment of Range Management | 20 plus 3-day field trip |

Research

(All research projects are undertaken in cooperation with other staff members in Range Management and involve the participation of third cycle students, whenever possible.)

Project I: Response of Alfa (*Stipa tenacissima*) to Clipping

The objective of the project is to determine the response of alfa, in terms of carbohydrate reserves and vegetative production, to various heights and intensities of clipping.

Alfa dominates 7% of Morocco. It is a plant used extensively for paper production by simply harvesting native uncultivated stands. It is also grazed but primarily in its early growth stages following burning because of its unpalatability in later growth stages. In many areas it is present as a monoculture, allowing livestock no other choice in the diet.

Carbohydrate reserves are thought to be used by plants as substrate for growth and respiration. Adequate carbohydrate reserves are important in perennial plans for winter survival, early spring growth initiation, and regrowth initiation after herbage removal, when the photogynthetic production is inadequate to meet these demands. Many pastures and range management practices are based upon knowledge of how various environmental factors and herbage removal treatments affect carbohydrate reserves. This understanding helps managers to maintain high yields of desirable species and to control undesirable species.

Knowledge of the response of alfa to defoliation is limited to two studies, one in Algeria, and one by Eaux et Forêts in Morocco. Both of these

studies were short term investigations into only aerial biomass production following clipping.

Project 2: Botanical Composition of the Diet of Sheep Grazing on Native Moyen Atlas Ranges

The objective is to determine the desirability of individual forage species by sheep during the growing season on three vegetation types in the Moyen Atlas.

Basic to improved range management and animal nutrition is a knowledge of the botanical and chemical composition of diets consumed by grazing animals. Characterization of the animal's diet on native ranges is complicated by animal selectivity for certain species and plant parts and by the heterogeneous nature of the herbage available for grazing. Botanical composition of the diet may vary considerably within or among growing seasons. There is a definite need to understand the reasons why livestock select certain species over others so that rangeland resources can be more effectively used for animal production. This information is basic to establishing management guidelines, especially so in important water producing areas such as the Moyen Atlas.

Project 3: Assessment of the Forage Resources of the Moyen Atlas

The objectives are:

(1) To characterize the vegetation and assess the potential incident of individual plant species on the important vegetative types.

(2) To evaluate the nutritive value of individual plant species on the important vegetative types. This will include chemical composition and digestibility of individual species.

3. Consultant Activities

Dr. J. E. Taylor, Associate Professor of Range Science, Montana State University, visited the Project from August 27 to September 10, 1977. The primary purpose of the visit was to advise Mr. Hamid Narjisse, a faculty staff member at the "Ecole Nationale d'Agriculture de Meknes", in establishing a range research program at the new research perimeter at Timahdit and to discuss with Mr. Narjisse his doctoral program. (Mr. Narjisse had spent last summer Autumn Quarter at Montana State University taking course work and doing library research.)

The report of Dr. J. Taylor is presented in Appendix II.B.

C. Horticulture

Section A. Fruit and Vegetable Production - period of 1975 to June, 1977 - by Drs. D. W. Sams and H. W. Young

1. Summary of Activities During 1975-1976

Due to the higher than average number of students majoring in horticulture and to the lack of adequate facilities and sufficient personnel to conduct large scale long term research projects, most of the program emphasis was placed on joint supervision by Drs. H. W. Young and D. W. Sams of third cycle memoires.

The following subjects were selected for the students:

Mr. Ammor: "Contribution à la production d'hybrides interspécifiques entre Prunus persica (Pêcher) et Prunus amygdalus (Amandier): Influence de quelques facteurs sur la rhizogenèse des boutures ligneuses du pêcher et de l'amandier." ("Contribution to the Production of Interspecific Hybrids Between Prunus persica (Peaches) and Prunus amygdalus (Almonds): Influence of Several Factors on the Rizogenesis of Ligneous Cutting of the Peach Tree and the Almond Tree.")

Mr. Laamamri: "Contribution à l'étude de la fertilisation azotée du poivron". ("Contribution to the Nitrogen Fertilization of the Green Pepper.")

Mr. Rasdi: "Contribution à l'étude-problème de tardivité de production de la tomate de printemps dans la region de Bar-Bouazza". ("Contribution to the Study of the Problem of Late Production of the Spring Tomato in the Region of Dar-Bouazza.")

Mr. Bennaceur: "Situation de la production et de la commercialisation de la pomme de terre primeur dans la région de Casablanca." ("Situation of the Production and Commercialization of the Early Potato in the Region of Casablanca.")

and also a stage report titled, "La station expérimentale de Dar-Bouazza." ("The Research Experiment Station of Dar-Bouazza.")

In addition, several field trips with students took place in the regions of Larache, Casablanca, Kenitra, Agadir, Erfoud and Meknes, with the objective of studying constraints limiting horticultural production in those areas.

A long term program on tomato breeding was developed at the end of the year.

2. Staffing of the Horticulture Unit During 1976-1977

Dr. H. W. Young terminated his assignment in October, 1976 and was replaced in April, 1977 by Dr. A. Lasheen (see Section B).

Dr. D. W. Sams terminated his assignment in July, 1977 and returned to the U. S. in September, 1977. Mr. M. Hallatou who graduated in July, 1977 joined the Horticulture Unit of the IAV and started working on a doctoral program under the direction of Dr. A. M. Lasheen.

3. Accomplishments During 1976-1977

Student Memoire Development

There were six sixth-year horticulture students associated with the Institute Three were specializing in vegetable crops and three in fruit crops. Each was expected to complete a memoire before August, 1977. The choice of memoire topics for these students was influenced by many factors. Among these factors are the available resources (physical, climatic, financial, and instructional), and the particular research interests of all involved parties. These factors present several rather severe problems. For example, the climate in the region of the Institute is too cool for significant winter fruit or vegetable production. Yet memoire research begins in late fall and should be finished by late spring. Many memoires are best conducted in production areas. If, however, one still desires to conduct memoire research at the Institute, he is hampered by the absence of horticulture field plots of significant fruit plantings.

These problems appeared to necessistate the utilization of other available resources and personnel. One available and previously useful resource was the DRA experiment station near Dar-Bouzza. It is located in a region of commercial tomato and potato

production about 25 kilometers south of Casablanca. For the past two years, one or more of the Institute's horticulture students have worked at this station and one of these former students now directs the station. The station has supplied labor and many needed supplies in addition ot field space in the past years.

The Ecole Nationale D'Agriculture de Meknes is a second highly useful resource. This four year school has a well developed horticulture program and a highly trained arboriculturist. It is located in an area of varied fruit production and is near a DRA experiment station containing extensive fruit plantings. Last year the only third cycle horticulture student studying fruits from the Institute lived and worked in Meknes receiving only limited guidance but nearly all supplies and equipment from the Minnesota Project. A similar arrangement with another sixth year student appears likely in 1977-1978.

The Organization of Commercialization and Exportation (O. C. E.) in Casablanca is a source of expensive and difficult to find supplies. For example, they often furnish seed for student projects and have made the Institute a more or less permanent loan of its original plastic greenhouse. The support

of these organizations seems essential so long as the horticulture program is based in Rabat and has limited funding. In all of the above instances, the support received has been related to the interest of the individual or organization in the proposed research topic. Continued support seems to be at least partially dependent on topic choices.

With the above factors in mind, student research topics were selected as follows:

Vegetable Students:

1. Student: Akrim, Lahee

   Topic: The effect of plastic mulch on yield of early potatoes

   Location: The DRA Research Station, Dar-Bouazza

2. Student: Kamel, Mohamed

   Topic: The effect of plastic shelters on earliness and yield of winter tomatoes in the Dar-Bouazza Region

   Location: The DRA Research Station, Dar-Bouazza

3. Student: Bennaceur, Mohamed

   Topic: Effects of cucumber mosaic and watermelon mosaic virus on cucumbers

   Location: Institut Agronomique et Vétérinaire Hassan II

Fruit Students:

The responsibility for these students was shared between Drs. Besri and Sams of the Institute and M. Walali of the Ecole Nationale de Meknes. M. Walali had the primary responsibility for these students because: a) the students will work in Meknes and he is aware of what facilities are available and what topics can be investigated there, and b) there is no trained arboriculturist at the Institute.

The students and their tentative proposed topics are:

1. Chabhar - A study of morphology, pollen germination and Erossibility of olives.

2. Anassi - Chemical thinning of apples.

Other Activities

Other activities included the following:

1. Participation in the planning, development, conduction and evaluation of the stage now being initiated for second year students. This activity included visits to the students in the field.

2. Participation in meetings and conferences on various aspects of Moroccan horticulture.

3. Participation in the presentation of student memoires at the Institute and the Ecole Nationale de Meknes as requested.

4. Direction and participation in various educational field trips with the third cycle students of horticulture or with second cycle students if requested.

5. Maintenance of contacts with members of the O. C. E., D. R. A. and other Moroccan institutions.

6. Travel to horticulture production areas of Morocco with University of Minnesota officials, professors from cooperating schools in Europe, or new project personnel.

7. Consultation with second cycle students interested in the opportunities and options open to Moroccan horticulture students.

4. Consultant Activities

Dr. S. E. Malo, Professor, Agriculture Research and Education Center IFAS, University of Homestead, Florida, was in Morocco between July 3 - 17, 1977. The major purposes of his visit were:

(1) to attend the memoire presentation of Mr. Mohamed Hallatou who had worked for 12 months under his direction at the University of Florida Agricultural Research and Education Center (AREC), Homestead. Mr. Hallatou worked on an interesting problem dealing with anatomical aspects of avocado graft unions, and at the same time became acquainted with South Florida's tropical fruit and vegetable industry. He wrote the results of his research in Homestead and submitted it to the Hassan II Institute as part of the requirements for obtaining his degree of Ingenieur d'Etat. The Memoire written in English was accepted but required the addition of a summary in French, the academic language of Morocco.

(2) to survey the country for its possibilities for tropical and subtropical fruit production; and

(3) to study the need for horticultural manpower training and evaluate Morocco's present academic status.

The report of Dr. Malo is presented in Appendix II.A.

## Section B. Development of a Phase II Program in Fruit Production (Summer, 1977) - by Dr. A. Lasheen

### 1. Horticultural Potentials in Morocco

Horticulture may be defined as an integrated field of knowledge involving science, art and business, as related to the successful culture and use of a large number of species of plants which require relatively intensive attention. Successful horticulture production requires natural resources developed by a series of shrewdly balanced and well articulated technological inputs from planning stages through planting and the ultimate market.

Lying between 22° and 36° north latitude, Morocco is essentially subtropical from the standpoint of fruit and vegetable production of a wide range of species. At higher altitudes in certain areas the successful production of some temperate fruit and vegetable species is also possible. In the Agadir area, on the other hand, the future of a number of tropical species of economic importance appears excellent. Morocco, in fact, compares favorably in shape, size, climate, and resources with California, the largest horticulture producing state in America.

This geographical location of Morocco also favors the cultivation of subtropical species in regard to their temperature requirements and absence of severe winter temperatures and killing frosts, particularly in the coastal plains. Those species are also favored with shorter days and cooler temperatures during the winter months to achieve optimum quality.

Rainfall distribution in Morocco is variable and ranges from over 1,000 mm at high elevations to only 50 mm in the desert. In some agricultural areas 300 mm to 400 mm are common, but some of the arable land receives only 200 mm to 300 mm. Successful agriculture is possible under normal conditions, however, since the rainy season (late October to late April) coincides with cooler temperatures and lower evaporation rates during that period. In many areas of the country, supplemental irrigation is available from surface waters by the many dams built by the Moroccan Government during two 5-year plans (1968-1972 and 1973-1977).

Many soil types in Northern Morocco appear quite suitable for horticultural crops. Some soils appear generally heavy, but with good drainage in many areas, satisfactory fruit planting and production is possible. In central and southern areas of the country light

soils are common. This coupled with other natural conditions would make the cultivation of many subtropical and tropical (in the south) species feasible.

In consideration of the above, natural resources and supplemental development, it is felt by many that the potentials for substantially increased horticulture production are promising. To realize these potentials and develop a horticulture industry capable of producing a disciplined flow of quality fruits and vegetables, consideration must be given to the constraints of such development. Some of these are discussed below.

## Constraints Facing Horticultural Development in Morocco

Foremost among these constraints is the lack of adequately trained personnel. A rough survey indicates that between 20 and 25 man-years are devoted annually to research on various phases of fruit culture by University graduates employed by the Ministry of Agriculture and Agrarian Reform and other government supported research units in Morocco. Only about two-thirds of those man-years involve personnel who devote a major part of their time to fruit culture problems. The remaining man-years encompass a large

number of people who devote only a part of their efforts to such problems.

Even fewer people are devoted to teaching courses concerned with horticulture. For example, at the Hassan II Institute there are only three Moroccan teaching courses in horticulture. During the 1977-1978 academic year they will be complemented by four expatriates.

Among the horticulture specialists in Morocco actively engaged in research or teaching, none hold the Ph.D. degree, some hold M. S. degrees, and the rest have B. S. degrees or the equivalent.

Because of the large number of horticultural species in both fruits and vegetables, and the specific requirements of most of these species, research in horticulture has many facets from the planting stage to the ultimate market. The following are some aspects of applied horticultural research, not to mention basic research: density and time of planting, propagating, pruning and other related practices, rootstocks, varietal adaption, flower biology, and chemical thinning, soil fertility, fertilizer requirements and cover crops, irrigation, drainage and other aspects of water relations, weed

control, insect and disease control, harvesting and the many problems in post-harvest physiology, shipping and marketing, etc.

From the above, it is clear that horticultural research and education efforts in Morocco suffer severely from a shortage of adequately trained personnel. Also, it is clear that locally trained graduates interested in careers in research or teaching in horticulture are in a very short supply.

Another constraint is the lack of research coordination. Horticultural research in approaching the many problems of horticulture in Morocco has been pedestrian. Whatever research is being done is now scattered among numerous divisions throughout the country. In most intances, there is a lack of coordination or cooperation, thus, inevitably resulting in diluted efforts and funds.

Another constraint is the disparity between the large, well organized growers and small holders. A significant portion of horticultural crops, particularly vegetables, is produced by small holders operating at relatively low levels of technology and financial commitment. The commercial fruit grower faces considerable demands both on his financial

resources and on his management skills. Furthermore, he operates in a volatile and uncertain market. Thus, he must be in a position to accept a fairly high degree of financial risk. It is this factor, above all others, which traditionally made commerical fruit growing intrinsically unsuitable for a small holder economy. In the long term, however, the possibility exists that more enterprising small-holder operations may grow into larger commerical operations.

This will occur only in response to greater rationalization in marketing and research and the availability of favorable financial credits. This adviser visited such an operation in the area south of Marrakech where His Majesty King Hassan II helped finance a successful cooperative of small holder olive growers.

Another constraint is the absence of an established fruit processing industry in Morocco. A long term possibility for expanding the commercial base of the fruit and vegetable economy is canning and freezing. However, until now, little progress has been made in this field, and the comparative failure of Morocco to exploit the opportunities which are open is probably due to the predominantly small holder base of Moroccan agriculture. Fruit and vegetable

processing should not be written off as a long term development possibility in the country, and once established, it could act as a useful stabilizing force in the market. A basic prerequisite to such a project, however, would be the simultaneous investment and organization of cooperatives to ensure the supply of raw horticultural materials.

Local marketing of fruits and vegetables in Morocco represent an important constraint for horticultural development. The commercial base for the fruit and vegetable growers, especially small growers, is at present very limited. The widest perspective for most horticultural produce in the country are the urban center markets. While these markets cater for both basic food needs of those urban centers and also for a small luxury sector for high spending residents and tourists, it is relatively inelastic at price levels that provide an economic return to growers and merchants.

The problem of scale are compounded by the uncertainties which are inherent in all fruit and vegetables marketing. Most fruits and vegetables are perishable, and in the absence of sophisticated methods of storage, the grower has little control over the timing of his marketing. He is, therefore,

at the mercy of the market which is governed by forces outside his control. Most fruit is also highly seasonal and yields may vary from year to year. Thus prices fluctuate both seasonally and annually. In some countries research has been focused on methods of controlling these fluctuations in output and heavy investments have also been made in the planned development of markets and market information services with the object of minimizing the uncertainties of demand. Morocco has been doing some of this, but it needs to do much more. The level of sophistication in marketing is low, the information available to the producer on the state of the market is minimal, and uncertainties from one year to the next remain very high.

2. Higher Education in Horticulture

Among the constraints for horticultural development in Morocco discussed above, the most limiting constraint is the critical shortage of manpower having technical training in the many facets of horticultural production. The projected manpower needs for horticultural development in Morocco by 1990 are 120 persons at the Ingénieur d'Etat level, 184 at the Ingénieur d'Application level, 630 at the Adjoint Technique level, and 839 at the Agent level.

Recognizing these critical national manpower needs in horticulture and plant protection, the Moroccan Ministry of Agriculture and Agrarian Reform is proceeding with the immediate development of a major branch of the Hassan II Institute in Agadir. The new Institute in Agadir is expected to open in September, 1978 with an initial enrollment of 540 students. The existing staff in horticulture and plant protection at the IAV, Rabat and the Ecole Nationale d'Agriculture, Meknes, have been alerted to the possibility of moving to Agadir at that time. Also a request to that effect has been made to the Minnesota staff in Horticulture.

Since the new institute will be the only institution in Morocco for horticultural training, it seems reasonable to make the following proposals, hoping they would be considered:

1. This institute should fill a need for an institution to carry out inter-disciplinary and developmentally oriented teaching and research on horticultural crops which now contribute 15% to the agricultural GNP.

2. It is well-known that most graduate students continue an interest throughout their working careers

in the study area in which they carried out graduate work. It is proposed that graduate students should work on segments of the overall research programs of the Institute.

3. At this state of horticultural development in Morocco, it is a commonly shared idea that most horticultural research should focus on problem solving. It is therefore proposed that graduate practical work for thesis studies would be of that type and within the programs and priorities of the Institute, but with full academic participation and collaboration in the planning studies of each student to ensure an adequate level of scholarship.

4. To insure adequate training for farmers, particularly in production techniques for new crops, it is recommended that a Farmer Training Center be established in the future. There would be short courses backed by a follow-up program, and also in-service refresher courses for extension staff. It is suggested that this center should be physically located at the site of the Institute in Agadir.

A well recognized danger of University agricultural education is that students become white collar oriented and lose any desire to maintain close links

with farmers and practical agriculture. The above proposal would counter this by providing excellent opportunity for students to meet and discuss agriculture with farmers as well as with academic staff throughout their undergraduate careers. It is envisaged that, although the Farmer Training Center would have its own staff, students would hold seminars with farmers and learn the methods of effective extension work by working practically on the job with skilled supervision.

A second danger of any research or academic institute is the lack of feedback of problems from farmers and a tendency for the research being carried out and the messages being taught to students to bear little relationship to the actual practices of agriculture. All too often, what is taught is relevantly only to foreign agriculture about which most textbooks are written. This again will be countered by the arrangement proposed.

5. A number of service activities would be common to both the institute and the proposed center. These include in particular:

(a) A statistical unit able to assist in the experimental planning and analysis of data and capable of training staff at both the

level of routine machine operation and analysis and in statistical research methodology.

(b) A soils and leaf analysis unit.

(c) A laboratory unit.

(d) A plant pathology and applied entomology unit.

(e) A varietal collections.

(f) A nursery facility.

3. Proposed Activities

Division Development

To make a positive contribution to horticultural development in Morocco, a long range program of research, education, and extension has to be supported by a corps of trained and dedicated people. The single most important aspect of institution-building is people, thus staff development should be of primary concern. At present the staff of horticulture at the Hassan II Institute is as follows:

| Name | Nationality | Speciality |
|---|---|---|
| Dr. Mohamed Besri | Moroccan | Plant Pathologist,Dept. Head |
| Mr. Loudiyi Walali | Moroccan | Pomologist |
| Mr. Mohamed Hallatou | Moroccan | Tropical Horticulturist |
| Mr. Raymond Loussert | French | Subtropical Horticulturist |
| Mr. Tawfig Benamer | Tunisian | Fruit Horticulturist |
| Dr. Aly Lasheen | American | Fruit Physiologist |
| Mr. Abderrahman Hillali | Moroccan | Vegetables |
| Mr. Michel Sirjacobs | Belgian | Vegetables |

It is obvious from the above that the number of qualified Moroccans in horticulture is limited. This will be even more obvious in light of the projected 40 faculty required in order to effectively carry out the program in horticulture and plant protection in Agadir next year. Thus, it is concluded that the Moroccan staff should be complemented by expatriate staff. It is also concluded that any foreign commitment of staff to Agadir would be a long term commitment, but one that will terminate when the Moroccanization of the faculty is achieved. To accelerate this process, promising young graduates may be sent to U. S. universities for graduate work in various aspects of horticulture.

To develop the horticulture division in Agadir, it is imperative to have Ph.D. level staff for permanent leadership. Such leadership would be able to develop a strong administrative organization and a realistic research orientation to insure optimum use of scarce trained personnel and facilities. It is also proposed that their selected thesis problems should be pertinent to Moroccan horticulture. As a guideline for future participants, the following list of specializations and degrees are suggested:

| Specialization | Degree |
|---|---|
| Fruit Breeding | Ph.D. |
| Fruit Physiology | Ph.D. |
| Tropical and Subtropical Horticulture | Ph.D. |
| Pomologist | Ph.D. |
| Fruit Extension | M.S. |
| Vegetable Breeding | Ph.D. |
| Vegetable Physiology | Ph.D. |
| Seed Technology | M.S. |
| Vegetable Extension | M.S. |
| Food Technology | Ph.D. |
| Post Harvest Handlings and Marketing | M.S. |
| Floriculture | Ph.D. |
| Weed Control | Ph.D. |
| Farm Management | M.S. plus OJT* |
| Library Science | M.S. |

Some students may be considered for practical research and production training being offered at the Asian Vegetable Research and Development Center, Taiwan.

Facilities for horticultural research and teaching are lacking at the Institute. It is hoped that the following facilities would be soon considered at Agadir: 1) a research orchard, 2) a tropical and subtropical fruit collection to be complemented by a temperate fruit collection at Meknes, 3) greenhouses, lath-houses, screenhouses, propagation, soil steriliza-

* The on-the-job training (OJT) may be received on two farms (one specializing in fruits, the other in vegetables) preferably in California. This practical training could also be received on an experiment station.

tion and similar facilities, 4) controlled temperature facility, 5) plant growth chambers, and 6) teaching and research laboratories.

In addition to the above, there will be the usual requirements for vehicles, tractors, mechanical spray equipment, pumps and pipes for irrigation, a variety of farm implements and tools, and many other similar items.

A heavy investment will be required in modern laboratory instruments and equipment.

2. Curriculum Development and Teaching

In anticipation of an accelerated horticultural enrollment at the new institute in Agadir, a horticultural curriculum particularly for the fifth year students should be drafted. In consultation with colleagues in Morocco and the U. S., the U of M staff will help plan a curriculum more relevant to the needs of Moroccan horticulture. Pertinent courses will be designed to fulfill those needs. The advice of a consultant from the University of California, Davis, will also be considered during his expected visit to Morocco during FY II.

This report concurs with earlier recommendations by Professor D. W. Davis, Department of Horticulture Science and L. A., UM, that a program schedule for post-sixth year training should be developed. This program should focus on helping those students make a smooth transition from graduate students to faculty members. The following should be considered: a) course development, including laboratory preparation, lecture plans, etc., b) experience in teaching assistance, and c) help in research planning of memoire projects.

It is also recommended that second cycle students should receive more instruction in horticulture. This will help them to: a) relate their instruction in basic sciences to practical food production techniques, and b) choose an area of specialization in their third cycle.

Another recommendation regarding curriculum development is the coordination of all higher level instruction in Morocco. This should be relatively easy to accomplish since most instruction in horticulture will be offered at the new institute in Agadir.

This author has been asked to teach a course in fruit physiology to third cycle students. He will be designing a course covering broad principles of fruit phsyiology, but specifically dealing with fruit species of economic importance in Morocco. It is hoped that a laboratory course will eventually be taught in conjunction with this course. This, of course, will depend on availability of laboratory facilities and equipment at the new institute in Agadir. To successfully teach such a course, or indeed any other course in French, will certainly require a high level of proficiency in that language. It is hoped that this will be the case particularly since the number of faculty required to teach a large number of students next academic year will be extremely limited.

3. Research Development

The most serious problem facing horticultural development in Morocco today has been the lack of relevant research resulting primarily from an acute shortage of adequately trained personnel. In consideration of this, every effort will be made to design research projects relevant to horticultural problems in Morocco.

The following research projects will be undertaken in cooperation with other staff members in the Horticulture Unit, and will involve the participation of third cycle students whenever possible.

Project 1: Establishment of a Plant Collection and Germ Plasm Bank.

The soul of this project is to establish a collection of existing major and minor subtropical and tropical horticultural species. Since all horticultural training will be in the new Agadir Institue, the decision was made by officials if IAV to locate the proposed plant collection in Agadir. Existing varieties and strains and near relatives of subtropical and tropical species found in Morocco would be included in the collection. This will be supplemented by introductions from the U. S. and other foreign countries. Attempts will also be made to introduce important commercial and other promising varieties from major producing countries. These would be assembled in primary variety collections of related species or groups. The most promising of these would be further evaluated in larger plantings at selected sites for commercial promise as fresh fruit, or for processing, or for both. The primary collections would serve as a repository of germ plasm to supply

propagative material to exchange with other countries, and as material for breeding programs and a wide range of biological studies.

This project will involve introduction of plant material, mostly from the U. S. Introduction of live plant material usually requires precise timing, handling and air-shipping. Thus, a well coordinated effort is essential.

Project 2: Avocado Roostock Trial.

