Review Report #1

U.S. Agency for International Development

Oregon State University

211(d)

MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

AID/ta-G-1221

September 1976

CONTENTS

Report prepared by: Office of International Agriculture
Oregon State University
Corvallis, Oregon 97331 / USA

September 1976

PROGRAM PROFILE

grant title •
MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

grant number •
AID/ta-G-1221

grantee •
OREGON STATE UNIVERSITY

grant program director •
DR. S.F. MILLER

AID liaison office •
TAB/AGR

AID liaison officer •
DR. DILLARD GATES

period of grant •
JULY 1, 1975 TO JULY 1, 1980

period covered by this report •
JULY 1, 1975 THROUGH JUNE 30, 1976

amount of grant •
$1,000,000

expenditures for report period •
$111,981.11

CONDENSED SUMMARY

Under the aegis of a $1,000,000, 5-year grant from the Agency for International Development, Oregon State University launched a program in mid-1975 to marshal and broaden existing expertise in dryland agriculture and create a center of excellence and information for assisting less developed countries.

A technical committee (techcom) was selected from OSU staff members of the agronomy, range, soils, agricultural engineering, and agricultural and resource economics departments, plus a representative from the library. The techcom became the nucleus and operating arm of the grant.

A work plan was formulated with five major outputs concerning information systems; education and training; research capability and knowledge base; advisory capacity; and linkage establishment.

An information retrieval program was initiated. The resulting mass of documents, all coded into a computer based system, numbered 1,200; many are physically collected in one spot, available to the techcom or others.

The techcom met at Riverside with UC/R's 211(d) group to assess mutual areas of interest. One immediate result will be a jointly organized seminar in early 1977.

During April 1976, most techcom members visited Morocco, Tunisia, Turkey, Iran, and Pakistan and observed dryland agriculture and related problems in those countries.

A dryland training site was identified and preparations begun to equip it for use by trainees. The techcom reviewed present OSU course offerings in dryland agriculture and suggested to the appropriate departments modifications that would make the courses more relevant to the need of students in dryland agriculture. Several academic programs of study, geared for different emphases, but all based on the need for educational experience related to dryland agriculture, were developed to insure compatability between student needs and course offerings.

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NARRATIVE REPORT

GENERAL BACKGROUND AND DESCRIPTION OF THE PROBLEM

Despite the publicity given the phrase, "in Oregon you don't tan, you rust," the state has an immense area in its eastern region that has low amounts of rainfall concentrated during a few months of the winter season. Agriculture in this region, aside from that which is irrigated, depends on winter season rainfall and is, in the full sense of the term, dryland agriculture, devoted to small grains, and animal forage.

A major effort by Oregon State University and the state's agricultural experiment station has been devoted over the years to developing methodology and practice to improve agricultural production in the dryland areas. One of the primary thrusts involved is conservation and beneficial utilization of available moisture. Numerous disciplines have taken part in the ongoing effort resulting in the establishment of a significant body of information and experience with dryland agricultural production dependent on winter rainfall.

OSU previously had experience with international programs in Turkey and Jordan oriented to increasing cereal production and expanding cereal production research and extension. The existence of these programs plus the interest and experience of OSU in dryland agricultural development led to discussions with the U.S. Agency for International Development and ultimately resulted in AID awarding a 5-year grant to OSU to marshall and expand its expertise and to develop a center of excellence in dryland agriculture that could be harnessed for application to less developed countries. The grant, entitled Moisture Conservation and Utilization in Low Winter Rainfall Areas of LDCs, was subsequently launched in mid-1975.

PURPOSE OF THE GRANT

The specific purpose of the grant, as stated in the accepted proposal is to mobilize and focus an institutional response capability at Oregon State University to deal with moisture conservation and utilization in relation to food production with emphasis on small farms in low winter rainfall (Mediterranean climate) areas of the LDCs.

The grant is to allow OSU to develop broader response capability in: 1) situations involving grain-livestock interaction as a major dryland activity; 2) improved moisture conservation and utilization related to the grain-animal-forage production complex; 3) more efficient use of farm power and equipment within LDC social and economic constraints.

OBJECTIVES OF THE GRANT

In broad perspective, the grant's objectives encompass the establishment and development of a center of competence with the ability and willingness to respond to needs of LDCs in low winter rainfall areas throughout the world to improve their dryland farming systems and, by extension, the quality of life.

Five major objectives/outputs were defined for the grant as follows:

Output #1 - Establish and operate a centralized information system.

Output #2 - Develop and provide an education training program specifically addressed to problems of LDCs.

Output #3 - Expand, improve, and marshal an institutional research capability and knowledge base.

Output #4 - Develop and provide increased advisory capacity.

Output #5 - Promote and strengthen domestic and international linkages.

The objectives/outputs are detailed in the grant work plan, a copy of which is attached (Appendix I).

The 211(d) program at Oregon State University has been in force for only one year, a fact that has precluded extended attention to, or activity on, all five program objectives. A curve of emphasis fairly well follows the objectives in order of listing; during the first year of grant life, more emphasis has been placed on designing and launching an information system, less on developing an education/training program and on expanding the institution's knowledge base (groundwork for the State of the Arts study). Less emphasis has been placed on both advisory capability and active establishment of linkages.

The specific work associated with each objective is spelled out in more detail in the next section of this report.

ACCOMPLISHMENTS

Each of the five objectives/outputs established for the grant are discussed in this section relative to the activity that has occurred within the particular sector. The objectives/outputs are condensed to just the words underlined in the section, Objectives of the Grant.

At the outset of the grant, an organizational structure was created within Oregon State University with the key body being the AID/OSU dryland grant technical committee (techcom). Membership of the techcom for 1975-76 was:

Dr. F.E. Bolton, Department of Agricultural Crop Science
Dr. D.E. Booster, Department of Agricultural Engineering
Dr. J.B. Fitch, Department of Agricultural and Resource Economics
Dr. T.L. Jackson, Department of Soils (Fertilizer)
Dr. C.H. Ullery, Department of Soils (Moisture-Soils Relationship)
Dr. A.H. Winward, Department of Range Management

Dr. S.F. Miller heads the techcom as grant director and information/library support is represented by S. Riehl working through the Agricultural Librarian of the William Jasper Kerr Library, M. Kinch. Responsibility for coordinating the grant lies with the Office of International Agriculture within the School of Agriculture.

A. CENTRALIZED INFORMATION SYSTEM

The initial efforts to establish an information resource have centered on the identification and collection of the existing body of literature concerned with dryland agriculture worldwide. Concurrently, grant supported staff have begun developing a system of information linkages with other institutions--both in the U.S. and abroad--where dryland research is carried out.