Observations made by Dr. Malo, a recent consultant, Dr. Lasheen and colleagues, suggest that avocado should have a big potential in this country. Observation on the performance of some avocado plantings in various areas of Morocco indicate the suitability of this species for large scale increase in planting. Avocado cultivars possess a wide range of adaption. Thus, many California varieties may well be suited for North Morocco, while certain varieties from Florida and California may well be suited for central and southern locations. Avocado fruit never ripen on the tree and require ripening at room temperature after harvest. Thus avocado fruit may be shipped economically to the European market without refrigeration or any special handling and still reach retail

markets in the hard stage. It is hoped that Morocco would seriously consider the avocado as an alternative to citrus. This project should, in time, yield valuable varietal selection data for various areas of the country.

Project 3: Testing Some Mango Varieties in Southern Morocco.

Mangoes require a severely hot dry season for reliable cropping and do well on a wide range of soil types. These conditions, particularly regarding several varieties, prevail in some areas of the south. The objective of this project is to introduce and test certain varieties of mango under conditions in South Morocco. This fruit would certainly have possibilities at least for the fresh market.

Project 4: Planting Almond and Olive Trees to Reduce Soil Erosion in Rain-Fed Slopes.

In many areas of Morocco, the Forest and Soil Conservation Service has planted several tree species to prevent soil erosion and to conserve water, particularly on steep slopes. Traditionally, forest species have been planted but in recent years they have been planting olives and almonds for dual purpose, to achieve the above objectives and also to

produce some crop. In several areas visited by Dr. Lasheen, erosion control is primarily achieved by planting those two fruit species. The olive and almond crops are usually harvested by farmers who own the land. In the absence of supplemental irrigation or any kind of cultural practice necessary for fruit production, the yields they obtain from those trees have been, understandably, very poor.

Under those severe conditions it would be valuable to find out whether or not an economical yield would be obtainable from those trees if they are provided with cultural practices (fertilizers, insect and pest control, etc.) other than water. This will be the objective of this project. A brief description of procedure follows:

A suitable number of olive and almond trees will be located at one or possibly two sites (Rommani and Khemisset). Half of the trees will receive fertilizer during the rainy season plus other cultural practices during the entire year. The other half will be left under natural conditions. Various data will be collected throughout the year including yield data. Comparison will be made between the two treatments regarding yields, costs of production and returns.

Project 5: Drip Irrigation Trial.

Drip irrigation systems permit precise allocation of a measured amount of water to the soil. Designed for frequent, slow application of water, these systems make it possible to adjust the volume of water applied in order to replace that which is removed from the soil through evaporation and plant transpiration. Use of drip systems should lead to reduced water runoff from soils and more efficient use of water and nutrients needed for plant growt. Drip irrigation permits more economical and efficient use of water; under certain conditions up to a 60-80% saving in water used could be realized. Obviously, this would be pertinent to Moroccan agriculture.

World-wide, drip irrigation almost doubled between 1974 and 1975, expanding from 143,000 acres to 270,000 acres. Drip irrigation systems are being increasingly accepted in areas of short rainfall, short water supply, and poor water quality. It is now being used in fruit orchards, vineyards, and vegetable fields, particularly where these crops are planted on hillsides.

Drip irrigation, however, is not a panacea. It is not for every person, every crop, every soil or every condition. It also requires good management.

The one limiting factor in its use is a lack of clean water and an efficient infiltration system necessary to prevent clogging of emitters.

D. Plant Pathology (Virology) - by Dr. B. E. L. Lockhart

1. Summary of Activities During 1975-1976

(a) Teaching Activities

The course entitled, "Introduction to Plant Virus Diseases and Plant Virology" was again taught to the third year class. From previous experience it was found that the students benefited substantially more from the lectures than from the laboratory sessions. The latter was therefore eliminated in favor of additional lectures. As in the past, concurrent research results were used to illustrate various principles with examples from the Moroccan situation.

An additional course was offered for the first time to the students in the Institute's new laboratory technician school. This course was entitled "Introduction to Virology", and was designed to acquaint these students with animal and bacterial viruses as well as plant viruses. Also in connection with the laboratory technician training program, one of these final year students spent a three-month

practical training period in the virology laboratory. His training involved a wide range of laboratory manipulations, preparative and analytical procedures, and operation of various instruments. He also wrote a personal research paper on some properties of a new pea virus isolate from the Tiflet region.

Virus cultures and research project ouline and guidance were provided to a student of the Ecole Nationale d'Agriculture at Meknes. His final year memoire research project dealt with the effect of potato viruses X and Y on yield of two potato varieties.

Najib Benchegroun returned to the virology laboratory in March from the University of California at Riverside. He completed his memoire on the effect of tetracycline antibiotics on Spiroplasma citri, the pathogenic agent of citrus Stubborn disease. He has been recruited to the faculty of the Institute. He will continue research on mycoplasma and virus diseases and will increasingly assume responsibility for the teaching program.

(b) Research Activities

The ongoing research program to catalog the virus diseases of crop plants in Morocco, and to estimate

their economic impact, was continued during 1976. As before, all work was done in cooperation with personnel of the DRA. The investigation was expanded in 1976 to cover virus diseases of tree crops.

(c) Other Comments

The virology laboratory is now completely equipped, and can continue to fulfill its teaching and research function without further major investment during the next several years. The last major item acquired was an incubator for mycoplasma cultures.

Publications

The following is a list of published research results appearing in 1976:

1. Lockhart, B. E. L., and H. U. Fischer. 1976. A strain of potato virus Y causing a calico disease of tobacco in Morocco. Plant Dis. Reptr. 60:111-114.

2. Lockhart, B. E. L., and H. U. Fischer. 1976. A disease of tobacco in Morocco caused by a veinal necrosis isolate of potato virus Y. Plant Dis. Reptr. 60:114-117.

3. Lockhart, B. E. L., and H. U. Fischer. 1976. Identification of soybean mosaic virus in Morocco. Plant Dis. Reptr. 60:260-261.

4. Lockhart, B. E. L., and H. U. Fischer. 1976. Cucumber mosaic virus infections of pepper in Morocco. Plant Dis. Reptr. 60:262-264.

5. Lockhart, B. E. L., and H. U. Fischer. 1976. Properties of an isolate of pea early-browning virus occuring in Morocco. Phytopathology (In press).

6. Lockhart, B. E. L., and H. U. Fischer. 1976. Natural infection of peppers in Morocco by broad bean wilt virus, Phytopath Z. (In press)

7. Lockhart, B. E. L. 1976. Les maladies à virus de solanées au Maroc. Proc. Conf. Cultures Maraîchères. Agadir. 1975.

8. Fischer, H. U., and B. E. L. Lockhart. 1976. A Moroccan isolate of turnip mosaic virus infections to garden pea and other legumes. Plant Dis. Reptr. 60:398-402.

9. Fischer, H. U., and B. E. L. Lockhart. 1976. Identification of broad bean stain virus as the cause of a widespread disease of broad beans in Morocco. Z PflKrankh. PflSchutz 83:332-337.

10. Fischer, H. U., and B. E. L. Lockhart. 1976. A strain of cowpea aphid-borne mosaic virus isolated from cowpeas in Morocco. Phytopath. Z. 85:43-48.

11. Fischer, H. U., and B. E. L. Lockhart. 1976. A strain of cucumber mosaic virus isolated from cowpeas in Morocco. Phytopath. Z. 85:132-138.

12. Fischer, H. U., and B. E. L. Lockhart. 1976. Maladies à virus des cultures maraîchères et agricoles au Maroc. Al Awamia, Rabat.

13. Fischer, H. U., and B. E. L. Lockhart. 1976. Virus disease of field crops in Morocco: Identity, distribution, and economic importance. (Invitational paper to be presented at the Première Conférence Internationale Sur L'Impact Des Maladies A Virus Sur Le Développement Des Pays Africains. Abidjan, Côte d'Ivoire, 13-18 Déc., 1976.)

2. Short Term Assignment in Morocco, June-July 1977

Dr. B. Lockhart who had spent the period 1971-1976 as a resident adviser of the University of Minnesota at the IAV, Rabat, returned to Morocco in June-July 1977 serving as a short term staff member under the Phase II Project.

The following achievements were realized during the visit:

1. Maintenance of Laboratory Equipment. Some items of laboratory equipment such as the pH meter, strip chart recorder for the density gradient fractionator and ultraviolet spectrophotometer and refrigerated centrifuge had developed minor malfunctions which were corrected. The repairs were relatively minor and did not require the services of an outside technician. A more serious fault in the ultracentrifuge was partially corrected. The local service technician had prescribed a new refrigeration unit (approx. $1,200). It was found that this was not the problem, which seemed to be related to faulty electrical contact(s) developing due to heating. The instrument is usable, taking proper precautions, but some servicing of the electrical circuits is required.

2. Field trips with Najib Bencheqroun. Field trips of several days' duration each were made to citrus growing areas to collect leafhoppers associated with citrus orchards and neighboring sugarbeet fields. This formed part of a continuing program to determine the role of leafhoppers in the spread of Stubborn disease of citrus in Morocco. The sugarbeet leafhopper has been shown in California to be the vector of the mycoplasma responsible for this disease.

3. Discussions with Najib Bencheqroun Concerning the Teaching Program For the Academic Year 1977-1978. An outline and timetable were established for the teaching of the courses in plant virus diseases to the students in the Ingénieur Agronome and Ingénieur d'Application programs. Prospective final-year memoire research topics for students in the latter programs were also discussed.

4. Discussions with Najib Bencheqroun Concerning His Personal Research Program and Goals. Najib Bencheqroun wishes to pursue a research program that will allow him to present its results for a doctoral degree. He wishes to embark on a program that will enhance his own knowledge as well as contribute usefully to agriculture in the country. Such a program must be shaped within the constraints imposed by

limited technical and tutorial resources and availability of expertise in related fields. At the same time it seems that the Institute's administration has not decided the details of the formula it wishes to adopt for its own doctorate. The choices open in this matter are therefore that Bencheqroun:

1. Return to the U. S. and complete a Ph.D. program.
2. Return to the U. S. and complere course work requirements for a Ph.D., then do his thesis research in Morocco.
3. Remain in Morocco and do a doctorate at the Institute.

Under 2 or 3, the areas of research most suitable were decided to be:

(a) Continuing work on epidemiological aspects of Stubborn disease in citrus in Morocco.

(b) Distribution, yield effects, varietal response and epidemiology of viruses in potato culture in Morocco. (This would mesh nicely with studies on the feasibility of producing seed potatoes in Morocco.)

(c) Distribution, yield effects, properties and control of viruses in <u>Prunus</u> spp. (almonds, plums, nectarines, etc.).

The final choice will depend on availability of necessary equipment, experimental plots, greenhouse space, travel requirements, etc.

5. Participation in Final Revision and Defense of Sixth Year Memoire of Mohammed Bennasser. This student began a research project last year on the effect of watermelon mosaic virus and cucumber mosaic virus infection on yield of greenhouse-grown cucumbers. The research was completed in the interim and results were presented for the Ingénieur Agronome degree. The memoire was accepted by the jury.

6. Investigation of a Virus Disease on Bananas in the Agadir Region. A high percentage of dwarf Cavendish banana plants in the Agadir region were found to be infected with an unknown virus. Preliminary studies to identify the virus were done but were not completed because of lack of time. This disease will be investigated at the next opportunity.

7. Identification and Properties of Virus Diseases of Almonds and Plums. This study was begun in cooperation with Dr. H. U. Fischer of the DRA more than a year ago. Dr. Fischer is continuing the project, the object of which is to eliminate the necrotic ringspot viruses from plantings of *Prunus* spp. During this visit to Morocco time was spent with Dr. Fischer at

the DRA working on this project. It is hoped that several students at the Institute will become involved in this long term project during their memoire research.

3. Long Term Objectives of a Cooperation Program in Virology with IAV

The objective of this effort is to assist the Institut Agronomique et Vétérinaire Hassan II (IAV) in developing its capacity to conduct teaching and research in plant pathology at a level consistent with the aspirations of an institute of higher agricultural education and with the needs of the country - both in quantitative terms (total manpower needs) and qualitative terms (types of specialists required).

Published and unpublished research results of the last five years' work at IAV have clearly demonstrated the importance of plant diseases in the agricultural economy of Morocco. As the level of technical input into agriculture increases and cultivation becomes more intensive, the role of plant disease as a limiting factor in agricultural production will tend to increase rather than decrease. This can be readily illustrated by comparing the relative contribution of plant disease to production loss in subsistence cereal farming and intensive truck crop farming along the Atlantic littoral of Morocco.

Given the current and future importance of plant diseases in Morocco, it is of utmost importance that training in plant pathology at IAV be as complete, as practical, and as relevant to the needs of the country as possible. Beyond the classroom phase, it is also of great importance that the Institute develop a solid capability to conduct research projects - both long and short term into the etiology, impact and control of plant diseases without having to rely heavily upon short term foreign consultants.

There is a real need for a comprehensive, continuing research program. Allied to this is the need to support and encourage the personnel involved in this research and to assist them in establishing and maintaining contacts with their counterparts in other countries.

This paper will deal more specifically with the area of plant virus diseases.

Research funded at IAV under Phase I of the Higher Agricultural Education Project, between 1972 and 1976 (Afr. 672/Project 608-11-110-088) brought to light some of the problems posed by plant virus diseases in Morocco. (See attached list of published titles.) This work was carried out with the close cooperation of the personnel of the Direction de la Recherche Agronomique. The purpose of this work was viewed as twofold:

(1) To determine the etiology of virus-like plant diseases, establish their economic importance and to devise feasible control methods.

(2) As instructional material to illustrate plant pathological principles, to cite examples of crops and situations familiar (and hence more meaningful) to the students, and finally to provide both the framework and substance of memoire research topics for third cycle students at IAV and final-year students at ENA (Meknès).

This research/teaching program dealing with virus diseases of crop plants had had a good beginning but is far from complete. One definite objective is to amass a sufficient body of data to complete a textbook that can be used by students at IAV as well as by other Moroccan researchers. Work on the identification, economic impact, and control of plant virus diseases of Morocco will continue to be carried out during short-term visits to Morocco (collection of specimens, field surveys) and at St. Paul (virus identification and characterization). Work currently being carried out according to scheme includes identification of virus diseases of barley (Meknès region), bananas (Souss Valley) and peas (Tiflet-Khemisset area).

An integral and indispensable component of this ongoing research program is the participation and contribution of students at IAV. Participation in this program affords a unique opportunity to these students because it provides them at once with a stimulating academic problem as well as the opportunity to make a practical and worthwhile contribution to the country. To date, five students from IAV and one from ENA Meknès have been involved in this program at the third cycle or final-year memoire level. One of these students, Najib Bencheqroun, has become a faculty member at IAV and will work towards his doctorate in this field.

4. Development of a Doctoral Program for N. Bencheqroun

If permission is granted for Bencheqroun to do part of his doctor's degree program in the U. S. and work under the supervision of Dr. Lockhart, the following program will be proposed:

The doctoral program for Najib Bencheqroun will involve the identification, distribution, properties, economic importance and control of virus diseases of potatoes. This program will allow him to strengthen his basic skills in laboratory work and experimental approach as well as to make a significant contribution to potato production in Morocco. In light of the GOM's

to make the country self-sufficient in seed potato production, this research project increases in relevance.

The plant virus disease laboratory at IAV is adequately equipped to handle all experimental work involved in this doctoral program. The lack of a greenhouse facility is a very serious handicap and will slow down the rate of progress and make certain kinds of experiments difficult to arrange.

In addition to his research program at IAV, it is proposed that Bencheqroun be given the opportunity to spend at least one year at the University of Minnesota during the next three years (1978, 1979, 1980). There is a well-conceived and effective program for the production of disease-free seed potatoes that has been designed by Drs. Banttari, Anderson and others. These University of Minnesota faculty members are currently actively engaged in this program, and it will be of enormous personal and professional benefit to Bencheqroun to become involved in this effort as a part of his doctoral program.

E. Soil Science

Section A. Soil Conservation - by Dr. J. P. Vavra

1. The Soil Conservation Problem in Morocco

One of the most critical areas in Moroccan

agriculture is the control of soil erosion and the development of a good program in Soil Conservation.

The Government of Morocco is spending millions of dollars in construction of dams for the storage of water for urban and agricultural use. The capacities of these reservoirs are being diminished annually due to the extreme amount of sedimentation. Due to the significant losses of topsoil by the extensive sheet, rill and gully erosion, the agricultural land is decreasing in soil productivity and the ability of the soil to absorb and hold water. During periods of drought the crops are susceptible to extreme periods of moisture stress.

Food production in Morocco is insufficient to provide for the needs of internal consumption. It is necessary for the Government of Morocco to import significant quantities of food products. This trend is increasing. For example, in 1973 the importation of wheat was over 107 million dollars, whereas in 1974 the importation of this grain produce increased to over 157 million dollars. With a population growth of three percent per year the trend may well continue to increase. In order to reverse this trend a concerted effort by the Governmental Authorities must be made to provide the funds for the development and

implementation of research programs designed to increase food production. An essential part of a research program is a well trained technical staff.

Present Status of Soil Conservation Research

Presently there are no research programs in soil conservation. Little or no research information is available on the effects of contour farming, strip cropping, terracing, crop rotations, deep tillage, minimum tillage, stubble mulch farming, use of fertilizers, etc., on the reduction of water and soil losses and the influence of these cultural practices on crop production. This is due in part to the serious shortage of trained scientists and the shortage of research funds to provide the facilities to conduct the research.

In lieu of research efforts being placed on agricultural lands having slopes of five to 20 percent, a major emphasis has been placed on controlling the erosion on the steep slopes (40-75%) of the Rif mountains. Although the land is not suitable for farming, it is being farmed, thus resulting in severe losses of soil. It is estimated that 40% of the total erosion occurs from two percent of the land surface which represents the Rif. The Rif areas represents a severe social-economical problem.

In 1971 F. A. O. started a project for the rural development in the Rif mountains. Through their efforts three watershed management projects were designed for the Loukkos watershed, covering 180,000 ha, the Nekor watershed of 78,000 ha and the Tleta watershed with 18,200 ha. The management program is now being implemented on approximately 5,000 ha in the upper Loukkos at a cost of 3,000 DH (700 dollars) per ha. The management practices that are implemented are planting of cacti, olive trees, grasses and the construction of stone wall bunkers on a contour. The Rif populace continues to farm on the steep slopes, normally planting cereals. This program is being implemented by personnel from "Eaux et Forêts et de la conservation des sols" with the assistance of a representative of F. A. O.

## Present Status of the Soil Conservation Teaching Program at IAV

One staff member was assigned to the soil conservation position in the Institute in September, 1977. The position was filled by Mr. Aziz Merzouk who was the first graduate from IAV with a specialty in soil conservation. Mr. Merzouk met the requirements for the Master of Science degree in the Department of Soils at the University of Minnesota.

He studied in the United States for two years. Mr. Merzouk is scheduled to teach 12 hours of soil conservation in the second cycle during the spring of 1978. The remainder of his time is devoted to field work.

The single third cycle student in soil conservation is Mr. Mohammed Laabdi. He is presently developing his memoire and plans to graduate from IAV in July, 1978. Mr. Laabdi studied in the Soils Department of the University of Minnesota during the academic year of 1976-1977. He received good basic training in soil science and acquired practical training by working in the field with the Soil Conservation Service. He is a highly motivated student.

Of the 11 students presently studying in the U. S. none are majoring in soil conservation.

## Present Status of Soil Conservation Extension Education

In addition to the need for a practically oriented research program it is essential to have an educational program in order to extend the research findings and known information to the rural population. There are no educational programs to

achieve this goal. IAV, through the development of a strong educational and research program in soil conservation, could serve as a focal point for organizing soil conservation teacher workshop programs, sources of information for radio and TV programs, newspaper and magazine articles, etc. The Institute would also assist in organizing national and international conferences in soil conservation.

It is understood that there are plans for the development of a two year technical school for students in soil conservation in Tetouan. There will be a heavy demand for soil conservation specialists to staff the school.

2. Program Development

Teaching

Based on the analyses of the Soil Conservation situation in Morocco, done during the summer of 1977, the following program was planned for the academic year 1977-1978.

1. To participate in the revision of the second cycle soil science courses.

2. To develop a third cycle curriculum in soil

3. To upgrade the expertise of the teaching staff by making the necessary arrangements to send them abroad for advanced training which will culminate in a doctor's degree. It is planned that Mr. Merzouk will begin the advanced degree in the Soils Department of the University of Minnesota in September of 1978.

4. To arrange and implement a soil science seminar program at the Institute. It is anticipated that the participants in the seminar will be staff personnel, third cycle students and specialists from outside of the Institute.

5. To develop jointly with Mr. Merzouk a research project for Mr. Laabdi's memoir to be completed by July 1, 1978. Details of this project will be discussed under "Research".

6. To develop jointly with Mr. Merzouk a soil conservation course for the second cycle. Mr. Merzouk will teach the course in the spring of 1978.

7. To contact second cycle students and motivate them to major in soil conservation and make arrangements for their program abroad.

Research

The research program is oriented towards the conservation of soil and water and economical increases in production on agriculture lands having slopes between five and 20 percent. The research program will be used as a basis for staff and graduate student research activities and provide information for teaching and extension. The following projects are planned for the academic year 1977-1978:

Project 1: The Effect of Soil Erosion on the Accumulation of Sedimentation in the Tleta Watershed Reservoir

Siltation is a major problem in reducing storage capacities of reservoirs. Soil losses represent losses of topsoil and nutrients. Information is needed on the amount of sedimentation that occurs from a watershed in Northern Morocco in a rainfall area that averages 700mm/year. Consequently, the objectives of the project are:

(1) To measure the quantity and composition of the sediments deposited in the Tleta watershed reservoir and related this to economical losses of topsoil and plant nutrients.

(2) To study the soil productivity values of several soils in the Tleta watershed in relationship to

soil productivity capacity of the deposited sedimentation.

Project 2: Evaluation of Soil Conservation Cultural Practices (Tleta Watershed and M'Da Station

There is no information available on Moroccan soil and climatic conditions to evaluate the influence of improved cultural practices on the reduction of soil and water losses and economical returns to the farmer. This information is needed for teaching, extension and guidance for watershed management projects.

The objectives of this project will be:

(1) To evaluate economically the current cultural practices used by the farmer, i.e., tilling up and down the slope, broadcasting the cereal seed by hand, using minimum amounts of fertilizer of imbalanced ratios, etc., with improved cultural practices, such as contouring, terracing, crop rotations, minimum tillage, improved fertilizer practices and methods of seeding.

(2) To measure the soil, water, and nutrient losses in relationship to the cultural practices.

(3) To measure the influence of these treatments on the available water in the soil during the growing season.

Other

In addition to the research projects listed above, demonstrations will be made on gully control and the extent of gully damage and the establishment of grass water ways.

As the program develops , research projects will be implemented on conservation tillage which reduces soil erosion by leaving residues from the previous crop on the surface. These residues break the fall of the rain drop, reduce the splash effect on reducing the size of the soil aggregate and slows down the rate of the water runoff.

During the development of the field phase of the research program, consideration will be given to using the plots for extension education. Emphasis will be placed on the economical values for conserving water and soil in increasing crop production.

## Section B. Soil Biology-Fertility - by Dr. J. A. E. Molina

### 1. Summary of Activities During the Year 1975-1976

Training

Two third cycle students came back from a fifth year spent in the U. S. Ali Hilali and Aissa Aanane who both were attached to the Department of Soil Science, University of Minnesota, under the supervision of Dr. S. L. Schmidt.

In agreement with the Institute policy, their course work in the U. S. was graded but they were not registered in the Graduate School.

A. Aanane: specialized in soil fertility and extension. The academic load taken in the U. S. was heavy; the results obtained were average. In addition, he went for two weeks in California to study the techniques of irrigation on soy; made several field trips in Minnesota with extension specialists; and during summer 1975, established a literature review on horse bean. A report in English was written for each of the three above mentioned special activities.

Mr. Aanane arrived at Rabat in September, 1975 to start a memoire centered around a fertility problem encountered in the growth of horse bean in the area of Tiflet-Khemisset.

The Jury awarded the "memoire" the grade 14/20 with the mention "passable".

Mr. Aanane spent three weeks with the Institute Service on Continuing Education. This gave him the opportunity to establish contacts with members of the Moroccan DMV Central Service at Rabat.

A. Hilali: specialized in soil microbiology; obtained good grades for his academic work in the U. S.; attended the Annual Meeting of the American Society for Microbiology. Remained in the Department of Soil Science, University of Minnesota, until the end of 1975 to complete a work on nitrification under the supervision of Dr. Schmidt for which a report in English was made.

Mr. Hilali arrived at Rabat in January 1976 and started on his memoire which was centered on the study of nitrate reduction. He was the first student of his class to present his memoire which was awarded 17/20 with "les félicitations du Jury".

Mr. Hilali has become the Moroccan soil microbiologist at the Institute. He may also give a lecture in Environmental Microbiology at the "Ecole Mohammedia d'Ingénieurs".

Research

In addition to the activities of the two third cycle students, two other projects started during the previous years were continued.

(1) The ecological study of several Moroccan Rhizobium species.

(2) Introduction and inoculation of soy in the irrigated perimeter.

2. Short Term Assignment in Morocco, March 25-April 19, 1977

Dr. J. Molina who had spent the period 1971-1976 as a resident adviser of the University of Minnesota at the IAV, Rabat, returned to Morocco between March 25 and April 19, 1977, serving as a short term staff member under the Phase II Project.

The following achievements were realized during the visit:

1. Teaching of eight hours in microbial ecology to third year students, as previously done during the Phase I Project.

2. Redaction of a paper from Hilali's third cycle work, and a note from Ms. N. Bennani from her work in electron microscopy (copies sent to the Department of Soil Science for editing).

3. Beginning of an experiment with Hilali to obtain much needed data about the longevity of R. Japonicum 138 in eucalyptus charcoal powder, to test its potential use as inoculum carrier. This experiment was the opportunity for Hilali to reactivate the soil microbiology laboratory, since, so far, most of his attention had been devoted to the teaching which he successfully accomplished. This work will also be used as a theme for the formation of a Moroccan technician in microbiology who will graduate in spring 1977 and may be appointed to the soil microbiology laboratory if he has given satisfaction.

4. Development of the first draft of a proposal for Mr. Hilali's doctoral work. This proposal takes a global view of Hilali's responsibilities as the only soil microbiologist in Morocco. This approach necessitated the inclusion in the proposal of considerations which go beyond the objectives of Phase II, Higher Education Moroccan Project. However, in the analysis of Hilali's functions, there is a need to insist on the problems which he will have to face when asked to supply inoculum for soy. Indeed, Morocco has decided to develop soy in its agricultural system (this will appear in the next National Plan, effective January, 1978). Thus, the problem of inoculum production will rapidly become pressing.

In an informal meeting (March, 1977) presided by the Director of the Extension Service - DMV, with the participation of the Research Service (DRA) and of the Institute, it was decided that the inoculum would be provided by the Institute, i.e., Hilali.

The proposal was well received by the Director of the Institute who decided to include it in the agenda of two meetings, scheduled for the same period with F. A. O. and AID officials. The Director of the IAV wished that Dr. Schmidt and Dr. Molina establish a program of graduate level courses to firm up Hilali's training.

3. Development of a Doctoral Program for Mr. Hilali

After his short term assignment in Morocco and consultations with various scientists of the United States and Spain, Dr. Molina developed a doctoral program for Mr. Hilali, staff member of the IAV in soil microbiology.

This program comprises the following objectives:

(a) A Ph.D. program at the University of Minnesota: academic, thesis, and residency requirements.

(b) A schedule to allow Mr. Hilali to spend one summer in Morocco to lecture the students of the

Institut Agronomique et Vétérinaire Hassan II (IAV). A program of research activities which can also be used to support the "Mémoire de Fin d'Etudes" of Moroccan third cycle students specializing in soil science or agronomy, with special reference to soy production and legume inoculation, under the supervision of Mr. Hilali and/or other IAV staff.

(c) The establishment of a fermentation unit for the production of Rhizobium spp.

This proposal takes a global view of Mr. Hilali's responsibilities as the only soil microbiologist in Morocco: as a Ph.D. candidate (objective a), as a professor (objective b), and involved in the development of agricultural production (objective c).

While objectives (a) and (b) clearly fall within the framework of the Moroccan Project, Phase II, objective (c) may have to be supported from outside Phase II.

Yet, the latter cannot be ignored when scheduling the activities of Mr. Hilali over the next four years.

The program is devised to coordinate objectives (a) and (b). The field plots set up for the gathering

of information on soy inoculation can be used by Mr. Hilali for his Ph.D. thesis and also by third cycle students. While in Morocco during the summers, Mr. Hilali can teach, carry on with field research, and keep in touch with the Institute's life.

Section C. Pedology - by Dr. P. P. Antoine

1. Summary of Accomplishments During 1975-1976

Teaching Activities

Second Cycle

- General Pedology (third year): 20 hours
- Soil Mineralogy (third year): 7 hours
- Internship Programs (third and fourth year): 10 days
- Soil Mapping (with Mr. Delacourt and Mr. Stitou)(fourth year students): 20 hours
- Regional Pedology (with Mr. Delacourt and Mr. Stitou)(fourth year students): one 3-day field trip
- Soil Conservation (fourth year students): 10 hours

Third Cycle

Preparation of sixth year "memoires" of M. M. Mohammi and Tikdirine who spent the 1975-1976 year at the I. N. A. - Paris.

Three potential subjects were clearly delineated:

(a) Soil mapping and characterization in the region of Ellouizia.

(b) Soil survey, mapping and characterization in the Loukkos perimeter.

(c) Influence of clay applications on water retention and plant growth in some sandy soils of the Mamora region.

Research Activities

Studies on potassium level in calcareous soils.

Field plots were established for the second time in the Tadla region to test the response of wheat to potassium fertilizers. Results of field studies corroborate chemical characterizations made in the laboratory and indicate that substantial savings could be made by decreasing the rate of potassium fertilizer applications to cereals in many soils of the Tadla.

Observations on two vertisols under irrigation since 1951 in the Gharb region. (Invitation paper for the Symposium on Arid Lands Irrigation in Developing Countries, Egypt, Feb. 16-21, 1976, P. Antoine and A. Delacourt.)

Recent deposition of sediments (severe floodings in 1963 and 1970), vertisol-forming processes, and

agricultural practices (mainly rice cultivation and fallow) have had a major influence, during the past 20 years on the properties of two irrigated soils (typic Chromoxererts) located in the Gharb plain of Morocco.

Argillopedoturbation has resulted in the reincorporation by the soil matrix of many recent sediments.

This phenomenon parallels an increase in the degree of melanisation and in the stability of the structure.

Beginning formation of fragments of a placic horizon typical of rice-cultivated soils can be observed. That formation seems to be rapid but reversible.

The practice of fallow results in an increase of exchangeable sodium ions in those soils. The use of available irrigation waters (non-alkaline) before the commencement of a new cycle of cultivation practices may solve the problem.

Generalized Soils Map of Morocco

Continuation of the work started during previous years, with emphasis on the Moulouya basin and the Zemmour plateau.

Chemical Cycles in Soils in Northern Morocco

Genetic studies with an emphasis on Al, Fe and Mn contents, pH characteristics and clay mineralogy of acid soils of Northern Morocco were conducted during 1975-1976. Annual cycles in the intensity of spodic characteristics were observed. The study must be completed before being ready for publication.

2. Short Term Assignments in Morocco - November 1976, July-August, 1977

Dr. P. Antoine who had spent the period 1970-1976 as a resident adviser of the University of Minnesota at the IAV, Rabat, returned to Morocco in the Fall, 1976 and the Summer, 1977, serving as a short term staff member under the Phase II Project.

The following achievements were realized during the visit:

(1) Teaching Activities (Second and third cycle)

The first part of the General Pedology course (about 10 hours) was taught to third year students during the November 1976 visit. An introduction to Soil Conservation principles was also offered to fourth year students during the same period.

studies in Pedology, a sizeable research effort was also initiated in the same region by Dr. J. Molina and A. Hilali, on the study of nitrogen fixation and Rhizobium inoculation in those soils.

After the presentation of the "memoires", corrections were made by P. Antoine and A. Delacourt on the maps and associated legends. Finally, during the Summer 1977, the work was completed and was ready for the publication of a technical report. It must now be typed and printed.

Generalized Soils Map of Morocco

Compilation of documents essential to the drawing of the Generalized Soils map took place during the summer visit. Specifically, latest reports published by the National Erosion Project were obtained and discussed with the authors.

Visits to the Northern and Central part of Morocco complemented earlier observations.

(3) Other Activities

Field trips took place in the Central and Northern part of Morocco at various times during the month of July and the first part of August,

in the company of the four new staff members of the University of Minnesota residing in Morocco. The purpose of these trips was to provide some guidance concerning potential research programs and critical needs and to share part of the experience gained during a stay of six years in Morocco.

3. Development of a Doctor's Research Program for Mr. Stitou

Mr. Stitou completed course work essential to his Doctor's degree program at the University of Arizona during the Summer 1977, and returned to the IAV in order to complete a research project leading to the writing of a thesis.

A potential program that offers good research possibilities is the study of the evolution of soil properties as a result of salinization processes.

It is known that during the 1960's the Government of Morocco decided to give priority to the development of irrigation perimeters on the basis that this was the best way to increase food production in a sizeable manner.

From the soils standpoint, successful irrigation practices imply that irrigation waters do not contain a high content of salts and/or that good drainage systems prevent salts from accumulating in the zone where roots normally develop.

Building up of salts in soils can result in disastrous effects for plant growth: the resulting increase of osmotic pressure make water uptake by plants more difficult (waste of energy) and the absorption of $Na^+$ on the soils cation exchange complex may result eventually in a marked pH rise (to values between 9 and 10), the dissolution of high amounts of soil organic matter, and the destruction of well-developed soil structures which are so important for permeability, aeration and root penetration.

The development of irrigation perimeters in Morocco does not seem to have been conducted in such a way as to completely avoid the danger of soil salinization or alkalinization. In fact, a sizeable part of the Loukkos, Gharb and Tadla perimeters already indicate build-ups of salts, mostly as a result of the rise of water tables rich in salts. This is due to the fact that the spacing between drainage ditches is too large or the depth of the

drainage ditch itself is insufficient in many cases to keep salts to a depth of six feet below the soil surface.

For instance, it is not unusual to observe moist spots at the surface of soils irrigated regions at the end of the summer, even though no irrigation (and no rainfall) has taken place during the summer. This demonstrates the importance of upper movement of water in Moroccan soils at some time during the year.

The reclamation of saline or alkaline soils is difficult to realize and is often very costly. There are even cases where soils have been completely abandoned after salt concentration reached disastrous high levels. These reasons amply justify the selection of the research topic.

The research of Mr. Stitou will focus on the dynamics of salt accumulation in some selected soils and on the resulting evolution of soil physical and chemical properties.

The first part of the study will be to make an accurate selection of representative sites with a known history in one of the major irrigation perimeters. It is highly desirable that chemical and

physical data gathered prior to the beginning of irrigation be available for all selected soils.

A study of the evolution of soils properties implies an analysis in function of time and the knowledge of the soil equilibrium at t = 0 is essential if one is to predict rates of changes of properties.

A complete morphological, physical and chemical study of selected soils will follow: degree of development of soil structure, stability of aggregates, salt content, ESP (exchangeable sodium percentage), nature of clay minerals, magnesium and calcium carbonates and bicarbonates content.

Hydrological characteristics of the region under study, chemistry of irrigation waters and water table will also be determined.

The dynamics of the evolution of properties (e.g., structural stability, ESP, depth of water tables, salt contents, profile of soil accumulation, pH, organic matter content...) will be determined through observation and sampling of soil sites at different times each year during the whole time of the study. Leaf analyses on selected plants will also

help in determining the relationship between plants and soil solution.

Eventually, a complete simulation model of movement of salts in soils will be used and some limited experimentation on soil columns will take place in the laboratory.

A special effort will be made at obtaining large scale aerial photos of the region under study since photo interpretation work enables to understand moisture characteristics and lateral movement of water in soils, better than any other technique. This latter effort implies the taking of aerial photos at different times during the year.

Remaining Research Activities

The following research activities started during Phase I could not be entirely completed during the period 1975-1976, due to lack of time allocated to Dr. Antoine under the contract and to the lack of sufficient budget to compensate for all chemical characterizations needed.

(1) Generalized soils map of Morocco

All major soils associations of the portion of Morocco west of the High Atlas mountains have been delineated and drawn. Work must still be

done in arid parts of the country at the same time as a collection of pictures and morphological data must be gathered. An extensive field review of the completed work must also take place as soon as possible.

Without taking into account work on the drawing board and in the laboratory, it is felt that a total of about six to eight weeks in the field must be granted before the map can be reasonably completed.

(2) Potassium status in some calcareous soils

It has long been debated whether or not potassium was present in sufficient amounts in major agricultural soils of Morocco subjected to intensive crop production (Tadla, Gharb, Sais...). Work on potassium status was initiated in 1972 using two different approaches: chemical characterizations and field plot work (Tadla region).

A report on field plot findings was written in 1977 indicating possibilities for substantial economic savings in potassium fertilizer use when growing wheat in the Tadla. However, before a comprehensive scientific paper covering the

subject can be written, chemical analyses must be completed in the laboratory.

The remaining analyses involve mostly the determination in the laboratory of total and readily available potassium in soils under study.

(3) Chemical cycles in soils of Northern Morocco

Genetic studies with an emphasis on Al, Fe, and Mn contents and clay mineralogy of acid soils of Northern Morocco were presented at the National Agronomy Meetings of Houston, Texas in 1976. However, before a scientific paper can be submitted for publication, some additional routine determinations on texture, organic matter content, cation exchange capacity and exchangeable ions must still be completed. These remaining analyses represent only a small portion of the total study. It would therefore be unfortunate to leave the study incomplete and, as a result, unpublished.

# IV. PARTICIPANT TRAINING IN THE U. S.

## A. Results of Participants

### Section A. Moroccan Staff Training Programs in the U. S. (FY I)

NARJISSE, Hamid — Animal & Range Sciences — Year: 1976-1977

Period: September 1976 - January 1977

Montana State University: Adviser: Dr. J. E. Taylor, Department of Animal & Range Sciences

Fall Term 1976:

| | | Credits |
|---|---|---|
| 1. | Range Inspection Trip | 1 |
| 2. | Range Ecosys. Measure. | 4 |
| 3. | Field Evaluation of Range Types | 2 |
| 4. | Advanced Range Ecosystems Management | 3 |
| 5. | Range Analysis (parts of course only) | 5 (Audit) |
| 6. | Individual Problems | 3 |

Field Trips

September 18-30: Southwestern United States
Examination of vegetational types and land management activities

October 16-17: Trip to Southwestern Montana
Visit livestock operations and research plots

Date of return to Morocco: January 1976.

TABET, Abdelaziz  Water Science  Year: 1976-1977

Period: September-December 1976

University of California, Davis: Adviser: Dr. D. R. Nielsen
Professor of Water Science Engineering

| Fall Term 1976 | Credits |
|---|---|
| 1. Transfer Processes in the Soil | 4 |
| 2. Measuring Water in the Soil/Plant Atmosphere System | 2 |
| 3. Introduction to Numerical Method to Computer | 3 |
| 4. Advanced Water Plant Relations | 3 (Audit) |

Field Trips

Visit to the Soil & Water Laboratory at the Riverside University
Visit to the Soil & Water Laboratory at Berkeley University (San Francisco)
Visit to the Soil & Water Laboratory at Tucson and Phoenix (Arizona)

Date of return to Morocco: December 1976.

ESSEDDIQI, Mohamed Forestry Year: 1976-1977

Period: October 1976 - December 1977

University of Minnesota: Adviser: Dr. Hans Gregersen, Department of Forest Resources

| Fall Term 1976 | Credits (Audited) |
|---|---|
| 1. Economic Analysis | 3 |
| 2. Forest Hydrology - Research Problems | 3 |
| 3. English Second Language | 10 |

State University of New York/Syracuse: Adviser: Dr. J. Petriceks

| Winter Semester 1977 | Credits |
|---|---|
| 1. Survey in Theory | 3 |
| 2. Operations of Non-Market Goods | 3 |
| 3. Operations Research II | 3 |
| 4. Managerial Economics, plus extra work | 3 |
| **Summer Term 1977** | |
| 1. Micro-economics | 3 |
| **Fall Semester 1977** | |
| 1. Resource Magni-Systems | 3 |
| 2. Resource Economics | 3 |
| 3. Research Methods | 3 |
| 4. Soil/Water Conservation | 3 |

Date of scheduled return to Morocco: September 1978

STITOU, Mohamed — Pedology — Year: 1976-1977

Period: September 1976 - July 1977

University of Arizona: Adviser: Dr. Hendricks

| Fall Semester 1976 | Credits |
|---|---|
| 1. Hydrology | 3 |
| 2. Quaternary Geology | 3 |
| 3. Soil Taxonomy | 3 |
| 4. Research Methods | 3 |
| 5. Special Problems | 1 |
| 6. English Speech | 3 (Audit) |

Special Studies in Western States (May 16-June 1977)

May 16-20: Visit of the Salinity Laboratory, Riverside. Equipment used, new techniques and emphasis on the dynamics of salt accumulation in the profile under irrigation.

May 22-27: Visit of the University of California, Davis. Recent salinity research projects.

May 31-June 1: Visit of the Stanford University.

June 2-5: Visit of the University of Nevada, Reno. Problems encountered in the use of the soil taxonomy in western states and E.P.A. requirements on the drainage waters.

June 6-12: Visit of the University of Utah, Logan. Discussion on soil genesis in arid regions.

June 14-17: Visit of the National Soil Survey Laboratory at Lincoln, Nebraska.

June 20-July 8: Visit of the University of Minnesota. Bibliography, tour of western and southern Minnesota, Southern Station, Waseca; Northern Central Soil Conservation, Research Center, Morris; Red River Valley Soil Survey Program at Southwest Station.

Date of return to Morocco: July 1977.

Section B. Results of the 1975 Class

(Arrival of the 8 students of the 1975 class in August 1975; 6 out of these 8 students spent part of their sixth year of studies (FY I) in the U.S.)

ATIQI, Mohammed Range Science Class of 1975

Period: October-December 1976

Colorado State University (Ft. Collins): Adviser: Dr. C.H. Wasser,
Department of Range Science

| Fall Term 1976 | Credits |
|---|---|
| 1. Special Study in Range Ecology | 4 |

Date of return to Morocco: December 1976

HALLATOU, Mohamed Horticulture Class of 1975

Period: October 1976 - June 1977

University of Florida, Gainesville and Homestead:
Adviser: Dr. S. E. Malo (Homestead)

| Fall Term 1976 | Credits |
|---|---|
| 1. Practice in Horticultural Science | 5 |
| 2. Non-Thesis Research - Horticultural Sciences | 4 |

| Winter Term 1977 | |
|---|---|
| 1. Practical Horticultural Science | 4 |
| 2. Non-Thesis Research - Horticultural Sciences | 5 |

Spring Term 1977

1. Continuing research and preparation of memoire

Thesis work on avocado production under the direct of Dr. S. Malo.

Date of return to Morocco: June 1977

MERZOUK, Abdelaziz — Soil Conservation — Class of 1975

Period: October 1976 - June 1977

University of Arizona: Adviser: Dr. J. L. Thames

| Fall Term 1976 | Credits (Audited) |
|---|---|
| 1. Discrete Systems Simulation and Modeling | 3 |
| 2. Dynamic Flow Systems | 3 |
| 3. Introduction to Computer | 3 |
| 4. Earth Dams | 3 |
| 5. Sediment Transportation | 2 |

University of Minnesota: Adviser: Dr. G. Blake, Department of Soil Science

| Winter Term 1977 | Credits |
|---|---|
| 1. Microclimatology | 5 |
| 2. Computer Programming Statistics | 3 |

| Spring Term 1977 | |
|---|---|
| 1. Soil Geography | 4 |
| 2. Soil Resources | 4 |

Date of return to Morocco: June 1977

OMERANI, Abdeslam — Soil Conservation — Class of 1975

Period: October 1976 - June 1977

University of Arizona: Adviser: Dr. John L. Thames, School of Renewable Natural Resources

| Fall Term 1976 | Credits (Audited) |
|---|---|
| 1. Seepage and Earth Dams | 3 |
| 2. Sediment Transportation | 2 |
| 3. Programming Techniques | 3 |
| 4. Introduction to Computing | 3 |

Winter Term 1977

1. Work on memoire research and paper

Spring Term 1977

1. Work on memoire research and paper

Date of return to Morocco: June 1977

OUSSIBLE, Mohamed  Agronomy-Special Crops  Class of 1975

Period: October-December 1976

University of Louisiana: Adviser: Dr. R. Ricaud, Department of Agronomy

| Fall Term 1976 | Credits |
|---|---|
| 1. Sugar Cane Production | 3 |
| 2. Soil Fertility and Soil Management | 4 |
| 3. Advanced Soil Physics | 4 |
| 4. Disease of Sugar Cane | 3 |

Date of return to Morocco: January 1977

TAYAA, M'Hammed — Watershed Management — Class of 1975

Period: October 1976 - June 1977

University of Minnesota: Adviser: Dr. A. Mace, Department of Forest Resources

Fall Term 1976

1. Bibliography for memoire
2. Watershed management practices for rehabilitation in critical areas

| Winter Term 1977 | Credits |
|---|---|
| 1. Range Management | 3 |
| 2. Computer Programming Statistics | 3 |
| 3. Research Problem: Forest Hydrology (memoire) | 2 |

| Spring Term 1977 | |
|---|---|
| 1. Research Problem - Forest Hydrology (memoire) | 2 |

Thesis work under the direction of Dr. A. Mace: "Watershed Management Practices for Rehabilitation of Critical Areas."

Date of return to Morocco: June 1977

## Section C: Results of the 1976 Class

AHYOUD, Abdelaziz — Watershed Management — Class of 1976

Period: October 1976 - September 1977

University of Minnesota: Adviser: Dr. A. Mace, Department of Forest Resources

| Fall Term 1976 | Credits |
|---|---|
| 1. Erosion Control, Watershed Engineering | 4 |
| 2. Colloquia: Soil Science (Meterology) | 2 |
| 3. English - Reading | 5(Audit) |

University of Arizona: Adviser: Dr. L. Smith, School of Renewable Natural Resources

| Winter-Spring 1977 | |
|---|---|
| 1. Range Management | 3 |
| 2. Silviculture | 3 |
| 3. Photointerpretation | 2 |
| 4. Watershed Management | 5 |

| Summer Term 1977 | |
|---|---|
| 1. Hydrology Field Course | 6(Audit) |

Date of return to Morocco: September 1977

EL GHARBAOUI, Abdelouahed  Range Management  Class of 1976

Period: October 1976 - September 1977

University of Minnesota: Adviser: Dr. A. Mace, Department of Forest Resources

| Fall Term 1976 | Credits |
|---|---|
| 1. Statistics Analysis I | 5 |
| 2. Ecology: Plant Communities | 5 |
| 3. English Language: Reading | 5 (Audit) |

University of Arizona: Adviser: Dr. E. L. Smith, School of Renewable Natural Resources

| Winter-Spring 1977 | |
|---|---|
| 1. Range Management | 3 |
| 2. Range & Forest Ecology | 2 |
| 3. Sheep & Swine Production | 2 |
| 4. Photointerpretation | 2 |
| 5. Climatology | 3 |

Date of return to Morocco: September 1977

HAFIDI, Brahim | Plant Pathology | Class of 1976

Period: October 1976 - October 1977

University of Minnesota: Adviser: Dr. B. Lockhart

| Fall Term 1976 | Credits |
|---|---|
| 1. Bacterial Diseases of Plants | 3 |
| 2. Plant Disease Diagnostic | 3 |
| 3. Research - Plant Virology | 3 |
| 4. Seminar | |
| 5. Reading English Course | 5 (Audit) |

University of California, Davis.

| Winter Term 1977 | |
|---|---|
| 1. Plant Virology | 5 |
| 2. Pathogens and Epidemiology | 3 |
| 3. General Biochemistry | 3 |
| 4. Bacterial Diseases of Plants | 3 |

| Spring Term 1977 | |
|---|---|
| 1. Plant Nematology | 4 |
| 2. Research in Virology | 5 |

Summer Term 1977

Research on memoire subject

Date of return to Morocco: October 1977

LAABDI, Mohamed — Soil Conservation — Class of 1976

Period: October 1976 - September 1977

University of Minnesota: Adviser: Dr. P. Antoine and Dr. Blake, Soil Science Department

| Fall Term 1976 | Credits |
|---|---|
| 1. Soil Physics | 4 |
| 2. Erosion Control Watershed Engineering | 4 |
| 3. Seminar | 1 |
| 4. Colloquia | 1 |

| Winter Term 1977 | |
|---|---|
| 1. Chemistry: Plant Nutrient Elements in Soils | 3 |
| 2. Aerial Photointerpretation | 3 |
| 3. Range Management | 3 |
| 4. Seminar Removal of Plant Nutrients from Soils by Percolation | 1 |
| 5. Seminar | 1 |
| 6. Colloquia | 1 |

| Spring Term 1977 | |
|---|---|
| 1. Hydrology | 4 |
| 2. Special Problems | 3 |
| 3. Colloquia | 1 |
| 4. Seminar | 1 |

Field Trips

Summer 1977: Special programs with U. S. Soil Conservation Service in Minnesota and Southwestern U. S.