The problem of providing relevant research literature is two-fold. First, the task of assembling necessary literature and establishing a procedure to search the literature for appropriate citations had to be solved. Literature delivery--the process of putting information into the hands of competent and needy researchers--constituted the second phase of the problem. It was determined that both activities need to be implemented simultaneously to create an effective system.

The major thrust of this objective is to increase the capacity of the William Jasper Kerr library at Oregon State University to provide basic and specific materials concerning dryland agriculture in the world. In this manner the opportunities to conduct relevant and important research are enhanced within OSU as well as without.

To date, over 1,200 separate literature citations have been assembled, processed, and incorporated into a computerized dryland bibliography. The bibliography covers all disciplines related to dryland farming, but devotes special attention to the disciplines of agricultural engineering, agricultural economics, soils, agronomy, and range management. Journals, books, serials, papers, bulletins, and previously uncataloged reports from the United States and the North African-Mediterranean region are included in the bibliography.

The bibliography may be searched by use of the computer through a key words system. Individual citations contain publication title, author's name, source, descriptive key words, and access numbers. It does not provide an abstract, however. The bibliographic system is increasing rapidly; the expectation is that it will double in size to over 2,500 listings by July of 1977.

Collected literature is housed in the Kerr Library in either the main library collection or in a special collection room prepared for dryland agriculture. The materials are all indexed, coded, filed, and readily available to research personnel inside and outside the University through library check-out procedures.

In July, 1976 the library staff developed a plan for document delivery services that will be offered to researchers in LDCs. Two hundred pages of noncopyrighted material from the collection will be copied and mailed free to requestors. Forty seven letters to research institutions have been sent announcing this service.

Cooperation in developing CIDNET, CID's integrated information network, is also underway with the other CID universities. OSU is prepared to provide a computer tape of the dryland bibliography to the University of California at Riverside (UC/R) as its contribution to CIDNET. The tape, with slight modification, should be compatible with the TRIM system presently utilized by UC/R.

An inventory of sources of individual and institutional expertise in international research and training was compiled. It includes not only expertise in dryland agriculture, but also other dimensions and disciplines of international agriculture. The inventory consists of individual questionnaires containing information on the background, expertise, and interest of all interested OSU faculty members. Constant use of the inventory is made in attempting to identify candidates for AID and CID positions. The present size of the inventory is 93.

The accomplishments of 1975-76 are consistent with, and inclusive of, the scheduled events and targets specified in the work plan. A total of 11.8 man months of professional time plus 659 hours of student help were spent in the pursuit of the objectives at a cost of $19,239.18 from the grant. An additional 2 man months of non-grant effort at a cost of $2,000 were utilized in the pursuit of the objectives. They arose primarily in the form of support provided by the library and administrative and logistic support of the University.

B. EDUCATION AND TRAINING PROGRAM SPECIFICALLY ADDRESSED TO PROBLEMS OF LDCs

Training programs in moisture conservation and utilization are needed at several administrative and research levels for research administrators, for scientists, and for trainees. Farmers also need training; however, their needs are best served by utilizing local trainers. Oregon State will emphasize training of personnel to train rural workers.

The training must consist of both formal degree as well as non-degree and informal opportunities. Because of the special nature of dryland farming and because of the need to consider agronomic, livestock, economic, and social issues in developing and conducting appropriate research and resource management policies, the formal academic training needs to be multi-disciplinary in nature. Considerable flexibility must be provided to allow trainees to pursue several disciplines simultaneously and to pick relevant courses from these.

The Master of Agriculture program at OSU appears to be a good vehicle for this purpose. It provides the student with an opportunity to select courses from at least three agricultural or agriculturally-related disciplines. The major professor will be from the student's major interest department. To determine the feasibility of utilizing the Master of Agriculture program, a review was made of existing departmental course offerings with regard to their filling the existing educational needs of prospective students. Selected programs were prepared with majors in Agricultural Economics, Soils, Crop Science, and Range-Livestock Management, and minors in related agricultural fields. Two new courses were identified as being required--one in moisture conservation and utilization, and a second in farm machinery at the graduate level. Course titles and outlines are being prepared presently for the new courses in order to solicit and receive necessary administrative approval for offering them.

In order for prospective students to have an adequate research facility for experimentation in an ecologic zone similar to the dryland areas of North Africa and the Mediterranean, a research and training center in dryland agriculture has been established at the Sherman Branch Station in Moro, Oregon. Applied field research and extension training can be pursued at this station as well as at surrounding off-station locations. Specialized equipment has been purchased to support training and research in dryland agricultural systems and moisture conservation techniques. To date, equipment ordered, purchased, or leased includes:

- 2½ ton equipment truck with roll-back ramp;
- 42 hp diesel crawler tractor with special wide tracks;
- dryland deep furrow grain drill (plot type);
- sweep plow, subsoiler plow, and off-set disk;
- vehicle-mounted hydraulic soil probe.

One half of the salary of the station manager at Moro is paid for out of the grant. The other half is paid by the University.

The center not only will serve the needs of students in formal academic training programs, but also can be used to conduct workshops, short courses, and symposiums. The first symposium scheduled, though, will not be at the station, but at Riverside, California, held in cooperation with UC/R during February 21-25, 1977.

This symposium will be funded in part by the two host institutions out of their respective 211(d) grants and in part through a special grant from AID/Washington. The symposium will cover moisture conservation and utilization in rainfed areas of the world. UC/R will develop the program for the summer rainfed areas and OSU for the winter rainfed areas. Approximately 30 participants will be invited from developing countries of the world who, together with scientists from the United States and international organizations, will create a total participation of between 100-120 agriculturalists. Additional short courses and workshops are planned for the future.

The University is providing major support for fulfilling this objective by providing the Sherman Branch Station training site in addition to continued administrative and logistic support. Approximately 87 man months and $21,105.99 of time and cash from the grant were expended in the pursuit of this objective.

C. INSTITUTIONAL RESEARCH CAPABILITY AND KNOWLEDGE BASE

A major objective of the grant is to develop a paper, or series of papers, describing the state of the technical arts (SOTA) with reference to dryland agriculture. It is envisioned that the paper will consist of three parts: a description of the present state of scientific knowledge regarding utilization and management of drylands in winter rainfall areas; an analysis of the present state of technology employed by developing countries in North Africa and the Mediterranean; and, identification of the gaps between information and techniques known and that being applied.

In order to prepare the paper, a complete review of scientific literature, by discipline, is required. Second, a trip to the region is needed to identify the present status of technology employed. And third, specific research projects and proposals need to be developed to improve the existing knowledge base.

An outline for the paper (or series) has been prepared by the techcom and authorship assigned for various sections. Initial rough drafts have been written and circulated for technical review as well as to enlarge the base of knowledge of techcom members about the specialties and disciplines of their fellow committee members.