Date of return to Morocco: September 1977

LARAISSE, Esserhini | Range Management | Class of 1976

Period: October 1976 - September 1977

University of Minnesota: Adviser: Dr. A. Mace, Department of Forest Resources

| Fall Term 1976 | Credits |
|---|---|
| 1. Sheet Production | 4 |
| 2. Livestock Meat Evaluation | 4 |
| 3. Advanced Animal Breeding | 3 (Audit) |
| 4. Principles of Animal Breeding | 5 (Audit) |
| 5. English Readings | 5 (Audit) |

University of Colorado: Adviser: Dr. Wasser

| Winter-Spring 1977 | |
|---|---|
| 1. Animal Nutrition | 4 |
| 2. Beef Management Decisions | 3 (Audit) |
| 3. Farm and Range Management | 3 (Audit) |
| 4. Independent Study in Range Management | 3 |
| 5. Principles of Range Management | 3 |

Summer Term 1977

1. International Technical Course in Range Management

Date of return to Morocco: September 1977

CHOUKR-ALLAH, Redouane. Horticulture Class of 1976

Period: September 1976 - December 1977

University of Minnesota: Adviser: Dr. D. Davis, Department of Horticulture

| Fall Term 1976 | Credits |
|---|---|
| 1. Statistical Analysis I | 5 |
| 2. Market Grades of Varietal Adaptation: Fruit-Vegetables | 4 |
| 3. Special Problems | 1 |
| 4. English Class (Grammar & Composition) | 5 (Audit) |

University of California, Davis: Adviser: Dr. L. Morris, Professor of Vegetable Crops

| Winter Term 1977 | |
|---|---|
| 1. Major Vegetable Crops in California | 4 |
| 2. Seed Physiology | 3 |
| 3. Seminar | 1 |
| 4. Advanced Plant Physiology | 3 |

| Spring Term 1977 | |
|---|---|
| 1. Vegetable/World Food Crop | 3 |
| 2. Advance Physiology | 3 |
| 3. Group Study | 3 |
| 4. Physiology/Cultiv. Plant | 4 |

| Summer Term 1977 | |
|---|---|
| 1. Session I: K Spray | 4 |
| 2. Session II: K Spray (work in the field and lab) | 4 |

| Fall Term 1977 | |
|---|---|
| 1. Principles of Vegetable Crops | 3 |
| 2. Soil Fertility and Fertilizers | 4 |
| 3. Microclimatology | 3 |
| 4. Post Harvest Phy. | 3 |

Date of return to Morocco: April 1978

EZZAHIRI, Brahim | Plant Pathology | Class of 1976

Period: September 1976 - December 1977

University of Minnesota: Adviser: Dr. A. P. Roelfs, Department of Plant Pathology

| Fall Term 1976 | Credits |
|---|---|
| 1. Bacterial Diseases of Plants | 3 |
| 2. Plant Disease Diagnosis | 3 |
| 3. Research | 3 |
| 4. Seminar | 1 |
| 5. English: Composition | 5 (Audit) |

| Winter Term 1977 | |
|---|---|
| 1. Insects in Relation to Plant Diseases | 4 |
| 2. Research | 3 |
| 3. Genetics of Plant Pathogens | 3 |
| 4. Seminar | 1 |
| 5. Plant Disease Diagnosis | 3 |
| 6. English: Grammar | 5 (Audit) |

| Spring Term 1977 | |
|---|---|
| 1. Ecology of Plant Pathogens | 3 |
| 2. Plant Epidemiology | 3 |
| 3. Research | 3 |

Summer Term 1977

Memoire research

| Fall Term 1977 | |
|---|---|
| 1. Virus Diseases of Plants | 3 |
| 2. Host Parasite Population Genetics | 1 |
| 3. Statistical Analysis I | 5 |
| 4. Seminar | 1 |

Date of return to Morocco: July 1978

KELILI, Driss | Plant Pathology | Class of 1976

Period: September 1976 - December 1977

University of Minnesota: Adviser: Dr. B. Lockhart, Department of Plant Pathology

| Fall Term 1976 | Credits |
|---|---|
| 1. Bacterial Diseases of Plants | 3 |
| 2. Research | 3 |
| 3. Seminar Plant Pathology | 1 |
| 4. Organic, Pesticidal Residues | 5 |
| 5. Problems: Agro for Adv Students | 3 |
| 6. English: Composition | 5 (Audit) |

| Winter Term 1977 | |
|---|---|
| 1. Weed Control | 5 |
| 2. Integrated Control | 4 |
| 3. Insects in Relation to Plant Diseases | 4 (Audit) |
| 4. Problems: Agro for Adv Students (Fall Term) | 3 |

University of California, Riverside: Adviser: Dr. J. W. Eckert, Professor of Plant Pathology

| Spring Term 1977 | |
|---|---|
| 1. Post Management: Methodology of Pesticides Application | 2 |
| 2. Plant Pathology: Diagnosis of Plant Diseases and Their Control | 4 |
| 3. Plant Pathology: Directed Research | 3 |
| 4. Pest Management: Seminar | 1 |

Summer Term 1977

Direct research with adviser

| Fall Term 1977 | |
|---|---|
| 1. Chemistry and Toxicology of Insecticides | 3 |
| 2. Chemistry and Toxicology of Insecticides (lab) | 2 |
| 3. Analysis of Pesticide Chemicals | 2 |
| 4. Chemical Control of Plant Diseases | 3 |
| 5. Direct Research | 3 |

Date of scheduled return to Morocco: September 1978

SKIREDJ, Ahmed | Horticulture | Class of 1976

Period: October 1976 - December 1977

University of Minnesota: Adviser: Dr. D. Davis, Department of Horticulture

| Fall Term 1976 | Credits |
|---|---|
| 1. Statistical Analysis I | 5 |
| 2. Market Grades of Varietal Adaptation: Fruits-Vegetables | 4 |
| 3. Special Problems | 1 |

University of California, Davis: Adviser: Dr. L. Morris, Professor, Vegetable Crops

| Winter Term 1977 | |
|---|---|
| 1. Major Vegetable Crops in California | 4 |
| 2. Seed Physiology | 3 |
| 3. Seminar | 1 |
| 4. Advanced Plant Physiology | 3 |

| Spring Term 1977 | |
|---|---|
| 1. Vegetable/World Food Crop | 3 |
| 2. Soil-Plant Relation | 3 |
| 3. Research | 3 |
| 4. Nutrition of Plants | 4 (Audit) |
| 5. Field Trip | 1 |

| Summer Term 1977 | |
|---|---|
| 1. Research work with Dr. A. O. Lorenz | |
| Session I | 4 |
| Session II | 4 |

| Fall Term 1977 | |
|---|---|
| 1. Soil Fertility and Fertilizers | 4 |
| 2. Microclimatology | 3 |
| 3. Group Study - Research with Dr. Lorenz | 2 |
| 4. Seminar: Water-Soil-Plant | 1 (Audit) |

Date of return to Morocco: April 1978

Section D. Results of the 1977 Class

(11 Fifth year students arrived in August 1977)

ACHAHBOUN, Mohamed | Horticulture | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Adviser: Dr. D. Davis, Department of Horticulture

| Summer Term 1977 | | Credits |
|---|---|---|
| Intensive English Program | | |
| **Fall Term 1977** | | |
| 1. | Market Grades, Varietal Adaptation | 4 |
| 2. | Systematics of Horticultural Food Crops | 4 |
| 3. | Special Problems | 3 |
| **Winter Term 1978** | | |
| 1. Stat 5021 | Statistical Analysis I | 5 |
| 2. Hort 5038 | Plant Propagation Research | 3 |
| 3. Hort 5091 | Special Problems | 2 |
| 4. Hort 5006 | Systematics | 4 |
| 5. Hort 5090 | Special Problems | 3 |
| **Spring Term 1978** | | |
| 1. Stat 5022 | Statistical Analysis II | 5 |
| 2. Agro 5040 | Management of Cropping Systems | 3 |
| 3. Hort 3032 | Vegetable Science | 4 |

Date of return to Morocco: It is likely that Achahboun will return to Morocco in April 1979

ACHOURI, Mohamed | Plant Pathology | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Adviser: Dr. B. Lockhart, Department of Plant Pathology

| Summer Term 1977 | | | Credits |
|---|---|---|---|
| Intensive English Program | | | |
| **Fall Term 1977** | | | |
| 1. | Intro to Plant Pathology | | 3 |
| 2. | Research | | 4 |
| 3. | English Reading | | 5 (Audit) |
| **Winter Term 1978** | | | |
| 1. | Agro 5020 | Intro Plant Breeding | 3 |
| 2. | PlPa 5016 | Mycology: Ascomycetes-Fungi Imperfect | 3 |
| 3. | PlPa 5215 | Insects in Relation to Plant Disease | 4 |
| **Spring Term 1978** | | | |
| 1. | GCB | Interim. Genetics III | 3 |
| 2. | PlPa | Fungus Diseases | 4 |
| 3. | PlPa | Principles Disease Control | 3 |

Date of return to Morocco: It is likely that Achouri will return to Morocco in October 1978.

BAZZA, Mohamed — Soil Physics — Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Adviser: Dr. W. P. Martin, Department of Soil Science

| Summer Term 1977 | Credits |
|---|---|
| Intensive English Program | |

Fall Term 1977

| | | |
|---|---|---|
| 1. | Water Resources Engineering | 4 |
| 2. | Intro to Programming Problem Solving | 4 (Audit) |
| 3. | English Lanugage | 5 (Audit) |

University of California, Davis: Adviser: Dr. D. Nielsen, Department of Soil and Water Sciences

Winter Term 1978

| | | | |
|---|---|---|---|
| 1. | Cr 5405 | Hydrology, Hydrologic Design | 4 |
| 2. | AgEn 5550 | Drainage and Irrigation Eng. | 4 |
| 3. | AgEn 5191 | Movement of Unsaturated Water | 3 |
| 4. | Csci 3101 | Fortran Programming | 4 |

Spring Term 1978

| | | | |
|---|---|---|---|
| 1. | WS 200 | Water-Soil-Plant Relationships in Irrigation | 3 |
| 2. | WS 198 | Hydraulics | 3 |
| 3. | CE 141 | Hydraulics Engineering | 3 |
| 4. | WS 299 | Special Topics - Bibliographic Research | 3 |

Date of return to Morocco: Bazza is expected to return to Morocco in July 1979.

DAALI, Allal | Forestry | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Dr. A. Mace and Dr. C. Sucoff, Department of Forest Resources

| Summer Term 1977 | Credits |
|---|---|
| Intensive English Program | |
| **Fall Term 1977** | |
| 1. Wood as Raw Material | 4 (Audit) |
| 2. English: Grammar, Reading, Composition | 15 (Audit) |
| **Winter Term 1978** | |
| 1. FR 5200 Aerial Photointerpretation | 3 |
| 2. FR 5212 Natural Resources Inventory | 3 |
| 3. FR 5100 Silviculture | 3 |
| 4. English as a Second Language | 5 (Audit) |
| **Spring Term 1978** | |
| 1. Fr 5153 Adv Forest Hydrology | 3 |
| 2. AgEn 5016 Computer Programming, Statistics | 3 |
| 3. Soil 5710 Adv Forest Soils | 4 |

Date of return to Morocco: It is likely that Daali will return to Morocco in July 1979.

EL HAIBA, Mostapha — Watershed Management — Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Drs. A. Mace and K. Brooks, Department of Forest Resources

| Summer Term 1977 | Credits |
|---|---|
| Intensive English Program | |
| **Fall Term 1977** | |
| 1. Erosion Control Watershed Engineering | 4 |
| 2. English | 15 (Audit) |
| **Winter Term 1978** | |
| 1. CE 5401 Water Resources Engineering | 4 |
| 2. CE 5405 Hydrology | 4 |
| 3. ER 5200 Aerial Photointerpretation | 3 |
| **Spring Term 1978** | |
| 1. AgEn 5016 Computer Programming, Statistics | 3 |
| 2. FR 5153 Adv Forest Hydrology | 3 |
| 3. Geo 5611 Ground Water Geology | 4 |

Date of return to Morocco: It is likely that El Haiba will return to Morocco in December 1978.

EL MAGHRAOUI, Abdelaziz | Range Science | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Drs. A. Mace and C. Mohn,
Department of Forest Resources

| Summer Term 1977 | | | Credits |
|---|---|---|---|
| Intesive English Program | | | |
| **Fall Term 1977** | | | |
| 1. | Sheep Production | | 4 |
| 2. | Livestock, Meat Evaluation | | 4 |
| 3. | English: Grammar, Speaking & Composition | | 15 (Audit) |
| **Winter Term 1978** | | | |
| 1. | FR 5231 | Range Management | 3 |
| 2. | Ent 5400 | Experimental Ecology | 3 |
| 3. | AgEn 5016 | Computer Programming in Statistics | 3 |
| **Spring Term 1978** | | | |
| 1. | AnSc 5232 | Applied Meat Animal Breeding | 3 |
| 2. | AnSc 5403 | Ruminent Nutrition | 4 |
| 3. | Agro 5010 | Pasture, Grassland Crops | 4 |
| 4. | AnSc 5406 | Computer Feed Formulation | 2 (Audit) |

Date of return to Morocco: It is likely that El Maghraoui will return to Morocco in April 1979.

GOURIMATE, Mohamed — Agronomy — Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Adviser: Dr. W. Martin, Department of Soil Science

Summer Term 1977

| | Credits |
|---|---|
| Intensive English Program | |

Fall Term 1977

| | | Credits |
|---|---|---|
| 1. | Soil Physics | 4 |
| 2. | English | 5 (Audit) |

Kansas State University: Adviser: Dr. A. Hobbs, Department of Agronomy

Winter Semester 1978

| | | | |
|---|---|---|---|
| 1. | Agr 15525 | Crop and Soil Management | 3 |
| 2. | Agr 15615 | Soil Problems | 3 |
| 3. | Agr 15810 | Agronomy Seminar | 1 |
| 4. | Agr 15820 | Plant/Water Relations | 2 |
| 5. | Eng 229075 | English Foreign Language | 3 |

Date of return to Morocco: It is likely that Gourimate will return to Morocco in September 1978.

JLIBENE, Mohammed | Plant Breeding | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Adviser: Dr. R. C. Rasmusson, Department of Agronomy

| Summer Term 1977 | | Credits |
|---|---|---|
| Intensive English Program | | |
| **Fall Term 1977** | | |
| 1. Genetics | | 3 |
| 2. Statistical Analysis I | | 5 |
| 3. English: Listening, Speaking/Pronunciation | | 10 (Audit) |
| **Winter Term 1978** | | |
| 1. Stat 5022 | Statistical Analysis II | 5 |
| 2. Agro 8330 | Research Plant Genetics | 2 |
| 3. Agro 5020 | Intro: Plant Breeding | 3 |
| 4. Agro 8200 | Prin. Plant Breeding I | 3 (Audit) |
| **Spring Term 1978** | | |
| 1. GCB 5033 | Inter. Genetics III | 3 |
| 2. Agro 8210 | Prin. Plant Breeding II | 3 |
| 3. Agro 8380 | Applied Statistics | 3 |

Date of return to Morocco: It is likely that Jlibene will return to Morocco in September 1978.

KHATOURI, Mohamed | Forestry | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Drs. A. Mace and C. Sucoff, Department of Forest Resources

| Summer Term 1977 | Credits |
|---|---|
| Intensive English Program | |
| **Fall Term 1977** | |
| 1. Wood Raw Material | 4 (Audit) |
| 2. English as a Second Language | 15 (Audit) |
| **Winter Term 1978** | |
| 1. FR 5212 Natural Resources Inventory | 3 |
| 2. FR 5100 Silviculture | 3 |
| 3. FR 5200 Aerial Photointerpretation | 3 |
| 4. English as a Second Language | 5 |
| **Spring Term 1978** | |
| 1. FR 5153 Adv Forest Hydrology | 3 |
| 2. Soil 5710 Adv Forest Soil | 4 |
| 3. AgEn 5016 Computer Programming, Statistics | 3 |

Date of return to Morocco: Khatouri is expected to return to Morocco in June 1979.

LAHLOU, Mohammed — Watershed Management — Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Drs. A. Mace and K. Brooks, Department of Forest Resources

| Summer Term 1977 | Credits |
|---|---|
| Intensive English Program | |
| **Fall Term 1977** | |
| 1. Erosion Control Watershed Engineering | 4 |
| 2. Soil Physics | 4 (Audit) |
| 3. English: Speaking, Listening, Composition | 15 (Audit) |
| **Winter Term 1978** | |
| 1. CE 5401 Water Resources: Lecture & Lab | 4 |
| 2. CE 5405 Hydrology Lecture & Lab | 4 |
| 3. FOR 5200 Aerial Photointerpretation | 3 |
| 4. Scientific English | 5 |
| 5. Composition English | 5 |
| **Spring Term 1978** | |
| 1. Geol 5611 Ground Water Geology | 3 |
| 2. FR 5153 Adv Forest Hydrology | 3 |
| 3. AgEn 5016 Programming | 3 |

Date of return to Morocco: It is expected that Lahlou will return to Morocco in December 1978.

TAYOUGA, El Hadj | Soil Fertility | Class of 1977

Period: August 1977 - June 1978

University of Minnesota: Advisers: Drs. P. Antoine (1977) and G. Malzer (1978), Department of Soil Science

| Summer Term 1977 | | Credits |
|---|---|---|
| Intensive English Program | | |
| **Fall Term 1977** | | |
| 1. Soil Physics | | 4 |
| 2. Special Problems: Soils | | 2 |
| 3. English: Pronunciation, Composition | | 10 (Audit) |
| **Winter Term 1978** | | |
| 1. Stat 5021 | Statisical Analysis | 5 |
| 2. Soil 5632 | Soil Microbiology: Plant Growth | 4 |
| 3. Soil 5430 | Chemistry: Plant Nutrient Elements | 3 |
| 4. Soil 5114 | Special Problems: Soils | 3 |
| **Spring Term 1978** | | |
| 1. Soil 5310 | Soil Chemistry, Mineralogy | 4 |
| 2. Stat 5022 | Statistical Analysis II | 5 |
| 3. AgEn 5016 | Computer Programming (Statistics) | 3 |

Date of return to Morocco: It is expected that Tayouga will return to Morocco in October 1978.

B. Observations on the Difficulties Linked with Participant Programs and Suggested Policies.

It has been increasingly obvious with the development of Participant Programs in the U. S. that the very informal administrative methods that worked well when there was a small number of Moroccan students in the U. S. are no longer adequate, and it becomes essential to have some more formal procedures and clear agreement on policy questions between the Institute and the University.

1. A problem of major magnitude lies in the fact that the University lacks adequate information on the prospective students until after the formal selection process at the end of July. This meant that for some specializations it was impossible to find any university at all for some of the students. The University was forced to keep them here at Minnesota and give them the course work available here.

Some American universities are on the quarter system and others are on a semester system. A number of the semester system universities, including most of the western schools offering range and watershed management, are now beginning their Fall term in August. The combination of a late selection decision by the Institute and the new early starting dates of many U. S. universities make it completely impossible to find an opening for some students.

2. Coupled with this problem is another problem of growing seriousness: there is an increasing tendency for U. S. universities to establish strict limits for admissions of foreign students. Many U. S. universities now have mandatory limits and in August we were much too late. The quota systems are not a form of political discrimination: they are an economic necessity for many of the smaller universities.

Consequently, it is strongly recommended that the Institute, in nominating students for U. S. study, try to follow the standard U. S. practice of early nomination. Specifically, it is suggested that not later than March the Institute, by means of a faculty committee or some other appropriate means, make a "preselection" of students who may come to the U. S. for fifth year study programs. In making such a "preselection" it is suggested that account be taken of academic performance, subject matter interests, and English language skills.

It is also suggested that the Field Chief of Party, with the assistance of appropriate officers of the Institute assemble a dossier on each preselected candidate and send it to this office. The dossier should include the student's academic record through his first three years and hopefully a record of the first half of his fourth year. For each student there should be a letter

evaluating the candidate. It should be written by the most appropriate Minnesota faculty member in Rabat.

3. A third problem of growing importance is the level of English preparation of the Moroccan students. Increasingly we are finding that the most desirable U. S. universities are adopting very high and rigid English admission standards. Now almost everywhere a TOEFL score is required and often at a level of about 500. Colorado State has a TOEFL score requirement of 550. At Minnesota we have a 425 requirement. There seems to be no alternative for the Moroccan students with low initial TOEFL scores other than to stay here at Minnesota for the Fall quarter and devote a considerable part of their time to intensive English. All of the eight students in the 1975 group, the nine students in the 1976 group and the eleven students in the 1977 group, spent a substantial part of their Fall quarter continuing to study English.

4. Another problem which has sometimes arisen has been the lack of formalization of the University administration on the study programs of each of the Moroccan students.

   (a) For each preselected Moroccan student, the most appropriate Minnesota faculty member in Rabat should prepare a preliminary recommended study program. It should be worked out with the student and other

appropriate members of the Institute faculty. It should include a statement of the overall objective of the study program. It should list the suggested courses to be taken and describe the kinds of practical experience desired as a part of the study program. If possible, it should indicate generally the area proposed for the memoire. This preliminary statement should hopefully be sent to the University together with the academic materials due here by March.

(b) The preliminary study programs should be reviewed at the University by the Project Director, the Training Officer, and also by the appropriate scientific adviser.

(c) It is unlikely that it will be possible to finalize a student's study program before the end of the first quarter of study and for some students until the end of the second quarter. By this time the student has some better understanding of the American system of higher agricultural education. He knows what is available at his U. S. university, and his on-campus adviser is sufficiently familiar with his interests and abilities so a good final study program can be made. The training officer in this office can then undertake to coordinate the finalization of the

study programs with the objective that they would all be completed by the middle of February.

5. Another area of developing problems is that of communications about participants. There are a lot of people who can properly make an input into the training activity: (1) the Minnesota staff members in Morocco, (2) other members of the Institute faculty, and (3) U. S. university staff (this office, on-campus project leaders, departmental graduate program committee chairmen, on-campus advisers at this and other American universities, and officers of graduate schools). With so many people involved it is easy for problems to arise.

   From long experience AID has learned that there simply has to be a single point of coordination at each American university, and for a contract training program like the University's in Morocco there needs to be a single point of contact for all of the American universities involved. It seems that the College Office at Saint Paul is in an ideal position to play this role since all special programming in the U. S. is generally handled through that office and could not be easily transferred to other administrative structures on the campus or in Morocco.

6. A final problem which has not been resolved yet is the lack of firm understanding and agreement between Minnesota

and the Institute as to the types of admission to be sought for the Moroccan students. The University of Minnesota offers the status of an "Adult Special" in the College of Agriculture, but other universities do not have this kind of arrangement.

A possible suggestion is that all Moroccan students would be admitted to the University's Graduate School on a "provisional" basis. At the end of the first quarter and again at the end of the second quarter the graduate committee in the student's department would have the opportunity of proposing the student for graduate student status on a course work only basis if his academic performance here merits such action. Some minimum GPA, perhaps 2.8 or 3.0, would be a necessary requirement.

In the absence of a departmental proposal for graduate student status, the student, at the end of his second quarter, would automatically become an adult special in the College of Agriculture.

There is another reason which is important in making graduate student status available to the Moroccan students. One of the objectives of our project is to develop a third cycle at the Institute which is fully equivalent to the American master's degree. It would be hard to achieve that objective if we followed a policy of deliberately

keeping all of the Moroccan students out of American graduate schools and instead gave them some kind of second-class training.

C. Observations on the Incorporation of U. S. Training Into Moroccan Advanced Study Programs.[1]

Introduction

The Hassan II Institute of Agriculture and Veterinary Medicine (IAV) was established by royal decree in 1966 to provide higher agricultural training for Morocco. The IAV offers a six year program which aspires to achieve the U. S. master of science training level. This program is divided into three cycles of two years each. During Cycle 1, the IAV program consists primarily of study in the physical, natural and some social sciences, but includes very little study in communications and artistic expressions which are part of our U. S. programs as indicated herein, Table I. During Cycle 2, the IAV curriculum consists of a broad, in-depth program including the fundamental sciences such as physiology, genetics and microbiology, economics, engineering, environmental, plant, and animal sciences. Approximately one-fourth time is devoted to internships or practical experiences in farm management during the third year and rural development during the fourth year. The IAV studies involved approximately 26 class hours

[1] Based on a paper presented before the American Society of Agronomy, Resident Instruction Division, Annual Meeting in Los Angeles, California, November 13-17, 1977. (J. C. Sentz and P. P. Antoine)

per week on an 11-month per year schedule, including practical work in the field. All students participate in identical programs during this second cycle. In our U. S. programs this is the time when students specialize in one or more major areas of agricultural science.

At the conclusion of the first year of study the top 20% of the 300 select students are chosen to participate in the full six year program (Agriculture and Veterinary Medicine). During the development of the third-cycle curriculum at the IAV, all students take their fifth year of studies abroad, initially in France and Belgium and now some in the United States. Most of the students return to the Institute for their work on a sixth year memoire, but some areas of specialization require a full two year third cycle program abroad (e.g., Civil Engineering, Forestry, etc.).

U. S. training for Moroccan third cycle students was rather alien to the Institute system, and its introduction was gradual as illustrated in Figure I. In the early years U. S. training was employed with considerable skepticism. In 1972, however, a single student came to study photo interpretation. His good progress and enthusiasm upon returning to the Institute initiated an increasing involvement for U. S. training in this program. To date, 39 students have come for their fifth year training in the U. S. and a few have stayed to

complete their sixth year studies also. Their specializations include the seven areas listed in Table II.

Preparation of Moroccan Students for U. S. Training

As with most foreign students, these from the IAV are confronted with major cultural and program adjustments when they come to study. Students interested in U. S. study will take limited English language studies during their fourth year at the IAV. This preparation, however, is generally inadequate for admission and to pursue full-time studies, but they must pursue the fifth year studies as soon as possible - since they one year only for this objective - consequently they come immediately following completion of their fourth year, about July 31, and participate in a six week intensive English program. Figure II shows the wide range in English preparation upon their arrival in the U. S. The Michigan Test of English Language Proficiency or evaluations modeled on those tests have been used in this program. A score of 80 including some experience with the language is considered adequate to pursue full-time academic studies. The wide range illustrated here appears to be primarily an expression of the amount of previous language training. Considerable achievement results from this effort so that 75-80 percent of the students are prepared to pursue academic study beginning with the fall term with only limited language constraints. It should be noted that the students scoring low on the initial evaluation register the

greatest improvement during this program. Generally they are highly motivated and demonstrate greater progress in their English proficiency than the average for the program.

One of the problems of admission of Moroccan students in U. S. institutions is the difficulty to appreciate the grade point average used at the IAV during undergraduate studies in U. S. terms.

Figure III illustrates the distribution of student achievement during Cycle 2 at the Institute where the evaluation is on a 0-20 scale with the range of average markes confined to smaller segments of that scale and seldom exceeding 15. The individual distribution for 1976 and 1977 appear to follow somewhat normal distributions. Equilibration of these marks with our U. S. grading system is not necessarily direct. Since these students are highly selected for inclusion in this program, one might expect their grade distributions to be more skewed to the left.

Academic Performance in U. S. Institutions

The students selected to study in the U. S. have been rather representative of the range of academic achievement at the IAV. In Figure IV their fifth year performance in the U. S. is plotted against their Cycle 2 academic performance at the IAV. The U. S. grade point average here is given on a 0-4 scale where four corresponds with an "A" grade. Average

performance of the 27 Moroccan students included in this diagram (all students who have completed U. S. studies) is 2.9 with a preparatory average at the Institute of 12.55. The solid line represents a 2.8 grade point which is the bottom line for maintaining good standing in our University of Minnesota Graduate School. Not all students falling below this line, however, have been low achievers at the Institute. Many factors are confounded in this comparison, including insitutional differences as approximately one-half of these students have studied on other campuses. In general, however, it appears that those students achieving less than 11.0 in Morocco have not been high achievers in their U. S. studies. One might view markes in the 11-12 range critically and look for other indications of competitive potential in accepting students for U. S. graduate study. (Appendix I is the "Description of Grading System at the IAV" which is currently sent to other universities with requests for admission of Moroccan participants.)