A trip was taken to the North African-Mediterranean area during April and May, 1976, by most of the techcom representing agricultural economics, soils, agronomic crop science, agricultural engineering, and range management. Five countries were visited: Morocco, Tunisia, Turkey, Iran, and Pakistan. The resulting trip report is included in this annual report as Appendix VI. The OSU techcom toured dryland farming and ranching operations in each country. Contacts were made with personnel from AID, CIMMYT, FAO, Rockefeller Foundation, Ford Foundation, and various governmental agencies and universities. An immediate result was acquisition of considerable literature. A second trip to Australia is planned this fall (1976) for several techcom members to gain familiarity with promising dryland farming techniques developed and successfully applied in Australia (wheat-medic rotations).

The SOTA review has resulted in four proposals for research projects to be instituted at the Moro station and elsewhere in Oregon. A budget using grant funds has been established and project work will begin in the next fiscal year. The funded proposals are:

1. Management of winter annual legumes and winter wheat cropping systems by T.L. Jackson, soils;

2. Soil temperature relationships under hay and stubble mulch fallow treatments, and effects on emergence of winter wheat and winter barley under dryland conditions by F.E. Bolton, agronomic crop science;

3. Fertilizer use in wheat-fallow systems under conditions of weather uncertainty by J.B. Fitch, agricultural resource economics;

4. Strip-tillage: a new method of managing summer fallow for cereal production in the Pacific Northwest by F.E. Bolton.

Selected students--domestic and foreign--will work in cooperation with the senior researcher on the projects.

Three special papers have been prepared on topics related to the development of dryland agriculture by students in International Agricultural Development, a course in agricultural economics. The students were directed by Dr. J.B. Fitch and the papers are:

1. The cultural setting for development in the Anatolian Plateau of Turkey;

2. Decision-making under uncertainty in dryland agriculture; and

3. An evaluation of Australian dryland production systems with respect to their potential for introduction in the Anatolian Plateau.

A proposal for additional AID funding has been prepared by Dr. T.L. Jackson and Dr. A.H. Winward and will shortly be submitted to AID/Washington. It is concerned with the potential development, utilization, and management of wheat-legume rotations.

Over 21.53 man months of effort and $48,548.88 were expended in the pursuit of this objective.

D. INCREASED ADVISORY CAPACITY

Problem identification, problem analysis, project design, training, research, technical services, and evaluation are all functions of an advisory group. OSU will continue to strengthen its capacity to provide these services to AID, international organizations including CID, and other agencies. Capabilities, which now exist in dryland agronomy, soil management, agricultural economics, and weed control, are being developed in livestock grazing management systems and agricultural power and machine specialties.

While in Morocco, the techcom was asked to evaluate a proposal developed by AID/RABAT for dryland agriculture. The proposal was evaluated, possibly leading to an opportunity to become involved with implementation of the project.

Requests are being received constantly for service of the University. The tables in Appendixes II and III provide a list of the requests and the action taken in each case. One of the major requestors, as seen in the tables, was CID. As a participating member in CID, Oregon State University feels a strong responsibility to respond constructively to these requests. However, manpower constraints often effectively curtail participation. It should be noted that many of the requests are beyond the immediate focus of the grant and, therefore, outside the strength in dryland advisory service that OSU is attempting to create.

An important aspect of creating advisory capacity is the training of personnel. A considerable amount of time has been spent at OSU orienting techcom members to conditions and problems in the North African-Mediterranean regions. The orientation has included seminars and lectures, as well as films and suggested reading. Guest discussants have included:

- Dr. Bill Wright, Rockefeller Foundation, Turkey
- Dr. Don Winkleman, CIMMYT
- Dr. Norman Goetze, OSU, Jordan project
- Dr. Ed Sehmessun, OSU, Economic evaluation of Jordanian activity
- Dr. Homer Hepworth, OSU, Turkey project
- Dr. Dave Moore, OSU, Jordanian project
- Dr. Willis McQuistion, OSU, Plant breeder with experience in Turkey

The study trip to the North African-Mediterranean zone was a major advance in training project personnel.

Members of the techcom traveled to the University of California at Riverside campus on December 3, 1975, for a two-day meeting with UC/R 211(d) project personnel. Project activities and plans were discussed. Problems, and approaches to problem solution, in international work were also discussed. Of special interest was the UC/R team's recent trip to the Sahelian zone of Africa. The importance of adequate planning was emphasized. The meeting led to an intensification of effort by OSU techcom members to verify schedules and contacts prior to arrival in North Africa and the Mediterranean.

Washington State University (WSU) has a contract with AID/Damascus to study a dryland region in Syria. Contact was made with WSU personnel to determine their objectives and the results of their visit. Two OSU techcom members visited WSU for this purpose. As a result, Syria was eliminated from the North African-Mediterranean trip itinerary. Contact is being maintained between the two institutions in an attempt to keep each other informed on progress of the respective contract and grant.

Three point thirty-one man months of professional time and $6,017.99 were used to improve the advisory capacity of the University.

E. DOMESTIC AND INTERNATIONAL LINKAGES

A network of linkages is necessary between OSU and other institutions with interests relevant to moisture conservation/management in areas of winter rainfall. Major linkages were established with CID member institutions. Of special concern is the linkage with UC/R, since similar conservation and management techniques are often employed in summer as well as winter rainfall areas.

A close linkage is being developed between OSU and the international centers, i.e., CIAT, IRRI, CIMMYT, ICRISAT, and the proposed center of ICARDA (International Center for Agricultural Research in Dry Areas). Unfortunately, this latter organization never truly came into existence because of the Lebanese civil war.

Through the efforts of the techcom, and with assistance of the OSU wheat breeding program being pursued with CIMMYT participation, an especially good relationship has developed between the OSU group and CIMMYT staff. Care is being taken to see that the linkage is strengthened. Team members are working cooperatively with the wheat breeding program in developing appropriate management packages for dryland farming. Funds have been set aside for this cooperative effort within the OSU breeding program.

A close linkage is being developed with AID missions and the Regional and Technical Assistance Bureaus. AID missions were very helpful in preparing the agenda and travel plans for the techcom's North African-Mediterranean trip. The techcom responded by leaving reports of its evaluation of the situation with the mission and by suggesting modifications in plans and approaches to dryland utilization. In Morocco the techcom was able to indicate a particularly strong interest in providing further technical assistance.

Strong linkages are being established with foreign governmental research and educational institutions and libraries. In the search for relevant dryland literature, and in the writing of the state-of-the-art study, contact has been made with many of the important governmental institutions in the region. In return for their help, the grant is providing them access to the OSU informational retrieval system. Selected publications previously developed in the OSU/Turkey project are also being supplied upon request.