Language is known to be a limiting factor in the early academic performance of foreign students. Table III shows that these students average five hours, which is equivalent to one course, in English as a second language during their first-term studies; and in Minnesota we require that students reduce their academic loads accordingly. The average first-term GPA under this reduced load is 2.79 in comparison with the second- and third-term average of 2.94. Obviously these differences

also reflect adjustment factors other than language, and the full impact of language may not be represented here because in adjusting the academic load those students with greater problems are reduced more while those with language capabilities are given a heavier load initially. Nevertheless, these adjustment limitations are factors in student performance and do limit the level of academic involvement early in the program.

Difficulties Linked with Short Term Programs in the U. S.

When one engages in short term programming (one year) in the U. S., it soon becomes obvious that our institutionalization of advanced degree study in the U. S. is not as flexible as might be assumed. Academically speaking there is flexibility, yes. Practically speaking, however, there are many deterrents. Some graduate schools evaluate their performance on the number of degrees granted in relation to the number of students admitted. Faculty members are evaluated on scholarly achievement which is generally equated with research. Since it is virtually impossible to develop a one-year study program for a new foreign student which will lead to publishable results, such as is possible for an M. S. student, these programs are less desirable from a faculty persons point of view. Also, one-year program students require as much and perhaps more counseling than a first-year M. S. candidate; and this with no mutual return to the adviser. Admission status is another concern. Many instructions do not have specific categories

for the advanced student who is not pursuing a degree. A few institutions will not admit advanced students to their graduate school unless they do matriculate for a degree, and under this circumstance the special student would obviously receive training comparable to that of advanced, degree-oriented students. Other universities have student quotas which makes short-term placement burdensome to their system.

Nevertheless, it has been possible for students to pursue advanced studies comparable to those of degree-oriented students through various mechanisms. In most cases, however it is the academic adviser who makes a personal commitment and a personal contribution to the student's program for which he is not compensated comparably with his other advisees. However, such ad hoc cooperation is a temporary solution to what should be a more open system.

## Conclusions

Our U. S. model of higher agricultural education emphasizes scholarly development which can be achieved only through an institutional capacity for research. Although one year of study is inadequate to achieve professional competence, it is sufficient to introduce students to our philosophy and system of advanced education and provide them significant grounding in scientific-based agricultural specializations. Concurrently at the IAV, the Minnesota resident faculty are working to

develop research and sixth year study programs in which these students will participate for the development of their memoire. Thus, the resident faculty play a vital role in the ultimate success of U. S. training, and also in assisting with the establishment of an objective-based graduate program with the IAV, which is the major goal of this project, and a clear priority for the Moroccan Ministry of Agriculture. While the observations described in the preceding pages are not based on a large number of students at this point in time, it is believed that they are sufficient to indicate significant directions. Moroccan students having come to the U. S. are well prepared in the basic sciences and agriculture through their four-year programs at the IAV. They are competitive, highly motivated, and seek practical experiences in research and application. Although the delivery of one-year advanced study programs, including some specialization, is not necessarily consistent with our institutionalized U. S. degree programs, we have realized sufficient flexibility and capacity has been realized to provide key and significant contributions to the advanced training and development programs of the Moroccan institutions.

TABLE I: PREPARATION COMPARISONS

| AREA | U. Minnesota (credit hours) | IAV |
|---|---|---|
| Basic Sciences | 45 | 2 years |
| Social Sciences | 14 | - |
| Communication | 21 | - |
| Artistic Expression | 8 | - |
| | 88 | |
| Major Field | 50-70 | 2 years - No Spec: Basic Environment Economics Plant |
| Supporting Electives | 30-50 | Engineering Animal Internships |
| TOTAL | 192 | 26 hr/wk, 11 mo/yr. |

TABLE II: SPECIALIZATIONS IN THE U.S.A.[1]

| AREA | NO. STUDENTS |
|---|---|
| Plant Pathology | 7 |
| Plant Breeding | 4 |
| Horticulture | 5 |
| Forestry | 2 |
| Watershed Management | 5 |
| Range Science | 7 |
| Soil Science | 9 |
| TOTAL | 39 |

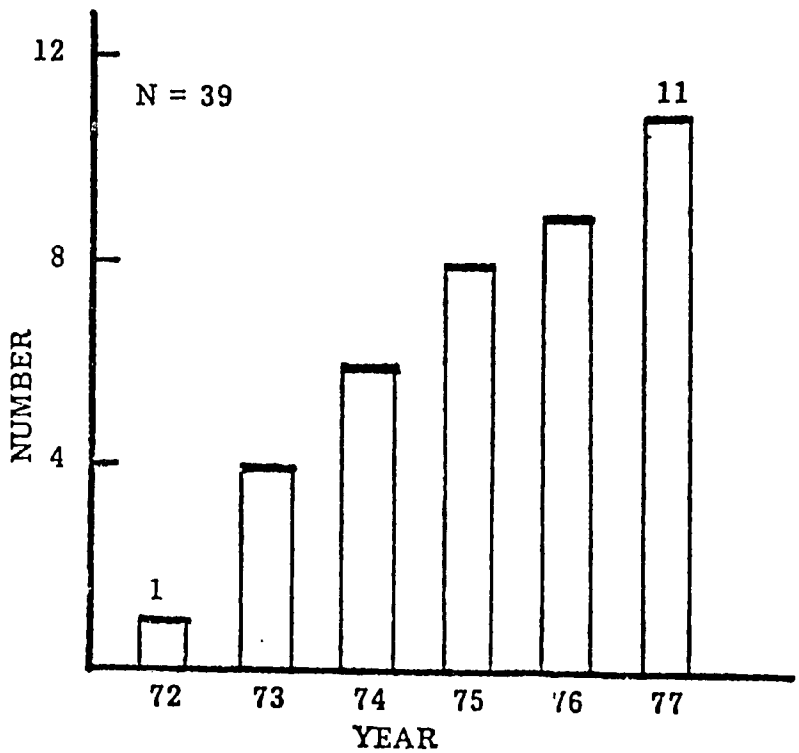
[1] Including the 1977 class

TABLE III: FIRST-YEAR PERFORMANCE OF MOROCCAN STUDENTS IN U. S. INSTITUTIONS

| TERM | GPA | CREDIT HOURS | |
|---|---|---|---|
| | | ACADEMIC | ENGLISH |
| 1 | 2.79 | 8.7 | 5 |
| 2,3 | 2.94 | 10.9 | - |
| AVE | 2.90 | 10.1 | |

N = 27 1973-1976

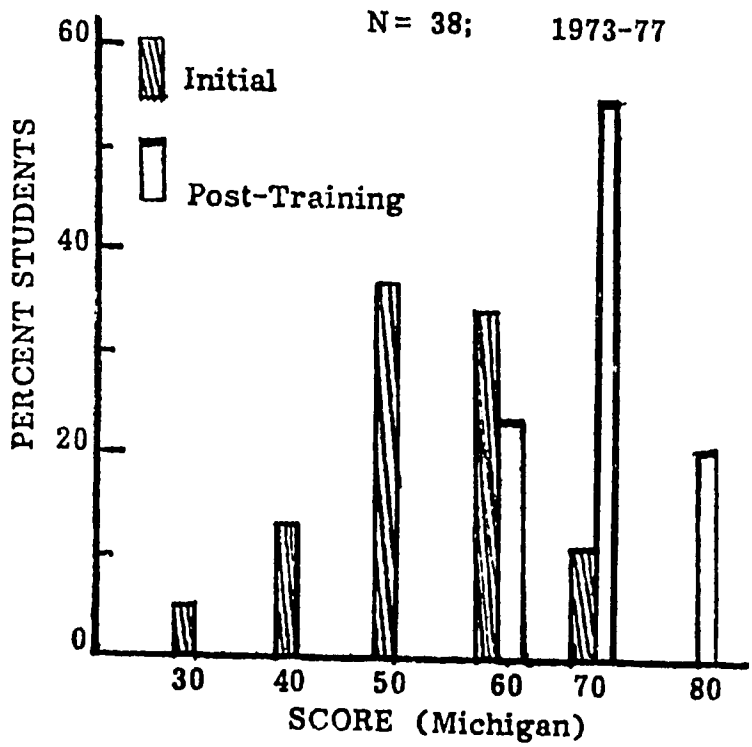
FIGURE I




PARTICIPATING MOROCCAN STUDENTS

IN U.S. PROGRAMS.

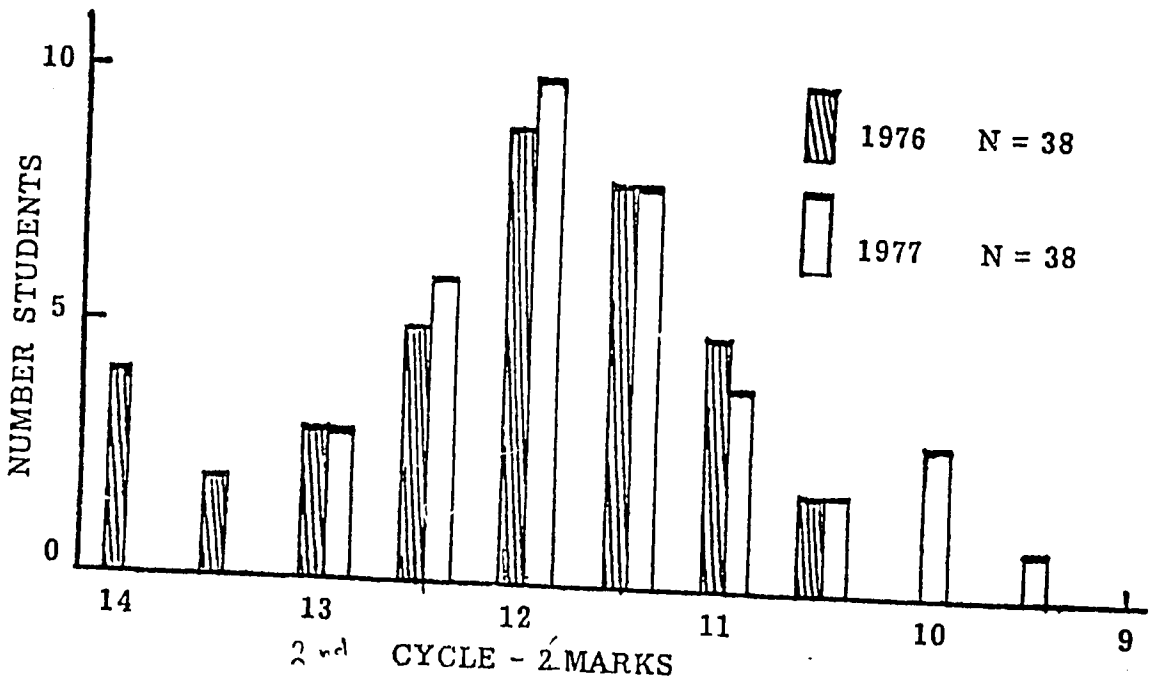
FIGURE II




ENGLISH PREPARATION OF

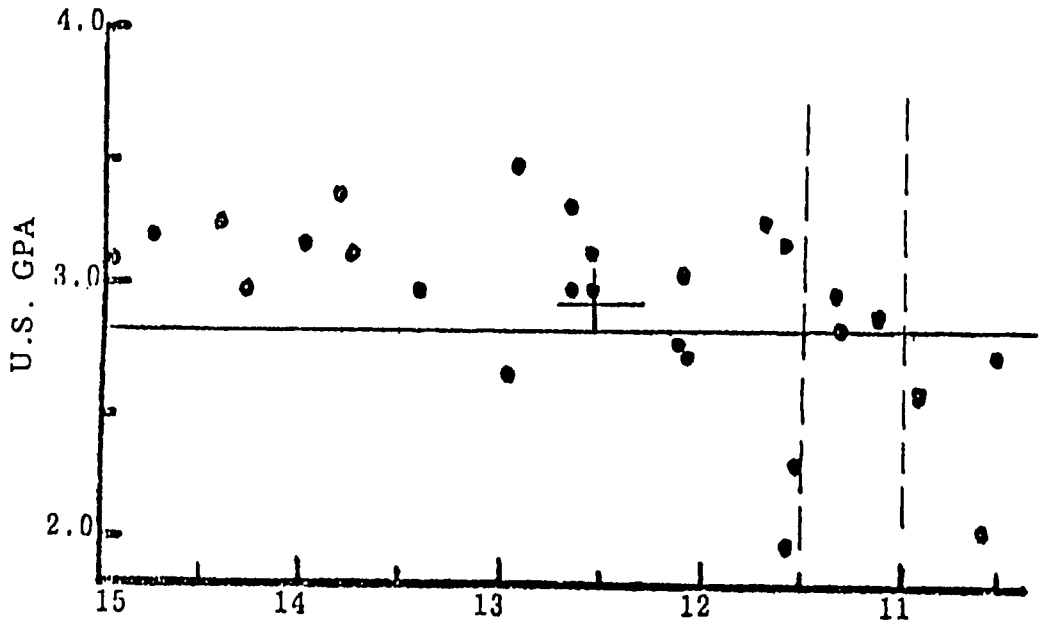
MOROCCAN STUDENTS

FIGURE III




ACADEMIC PERFORMANCE OF TWO GROUPS OF IAV STUDENTS DURING THEIR FOURTH YEAR OF STUDY IN RABAT (1976 & 77).

FIGURE IV




IAV MARKS - DURING SECOND CYCLE

ACADEMIC PERFORMANCE OF MOROCCAN STUDENTS AT IAV AND IN THE U.S.

# V. FRENCH TRAINING FOR NEW FACULTY

## A. Introduction

In March 1977, the University signed a contract with the Chastain Language School, for the French training programs of the four newly hired staff members.

The Chastain Language School program was preferred to the standard F. S. I. program offered in Washington, D. C. or to other programs available in Minnesota for the following reasons:

(1) For a similar cost, it offered more direct contact between instructor and student (very low instructor/student ratios).

(2) It was directly oriented towards a vocabularly pertaining to agriculture, education and the North African environment.

(3) Part of the training program could take place in a French speaking environment where a better immersion into French was supposed to be achieved.

(4) Part of the program could take place on the St. Paul campus of the University, where the newly hired staff members can integrate themselves into their own departments and become better acquainted with their colleagues, participant programs in the U. S. and the overall organization of the Project. In addition, the program could make use of the many resources and facilities available on the campus.

(5) The responsibility of the whole program, both in the U. S. and in Morocco, would be offered to the Director of the Chastain Language School, who had already conducted similar programs in the U. S. and in Morocco.

B. Nature and Content of the Program

The following is a description of the principal components of the program:

Component A - This component is based upon the feasibility under the projected conditions of providing a large number of hours of individualized language instruction to each trainee. Individualization of instruction is effected by maintaining a one-to-one ratio of instructor to trainee in fully 20% to 25% of the projected contact hours. The one-to-one instructor/trainee ratio is central to the project not only because it permits the instructor to engage with great frequency in meaningful conversation with the trainee on an individual basis, and therefore to concentrate upon the specific needs of the student in the realms of basic structures and vocabulary, but most pertinently, because it permits the student himself to identify through extended periods of communication in French those areas of structure and vocabulary which are most crucial to the eventual performance of his professional duties. The instructor is thus able to devote his undivided attention to the professional needs of the student, and research and

preparation on the part of the instructor permits the compilation of specialized teaching materials in specific professional areas to complement those materials which have already been prepared in the broad field of agriculture.

Component B and C - These two components encompass all actual classroom contact hours during which the ratio of instructor to trainee is greater than one to one. Due to the extremely limited number of trainees involved in the projected program, this ratio can, of course, never exceed one to four, which is, in itself, a much more advantageous instructor/student ratio than is often encountered in intensive language programs.

Component B, in which the maximal instructor/trainee ratio is utilized, is dedicated to activities such as initial presentation of new structures and vocabulary, or grammatical analysis of recently presented structures, where the maintenance of a smaller instructor/trainee ratio offers no clear advantage.

In Component C, an instructor/trainee ratio of one to two is maintained. Under this arrangement, structures and vocabulary initially presented in Component B are drilled and manipulated extensively, and an environment of actual communication, calculated to simulate situations encountered on a daily basis, is fostered. The instructor/trainee ratio of one to two,

which is more advantageous for these purposes, is maintained in one-third to one-half of all contact hours other than those allotted to Component A.

Component D - This component consists of all supervised study and/or supervised activities dedicated to the furtherance of linguistic skills in which an instructor is present with the trainees in an advisory capacity outside of the formal classroom situation. Such supervised study and activities include work with videotaped and/or audiotaped materials in the language laboratory, regular luncheon meetings conducted in French, occasional evening meals of a special French or Moroccan character conducted in French, lectures in French by faculty and students of the University of Minnesota with previous experience in Morocco, movies in French and other activities which promote active control of the French language. (These activities are offered as a supplement to the actual number of contact hours described in the program.)

Component E - This component consists of all unsupervised independent study carried out by the trainees at times other than those devoted to Components A through D. Actual hours available for this form of study vary according to conditions prevalent in various stages of the project, but trainees will be provided with appropriate study guides, texts, programmed readers and polycopied materials and encouraged to devote a minimum of ten hours per week to this form of study for the

duration of the project. (Component E, like Component D, is offered as a supplement to the total number of contact hours comprising Components A, B, and C.)

By the end of the first stage of training, a successful trainee has attained a high degree of competency in the manipulation of the most essential structures of the French language, as well as a vocabulary adequate to meet the demands of everyday existence in a francophone country and the beginnings of a vocabulary suited to meet the demands of his professional duties.

During the second phase of the program carried out in Rabat, a number of new factors come into consideration which may eventually alter the nature of the training. (It is at this point that the principal trainees are spending a portion of their time at the Hassan II Institute in Rabat, and it is also at this point that they are joined by their wives and children.)

Experience has shown that a project composed of a stateside phase followed by an in-country phase is far superior to a project carried out entirely in the U. S. or entirely abroad, so long as the necessary continuity is maintained between the two phases.

It is in Morocco itself that in theory the trainees are best afforded the opportunity to become acquainted with the country in which they will live and work for two years, and it is there that they find, during the second phase of training, a natural environment in which to develop their control of French. Moreover, the Rabat phase enables the principal trainees to exercise their newly-acquired linguistic skills on a regular basis in the gradual assumption of their duties at the Hassan II Institute and determine through actual experience the areas in which they need further individualized instruction.

The following is an outline of the distribution of study activities and actual contact hours of instruction for the two stages of the program.

St. Paul Phase - Actual Contact Hours

11 weeks x 5 hours per day on a 5 day per week basis = 275 contact hours per candidate, distributed as follows:

Component A - (1/1 instructor/trainee ratio)

6.25 hours per week x 11 weeks = 68.75 contact hours/candidate

Component B - (1/4 instructor/trainee ratio)

6.25 hours per week x 11 weeks - 137.5 contact hours/candidate

Component C - (1/2 instructor/trainee ratio)

6.25 hours per week x 11 weeks = 68.75 contact hours/candidate

St. Paul Phase - Supervised and Unsupervised Study

11 weeks x 3½ hours per day on a 5 day per week basis = 192.5 study hours per candidate, distributed as follows:

Component D - (Supervised study activity)

7½ hours per week x 11 weeks = 82.5 study hours/candidate

Component E - (Unsupervised study activity)

10 hours per week x 11 weeks = 110 study hours/candidate

Rabat Phase - Actual Contact Hours

5 weeks x 3 hours per day on a 5 day per week basis = 75 study hours per candidate, distributed as follows:

Component D - (Supervised study activity)

5 hours per week x 5 weeks = 25 study hours/candidate

Component E - (Unsupervised study activity)

10 hours per week x 5 weeks - 50 study hours/candidate.

As an illustration, the following sample outlines a typical day's activities during the St. Paul Phase of training:

8:30-9:30 Component B (1/4 ratio)
Initial presentation of new structures = 1 hour/candidate

9:14-11:15 Component C (1/2 ratio)
Intensive manipulation of new structures = 3/4 hour/candidate;
Component A (1/1 ratio)
Individualized instruction = 2/3 hour/candidate

11:30-12:00 Component B (1/4 ratio)
Grammatical analysis of new structures = 1/2 hour/candidate

12:15-1:00 Component D (supervised)
Lunch and conversation in French = 3/4 hour/candidate

1:15-2:00 Component D (supervided)
Language laboratory activities = 3/4 hour/candidate

2:15-3:15 Component B (1/4 ratio)
Initial presentation of new vocabulary = 1 hour/candidate

3:30-4:30 Component C (1/2 ratio)
Intensive manipulation of new vocabulary = 1/2 hour/candidate;
Componant A (1/1 ratio)
Individualized instruction = 1/2 hour/candidate

After 4:30 Component E (unsupervised)
Independent study at lab or home = 2 hours/candidate

<u>Totals</u>

Component A = 1¼ hours

Component B = 2½ hours

Component C = 1¼ hours
5 contact hours/candidate

Component D = 1½ hours

Component E = 2 hours
3½ study hours/candidate

C. General Comments and Recommendations

There is a general consensus among University of Minnesota staff members that the Chastain Language School program was very well organized and that the program should be extended to future staff members.

However, in light of results achieved during this first program, the following observations seem to be pertinent:

(1) The total length of the program (16 weeks) is considerably shorter than an equivalent F. S. I. program. This resulted in a very tight scheduling which somewhat interfered with cross cultural training and integration into Departmental activities in St. Paul. An addition of four to six weeks to the program appears to be sound and justified (e.g., two additional weeks in St. Paul and four additional weeks in a French speaking environment).

(2) Insufficient time was available in St. Paul for the presentation of the total French grammar. A minimum of 12 weeks in St. Paul rather than 11 weeks seem to be necessary to present the entire basic grammar of the French language.

(3) If 12 weeks were allotted to the St. Paul Phase of training, additional time could be budgeted for the trainees to become acquainted with their colleagues and their duties

at the University of Minnesota. (This integration of each staff member into the Departmental activities was very difficult during the 11 week program, due to the necessity to keep a very tight schedule.

(4) On a qualitative basis, some valid criticisms may be leveled at a language training program to be carried out in Rabat, since other activities clearly interfere on a daily basis with the French program: families have to adapt to a new and very foreign environment upon their arrival in Rabat and naturally worry about material tasks like finding a house, servants, etc.; staff members have to adapt to totally new conditions in regard to their professional environment and the carrying out of their professional duties; staff members have also to adapt to a brand new linguistic environment in which French is no longer an academic subject, but a basic mode of communication.

One of the solutions to alleviate the above difficulties is to conduct the in-country part of the French training program in a Moroccan city other than Rabat. Not only would this minimize contact with the English-speaking community of Rabat but it would also postpone the trainee's arrival and assumption of duties at the Hassan II Institute, which may often interfere with the implementation of the French program. This expedient

would also entail the postponement of many of the time-consuming tasks related to the location of permanent lodging which also tend in one way or another to interfere with language training.

# PROJECTIONS FOR FY II

Major goals of FY II will remain identical to goals of Phase I and Phase II (FY I), but the training of faculty will become a larger compon- of the program and will eventually constitute the primary effort of the Project in future years, unless the Project is amended.

A. Permanent Long Term Members

The major goals of each permanent member will be to get a research program under way, to develop doctoral degree programs for their Moroccan counterparts and to advise Moroccan third cycle students during their thesis work. Little, if any, formal teaching will be done during FY II by the U. S. professors. The following paragraphs summarize the major aspects of workplans submitted and approved at the end of 1977.

Dr. J. Vavra (Field Chief of Party and Soil Conservationist)

Research emphasis will be placed on the study of the effect of soil erosion on the accumulation of sedimentation in the Tleta Watershed reservoir and on an evaluation of soil conservation cultural practices at the station of M'Da and in the Tleta Watershed. A third cycle memoire will stem from the first study, and Mr. Merzouk (IAV) will be closely associated with each research activity.

A soil conservation program for second and third cycle students will be developed, and a doctoral degree program will be planned for Mr. Merzouk.

Dr. Blake of the University of Minnesota will visit the Project in the spring of 1978 as a consultant.

Dr. E. Berglund (Watershed Management)

Research emphasis in the academic unit will be placed on studies of relative water infiltration rates in forest and range cover types, of surface erosion in the Tleta basin, and on surface runoff and erosion studies in two small watersheds in each of the Rif and Moyen Atlast Mountains. A third cycle student, Ahyoud, will write his thesis in conjunction with the first study listed above.

Courses in Climatology and Hydrology will be developed with Mr. Tayaa, and also a doctoral degree program for Mr. Tayaa himself.

A consultant (probably Dr. Beschta) will visit the Project during the spring of 1978.

Dr. J. O'Rourke (Range Management)

The following research project will receive primary attention: the response of alfa to clipping (memoire of El Gharbaoui), the botanical composition of the diet of sheep grazing native Moyen Atlas ranges (memoire of Laraisse), and the assessment of the forage resources of the Moyen Atlas (doctor's thesis of H. Narjisse). Other research activities may include the establishment of a range research area in the

woodland type, and an evaluation of existing range evaluation exclosures.

Attempts will be made at strengthening the curriculum in Range Management at the Institute, and a doctoral degree program will be developed for Mr. Berkat.

A scientific paper will be presented at a professional meeting in Denver, in August 1978. A consultant, not yet identified, from the U. S. will visit the Project during the course of the year.

Dr. A. Lasheen (Fruit Production)

Primary research emphasis will be placed on an avocado rootstock trial, the establishment of a plant collection and germ plasm bank, the testing of some mango varieties in Southern Morocco, the planting of almond and olive trees to reduce soil erosion on rain-fed slopes, and on a drip irrigation trial (location to be determined during the winter of 1978).

Contributions will be made to the development of a curriculum for the new horticulture institute at Agadir. An attempt will be made to strengthen horticulture training at the second cycle level. A doctoral degree program will be developed for Mr. Hallatou.

Dr. J. Gallagher (Plant Breeding) and Dr. J. Burleigh (Cereal Pathology)

These permanent faculty members will join the Project in April and June, 1978, respectively.

Their major emphasis during FY II will be the intensive study of the French language at the University of Minnesota. Research priorities will be determined during the first part of the summer 1978, in conjunction with the Heads of Departments and their Scientific Advisers.