OSU also provided $10,000 to the CID administrative office to further the liaison capabilities of the consortium. An additional $10,000 will be given each year of the remaining life of the grant. The consortium provides an ideal unit for close cooperation and effort on international projects. The associated universities can pool talent and collectively provide better service to the developing world.

Seventeen thousand nine hundred eighty one dollars and eleven cents and 2.01 man months of project effort were used in creating and strengthening linkages.

OTHER RESOURCES FOR GRANT-RELATED ACTIVITIES

Oregon State University is making a major contribution to the objectives of the grant through the free use of University facilities and administrative staffs. While this contribution was understood at the time of awarding the grant, its importance to the success of the grant should not be overlooked. The library provided $2,000 of support through the efforts of the William Jasper Kerr agricultural librarian.

Also, the OSU cereal breeding program is making available $4,500 for the support of a graduate student in dryland production systems. Dr. F.E. Bolton, dryland agronomist and techcom member, is supervising this program. The objectives are consistent and compatible with those of the grant.

Funding is being sought for additional support, including a proposal for developing management strategies for wheat-legume rotations, from AID/Washington and other local and non-University sources. However, no additional funds are available presently.

UTILIZATION OF INSTITUTIONAL RESPONSE CAPABILITIES IN DEVELOPMENT PROGRAMS

The first year of the grant witnessed the commencement of assistance requests, primarily in connection with suggesting names of individuals to be considered for overseas assignments. Appendix II provides a log of these requests, mainly from CID, that were fulfilled, while Appendix III notes two requests that were not fulfilled.

NEXT YEAR'S PLAN OF WORK AND ANTICIPATED EXPENDITURES

Activities for the coming year will be discussed by major output.

1. CENTRALIZED INFORMATION SYSTEM

Continued effort will be made to collect, evaluate, and disseminate information covering U.S. and other developed countries, as well as developing country dryland agricultural production systems. The computerized dryland bibliography will continue to expand and should contain upward of 2,500 citations by the end of the grant's second year. Special attention will be given to helping develop the CID information network.

A distribution policy has recently been developed by the grant and is being advertised. Foreign researchers will be offered a limited photocopying service for OSU dryland material. Duplicate copies of materials will be available on an unrestricted basis. Bibliographic searches will be made without cost to the requestor.

Considerable effort will be directed toward increasing acquisitions of the special collection on dryland agriculture in the William Jasper Kerr Library. As the SOTA literature reviews continue to uncover related material, it will be obtained and incorporated into the special collection and subsequently the computerized bibliography.

As the SOTA paper becomes more formalized, a policy and procedure will be established for its dissemination. This may take several forms including, but not restricted to textbook, technical bulletins, extension publications and newsletters.

Effort will be made to increase and update the inventory of individual and institutional talent within the University, the U.S., and other developed and developing countries. Improved response capability to assist requests should result from this activity.

2. EDUCATION AND TRAINING PROGRAM

The first graduate students to attend OSU as a result of grant activities are expected to arrive in the fall of 1976. This is one year ahead of anticipated arrival. However, adequate plans have been made and a special curriculum developed consistent with the techcom's general review of existing and needed course offerings in dryland agriculture.

The Sherman Branch Station is adequately staffed and equipped to start the necessary applied training of the students.

A rainfed agriculture symposium in cooperation with UC/R is scheduled for February 1977. Extensive plans have been made to bring in both participants and observers from developing countries. The symposium will provide a useful forum to test the conclusions and summaries of the SOTA paper.

The need for special courses and workshops is recognized. However, it is doubtful that any can be prepared within the next year.

3. RESEARCH CAPABILITY AND KNOWLEDGE BASE IMPROVEMENT

A major commitment has been made to complete the SOTA paper during the next year (1976-1977). To do so, a trip by techcom members to Australia will be required to review cereal-legume rotation and assess its applicability to North African and Mediterranean areas. The grant agricultural economist will also visit Turkey and Tunisia since he was unable to participate in the earlier trip to this region.

An outline of the SOTA paper has been prepared and authorship assigned for all the sections. The material developed will serve not only for the SOTA paper, but also as part of individual presentations for the joint OSU-UC/R symposium.

Research proposals have been written and funded for the next year. Work has started, and will continue during the next year. The proposals were listed earlier in Accomplishments, Section C, of this report. Additional research needs will be identified and proposals developed. Funding will be sought both within and outside the grant.

The primary result of achieving this objective is to identify OSU as the principal institution for dissemination of knowledge and technical service and advice with regard to dryland farming in areas of low winter rainfall.

4. INCREASED ADVISORY CAPACITY

Since the basic objective of the grant is to improve OSU's ability to respond to needs in dryland agriculture of developing countries, continued emphasis will be placed on developing staff competency. The recent trip to the Mediterranean was extremely valuable in providing insight into the physical, social, and economic problems of these developing countries.

At present, consultants are available at OSU for dryland agriculture, soil management, weed control, and production economics. By the end of the next fiscal year, a complete consulting and advisory service should be available in cereal production, soil management, moisture conservation, range management, pest management including weed control, farm management, and farm power and machinery management.

Seminars, workshops and conferences are planned that will increase the knowledge base of the techcom members. A special course in nitrogen fixation will be attended by the soil scientist. A tillage conference in Colorado during August will be attended by the production agronomist.

5. DOMESTIC AND INTERNATIONAL LINKAGES

Strong association will be continued with CID institutional members, especially UC/R. The February 1977 joint symposium on rainfed agriculture stems from this association. In addition, OSU expects to provide talent to, and leadership for, selected CID projects and contracts.

The linkage with CIMMYT, through cooperation in the cereal breeding program, will be maintained. The objectives of the two programs are so interwoven as to insure the success of the cooperative effort.

The Rockefeller Foundation, through the training and research center in dryland agriculture in Turkey, will be a strong ally. Oregon State is recognized as a lead university in dryland agriculture by international experts working in the field. These individuals in turn provide strong bonds to indigenous institutions with which they are working. These ties will continue to be strengthened.

The techcom agricultural economist plans to visit FAO in Rome and the World Bank in New York to explain the project and its progress, obtain support for potential graduate students, and reinforce current linkages.

Close contact is presently being maintained with former OSU students in the Mediterranean region. These former students provide entry into the established ministries and universities of the developing countries. These ties will be maintained and reinforced during the coming year.

INVOLVEMENT OF MINORITY PERSONNEL AND WOMEN

All techcom members are regular employees of Oregon State University and its various departments. No new technical positions were created because of the grant; however, new hirings were necessary for the position of project secretary and the professional position of project librarian. In addition student help was required in the library.

All classified and non-classified positions at Oregon State University are recruited through established procedure, utilizing and following the statement of the Office of Affirmative Action and Equal Employment. The positions of project secretary and librarian were both filled by women.

During the year four students were hired for library assistants; all four were women.