B. Short Term Staff Members

Dr. P. Antoine (Soil Classification)

Primary emphasis will be placed on the completion of research activities initiated during Phase I of the Project. FY II will coincide with the completion of the soils map of the Tiflet-East region and studies on potassium status in some calcereous soils and chemical cycles in soils of Northern Morocco.

A review of the work done on a generalized soils map of Morocco will take place in July, but completion of that project is not scheduled before FY III.

Guidance will be provided to Mr. Stitou for the development of his doctoral degree program, in collaboration with Dr. R. H. Rust. This program will be finalized during the winter,

1978. Trips to Morocco, as a short term faculty member, are planned for February and July, 1978.

Dr. B. Lockhart (Virology)

Primary emphasis will be placed on the development of a doctoral degree program for Mr. Bencheqroun. Since communication with Mr. Bencheqroun has not been fully established yet, the program of B. Lockhart for FY II will not be fully defined until the winter of 1978.

Dr. J. Molina (Soil Biology)

The major goal will be to serve as an adviser for the doctoral degree program of Mr. Hilali which will be finalized during the winter of 1978.

On site visit in Morocco may take place between May and June of 1978.

C. Participant Training

Students (Eleven Fifth Year Students and Four Sixth Year Students)

Moroccan third cycle students come to the U. S. to partially satisfy the requirements of the "Ingénieur" degree. During their stay, they concentrate mostly on course work and field experience at the graduate level and return to Morocco after carefully reviewing the bibliography, materials and methods needed for their thesis.

The programs in the U. S. are oriented primarily towards the training and staffing of the Institute and related institutions in the broad fields of soil and plant sciences, and the length of stay of students in the U. S. is primarily decided on the basis of these goals.

Faculty

The training of faculty will constitute the primary effort of the Project beginning in FY II. The goal of faculty training will be the U. S. Ph.D. degree, with course work undertaken in the U. S. and research in Morocco. During FY II, one member (Essiddiqi) will complete his two year stay at Syracuse, New York (M.S. in Forestry) and five to seven new members selected by IAV may arrive in the U. S. around August 1978.

# APPENDIX I

## Description of the Grading System at the Institut Agronomique et Vétérinaire Hassan II

Description of the Grading System at the Institut Agronomique et Veterinaire Hassan II, Rabat, Morocco

The Hassan II Institute of Agronomy and Veterinary Medicine was established in 1966 to provide higher agricultural training for Morocco. The six-year program is divided into three cycles of two years each. The first two years consist primarily of a preparatory general sciences curriculum. At the conclusion of the first year, the top 20 percent of the students are selected to continue studies in the agricultural sciences at the Institute. The remainder of the students that have successfully completed year one pursue studies in applied agriculture and forestry for an additional three years at other institutions.

Cycle II studies at the Institute consist of a uniform curriculum encompassing the basic agricultural sciences for all students. During Cycle III, years 5-6, students specialize in one of the agricultural disciplines. Fifth year studies are currently taken either in Europe, or in the U. S. through the University of Minnesota program. The sixth year of study, which consists primarily of research, is taken at the Institute under the direction of the Moroccan and foreign resident faculty. Upon successful completion of Cycle II, students are awarded a Diplôme d'Agronomie Générale considered equivalent to the U. S. Bachelor of Science. Students successfully completing the third cycle receive a Diplôme d' Ingénieur d'Etat, which is being established to be equivalent to our U. S. Master's degree.

The Institute employs a 0-20 grading scale following the European system. Letters are assigned to these scores as follows: A=17-20; B=13-16; C=9-12; D=5-8; E=0-4. However, these letters have no equivalence to our U. S. grading system. Scores received in individual subjects are averaged for Cycle II and provide a measure equivalent to our U. S. grade point average. Students are also numerically ranked according to this average score.

Our experience with some 19 students who have studied in the U. S. during the past three years indicates that those achieving a minimum average score of 11.0 can be expected to successfully compete at the graduate level in the U. S. This experience includes students who have studied at Utah, Oregon, Colorado and Louisiana State Universities, University of Californa-Davis and Riverside, and the University of Florida, in addition to the University of Minnesota. In comparison with U. S. higher education, students entering the Cycle II program at the Institute in Morocco are highly selected with the result that poor performance or failure is usually associated with either illness or personal problems.

Because of the present tutorial type studies in Cycle III, the grading system employed at the institute is less rigorous with the result that the dividing line between an equivalent U. S. B and C letter grade is

approximately 13 on the Moroccan 0-20 scale. However, Institute students must complete the Cycle II program with an average score grater than 10.0 in order to advance to Cycle III studies. For those students coming to the U. S.with the Moroccan Ingénieur d'Etat degree, the analysis of their Cycle II studies is the more critical indicator of their academic abilities, and their Cycle III performance is more indicative of their research capacity for pursuing advanced studies in the U. S.

# APPENDIX II

## Reports of Consultants Who Visited the Project During 1976-1977

Section A. Dr. S. Malo, Horticulture

Section B. Dr. J. Taylor, Range Management

Section C. Dr. A. Mace, Jr., Watershed and Range Management

## A. HORTICULTURE:

Dr. S. Malo, Professor,
Agricultural Research and Education Center,
IFAS, University of Homestead, FLA 33031

Dr. S. Malo was in Morocco between July 3-17, 1977. The major purposes of his visit were:

1) To attend the Memoire presentation of Mr. Mohamed Hallatou who had worked for 12 months under his direction at the University of Florida Agricultural Research and Education Center (AREC), Homestead. Mr. Hallatou worked on an interesting problem dealing with anatomical aspects of avocado graft unions, and at the same time became acquainted with South Florida's tropical fruit and vegetable industry. He wrote the results of his research in Homestead and submitted it to the Hassan II Institute as part of the requirements for obtaining his degree of Ingénieur d'Etat. The Memoire written in English was accepted, but required the addition of a summary in French, the academic language of Morocco.

2) To survey the country for its possibilities for tropical and subtropical fruit production, and

3) To study the need for horticultural manpower training and evaluate Morocco's present academic status.

The following pages are an excerpt of the report of activities and observations made by Dr. S. Malo during his visit.

"Areas and Institutions Visited

In the two weeks of my stay in Morocco the following areas and institutions were visited: Meknes and surroundings, including the four-year agricultural college (L. Wallali, Director), and the two-year horticulture school. Personnel of these colleges were interviewed, particularly A. Bouchanine, Director of the Ecole d'Horticulture. The experiment station d'Ain-Taoujdat, situated between Meknes and Fes, was surveyed at some length and its fruit plantings evaluated. Personnel of this station were queried regarding climatic and soil conditions, major problems, etc. The sandy flatlands from Sidi-Kacem to Kenitra were rapidly surveyed. The soils in this area appeared to be similar to Florida's deep sandlands, with abundant water from rivers, irrigation projects and relatively shallow wells. The irrigated perimeters of Beni-Mellal, including the local D. R. A. (Ministry of Agriculture) Station and a private citrus orchard were visited and notes were made on rootstocks, cultivars, soils, and major problems. An overnight stop in Marrakech presented an opportunity to see the crops of this area and to make a judgment of possibilities. The area of Agadir and surroundings were surveyed in some detail. These included

the monumental irrigation projects of the Massa River and its recently finished dam, and some localities in the Souss Basin. The local D. R. A. experiment stations were visited and the level of technology of their operations evaluated. Since the Massa area is the southernmost irrigated perimeter in the country, it has much interest for subtropical and tropical crops. A banana ('Dwarf Cavendish' cultivar) planting was visited in the company of Mr. Mustapha Ghazouli, in charge of agricultural extension in the Souss-Massa area. The plantings are located north of Agadir in the protected coastal valleys around Tamri.

## "Geographical Location and Climate of Morocco

Morocco is situated in the Northwest coast of Africa between latitude 36° N in the north and 26° N in the south, although recently its present territory has extended to latitude 22° N with the annexation of what used to be called Spanish Sahara. There are approximately 900 miles (1440 K.) from Oujda on the northern border of Algeria and Tarfaya in the south. Morocco can be compared favorably to California in many respects. In size it has 445,050 $Km^2$ (171,835 sq. mil) as against California's 411,013 $Km^2$ (158,693 sq. mi.). Because California is situated further north (from latitude 32° N to 42° N) it has an average colder climate than Morocco's, although the milder southern coastal climate of this state, from Los Angeles to San Diego, is quite similar in many respects to Morocco. There are also notable similarities between this country's climate and the year round, balmy mediterranean temperatures of southern Spain from Algeciras to Almeria. In this region subtropical fruit crops with exacting requirements such as chirimoyas (Annona cherimola) grow and produce extremely well. The Canary Islands, although also cooled by the same ocean currents that affect Morocco, appear to have a slightly warmer average temperature, as judged by the type and manner of growth of some tropical plants ('Dwarf Cavendish' bananas, Ficus nitida: Indian laurel and Schinus terebinthifolius: Brazilean pepper, and others). Nevertheless, in the Agadir area tropical fruits with excellent market appeal, such as mango, lychee, longan and macadamia should be field tested for a complete evaluation of adaptation.

The absence of severe winter temperatures in the low, coastal plains make Morocco a natural for subtropical horticultural crops. With few exceptions, freezes are quite rare, and when they occur, even the most severe are not low enough to injure avocado trees in the medium elevation (550 m) valleys of Meknes and Fes. The Atlas mountains protect the country from the harsh, drying winds from the Sahara.

Some areas, however, are prone to damage from the "Chergui" (hot winds of 40° C or higher) which occasionally blow from the desert from April to July.

The rainfall throughout the country is generally very scanty and ranges from 1000 mm in the high mountains to 50 mm in the south. In the

agricultural areas there are well known belts with 300 mm to 400 mm, but the majority of the arable land receives only 200 mm to 300 mm. This amount is barely sufficient for a low crop of barley, and not enough for wheat which needs a minimum of 300 mm to satisfy evapotranspiration requirements of plant growth. Wheat requires additional amounts of water for grain production. Thus, theoretically each additional mm of water above 300 mm will produce 20 Kg/hectare of grain, consequently a level of rainfall of 400 mm could produce 2 metric tons (MT) of wheat per hectare.[1] Fortunately, the rainfall coincides with the cooler months of November through April and the evapotranspiration is not as high as it could be in the summer.

"Pertinent Agricultural and Demographical Facts

From the facts discussed above it is clear that supplemental irrigation is a must if Morocco's agricultural output is to increase. Irrigation is particularly important for any of the horticultural crops which reqire abundant water to maximize yields. The country has invested tremendous amounts of capital in irrigation projects during the 1968-72 and 1973-77 five-year plans; however, much still has to be done, particularly in rainfall conservation and in improved techniques of dryland farming. At present, 90% of farmlands are under rainfed agriculture and their output is pitifully low.

The estimated present population, increasing at a rate of three percent per annum, is around 18.5 million. Of this, 11.5 million can be considered rural, with a total population of 1.9 actual farmers. It has also been estimated that Morocco has 900,000 farm units - mostly very small - dedicated to horticulture production employing a labor force of approximately 175,000 people. These farming units comprise approximately 800,000 ha, of which 730,000 ha include all fruit crops and 110,000 ha all vegetables. This acreage is approximately 9.4% of the total cultivated land. Government statistics also indicate that fruits and vegetables constitute 47% of the total agricultural value of the country, and 35% of the total agricultural output. Other revealing numerical facts pertaining to horticultural production are the following in Tables 1 and 2.

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[1] D. G. Hanway, et al. 1977. Dryland Farming in 200-400 mm Rainfall Zones of Morocco. A report prepared for AID by Midamerican International Agr. Consortium, as quoted from P. V. Pumphrey's Wheat Production Manual (Oregon Sta. Univ.) prepared for use in Turkey.

Table 1. Fruit Production of Morocco (US Tons) for 1974*

| | | | |
|---|---|---|---|
| Oranges | 819,000 | tons | including 'Clementines' and tangerines |
| Lemons | 3,000 | " | |
| Grapefruit | 17,000 | " | |
| Grapes | 219,000 | " | including those for wine and table |
| Olives | 241,000 | " | |
| Figs | 67,000 | " | |
| Dates | 95,000 | " | |
| Total | 1,532,000 | tons | |

*Source: Foreign Agricultural Services, USDA, 1976.

Table 2. Total Area Planted to Major Horticultural Crops in 1974-75*

| | | |
|---|---|---|
| Citrus (all) | 73,900 | Hectares |
| Olives | 300,000 | " |
| Other fruits | 193,800 | " |
| All vegetables | 104,200 | " |
| Total | 671,900 | Hectares |

* Source: Ministère de l'Agriculture et de la Réforme Agraire (MARA) Statistiques Agricoles. Principales Productions Végétales. Campagne 1974-1975.

Domestic demand exceeds the production of nearly all agricultural commodities. The country imports cereals, meat, dairy products and oilseeds because of their critical need, but also because they are available in the international market. However, it also suffers a critical need of perishables such as fruits and vegetables which are expensive and require specialized handling if they are to be imported from abroad. Paradoxically, Morocco is a net exporter of winter vegetables and fruits, particularly tomatoes and citrus. Obviously there appears to be a great imbalance in the horticultural output of the country. Production of exportable crops is actively encouraged since it generates needed foreign exchange which can be used to buy wheat and other cereals for bread, the country's most basic staple.

Personal observations and available reports[2] indicate that vegetables and fruits are scarce, very expensive and of poor quality. Government figures notwithstanding, rural families as a rule do not seem to grow fruits and vegetables for their own use and for sale. Thus, the populace, particularly young children, suffer the consequences of a lack of these

[2] D. G. Hanway, et al. 1977. Dryland farming in 200-400 mm rainfall zones in Morocco.

important items in their diet. In a country with ideal climatic conditions for fruit and vegetable production this is a sad state of affairs, indeed.

As in most developing countries the rural population suffers from the so-called "urban bias", namely, government authorities are primarily concerned with the urban population which has the necessary political clout, even in absolute monarchies, while the rural sector suffers the consequences of the indifference of a city-oriented elite.

"Some Revealing Findings

As can be surmised from the above discussion, Morocco has excellent climatic conditions for subtropical horticulture. Although the soils appear generally heavy, there are aslo many areas where the drainage seems very satisfactory for orchard planting. Northern Morocco is perhaps the only area of the world where I have seen avocado and cherry trees growing side by side and producing apparently acceptable crops. This means that at least in this area of the country there is a minimum of 800 hours of winter chill (accumulated temperature below 8° C or 45° F) to break dormancy of cherries. At the same time winter temperatures do not get down appreciably below 0°C (32° F) to cause major damage to avocados. These peculiar climatic conditions afford a very wide latitude for adaptation of frost susceptible crops, while being sufficiently cool during the winter to satisfy the high chilling requirements of most temperature fruits.

In Central and Southern Morocco the conditions for subtropical fruit growing are close to ideal with cool, relatively frost-free winters with low relative humidity, warm springs and warmer summers. Where adequate irrigation and light soils are available the possibilities for growing horticultural crops are only dependent on the level of technology available.

In the Agadir area there are apparently many protected areas where the majority of dryland and monsoon-type (alternating six months of rainfall and dry season) tropical fruits should be tested. "Dwarf Cavendish" bananas, which are better adapted to subtropical and marginal conditions than other commercial types would produce adequately well under good cultural practices. I would compare the Agadir area with the cooler banana locations of the Canary Islands where only good farmers succeed, and where it is not possible to obtain good yields without much technology, cultural care and attention to detail. The banana decline in the Tamri area is perhaps a case in point. Here, after a field examination of the problem, a complex of maladies stemming mostly from climatic stress and poor management were found. Long periods of cool, windy weather coupled with other adverse conditions such as heavy and alkaline soils (causing Fe-chlorosis) had weakened banana plants. A poor irrigation program - too much water alternating with insufficient amounts - had a debilitating effect on roots. In addition, populations of the rootknot nematode (Meloidogyne spp.) were so high that healthy roots were almost nonexistent, to the extreme that plants were easily pushed over by a few strong rocking shoves. On top of everything else, what appeared to be banana

bunch top disease was widespread throught the plantings.[3] It is known that cooler climatic conditions and adverse soil situations lower the resistance of tropical fruit trees, including the banana[4], to diseases and pests which under normal conditions cannot get a foothold and attack the plant. As shown before, it is possible to get adequate yields of bananas under these conditions but a higher level of technology than that required under warm climates is needed. Morocco imports bananas from the American tropics, thus, a serious attempt should be made to produce their own.

There is much interest in finding suitable replacements, particularly with fruit crops, for date trees (Phoenix dactilifera) which have been killed by the "Bayoud" disease. This problem, caused by Fusarium oxysporum f. sp. albedinus[5] has resulted in considerable social upheaval in rural areas which depended on date orchards for their living. Thousands (perhaps millions) of palms of the best cultivars ('Medjool','Bou Feggous', 'Deglet Noor' and others) have been destroyed since the early 1900's. The disease continues its ravages, although sporadically, because an effective control has not been found yet.

A very revealing finding, and in many ways a disturbing one, is the lack of adequate numbers of horticulturists working for the government, particularly those with experience and practical training. Most of those at experiment stations and at crucial administrative positions were young people, some of whom readily admitted to having a limited knowledge not commensurate with their responsibilities. It appears that the bureaucratic system is organized in such a way that allows experienced professionals to drift to semi-official organizations, such as the O. C. E. and others, because of an unrewarding salary scale. These organizations and the private sector need many more horticulturists than the country can supply. Obviously, this has created the impetus behind the establishment of the Agadir Horticultural Institute Hassan II.

Other study teams from abroad, even those not specializing in the solution of horticultural problems, have recognized the dire need for improving the production of fruits and vegetables, particularly in rural areas. The recent report on dryland farming mentioned before that was prepared for AID, specifies the need for training horticulturists in the U. S., at the Master's and Ph.D. level, as part of the whole "dryland" package. If Morocco is to exploit its full horticultural potential it

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[3] For an up-to-date source of information on banana bunch top see: Stover, R. H. 1972. Banana, Plantain and Abaca diseases. Commonwealth Mycological Institute. Kew, Surrey, England.

[4] Stover, R. H. and S. E. Malo. 1972. Occurrence of Fusarial wilt in normally resistant 'Dwarf Cavendish' bananas. Plant Disease Reptr. 56: 1000-1004.

[5] Nixon, R. W. 1950. Observations on the Bayoud disease of date palms in Morocco. Plant Diseas Reptr. 34(3):71-73.

would need large numbers of trained people, who can translate their theoretical knowledge into practical results in the field.

"Some Fruit Crops Worth Testing in Cultivar Collections

Based on experience obtained in areas with somewhat similar climatic conditions such as Israel, Southern Spain, Canary Islands and Southern California, I would like to recommend a list of fruits for introduction and testing (Table 3). Tropical fruits can be tried in frost-free, coastal locations such as Agadir and further south, where protection against the wind can be found, either naturally in valleys or through the use of wind-breaks. Winds intensify the deleterious effects of a cool climate on tropical plants and become more important as the average temperature drops. It can be especially damaging to plants such as tree tomatoes, bananas and papayas with large, rather succulent leaves. Only tropical fruits which come from the dry tropics or from monsoon climates are considered here, since they are the most likely to succeed. In the future, others of lesser priority can be added as more information is obtained.

Table 3. Tropical and Subtropical Fruits Worth Testing in Morocco

| Common Name | Scientific Name |
|---|---|
| For Northern, Central and Southern Locations | |
| Avocados | *Persea americana* (cultivar collections) |
| Blueberry | *Vaccinium* spp. |
| Feijoa | *Feijoa sellowiana* |
| Figs | *Ficus carica* |
| Jujube | *Zizyphus mauritiana* |
| Kiwi fruit | *Actinidia chinensis* |
| Loquats | *Eriobotrya japonica* |
| Macadamia | *Macadamia integrifolia* (several cultivars) |
| Persimmon | *Diospyros kaki* (several cultivars) |
| Pistachio | *Pistacia vera* |
| Pecan | *Carya illonoensis* (cultivar collections) |
| Pomegranate | *Punica granatum* |
| Tuna | *Opuntia ficus-indica* |
| White sapote | *Casimiroa edulis* |
| Temperate fruits (low chilling) | *Rubus* sp. |
| | *Prunus* sp. |
| | *Malus* sp. |
| | *Pyrus* sp. |
| | *Vaccinium* spp. |

Table 3 cont.

| Common Name | Scientific Name |
|---|---|
| For Central (Coastal) and Southern Locations | |
| Chirimoya | *Annona cherimola* |
| Guavas | *Psidium guajava*, *P. cattleianum* |
| Lime, Tahiti | *Citrus latifolia* |
| Lychee | *Litchi chinensis* |
| Passion fruit (purple) | *Passiflora edulis* |
| Tree tomato | *Cyphomandra betacea* |
| For Southern Locations Only | |
| Mango | *Mangifera indica* (cultivar collections) |
| Longan | *Euphoria longana* |
| Papaya | *Carica papaya* |
| Pineapple | *Ananas comosus* |
| Sapodilla | *Achras zapota* |

Most of the subtropicals will thrive well in the majority of inland localities or even at elevations of 750 m or higher. Some, like the lychee, avocado and macadamia, straddle climatic requirements and can be considered either subtropicals of low tolerance to frost or tropicals hardy to cold, although there are great differences in this respect among cultivars. Some avocado varieties will withstand as much cold or more than oranges (around 15° F or -10° C). Some subtropicals like the loquat, feijoa, pomegranate and others are closer to temperate fruits in their tolerance to cold, although may not need to accumulate any chilling themselves because they do not have a dormancy period as we know it in temperate trees. These types of fruits can be grown practically anywhere in Morocco. This is also true of low chilling temperate fruits which could be tested in Agadir as well as in the lower Atlas where winters are not severe. In the mountains these fruits will bloom very early and late winter frost can be a potential hazard to blossoms. By blooming early, some low chilling peaches may mature as early as April.

The fruits in Table 3 are classified according to their p ssible adaptation to three geographical locations in Morocco. Obviously, this is just tentative, for there may be enough experience with some fruits which I actually did not see. Two weeks is not enough for a survey of a country of the size of Morocco. For a start, three localities with different climatic conditions, based on the scarcity of winter frost can be chosen. I would recommend the station d'Ain-taoujdat as one at the critical end of the winter temperature scale for tropicals. Another reason is that there is already much experience with pistachio, pecans, loquats and avocados

at this station. A second location could be south of Casablanca, a coastal one perhaps at Safi, and the third in the Souss-Massa area (Agadir).

Fruits such as the avocado contain many cultivars with a large degree of adaptation. Thus, California varieties can be tested mainly in the north, while Florida's and combinations of both can be tested in central and southern locations. The same applies to the mango. Many cultivars are extremely susceptible to seed abortion ('Haden', 'Irwin' and others) when temperatures are in the high 30's and 40's F ($0^{o}$ - $12^{o}$ C) for prolonged periods of time, while others such as 'Glenn' appear to be less susceptible to this problem. By testing many cultivars some can be found with better adaptation to Moroccan conditions. New pecan cultivars are more precocious and productive than 'Mahan' and older varieties already grown in Morocco for many years.

"An Argument for Tapping the Export Trade

The proximity of the European Common Market and its demand for fruits other than citrus should be an incentive for Moroccan authorities to consider exploiting the country's natural horticultural possibilities. Without a doubt, the first step is to train the necessary personnel which at present is practically nonexistent and which is the most limiting factor in programs of development.

International and U. S. organizations for development are never sympathetic to the idea of encouraging the production of crops with a potential for export. This is usually a short-sighted attitude based on political considerations and under the supposition that with export crops only the rich stratum of society benefits, while the poor do not participate. Exports of agricultural products create jobs and favor the rural poor which are the most disadvantaged in developing nations. Since only the best quality produce is suitable for shipping, the remainder enriches local diets. This is the case of Mexico, Canary Islands and Spain which export winter vegetables and fruits. Recent figures on French imports (Table 4) are relevant to the above discussion.[6] The avocado tonnage from Israel (10,338) and from South Africa (3,689) for 1976 comprise 88% of total imports for this fruit. Morocco only contributed 88 tons or 0.55% of the total. The natural facilities for avocado production of Morocco, the closeness to Marseilles and the special relation with France constitute a great advantage over other countries which should be exploited.

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[6]Naville, R. 1977. Les importations de fruits tropicaux et subtropicaux en France en 1976. Fruits. Vol 32(3):211-219.

Table 4. Importations of Tropical and Subtropical Fruits to France in 1975-.6 (metric tons).

| Fruits | 1975 | 1976 |
|---|---|---|
| Bananas | 479,869 | 456,068 |
| Pineapples | 34,788 | 35,948 |
| Avocados | 14,704 | 15,893 |
| Mangos | 609 | 732 |
| Guavas | 14 | 9 |
| Papayas | 69 | 62 |
| Oranges | 624,371 | 618,218 |
| Tangerines | 12,615 | 14,614 |
| Clementines | 133,444 | 165,996 |
| Lemons | 115,090 | 102,128 |
| Grapefruit | 91,564 | 100,017 |

"Conclusions and Recommendations

1. Morocco has a wide latitude of climatic characteristics. On one hand, its high plateaus and mountainous regions satisfy the chilling requirements of most temperate fruits, and on the other the mild frost-free subtropical areas are well suited to the exacting demands of many exotic horticultural crops.

2. The available number of well trained horticulturists in Morocco is very small. It is in no way commensurate with the country's possibilities of production, both to improve its internal consumption of fruits and vegetables, and to satisfy the demands of the European markets for winter vegetables and exotic fruits.

3. As a member of the University of Minnesota team, I concur with its conclusions that supporting the initial efforts of the Agadir Horticultural Institute Hassan II is at present of prime importance. The training and counseling of its young faculty must be given academic top priority if the high expectations for this large investment are to be realized.

4. A list of fruits for introduction and testing is given. Three localities to assemble, grow and conduct nationwide evaluations of cultivars are recommended. Possible replacements for date palms in "Bayoud" ravaged localities will emerge from these collections. Since fruit horticulture and the trainings of relevant personnel is a long term proposition the sooner it is started the quicker the initial results will appear.

## B. RANGE MANAGEMENT:

Dr. John E. Taylor,
Associate Professor of Range Science,
Montana State University

The primary purpose of the visit, which took place between August 27 and September 10, 1977, was to advise Mr. Hamid Marjisse, an Instructor at the "Ecole Nationale d'Agriculture de Meknes", in establishing a range research program at the new research perimeter at Timahdit and to discuss with Mr. Narjisse his doctoral program. (Mr. Narjisse had spent last Autumn Quarter at Montana State University taking course work and doing library research.)

The following pages are an excerpt of Dr. J. Taylor's final report.

### "Approaches

In order to gain some general knowledge of the Moroccan rangeland situation and thus some perspective against which to evaluate Mr. Narjisse's specific proposals, I felt that it would be extremely valuable to tour as much as possible of the area regarded as livestock grazing land. Mr. Narjisse and Dr. O'Rourke agreed with this view, so we sepnt several days observing vegetational and topographic types, land uses, and range management activities, primarily in the Moyen Atlas Mountains. We also saw portions of high plateau and Rif areas.

During most of the tour, we were fortunate to be accompanied by Drs. Arnett Mace and Erwin Berglund, who added the important viewpoints of Forestry and Watershed Management. This activity was indeed indispensable to me in viewing Mr. Narjisse's area and proposed research in a whole-country context.

With this background, most of the rest of my trip was spent with Mr. Narjisse and Dr. O'Rourke at Meknes and Timahdit. We spent considerable time going over the detailed research plan and discussing graduate level training of Moroccan Range Scientists, both in general and in Mr. Narjisse's particular case.

### "General Comments: Moroccan Rangelands and Their Management

The rangelands of Morocco constitute a large, varied, and important resource. Vegetational types include desert grasslands, shrub steppe, oak chaparral, and forest, among others. These vary considerably as to soils, climate, productivity, and management requirements, including seasonal use, suitability for various classes of livestock, and grazing capacities.

Even though these lands have been grazed by domestic stock for hundred of years, it is my impression that there are many unanswered questions about the fundamental ecological relationships and their implications for optimum rangeland management.

Based on my limited observations, the rangelands we visited were generally in much better condition than I had anticipated. This was evidenced by good ground cover, minimal soil erosion, and the presence of a diverse plant composition, including palatable plants in dominant quantities. The centuries-long grazing history of these areas has developed traditional approaches to handling animals so as to perpetuate the resource, or at least to keep it from destructive levels of use. Apparently, the native graziers often alternate the early season use among various parts of their grazing units, in effect using a deferred rotation system. As much as they can they avoid areas of fragile soils or use them lightly. Further, the continual herding of animals allows the uniform utilization of the landscape, virtually eliminating problems of differential distribution, one of the principal difficulties on many rangelands of the western U. S.

Nevertheless, there are indications of inadequate knowledge of range management principles. In spite of the relatively desirable composition of vegetation on most of the ranges we examined, I was struck by the close degree of use. Recognizing that these observations were made during the dry season, I still wonder whether such intensity of grazing can be tolerated for long without seriously deterioration of the range. I understand that livestock densities have been steadily increasing under recent policies of land use conversion and afforestation, which have reduced the amount of available grazing land at a time when livestock numbers have been increasing with an increasing human population and greater affluence. This question should be addressed in the development of research programs in typical examples of range vegetation types throught the country since it is fundamental to proper range use.

The question of land use conversion appears to be a serious one. Apparently, the Moroccan government is allowing certain parcels of the traditional collective grazing lands to be acquired by individuals who will demonstrate that the land can be cultivated. This breaking of the native cover, when applied in areas of dry climate, thin soils, and steep slopes, can quickly result in irreversible losses of site potentials, including grazing values. In a country with as long a grazing history as Morocco most lands which are capable of long-term crop production probably are already in that use. It seems to me that extreme caution is indicated in land use conversion programs under these conditions.

Another problem I see in the Moroccan attitude about range management is a failure to recognize the ecological basis of rangeland principles as opposed to the agronomic viewpoint of traditional farming. In particular, it appears that range reseeding is held to be very nearly a

panacea for range ills, and in fact often seems to be the only activity considered when range management is mentioned. This point of view is not unique to Morocco, but is widespread in many parts of the world, including the U. S. Nevertheless, it should be countered at every opportunity.

This attitude is fostered by those whose training and experience suggest that the best use of land is to plow it up and replace the native cover with "improved" species, usually in monocultures. This training and experience usually is associated with more favorable sites than comprise most rangelands. Cropping is, of course, an appropriate practice in a great many cases. The croplands of the world are obviously good examples of the application of agronomic principles in the appropriate places. However, the artificial revegetation of rangelands should be regarded with caution.

This is not to say that range seeding is never a good idea. There are many cases where a particular need is best met by a seeding of native or improved forage varieties. There has been some research in Morocco as to which species are adapted and perform well under certain local conditions. For example, we visited a large revegetation project near Midelt, which looked very good. The point remains, however, that such practices should be regarded as special and not general cases, and should be applied on the best sites for particular purposes (such as seasonal forage) not met by the native vegetation. Also any revegetation proposal must be evaluated in terms of its role in the total system under consideration.

The basis of range management as it should be practiced is the manipulation of the vegetation, primarily through the management of grazing animals, so as to produce the maximum sustained yield of rangeland products consistent with the perpetuation of the resource and with the minimum input of energy. In this context reseeding ranges represents high energy-input activity, and also engenders a commitment to continued energy inputs if the seeding is to maintain its natural productivity against the ecological tendency to reestablish a diverse cover through plant succession. In the U. S. it has taken us a long time to recognize the importance of this distinction. Morocco is in a position to profit by our experience.

## "The Proposed Research Program at Timahdit

After having gained at least a general feeling for the rangeland situation in Morocco I was better able to evaluate the research program which Mr. Narjisse had proposed for the newly established research perimeter at Timahdit.

The proposal consists of four main parts:

(1) The characterization of the vegetation and an assessment of its potential,

(2) Evaluation of the nutritive value of the vegetation, including palatability, chemical composition, and the digestibility of the important forage species, with implications for supplementation of inadequate nutrients,

(3) Socio-economic studies, including the traditional manner of range use and the economic and sociological implications of changing these patterns,

(4) Research in rangeland improvement practices, including the introduction of improved forage varieties, fertilization, and the eradication of undesirable species.

While all of the parts of the project could be conducted concurrently, each also can enjoy a certain degree of autonomy. I feel that parts 1 and 2 comprise a very nice doctoral research project for Mr. Narjisse, probably with some of the peripheral areas available for Master's studies for other students. Parts 3 and 4 would require different kinds of expertise, and could probably best be handled either as student projects or as a part of the general scientific program of the school at Meknes.

One of the favorable features of all this proposed work is its orientation to practical on-the-ground problems. There is a point in the development of useful research information when abstract theory must be tested in the real world. This time is at hand at Timahdit.

Since my primary role in Morocco was to work with Mr. Narjisse in the development of his doctoral training program, I will discuss in some detail the portions of the overall program which I feel will make him a good study.

"Proposed Doctoral Research Study for Hamid Narjisse

The first thing that needs to be done at Timahdit is to delineate the natural vegetation units present, develop a map of their extent and distribution, and then to start looking at their ecological interrelationships.

This will best be approached by mapping the perimeter to vegetational units, using aerial photography. Then, study exclosures should be established in examples of each of the important types and studies begun to look at the structure and function of the plant communities represented. Then forage samples taken from the exclosures and from the open range can be analyzed for nutritive value, and these values related back to the vegetation and its management. Each of these activities is discussed below.

## Aerial Photography

Complete aerial photography should be assembled for the study area. The coverage we examined was good quality black-and-white imagery, although some of the flight lines were incomplete and others (notably IX) were poorly printed, and should be re-done. A set of photographs should be acquired exclusively for the use of the range project so that it always will be available and can be marked up if desired. Also, an attempt should be made to locate any other existing photography, especially any which may have been made during the dry season. Some of the vegetational types which were very conspicuous on the ground in September were not very clearly delineated on the green-season photography. This should be remedied with later coverage, especially when dealing with shrubby plant species.

Detailed information about the photography should be obtained: date, elevation, lens focal length, filtration used, film type, original scale, and the location of the original imagery.

An index mosaic should be prepared for ease in identifying appropriate photo coverage in the field. Also, set of the photos should be assembled into a map mosaic for use as an uncontrolled (but extremely useful) base map. This can be overlain with additional information for a variety of purposes.

## Vegetational Mapping

Once the aerial photography is assembled it should be taken into the field and used to construct the preliminary vegetation map. This will require a thorough reconnaissance of the perimeter, and should include notations of roads, dwellings, water sources, topographic barriers, and grazing boundaries, in addition to the plant community indications.

Based on our field observations, the following plant types are proposed for the original mapping:

Cedar forest
Oak forest
Adenocarpus shrub-steppe
Genista/Thymus shrub-steppe
Grass/sedge vegetation
Lowland areas.

It may be feasible to distinguish dense and open stands of the forest and shrub types, and also mixed and pure stands. Decisions on the degree of discrimination must depend upon the field time and personnel available and on the ease of distinguishing various situations on the aerial photography.

A reasonable scale for the initial mapping would be on the order of 1:20,000, with minimum mapping units 16-20 hectares. This would allow fairly detailed characterization of the vegetation for management purposes and still retain a management map size. Of course, field experience may suggest different scales for different purposes.

Some mapping information may be rescaled to overlay the topographic maps of the perimeter; this often illustrates some important phyiographic relationships.

## Study Exclosures

Many important range relationships are best studied in the absence of grazing. Therefore, once the vegetational reconnaissance and mapping are completed, fenced areas designed to exclude livestock should be established in areas of typical stands ormosaics of the mapped types. Initially, one exclosure per type should suffice, although additional replicate areas may be indicated for additional purposes.

Exclosures should be at least 40 x 50 meters in dimension so as to minimize the microclimatic effects of the fence. Also, they should lie on topographic contours as much as possible.

Within the exclosures permanent line transects should be established. With a 10 meter buffer area immediately inside the fence, five 20-meter lines would allow ample space for other studies. These lines should be no closer than two meters apart, and can be laid out parallel to each other. With observations at meter intervals, 100 plot locations are thus available for studies of species composition and production changes due to protection from grazing. In the vegetational density at Timahdit, square-meter plots would appear to be about right to minimize inter-plot variability and still allow rapid data collection.

The initial characterization of the vegetation would be most efficiently accomplished with cover and production data. Cover can be measured or estimated on the square-meter plots. I would recommend canopy coverage for the shrubs and basal area for the grasses and forbs. The details of data collection procedures can be worked out in the field and with consultation of the literature.

With the proposed exclosure size, the available space for clipping would soon be used up with annual or seasonal forage sampling because of the inadvisability of sampling the same plots much more often than every fifth or sixth year in dryland situations. Therefore, production estimates should be made by ocular estimation, reinforced with double sampling from limited areas. Of course, some forage material will have to be collected for chemical analysis.

With the maturation of the research, additional studies will be initiated both inside and outside the exclosures. These might include utilization, photo plots, grazing responses of individual plants, etc. Also, a complete plant collection should be begun as soon as possible, with reference herbaria established at Meknes and at Timahdit. This will be an invaluable resource.

The exclosures should be designed so that they can be grazed, but only with difficulty. They should be protected for at least ten years to start with so that deferment effects may be observed through a sampling of the natural variability among years. Stiles should be constructed for easy access by the workers and to protect the fences. Eventually, it probably will be decided to allow grazing within the exclosures. Then, the fence can be dropped, unlocked, or otherwise made passable.

## Determination of Forage Values

Forage samples should be collected by hand and through the use of esopageal-fustulated animals. These samples reflect the plant species present as interpreted by the grazing animals, ald also indicate the potential nutritive regime of each of the range types. It is important that these samples represent the relative abundance of each of the types if data are to be extrapolated to other areas. Similarly, the fistulated animals should be observed carefully in order to determine which vegetation types their diet is derived from.

In order to characterize the seasonal variability of forage values samples should be taken throughout the year. A minimal collection schedule might include: October (before snow), during the snow period, after snow but before substantial plant growth, during the green season (maybe two collections here), and during the summer dry period.

Once the samples are in hand, chemical analyses and digestibility of important nutrients can be determined through standard laboratory procedures. I would especially recommend the net energy approach to nutritive value. These data can then be carried back to the field and the seasonal nutritive regime related to the plant communities. A forage value map can be prepared, showing the optimum seasonal use of the range. This sort of document is essentially unprecedented, and will be a real contribution to the methodology of grazing land management.

## Data Processing

Of course, all data should be subjected to standard statistical tests for significance. In this connection, computer support should be obtained from the very first. Data formats should be designed to allow easy transition from field to computer and back again. I also recommend that the researcher keep a tight rein on his data even with computer processing. At

least the simpler calculations should be done in the field, and as soon as possible after data collection. This not only helps keep researchers alert to data anomolies and errors, but also serves as a check on the computer outputs and allows adjustment in data collection procedures if they are necessary.

Summary

This is an ambitious proposal, but is one which can contribute immeasurably to the understanding and better management of substantial portions of the Moyen Atlas rangelands. Furthermore, the principles and procedures developed at Timahdit can apply essentially any Moroccan range areas. It also will raise many questions, as good research always does. This should stimulate further work directed to the good management and conservation of the land.

"Proposed Course Work for Hamid Narjisse

Mr. Narjisse has a strong background in animal science and knows quite a lot about vegetation. Nevertheless, in conversations and discussions it became apparent that if he is to concentrate in Range Science he needs some formal training in several phases of plant science and related areas.

Areas in which additional training is indicated include principles of range management, grazing influences (plant/animal relationships in a range context), range analysis, plant ecology (principles, autecology, synecology), range improvement and reclamation, range nutrition, range management planning, and watershed management. Also, I would suggest course work in research methods and aerial photo interpretation.

Although there is a concentrated effort to develop graduate training in Morocco in the field of Range Management, I feel that until a cadre of native scientists is trained, most of this course work will have to be obtained in the U. S., at least on the doctoral level. Schools which have programs closely aligned with Mr. Narjisse's requirements include Utah State University, Arizona State University, Oregon State University, and Texas A & M University.

The time required to complete the necessary course work will have to be determined by the institution, the graduate committee, and US AID, in consultation with Mr. Narjisse and the Ministry of Agriculture. However, the program should be launched as soon as possible, perhaps in Autumn, 1978. Further, I strongly recommend that the course work be completed in one concentrated session rather than trying to work in a quarter or two whenever it is convenient. It is essential to the rapid and sound growth of the Moroccan program to develop the native expertise and credibility at the earliest possible time.

"General Remarks on Narjisse's Doctoral Program

One of the first things that should be done is to form a graduate committee to help Mr. Narjisse in the development of his research and his course of study. This committee should consist of both Moroccan and American scientists, although this means that most of the planning and coordination will have to be carried on through the mails. I do not see this as a serious problem, since by the time he is ready to complete his degree he will have had ample opportunity to discuss his work in both countries. Any work to be included in the thesis will have to be reviewed and approved by the committee prior to its acceptance.

From the logistical point of view his immediate project direction must originate in Morocco. There probably always will be a range-trained individual in the country who can function as his Major Professor. This person may or may not be associated with an institution of higher education. When the time comes for completion of the degree, the granting institution will have to work out the details of committee membership and approval within the constraints of its policies and guidelines.

The committee should be especially watchful for the independence of the research data presented for the degree. Because of the newness of the facility at Timahdit, several new projects will be initiated concurrently. It undoubtedly will transpire that several students will be working in the same general research area. It is essential that each student have a self-contained and independent data base for his degree work even if it is necessary to arbitrarily subdivide some project data for this purpose. In short, no thesis study can legitimately contain another.

"Development of Range Management Training in Morocco

The Moroccan government is very interested in establishing a program of training in Range Management. In my view, this is being approached in the right way, with the development of a native cadre of range-trained people who can begin by teaching principles and their application to students in general agriculture curricula. With the expansion of research facilities and the development of a body of research and demonstration experience, graduate training logically follows.

For the time being, I recommend that graduate degrees granted wholly by the Hassan II Institute or other institutions of higher education in the country be restricted to the master's level. Doctoral course work, at least the major part of it, should be taken in the U. S. until Moroccan capability is developed. Of course, doctoral research projects should address Moroccan problems in Morocco.

It is important to emphasize that Range Management is a field-oriented area, and both undergraduate and graudate training should be strongly directed that way. It is critical to the logical development of range

management practices that local, real-world problems be faced, with careful attention to the uniqueness of the lands involved. While the fundamental principles apply anywhere, it is the understanding of the local dimensions which makes them work in local situations.

"Research Needs in Morocco

As the need for the scientific management of Morocco's rangelands becomes better recognized, certain deficiencies will be noticed in the basic knowledge necessary to this end. The following is not a comprehensive list, but a series of suggestions of things which will come up.

(1) Basic studies of range vegetation types in a variety of geographical situations. These will include characterization of species composition, productivity, forage values, reactions to grazing and other disturbances, and ecological responses to such variables as climate, intensity of use, and soils. THis will be the first priority activity.

(2) Codification of the utility of important plant species as indicators of range conditions, disturbance, and site characteristics. Also, determination of key management species and how to use them. This information will be acquired in the process of conducting ecological studies and long-term observations.

(3) Development or adaptation of methods of rangeland analysis, including criteria and methodology for determining range condition, trend, and grazing capacity.

(4) Basic ecological studies of important forage species, including life histories, site relationships, phenological patters, and ecophysiological characteristics.

(5) Develop management systems to optimize range use and preserve the range resource.

(6) Determine the importance of and the interactions between livestock grazing and other rangeland products, particularly watershed and forestry.

## C. WATERSHED AND RANGE MANAGEMENT:

Dr. Arnett C. Mace, Jr.,
Professor and Head,
Dept. of Forest Resources, College of Forestry
University of Minnesota

The basic purpose of the trip of Dr. Mace to Morocco (August 28, 1977 - September 14, 1977) was to consult with Drs. E. Berglund and J. O'Rourke, Watershed and Range Management Specialists, respectively.

This consultation focused on development of their research and instruction program as part of the University of Minnesota Contract with USAID for training and development of an indigenous faculty at the Moroccan Hassan II Institute of Agriculture and Veterinary Medicine (IAV).

This report contains basic recommendations regarding further training and research activities in these two fields with the major emphasis in watershed management. Also, general observations regarding operation of the project are contained.

Approximately one week was spent traveling in the field and the remainder in the vicinity of Rabat meeting with team members, IAV staff and various AID and Moroccan officials. The remainder of the field trip was designed for me to introduce E. Berglund to two areas in which previous hydrologic investigations have been conducted by FAO and Forest Research Station scientists.

The following pages are a summary of the consultant report of Dr. A. Mace.

### "Watershed Management Research

From my perspective, watershed management research in Morocco has not had a central focus during the past ten years. A number of nonrelated studies have been conducted throughout the country focusing on erosion control. If Morocco is to continue to develop, a major emphasis must be placed on the acquisition of basic hydrologic information. This information is a prerequisite for effective planning of the allocation and management of the water resource - a limiting factor for food and fiber production. Also, this information is essential for design of biological and physical management systems to control the large amount of erosion - particularly in Pre-Rif, Rif and parts of the Atlas Mountains. Control of this erosion is needed to reduce sedimentation of present and future reservoirs and loss of soil productivity.

In my view, the most expedient and effective research approach is to establish experimental watershed in the major hydrologic and land use

areas of the country. First priority should be given to the most critical erosion and water production areas. Also, I would concentrate on upstream watersheds rather than the large diverse basins such as the Qued Sebou. I would advise that only one or two such watersheds be initially installed due to the present lack of trained staff to monitor and evaluate this research.

The basic objective of these experimental watersheds would be to serve as principal locations for installation of sufficient equipment to monitor the basic hydrologic components, conduct detailed studies on hydrologic processes, evaluate interrelationships of present and future management practices on these processes and obtain long term data for water resource planning and use.

Major attention should initially be given to acquisition of data that relate to water yield and quality (sediment yield). It is my understanding that such baseline data are not available and a great diversity occurs in the available scattered long term records. This type of information is critical to long term land management planning and design of water resource structures to effectively manage the water resource which is nonuniform in geographical and temporal distribution. Studies of temporal variation in yield and sediment production by vegetation and land use classes is essential. These types of studies are amenable to short term graduate student memoire research and longer term faculty research.

Also, a qualitative and quantitative evaluation of past management practices to control erosion should be undertaken. There has been some research of this nature on the Oued Sebou, but a more detailed analysis is in order to determine those practices that are most adaptable to different geologic, soil vegetation and climatic zones. Consideration of the past and present land use patterns in these zones may be possible through the use of a series of aerial photographs and/or visitation-aerial photograph combinations.

There is an absence to the best of my knowledge, of any economic analysis of the effectiveness of the erosion control work or reservoir construction. Furthermore, economic analysis of water use, i.e., upstream versus downstream, is not evident in any of the literature.

Finally, I can only emphasize again the importance of establishment of experimental watersheds for the acquisition of long term hydrologic data and the study of effects of management practices on hydrologic processes and components. Furthermore, these watersheds would serve as demonstration areas to landowners for trial of alternative management practices. Also, problem analysis of specific watersheds is essential prior to the initiation of research activities.

"Watershed Management Instruction

Students graduating from the second cycle of IAV have very little training in watershed management other than a course in hydraulics, statistics, and a basic science background. Consequently, it is essential that these students acquire all of their watershed management course work in the U. S. prior to beginning their memoire. This will require at least five to six quarters or three to four semesters of study depending upon the specific emphasis of training. Also, this is based upon the present lack of courses at IAV, and the initiation of third cycle instruction at IAV in 1979-1980. I have recommended that Drs. Berglund and Vavra initiate an informal seminar this academic year for their counterparts, interested parties at IAV, Forestry Research Station staff, and others to discuss various watershed management and soil conservation topics.

Academic programs for students commencing graduate study in the U. S. should be designed to develop a broad base of expertise in watershed management rather than focusing on a single aspect. In this regard, I would suggest that programs be oriented towards a basic core of hydrology courses (4-5) with specialities in erosion control (physical and biological), water use by vegetation, engineering, soil-plant-water relations and economics. I do not believe that it is wise to emphasize water quality aspects of water resources except for an introductory course and aspects of sediment. It is my belief that this is an area of concern for the future, but the water quantity problems are so immense that they must be given the highest priority for the present time.

M. Tayaa discussed his desire to return to the U. S. to obtain course work for this "doctorate program" and will be provided with study options at various U. S. institutions with strength in erosion control. It is felt, however, that field research experience would be beneficial prior to his undertaking a "doctorate" program provided the opportunity to complete the degree program at a later date is possible.

A constant dilemma evolves around the granting of a U. S. versus a Moroccan degree with associated advantages and disadvantages. A Moroccan degree will be granted by IAV even though a student has complted a U. S. Master of Science Degree. After weighing the advantages and disadvantages I am still of the opinion that a U. S. degree should not be granted. The course work should be equivalent and the "memoire" completed in Morocco under the direction of a staff member with expertise in that particular field. If a staff member at the IAV is not available, the U. S. degree is an alternative.

A possible solution is to encourage new students to apply for graduate admission without degree objectives to determine their graduate qualifications.

Early identification of students to undertake studies in the U, S. would increase our effectiveness and efficiency in planning programs.

Presently, the late identification of such students and their field of specialization does not permit sufficient time for planning of programs for the period of study, particularly if the student will be entering a university other than Minnesota, a date in early March would be of assistance.

I am recommending that most watershed management students complete their studies at the University of Minnesota. This recommendation is based upon our familiarity with the water resources and associate problems in Morocco, strength and breth of courses at the University and cooperative efforts between the scientific advisor and Team Watershed Management Specialist at IAV. Course work should be supplemented with either research experience or on-site visits at locations in the southwest or Rocky Mountain Region. This can be arranged through contacts with various federal agencies. In addition, an "intern" arrangement might be a potential. In all cases, the course work should be comparable to that required of a U. S. Master of Science or Ph.D. Degree.

"Range Management Research

Range management research in Morocco has previously focused basically on increasing grazing through reseeding and species trials. This has been the result of the consensus that it is impossible to regulate and/or control grazing on the rangelands because of the history and culture of the country.

It is my opinion that regulation of grazing in some form is a necessity, if increased production is an objective. In most cases, uncontrolled grazing of newly reseeded areas will result in the loss of potential increased productivity of forage and reversion to original or near-original conditions. A demonstration program of long term nature may be one method of showing the value of proper range management and range productivity. Also, native species managed properly may be more desirable than introduced species. I would emphasize that any demonstration project of controlled grazing must be long term - 10-15 years at least.

Most of the range management should probably be concentrated and coordinated to provide the maximum results. In this regard, a concentrated effort in one or two areas will provide information on interrelationships between management practices, nutrition and forage production as well as others. This is similar to my feelings towards watershed management research.

This does not mean to imply that range management research should not be initiated in other areas such as the oak forest type. Initiation of research in these areas are important since little is known about range conditions or management. However, the primary focus should be directed towards one or two study areas such as the Timahdit area to efficiently utilize available resources and produce maximum results through coordinated efforts.