Opportunities are being created for graduate training through the grant. Prospective students will be evaluated without regard to race, creed, religion, or sex. All academic departments and the OSU registrar are careful to abide by this standard.

Many foreign students already are on campus. A review of the list (Appendix V) suggests that discrimination is not an issue in graduate training at Oregon State University.

FINANCIAL REPORT

Table F-1 Financial Summary

Categories	Total 5-Year Budget	Cumulative Expenditures to June 30, 1976	Balance as of July 2, 1976
Total Salaries and Wages	$ 549,000.00	$ 70,574.00	$478,426.00
Academic Staff	470,817.00	67,340.00	430,477.00
Classified Staff and Students	78,183.00	3,234.00	74,949.00
Other Payroll Expenditures	82,822.00	10,147.84	72,674.16
Materials and Services	83,678.00	1,569.91	82,108.09
Computer Costs	17,000.00	676.62	16,323.38
Publication Costs	20,000.00	0	20,000.00
Travel	127,500.00	13,869.24	113.630.76
Contribution to CID	50,000.00	10,000.00	40,000.00
Equipment	70,000.00	5,143.50	64,856.50
TOTALS	$1,000,000.00	$111,981.11	$888,018.89

Table F-2 Expenditure Report for July 1, 1975 to June 30, 1976

		NAME	PERCENT	AMOUNT	
I.	A. Salaries				
	Academic	Floyd Bolton	.75	$16,146	
		Dean Booster	.25	5,175	
		Jon Elliott	.14	1,765	
		James Fitch	.25	4,800	
		Thomas Jackson	.25	6,929	
		Stanley Miller	.46	11,336	
		George Smith	.23	2,500	
		Charles Ullery	.25	4,506	
		Alma Winward	.50	8,883	
					62,040
	B. Other				
	Library		.50	5,300	
	Clerical		.25	1,787	
	Other Non-Professional			1,447	
					8,534
					70,574
	C. Fringe Benefits			10,147.84	
II.	Student Support			--	
III.	A. Consultants			--	
	B. Guest Lecturers Visitors, etc.			--	
IV.	Travel	TOTAL NOS. OF TRIPS		TOTAL AMOUNT	
	A. Domestic	30		4,697.43	
	B. Foreign	7		9,171.81	
					13,869.24
V.	Equipment				
	One Hydraulic Soil Coring and sampling machine			3,100.00	
	Other			2,043.50	
					5,143.50
VI.	Library Acquisitions			146.50	
VII.	Publications				
VIII.	Other			12,099.83	
					111,981.11

Table F-3 Expenditure Report, Actual and Projected Summary

	Expenditures to Date		Projected Expenditures				Total
	Reporting Period	Cumulative Total	YEAR 2	YEAR 3	YEAR 4	YEAR 5	
Total Salaries & Wages	70,574.00	70,574.00	122,734	121,398	133,228	97,933	545,868
Academic Staff	67,340.00	67,340.00	108,680	106,238	116,862	80,231	479,351
Classified Staff & Students	3,234.00	3,234.00	14,055	15,160	16,366	17,702	66,517
Other Payroll Expenditures	10,147.84	10,147.84	19,638	19,424	21,316	15,669	86,195
Materials & Services	1,569.91	1,569.91	21,000	20,500	20,500	19,690	83,260
Computer Costs	676.62	676.62	3,000	4,500	4,500	4,500	17,177
Publications Costs	0	0	5,000	7,000	4,000	4,000	20,000
Travel	13,869.24	13,869.24	43,000	28,000	25,000	17,631	127,500
Contribution to CID	10,000.00	10,000.00	10,000	10,000	10,000	10,000	50,000
Equipment	5,143.50	5,143.50	20,000	18,000	16,857	10,000	70,000
TOTALS	111,981.11	111,981.11	244,373	228,822	235,401	179,423	1,000,000

Table F-4 Distribution of 211(d) Grant Funds and Contributions from Other Sources of Funding, Reporting Period July 1, 1975 to June 30, 1976

Grant Objectives/Output	211(d) Expenditures				
	Period under Review	Cumulative Total	Projected Next Year	Projected to End of Grant	Non 211(d) Funding Amount
Centralized Information System	19,239.18	19,239.18	35,000	126,000	2,000 library
Education and Training	21,105.99	21,105.99	45,000	189,000	--
Research Capability & Knowledge Base Information	48,548.88	48,548.88	100,000	468,000	4,500
Advisory Capability	6,017.99	6,017.99	10,000	72,000	--
Domestic & International Linkage	17,069.07	17,069.07	20,000	145,000	--
	111,981.11				

APPENDIXES

Appendix I - Work Plan

Appendix II - Requests for Assistance Received and Fulfilled

Appendix III - Requests for Assistance Received and Not Fulfilled

Appendix IV - Short-term Visitors

Appendix V - Foreign Graduate Students in the OSU School of Agriculture

Appendix VI - Techcom Trip Report, North Africa-Mediterranean, April 1976

Work Plan

Oregon State University

MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

211(d) program

sheet 1 of 7

OUTPUT: #1 Centralized Information System

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
a) Collect, evaluate, inventory and disseminate information covering current LDC, U.S. and other developed countries' dryland agricultural production systems.	All	Sept. 1975-Sept. 1977	CID Information Workshop Sept. 22-26, 1975	Published information summary and computer listing of available reference materials at OSU and other CID institutions	6 MM* $21,400
1) Assessment of availability of current information already assembled at UCR, other CID Universities, and other institutions and/or agencies (USDA, FAO, etc.).	All		Visit UC/R Oct. 1975		
2) OSU library linked to UCR and CID library information systems.	Lib.				
3) Assist in developing integrated information system in cooperation with CID Universities.	Lib., Dir.				
b) Integrate information from the State-of-the Art survey from the LDC's in low rainfall areas into the information system.	Lib.	Cont. through Jan. 1978			3 MM $10,700
c) Inventory of sources of individual and institutional talent within LDC's and developed countries.	All	Cont. through July 1978	Questionnaire sent to all OSU Faculty - Jan., 1976 Incorporation of talent into general CID pool	Improved response capability	2 MM $ 8,400
d) New knowledge from the State-of-the-Art survey to be disseminated through textbooks, newsletter, technical bulletins and extension-type publications.	All	Cont. through July 1978	Determination of appropriate method of dissemination July 1978	Improved scientific awareness of the State-of-the-Art	
e) Design and develop an information retrieval system for acquisitions and dissemination of materials from the information bank in cooperation with CID.	Lib., Dir.	Sept. 1975 - Jan. 1976	CID Information Workshop Sept. 22-26, 1975. Initiate information retrieval systems Nov. 1975	A computerized searchable retrieval system available to scientists conducting research in dryland areas	2 MM $ 8,400
					13 MM $47,000