# APPENDIX III

Curricula Vitae of Project Personnel

Section A. Administration of the Project

Section B. Long Term Field Staff Members

Section C. Short Term Field Staff Members

Section D. Consultants

Section A. Administration of the Project

James F. Tammen, Director of International Agricultural Programs and Dean, College of Agriculture

Pierre Ph. Antoine, Project Director: included in Section C: Short Term Staff Members

Joseph P. Vavra, Field Chief of Party: included in Section B: Long Term Staff Members

# JAMES F. TAMMEN

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1945-1946 | Sacramento College |
| 1946-1949<br>B. S. | University of California, Berkeley and Davis. Major: Plant science |
| 1950-1954<br>Ph.D. | University of California, Berkeley<br>Major: Plant pathology |

## Professional Experience and Employment

| | |
|---|---|
| 1949-1950 | Jr. Plant Pathologist. State of California, Bureau of Plant Pathology, Riverside. Virus diseases of citrus trees. |
| 1950-1953 | Graduate Research Assistant. University of California, Berkeley. Doctoral studies on the Fusarium disease of wheat and carnation. |
| 1953-1954 | Jr. Plant Pathologist. University of California, Berkeley. Research on the disease of floriculture crops. |
| 1954-1956 | Plant Pathologist and Chief, Plant Pathology Laboratory. State Plant Board of Florida, Gainesville. Diseases of ornamental plants. |
| 1956-1976 | Assistant Professor, Associate Professor, Professor of Plant Pathology. The Pennsylvania State University. Teaching and research on the disease of floricultural crops. |
| 1963-1976 | Professor and Head, Department of Plant Pathology, The Pennsylvania State University, University Park. |
| 1976-date | Professor and Dean, Director of International Programs, The College of Agriculture, Institute of Agriculture, Forestry and Home Economics, The University of Minnesota, St. Paul. Responsible for the programs of eleven academic departments, domestic and international. Program Director U.Minn/USAID/Morocco Project in higher education in agriculture. |

James Tammen cont.

Professional and Scientific Societies

American Phytopathological Society
International Society of Plant Pathology
American Institute for Biological Science
American Association for the Advancement of Science
Council for Agriculture Science and Technology
Sigma Xi
Gamma Sigma Delta
Pi Alpha Xi
Minnesota Academy of Science

Publications

37 scientific and technical papers.

March 1977

Section B. Long Term Field Staff

Agronomy: John L. Caddel (Plant Breeding)

Forest Resources: Erwin R. Berglund (Watershed Management)

James T. O'Rourke (Range Management)

Horticulture: Harold W. Young (Fruit Production)

Aly M. Lasheen (Fruit Production)

David W. Sams (Vegetable Production)

Soil Science: Joseph P. Vavra (Soil Conservation)

# JOHN L. CADDEL

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1966<br>B. S. | Texas A & I University, Kingsville, Texas.<br>Major: Agronomy |
| 1970<br>Ph.D. | Oklahoma State University, Stillwater, Oklahoma. Major: Plant Breeding and Genetics |

## Employment

| | |
|---|---|
| 2/71-present | Assistant Professor (employed under USAID - U. of M. contract at the IAV, Morocco) Agronomy Department, University of Minnesota. Since July 1971, Acting University Representative in Morocco. |
| 9/70-2/71 | Research Assistant, Agronomy Department, Oklahoma State University. Work - Sorghum breeding. |
| 4/66-6/69 | N.D.E.A. Fellow, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma. Work - Sorghum breeding. |
| 9/68-6/69 | Teaching Assistant, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma. Work - Introduction to Plant Science. |
| 6/69-9/69 | N.S.F. Fellow, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma. Work - Sorghum breeding. |
| Summers | Research Assistant, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma. Work - Sorghum breeding. |

## Language Proficiency (additional to English)

| | |
|---|---|
| French: | excellent speaking, reading, writing and understanding abilities |
| Spanish: | good reading ability, fair understanding |
| German: | good reading ability |

John L. Caddel cont.

Professional Qualifications

American Society of Agronomy
Crop Science Society of America

Publications

Eight scientific and technical papers.

September 1976

# ERWIN R. BERGLUND

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1970<br>Ph.D. | University of Minnesota<br>Major: Forest Hydrology |
| 1967<br>M.S. | University of Arizona<br>Major: Watershed Management |
| 1965<br>B.S. | University of Minnesota<br>Major: Forest Management |

## Professional Experience and Employment

| | |
|---|---|
| Jan. 1973<br>to July 1976 | Extension Watershed Management Specialist and Assistant Professor in the Department of Forest Engineering, Oregon State University. |
| Sept. 1970<br>to Dec. 1972 | Assistant Professor in the Department of Land Resources and Agricultural Sciences, University of Alaska. |
| July 1967<br>to Aug. 1970 | Research Assistant in the College of Forestry, University of Minnesota. |
| July 1965<br>to June 1967 | Research Assistant in the Department of Watershed Management, University of Arizona. |

## Professional Societies and Honors

American Geophysical Union
Gamma Sigma Delta
Xi Sigma Pi
National Science Foundation Traineeship, 1969-1970
Chapman Foundation Forestry Scholarship, 1964
Gillick Scholarship, Milwaukee Railroad, 1961-1965

## Publications

14 scientific and technical papers.

December, 1976

# JAMES T. O'ROURKE

## Personal Data

Age: 33

## Education

| | |
|---|---|
| 1965<br>B.S. | Colorado State University<br>Major: Forest-Range Management |
| 1967<br>M.S. | University of Arizona<br>Major: Range Management |
| 1968-1969 | Utah State University<br>Major: Correspondence in beef production |
| 1969 | U.S. Armed Forces Institute<br>Major: Correspondence in Spanish and Statistics |
| 1967,<br>1969-1970 | University of Wyoming. Ph.D. not completed.<br>Major: Range Management |
| 1974 to<br>present | University of Arizona. Ph.D. being completed.<br>Major: Range Management |

## Professional Experience and Employment

| | |
|---|---|
| Aug. 1975<br>to April 1977 | Graduate Research Associate, Instructor in School of Renewable Natural Resources and Agricultural Experiment Station. |
| June-Aug. 1975,<br>Nov-Dec. 1975 | Range Ecologist on eight member Bakel Range Livestock Project team in Eastern Senegal. |
| Dec. 1974<br>to June 1975 | Graduate Assistant in Research in Watershed Management and Agricultural Experiment Station. |
| March 1972<br>to July 1974 | Range Management Specialist on the USAID funded Masai Livestock Improvement Project in Tanzania, East Africa. |
| May 1971 to<br>March 1972 | Assistant District Ranger in charge of range management, wildlife management and watershed management on the Jemez Range District, Santa Fe National Forest, New Mexico, U.S. |

James T. O'Rourke cont.

| | |
|---|---|
| Nov. 1970 to May 1971 | Assistant Ranch Manager on 1500 acre dairy/beef/ sheep farm in Wyoming. |
| Sept. 1970 to Nov. 1970 | Short term Range Advisor to Wyoming ranching firm concerning feasibility of various ranching operations in the Llanos of Colombia, South America. |
| June 1969 to Sept. 1970, June 1967 to Oct. 1967 | Graduate Research Assistant at the University of Wyoming in the Range Management Section. |
| Oct. 1967 to June 1969 | U.S. Army Education Representative to 20 units stationed on the DMZ of Korea. |
| Sept. 1966 to June 1967, Feb. 1966 to June 1966 | Graduate teaching assistant in the Watershed Management Department, University of Arizona. |
| June 1966 to Sept. 1966, June 1965 to Feb. 1966 | Forestor on Sitgreaves National Forest, Arizona. |
| Summer Work | Range technician (1 year), Forestry Aid (4 years), Work Foreman (1 year), Ditch Rider (2 years). |

Professional Organizations

Society for Range Management
American Society of Agronomy
Soil Science Society of America
Crop Science Society of Aermica
Tanzania Society of Animal Production
East African Weed Control Society (in formation)
American Forage and Grassland Council
Soil Conservation Society of America
Tri-State Old Time Cowboys Association
Sigma Xi - National Agricultural Honorary

Languages

Swahili and Spanish

James T. O'Rourke cont.

Publications

16 scientific and technical papers.

March 1, 1976

# HAROLD WILLIAM YOUNG

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1957<br>Ph.D. | Ohio State University, Columbus, Ohio.<br>Major: Horticulture and Plant Breeding<br>Minors: Agronomy and Botany<br>Advisors: Dr. F. S. Howlett, Dr. W. N. Brown, and Dr. David C. Rife |
| 1949<br>B.S. | University of Idaho, Moscow, Idaho.<br>Major: Horticulture<br>Advisors: Dr. James E. Kraus and Dr. Leif Verner |

## Professional Experience and Employment

| | |
|---|---|
| Sept. 1963 to Aug. 1973 | Associate Horticulturist and Center Director, Agricultural Research Center, Monticello, University of Florida, Monticello, Florida. |
| Aug. 1958 to Sept. 1963 | Agricultural Research and Education Center, Quincy, Florida. |
| July 1954 to Aug. 1958 | University of Georgia, Athens, Georgia. Teaching vegetable production and seminars, and research. |
| June 1949 to July 1954 | Fellowship recipient of the Helena Chamberlain Memorial Fund, Ohio State University, Columbus, Ohio. Fellowship required full-time academic work. |
| Summer of 1948 | New York Agricultural Experiment Station, Geneva, New York. Student Assistant to Prof. W. T. Tapley, Vegetable Breeder. |
| Jan. 1946 to June 1949 | University of Idaho, Moscow, Idaho. Student Assistant in the Department of Horticulture. |

Harold William Young cont.

Military Experience

| | |
|---|---|
| Feb. 1943 to Jan. 1946 | U. S. Army Warrant Officer. |
| Sept. 1940 to Feb. 1943 | U. S. Army. NCO with various grades up to Technical Sergeant. |

International Experience

| | |
|---|---|
| 1944-1945 | China, Burma and India with U.S. Army - Assam, India, northern Burma, and Kweiyang, China areas. |
| 1971 | Mexico, visited peach research and production areas north of Mexico City. |
| 1971-1972 | South American countries of Brazil, Uruguay, Argentina, Chile, Bolivia, Peru, Ecuador, Colombia and Venezuela to observe fruit research and production. |
| 1974-1976 | Morocco. |

Professional Organizations

American Association for the Advancement of Science
Sigma Xi
Gamma Sigma Delta
Phi Epsilon Phi
American Society of Horticultural Science
AAUP
Tomato Genetic Coop
American Pomological Society
Genetic Society of America
Jefferson County Historical Society
Florida Pecan Growers Association
Florida Peach Growers Association
Texas Pecan Growers Association

Professional Biographical Dictionary

American Men of Science
Personalities of the South
Dictionary of International Biography

Publications

70 scientific and technical papers

# ALY M. LASHEEN

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1942<br>B.S. | University of Cairo<br>Major: Agriculture |
| 1949<br>M.S. | University of California, Los Angeles<br>Major: Horticulture and Plant Physiology |
| 1954<br>Ph.D. | Texas A & M University.<br>Major: Horticulture and Plant Physiology |

## Professional Experience and Employment

| | |
|---|---|
| Oct. 1975<br>to present | Associate Professor of Horticulture, University of Kentucky, Lexington, Kentucky. |
| Sept. 1971<br>to July 1975 | Horticulture Advisor, University of Kentucky - AID Contract, Khon-Kaen, Thailand. |
| July 1966<br>to Sept. 1971 | Associate Professor of Horticulture, University of Kentucky. |
| May 1965<br>to May 1966 | Professor of Plant Physiology, University of Kentucky - AID contract, Bogor, Indoesia. |
| May 1961<br>to May 1965 | Associate Professor of Plant Physiology, University of Kentucky - AID contract, Bogor, Indonesia. |
| March 1957<br>to May 1961 | Assistant Professor of Horticulture, Washington State University, Pullman, Washington. |
| July 1955<br>to March 1957 | Junior Plant Pathologist, Irrigation Experiment Station, Washington State University, Prosser, Washington. |
| July 1954<br>to July 1955 | Research Associate, Texas A & M University, College Station, Texas. |
| Jan. 1951<br>to June 1954 | Teaching and Research Assistant, Texas A & M University, College Station, Texas. |
| Jan. 1950<br>to Jan. 1955 | Assistant Foreman, Rancho Sespe (citrus and avocado farm) Fillmore, California. |

Aly M. Lasheen cont.

Languages

| | |
|---|---|
| Arabic | Excellent reading, speaking, understanding, writing |
| French | Fair reading, speaking, understanding, writing |
| Indonesian | Fair speaking and understanding |
| Thai | Fair speaking and understanding |

Professional Organizations

American Society of Horticultural Sciences
American Society of Plant Physiologists
Sigma Xi
Gamma Sigma Delta
AIBS
International Society for Cryobiology
AAAS
Southern Region, ASHS
Dwarf Fruit Tree Association

Publications

59 scientific and technical papers

March 1976

# DAVID W. SAMS

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1965<br>B.S. | Washington State University, Pullman, Washington<br>Major: General Science |
| 1971<br>M.S. | Washington State University, Pullman, Washington<br>Major: Horticulture |
| 1974<br>Ph.D. | University of Minnesota, St. Paul<br>Major: Plant Breeding |

## Professional Experience and Employment

| | |
|---|---|
| 1971-1974 | Graduate Student, NDEA Fellowship to University of Minnesota. |
| 1970-1971 | Graduate Student, Washington State University. |
| 1969-1970 | Teacher in North River Public Schools teaching math, biological sciences, and physical sciences. |
| 1967-1969 | Teacher in Oakville Public Schools teaching math, biological sciences, and physical sciences. |
| 1965-1967 | Teacher in the Lyle Public Schools teaching math, biological sciences, and physical sciences. |

## Graduate and/or Professional Honors

Horticulture Department Scholarship, Washington State University
National Defense Education Act Fellowship

December 1974

# JOSEPH P. VAVRA

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1943<br>B.S. | Michigan State University<br>Major: Soils |
| 1948<br>M.S. | Michigan State University<br>Major: Soils |
| 1951<br>Ph.D. | Purdue University<br>Major: Soils<br>Minor: Chemistry, Crop Physiology |

## Professional Experience and Employment

| | |
|---|---|
| 1972 to present | Research Coordinator of National Research Program for Cereals and Grain Legumes, Ministerio de Agricultura, Instituto Nacional de Investigaciones Agrarias, Madrid, Spain. |
| 1969-1971 | Soils Advisor to the Research Division of the Brazilian Ministry of Agriculture, Rio de Janeiro, Brazil. |
| 1951-1969 | Assistant to Full Professor, Department of Plant Industries, School of Agriculture, Southern Illinois University, Carbondale, Illinois. |
| 1949-1951 | Research Fellow, Department of Agronomy, Purdue University. |
| 1948-1949 | High School Agricultural teacher, White Cloud High School, White Cloud, Michigan. |
| 1947 | Baseball Pitcher, House of David Professional Baseball Team. |
| 1943-1946 | Officer, U. S. Army - Platoon Officer, Personnel Officer for German Civilians and Camp Commander of a German Political Prison. |

Joseph P. Vavra cont.

Languages

Portuguese and Spanish

Honors and Other Activities

President, Egyptian Soil Conservation Society
Fellow, American Association of Advancement of Science
Who's Who in Education
Who's Who in the Midwest
Consultant, United Electric Coal Company, Sahara Coal Company
Consultant, Sorir Desert Agricultural Development Project, Libya
Advisor, Southern Illinois Herbicide and Fertilizer Association

Professional Organizations

American Society of Agronomy
Soil Science Society of America
Crop Science Society
Brazilian Soil Science Society
Spanish Soil Science Society
International Soil Science Society
Illinois State Academy of Science
Sigma Xi

Publications

22 scientific and technical papers

January 1976

Section C. Short Term Field Staff

Plant Pathology: Benham E.L. Lockhart (Virology)

Soil Science: Jean A. Molina (Soil Microbiology)

Pierre P. Antoine (Pedology)

# BENHAM EDWARD L. LOCKHART

## Personal Data

Date of Birth: [redacted]

Citizenship: U.S.

## Education

| | |
|---|---|
| 1965<br>B.Sc (Agric) | University of the West Indies, Trinidad<br>Major: Crop Science |
| 1963-64 | University of Rhode Island, Kingston, Rhode Island. Summer Exchange Student; trainee in Poultry Science, Summer Session course in German |
| 1969<br>Ph.D. | University of California, Riverside, California<br>Major: Plant Pathology |

## Professional Experience and Employment

| | |
|---|---|
| July 1976<br>to present | Assistant Professor, University of Minnesota doing virus research and teaching. |
| July 1971<br>to July 1976 | Assistant Professor, University of Minnesota at IAV, Morocco doing virus research and teaching. |
| July 1969<br>to July 1971 | Instructor, University of Nebraska doing virus research. |
| 1967-1969 | Research Fellow, University of California, in virus research. |
| 1965-1966 | Lab assistant for part time employment in mycology at the Universith of California. |
| 1966-1969 | Research assistant in virus research for summer employment at the University of California. |
| 1965 | Research assistant for citrus research for summer employment at the University of the West Indies. |
| 1963,1964 | Exchange student in Poultry Science and Poultry Pathology during the summer at the University of Rhode Island. |

Benham Edward L. Lockhart cont.

Undergraduate and Graduate Honors

1962 St. Vincent Scholar Award to student placing highest in 1961 University of Cambridge Higher School Certificate examinations given by the United Kingdom Government.
Jesse Carr Fellowship (1967) - University of California
University of California Research Fellowship (1968) - University of California
Postdoctoral Research Fellowship, 1969, University of Nebrasla/USDA

Languages

| | |
|---|---|
| French | Can serve as an interpreter |
| Latin | Can translate publications in the language into English |
| German | Can translate English publications into the language and German publications into English; can read a newspaper in the language. |
| Spanish | Can read a newspaper in the language, present competency in the language limited, but could be regained with some review |

Publications

34 scientific and technical papers

March 1977

# JEAN-ALEX E. MOLINA

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1955<br>B.A. | University of Paris |
| 1960<br>I.A. | Institut National Agronomique, Paris, France. |
| 1963<br>M.S. | Cornell University, New York.<br>Major: Agronomy. |
| 1967<br>Ph.D. | Cornell University, New York.<br>Major: Agronomy. |

## Professional Experiences and Employment

| | |
|---|---|
| 1961-1963 | Research Assistant, Department of Agronomy, Cornell University, New York. |
| 1963-1965 | French Liaison Officer during French military service. |
| 1965-1967 | Research Assistant, Department of Agronomy, Cornell University, New York. |
| 1967-1970 | Assistant Professor, Department of Agronomy, University of Illinois, Urbana-Champagne, Illinois. |
| 1970-1972 | Assistant Professor, Department of Soil Science, University of Minnesota, St. Paul, Minnesota. |
| 1972-1976 | Associate Professor, Department of Soil Science, University of Minnesota, St. Paul, Minnesota. |
| 1970-1975 | Leader , USAID/Minnesota Project, Hassan II Institute, Morocco. Member of an overseas program of the University of Minnesota at the Hassan II, Institute of Agriculture and Veterinary Medicine, Rabat, Morocco, employed as Associate Professor, Department of Soil Science and International Agriculture, University of Minnesota. |

Jean-Alex E. Molina cont.

Languages

| | |
|---|---|
| French | Excellent speaking, reading and writing (native language) |

Professional Organizations

American Society for Microbiology
American Society of Agronomy
Phi Kappa Phi
American Association for the Advancement of Science

Publications

13 scientific and technical papers.

# PIERRE P. ANTOINE

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1970 | University of Minnesota, Department of Soil Science: Ph.D.<br>Major: Soil Genesis, Morphology and Classification<br>Minor: Supporting program in Mineralogy, Photo-interpretation and Statistics |
| 1965 | Ingénieur Chimiste et des Industries Agricoles: from the Institute of Agriculture, University of Louvain, Belgium. (European degree in Chemical Engineering granted by Institute of Agriculture with emphasis on Food Technology, Physical Chemistry and Mineralogy.) |

## Professional Experience and Employment

| | |
|---|---|
| 1976 to present | Assistant Professor (tenure track position), Department of Soil Science, University of Minnesota, and Project Director, International Agricultural Programs, College of Agriculture, University of Minnesota. |
| 1970-1976 | Member of an overseas program of the University of Minnesota at the Hassan II, Institute of Agriculture and Veterinary Medicine, Rabat, Morocco, employed as Assistant Professor, Departments of Soil Science and International Agriculture, University of Minnesota. |
| 1975-1976 | University of Minnesota representative for the University's six-man team in Morocco. |
| 1965-1970 | Research Assistant, Department of Soil Science, University of Minnesota. |

## Languages

| | |
|---|---|
| French | Excellent speaking, reading and writing (native language) |
| Spanish | Very good reading, good speaking and fair writing |
| Dutch | Fair knowledge (fluency attained during youth) |
| Latin & Ancient Greek | Six years of high school |

Pierre P. Antoine cont.

Professional Organizations

American Society of Soil Science
International Society of Soil Science
Belgian Society of Soil Science

Publications

Seven scientific and technical papers.

March 1978

Section D. Consultants

Horticulture: Simon E. Malo

Range Management: John E. Taylor

Watershed Management: Arnett C. Mace, Jr.

# SIMON E. MALO

## Personal Data

Date of Birth: [redacted]

Citizenship: U.S.A.

## Education

| | |
|---|---|
| 1954 | Diploma in Tropical Agriculture (Agronomo)<br>Panamerican School of Agriculture<br>Tegucigalpa, Honduras |
| 1957<br>B.S.A. | University of Florida, Gainesville, Florida<br>Major: Fruit Crops and Nematology |
| 1960<br>M.S.A. | University of Florida, Gainesville, Florida<br>Major: Fruit Crops and Nematology |
| 1964<br>Ph.D. | University of Florida, Gainesville, Florida<br>Major: Fruit Crops and Nematology |

## Professional Experience and Employment

| | |
|---|---|
| 1964 to date | Associate Horticulturist (Professor), University of Florida, IFAS. Agricultural Research and Education Center, Homestead, Florida. |
| 1960-1961 | Production Manager, research project on tropical fruits and ornamentals. Palmer Nurseries, Saratoga, Florida. |
| 1957-1958 | National School of Agriculture, Managua, Nicaragua, teaching tropical horticulture.<br>U.S. AID - Nicaraguan Government. |
| 1954-1955 | Panamerican School of Agriculture, Tegucigalpa, Honduras, teaching tropical horticulture. |

## Languages

Fluent in Spanish, very good working knowledge in Portuguese.

March 1977

# JOHN E. TAYLOR

## Education

| | |
|---|---|
| 1958<br>B.S. | Idaho State University<br>Major: Conservation |
| 1960<br>B.S. | Washington State University<br>Major: Zoology |
| 1967<br>M.S. | Montana State University<br>Major: Range Science |
| 1976<br>Ph.D. | North Dakota State University<br>Major: Plant Ecology |

## Service at Montana University

| | |
|---|---|
| 1960-1963 | Graduate Research Assistant |
| 1963-1967 | Instructor |
| 1967-1976 | Assistant Professor |
| 1976-present | Associate Professor |

## Professional Organizations

Society for Range Management
Ecological Society of America
American Society of Photogrammetry
American Association for the Advancement of Science
American Association of University Professors
Montana Society for Remote Sensing (current President)
Montana Academy of Science

## Honorary Societies

Phi Mu Alpha (music)
Sigma Xi (scientific research)
Phi Sigma (biology)
Alpha Zeta (agriculture)

John E. Taylor cont.

Current Research (Principal Investigator)

| | |
|---|---|
| G&C 804 | Monitoring plant community changes due to fossil fuel power plants in eastern Montana (EPA). |
| G&C 665 | Photographic monitoring of native vegetation for air quality studies. |

Publications

12 scientific and technical papers.

March 1977

# ARNETT C. MACE, JR.

## Personal Data

Date of Birth: [redacted]

## Education

| | |
|---|---|
| 1960<br>B.S.F. | West Virginia University, Morgantown, West Virginia. Major: Forestry |
| 1962<br>M.S. | University of Arizona, Tucson, Arizona.<br>Major: Watershed Management/Botany and Soils |
| 1967<br>Ph.D. | University of Arizona<br>Major: Watershed Management/Plant-Soil-Water Relations |

## Professional Experiences and Employment

| | |
|---|---|
| July 1974<br>to Dec. 1977 | Professor and Head, Department of Forest Resources, University of Minnesota, St. Paul, Minnesota. |
| July 1972<br>to June 1974 | Associate Professor and Head, Department of Forest Biology, University of Minnesota, St. Paul, Minnesota. |
| July 1971<br>to June 1972 | Associate Professor, College of Forestry, University of Minnesota, St. Paul, Minnesota. |
| Sept. 1967<br>to June 1971 | Assistant Professor, College of Forestry, University of Minnesota, St. Paul, Minnesota. |
| July 1965<br>to Aug. 1967 | Instructor-Research Associate, Department of Watershed Management, University of Arizona, Tucson, Arizona. |
| Feb. 1964<br>to July 1965 | Research Associate, Department of Watershed Management, University of Arizona, Tucson, Arizona. |
| May 1962<br>to Feb. 1964 | Research Forester, Rocky Mountain Forest & Range Experiment Station, Tempe, Arizona. |
| Nov. 1960<br>to May 1962 | Graduate Research Assistant, Department of Watershed Management, University of Arizona, Tucson, Arizona. |

Arnett C. Mace, Jr., cont.

| | |
|---|---|
| Sept. 1960 to Nov. 1960 | Graduate Teaching Assistant, Department of Watershed Management, University of Arizona, Tucson, Arizona. |
| June 1960 to Sept. 1960 | Summer Graduate Assistant, Department of Watershed Management, University of Arizona, Tucson, Arizona. |
| Sept. 1959 to May 1960 | Student Assistant, Department of Forestry, West Virginia University, Morgantown, West Virginia. |
| June 1959 to Aug 1959 | Student Instructor, Department of Forestry, West Virginia University, Morgantown, West Virginia. |
| June 1957 to July 1957 | Summer Employee, U. S. Forest Service, Region 5, San Andreas, California. |

Professional Organizations

Society of American Foresters, Past Secretary-Treasurer and Chairman of Southern Minnesota Chapter
American Geophysical Union
American Water Resources Association
Sigma Xi
Xi Sigma Pi

Honors and Awards

Outstanding Senior in Forestry - West Virginia University
"Uncle of Paul" - given to faculty member who has made significant contributions to the Forestry Club - 1969
Horace T. Morse Award - All-University Award given for outstanding contribution to Undergraduate Education - 1974

December 1977