*Man-months

Work Plan

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OUTPUT: #2 Education and training program specifically addressed to problems of LDC's

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
a) Identify educational needs of LDC's in dryland agriculture as part of the State-of-the-Art survey.	All	March 1976 - Oct. 1976	On-site visits to Med. region March-May 1976; Sept. - Oct. 1976	Identified education needs and priorities for both formal and informal training	5 MM $21,000
b) Establish an interdisciplinary curriculum committee to evaluate existing course offerings and identify areas of need.	All	Jan. 1976 - March 1976	First draft of suggested curriculum changes, Feb. 1976	Improved curriculum for formal training in dryland production and utilization	3 MM $12,600
c) Develop capacity to handle an increased number of LDC and U.S. graduate students in disciplines associated with Dryland agriculture.	All		First student arrivals, Sept. 1977	6 Ph.D. and 25 M.S. in progress by Fall, 1978	3 MM $12,000
d) Develop capacity to conduct short courses on a pilot basis for a) senior policy decision makers, b) junior technical personnel at OSU and/or selected sites on specific topics involving dryland agriculture.	All		First short course to be offered Spring, 1978		5 MM $21,000
e) Develop special courses, workshops, conferences as needed for AID and CID personnel.	All	Dec. 1975	Symposium on dryland agriculture in cooperation with the UC/R	Potential topics: Tillage and moisture conservation; Farm implements and machinery; Crop & livestock interrelationships; Cereals & Forage production; Grazing systems; Dryland agricultural systems;	2 MM $8,400
f) Establish an education, training, and research base in dryland crop production at the Sherman Branch Station in Moro, Oregon.	All	Nov. 1975 - Termination of project	Equipment needs to be specified Fall, 1975 Equipment to be purchased Fall, 1975 - Spring, 1976 First applied field trials Fall, 1976	Completed training and research center for applied research and extension training	2 MM $8,400
					20 MM $83,400

Work Plan

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MOISTURE CONSERVATION AND UTILIZATION
IN LOW WINTER RAINFALL AREAS OF LDCs
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OUTPUT #3 Research Capability and Knowledge Base will be improved.

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
Preliminary steps for on-site visit to Mediterranean.	All	Oct. 1975-Mar. 1976	Identification of team members; initial review of literature; determination of meaningful data to collect; establishment of countries and persons to be visited; schedule meeting with AID, CID and UC/R to coordinate mutual activities and share accumulated knowledge.	Written on-site visitation plan and schedule Awareness of the program of UC/R	4 MM $ 16,800
State-of-Art paper of dryland technology will be written. Sections to be included are:					
Cereal-production technology	F.B.	Oct. 1975-Dec. 1976	Completed bibliographic review Identification of relevant literature; circulation of section rough draft.	Completed State-of-the-Art paper	30 MM $126,000
Cereal-forage technology	F.B., A.W.				
Cereal-equipment	F.B., D.B.				
Forage-Livestock	A.W.				
Forage-Livestock Equipment	A.W., D.B.				
Production economics	A.E.				
Livestock					
Cereals					
Market and institutions	A.E.				
Livestock					
Cereal					
Soil-Moisture Relations	C.U.				
Livestock					
Cereal					

Work Plan

OUTPUT #3 Research Capability and Knowledge Base will be improved. (continued)

Oregon State University

MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs
211(d) program

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
On-site visit to Mediterranean region to compare existing conditions with State-of-the-Art	All	March-May 1976; Sept.-Oct. 1976	Two visits to the same area: one in Spring to see conditions of cereals and livestock coming out of the winter, the second to see planting and livestock conditions going into winter. Conference with AID and CID to review results of comparison.	Comparison report of existing conditions vs. State-of-Art	10 MM $49,800
Develop research proposals on knowledge gap as identified by on-site visits.	All	Jan.-July 1977	Three to four long term research proposals to diminish identified knowledge gaps. Emphasis to be placed on improving cereal and livestock production and conservation of natural resources. Special attention to be given to small- and medium-size farms.	Proposals sent to AID and other potential resource agencies for funding	2 MM $ 8,400
Serve as repository and principal institution for dissemination of knowledge with regard to dryland farming in low winter rainfall zones.	Lib.	Aug. 1975-July 1978	Determine system of collection and cataloging. Obtain necessary materials through appropriate means including purchase when necessary. Establish a literature search service.	Complete collection of published works; Ability to send relevant materials to requesting agencies	4 MM $14,000
					50 MM $142,800

Work Plan

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MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

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OUTPUT: #4 Increased Advisory Capacity

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
Develop efficient advisory service for providing short-term and long-term consultants in dryland use.	All	Jan., 1975 - June, 1980 July, 1977 - June, 1980	Initial capabilities to provide consultants to start by Jan. 1976 in dryland agronomy, soil management, agricultural economics, and weed control. Provide advisory and consultant service in addition to the above in livestock-grazing management systems and agricultural power and machinery specialties	Increase competency in problem identification analysis and design. Increase capability to assist in project operations dealing with education, research or extension. Increase capability to evaluate proposed and on-going programs and projects. Complete consultant and advisory service in: Cereal Production Soil management/ moisture conservation Range management Pest management including weed control Farm management Farm power and machinery management	4 MM $16,800
Staff participation in special training programs consistent with grant objectives that are available through AID, CID and other groups.	All	July, 1975 - June, 1980		Improved staff response capability.	2 MM $8,400
Provide for faculty exchange with other institutions or agencies.	Selected			Enlarge talent selection in pool.	1 MM $4,200
Bring outside faculty to OSU to conduct seminars, workshops and conferences for staff improvement.	All	July, 1975-June, 1980	Bill Wright (Rockefeller Foundation Turkey) to discuss existing cereal forage production problems. (Sept. 1975) Dr. R. J. French (Australian Dept. of Agriculture) to discuss dryland research in Australia.	Staff education.	1 MM $4,200
					8 MM $33,000

Work Plan

Oregon State University

MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

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OUTPUT #5 Domestic and International Linkages ---*

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
a) Prior to the on-site visit, a close association between CID and OSU will be established to ascertain areas where interinstitutional approaches are desirable and existing information can be exchanged. Special emphasis will be placed on the programs at U of A and UC/R where complementary activities and interties can be developed.	All	Continued	Preliminary meeting with UC/R to exchange information and solicit cooperation (Oct. 1975).	Close working relationship with CID universities and especially UC/R.	1 MM $4,200
b) Professional partnerships will be established with USAID, CID, ICARDA, CIMMYT and FAO for the purpose of initiating personnel exchange, developing contacts in LDC's and facilitating travel, fostering faculty-student exchanges, information exchange, plan and conduct cooperative research programs, joint advisory services and develop common training programs both in the US and LDC's. These latter inputs will be a continuing activity conducted throughout the period of this program.	All: (Director to have special responsibilities.)	Continued	Contact with many of the institutions will be made as part of on-site visits.	Close working relationship with international agencies and centers.	1 MM $4,200
c) A strong linkage with Rockefeller Foundation, Ford Foundation, USAID and ICARDA will be developed to aid in identifying and financing students to participate in training programs at both the M.S. and Ph.D. levels. FAO can provide resources and identify people to participate in short courses and training programs of longer durations.	All	Continued	Contact will be made with the institutions as part of on-site visits. In addition, present personal and project linkages will be strengthened.	Facilitated flow of students to participate in OSU training programs.	1 MM $4,200

* Domestic and International Linkages will be strengthened and new relationships established between Oregon State University and agencies or institutions with similar interests in dryland agriculture.

Work Plan

Oregon State University

MOISTURE CONSERVATION AND UTILIZATION IN LOW WINTER RAINFALL AREAS OF LDCs

211(d) program

OUTPUT #5 Domestic and International Linkages ---* (continued)

ACTIVITY	STAFF	DATES FOR START & FINISH	SCHEDULED EVENTS / TARGETS	EXPECTED RESULTS	MM and $ FOR 2 YEARS
d) Linkages will also be developed with scientists in selected LDC's where cooperative research and training can be conducted. When M.S. and Ph.D. students start returning to their respective LDC's they will remain closely associated with the total program and permanent linkages will be established.	All	Continued	List of active LDC scientists working in dryland area will be developed. The possibility of providing information and scientific results through a periodic newsletter or other device will be explored. Cooperative research to be initiated with local scientists through new AID/OSU contracts July 1978.	Closely knit group, if scientists aware of the state of art and aware of work being conducted in similar ecological zones. Active research effort in adapting existing technology and developing needed new technology.	2 MM $8,400
					5 MM $21,000

* Domestic and International Linkages will be strengthened and new relationships established between Oregon State University and agencies or institutions with similar interests in dryland agriculture.

Appendix II - Requests for Assistance Received and Fulfilled

Description of Request	Received from: Organization	Received from: Contact	Description of Assistance
Company wanted to know procedure for hiring OSU people as consultants for an African contract	CH2M Hill	Mr. Ed Lance	Referred request to Mr. Millison and sent CID brochure
2 short-term consultants.	Council for Int'l Exchange of Scholars: Ecuador	Dr. Bruce Anderson	Request sent to Ag. Engr. & Crop Science
Extension specialist Seed specialist	CID	Fischer	Sent inventory sheets of all potentials to CID
Ag-marketing specialist	CID	K. Allred	Groder recommended (still pending)
Women faculty members from OSU/list for seminar and proposal	U. of Arizona	Dinnerstien and Cloud	List of 14 in the specific fields mentioned sent 11/12/7[illegible]
Data bank for CID/OSU Ag. Expertise available for consultant positions	CID	B. Anderson	Inventory forms of OSU/Ag. interested on file in O.I.A. Appropriate forms sent to CID (31) for specific request
Survey of interest in OSU/UCV(Chile) interchange	UCV (Chile)	President MacVicar	Circulated letter and collected responses
Extension Director for Bolivia CID contract	CID	K. Allred	Nominated Gene Lear for position
Suggest candidates for dryland position in Iran	CID	J. Wood	Nominated Mike Lindstrom for positi[illegible]
Nominate candidates for extension specialist in Niger	CID	J. Fischer	R. Todd applied and accepted.

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Appendix III - Requests for Assistance Received and Not Fulfilled

Description of Request	Received from		Description of Assistance
	Organization	Contact	
OSU/Ag Short Courses	Israel, Min. Agriculture	C.S.U.	no such courses available at Colorado or OSU
OSU/Ag. to be lead Univ. in the Kenya Project	CID	Fischer	Animal Science Dept. unable to supply the needed personnel.

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Short-term visitors

NAME	Country	Dates	OSU contact(s)	Arranged by (name)	(Organization)
Gheroghe Burloi	Romania	2/18-19/76	Krugman, Cooney Cown, Davis Dilworth Kronstad Eisgruber Romancier Stevenson	Juraj L. J Slavik	USDA
Young Hee Lee	Korea	5/24-28/76	MacSwan	H. Robert Wack	USDA
Tone Wagner	Yugoslavia	6/5-11/76	Horner Haunold	F. E. White	USDA
Sergio Augusto Hiroaki Kurachi	Brazil	6/14/76	Booster Deutsch Miller Fraser	J. Ronald Miner (Kurachi made a personal request)	OSU
Abdel Monum Makky	Egypt	6/14-25/76	Krueger Youngberg Oldfield Winward Miller Conklin Claypool McGuire Adams & Weswig	Schroeder	USDA
Alejandro Acevedo & Dr. Jose Calvo	Costa Rica	6/28-29/76	Locatelli Burrill	Acevedo himself	Fertiizantes de Centro America
Prof. B. Ristevski	Yugoslavia	7/6-7/76	Lagerstedt, Thompson Paul Roberts	F. E. White	USDA
Edilberto Possamai	Brazil	7/21-22/76	Rotta Danielson Park	Bunch	MSU

NAME	Country	Dates	OSU contact(s)	Arranged by (name)	(Org.)
Luciano Gomes	Brazil	7/30/76	Danielson Park	Bunch	MSU
Mrs. Sarada Ojha	Nepal	6/24/76 to 3/18/77	Danielson	Bolling	USDA
Benedito de Souza & Gloria Fernandes	Brazil	8/16-17/76	Danielson Park Cain Mansour Koepsell		
Christopher P. Norris Lindsay D. Ward Maxwell K. Middleton Allan R. Ellwood	Australia	8/26-27/76	Ramig	Lemmich	USDA
Kamel Belkhodja Moncef Ben Said Ali Ben Zaid Salmi	Tunisia	9/1-3/76	Cooney Davis Wadsworth Stevenson Eisgruber Purvis Jolliffe Miller Bolton Fitch Hilderbrand	Werner Kiene	Ford Foundation

Appendix V - Foreign Graduate Students in the School of Agriculture, Spring and Summer 1976

Name	Country	Specialization
Michel Abi-Antune	Lebanon	Crop Science
Andres Abramovich	Argentina	Crop Science
Taufio Ahmed	India	Poultry Science
Selman Aktan	Turkey	Crop Science
Abdulilah M. Al-Ari	Iraq	Horticulture
Marcos Assuncao	Brazil	Seed Technology
Solomon Bellete	Ethiopia	Agricultural Economics
Ata K. Bonna	Ghana	Agricultural Engineering
Pedro Brajich	Mexico	Crop Science
Carlos Camargo	Brazil	Crop Science
Vanderlei P. Canhos	Brazil	Food Science
Sou Chia Chen	Taiwan	Food Science
Kee Nam Cheung	Hong Kong	Agricultural Economics
Byung Han Choi	Korea	Crop Science
Kee Chai Chong	Malaysia	Agricultural Economics
Thomas Cusack	England	Agricultural Economics
Mawan B. Daabag-El-Margnane	Libya	Food Science
Ghanshyara Das	India	Agricultural Economics
Oliver G. Dawson	Canada	Agricultural Economics
Marta L. Dondero	Chile	Food Science
Francisco Dubbern de Souza	Brazil	Crop Science
Mawuena F. Dzogbefia	Ghana	Crop Science
Babiker A. El Hassan	Sudan	Range Management
Yousef El-Shrek	Libya	Food Science
Elgasim Elgasim	Sudan	Animal Science
Partick Erhabor	Nigeria	Agricultural Economics
Matthew Ezemwa	Nigeria	Soil Science
Clarito Felipe	Philippines	Fisheries & Wildlife
Tarciso Filgueiras	Brazil	Crop Science

Name	Country	Specialization
Ahmet Firat	Turkey	Crop Science
Raymundo Fonollera	Philippines	Agricultural Economics
Vilma Fonollera	Philippines	Crop Science
Yosef I. Geddeda	Libya	Horticulture
Edison J. Geromel	Brazil	Food Science
David Halim	Indonesia	Food Science
Abdullah Hamidi	Iran	Range Management
Moncef Harrabi	Tunisia	Crop Science
Jose Hennigen	Peru	Crop Science
Ahmed Hussen	Ethiopia	Agricultural Economics
Yuh-Mei Jong	Taiwan	Food Science
Sami Karam	Lebanon	Crop Science
Rahmati Keshavarz	Iran	Food Science
Ahmad Khan	Pakistan	Agricultural Economics
John H. Kinzell	Canada	Animal Science
Ahang Kowsar	Iran	Soil Science
Michel L. Kulbicki	France	Fisheries
Jae Sung Lee	Korea	Food Science
Julio Lhamby	Brazil	Crop Science
Eduardo Locatelli	Uruguay	Crop Science
Alfonso Lopez Benitez	Mexico	Crop Science
Claudio Lovato	Brazil	Crop Science
Huey-Sheng Ma	Taiwan	Food Science
Carlos Francisco Madero	Mexico	Food Science
Cesar Martinez Racines	Colombia	Crop Science
Felix Mathenge	Kenya	Crop Science
Marlene Matos	Brazil	Crop Science
Mei-Chen Miaw	Taiwan	Food Science
Byung Ik Min	Korea	Veterinary Medicine
Raul Moreno	Chile	Crop Science
Marut Muangkol	Thailand	Agricultural Economics
Mohd M. Mumtaz	India	Entomology
Mbuki Mwamufuja	Zaire	Agricultural Economics

Name	Country	Specialization
Pierre R. Ngaba	Cameroon	Food Science
Joe Ngam	Cameroon	Animal Science
Mathenge Felix Njeru	Kenya	Seed Technology
Dennis T. O'Brien	Australia	Agricultural Economics
Paul O. Onafeko	Nigeria	Animal Science
Conrad O. Perera	Sri Lanka	Food Science
Aimee Rabakoarihanta	Madagascar	
Kazi Rahim	India	Agricultural Economics
Lekkala Reddy	India	Crop Science
Enrique Rico	Mexico	Horticulture
Dilson Rocha	Brazil	Agricultural Economics
Philip Rolston	New Zealand	Crop Science
Benigno Rotta	Brazil	Crop Science
Rubens Sader	Brazil	Crop Science
Promode Shah	India	Crop Science
Gody Spycher	Switzerland	Soil Science
Jerachone Sriswansdilek	Thailand	Agricultural Economics
Ko-Li Cary Sun	Taiwan	Horticulture
Teshome Tafari	Ethiopia	Agricultural Economics
Mui Heng Tan	Malaysia	Agricultural Economics
Jacabo J. Totesautt	Venezuela	Range Management
Mohammad Vahabran	Iran	Crop Science
Mei-Hwa Wang	Taiwan	Horticulture
Benny Wanjala	Uganda	Fisheries
Yueh-Mei Wong	Taiwan	Horticulture
Kamil Yakar	Turkey	Poultry Science
Anthony Lungteng Yang	Taiwan	Animal Science
Albert Obiri Yeboah	Ghana	Agricultural Economics
Suntaru Yingjajaval	Thailand	Soil Science

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Appendix VI - Techcom Trip Report, North-Africa - Mediterranean, April 1976

Travel Report - April 14 - May 10, 1976

Countries Visited - Morocco, Tunisia, Turkey, Iran and Pakistan

Travelers - OSU Dryland Agriculture Team:
S. F. Miller, Project Leader;
D. E. Booster, Ag. Engineering;
F. E. Bolton, Agronomic Crop Science;
T. L. Jackson, Soils;
C. H. Ullery, Soils;
A. H. Winward, Range Management

Purpose - Review dryland production techniques presently employed in North Africa and the Middle East as part of the preparation of a report on the state of technical arts in the utilization and conservation of moisture in regions of low winter rainfall.

This report reflects opinions of the travelers on the basis of what they observed. It is cursory at best and should be considered as only an interim working document.

INTRODUCTION

Dryland agricultural production in most of the developing countries located in the Middle East and the northern coast of Africa is lagging behind the demand for food and fiber production. Population is expanding in many areas at rates of up to four percent per year. Many of the countries are importing significant amounts of agricultural products to prevent widespread shortages. Severe balance of payment problems also result. Although all of the countries have the potential for being self-sufficient and possibly even being exporters of their own agricultural products with reasonable population growth, the actual production level is very low. Little modern technology, which has resulted in high productivity in the developing countries, is being used.

As a result of recent activities by several international agricultural assistance programs and visits by agricultural production scientists from the developed countries, there is almost unanimous agreement that adequate technology is available to double, or perhaps triple, agricultural production in the Middle East and North African countries. This change would require the adoption of improved soil, crop, and livestock management practices currently being used in the developing countries. In addition changes in economic, social and institutional constraints must be made.

The purpose of the visit of the Oregon State University 211d Dryland Team was to view the dryland cereal-range-livestock production areas and become familiar with the existing agricultural technology and the research activities currently under way in the Middle Eastern countries, as part of the preparation of a summary of the state of technical arts for the agricultural production practices followed in these areas.

The following material is divided into four sections. In the first, cereal production practices as they exist in the Pacifc Northwest are discussed. This establishes a basis for comparison. In the second, factors which determine the selection of a production system are discussed. The following two sections provide an overview of the countries visited and finally a discussion of the specific countries.

DRYLAND CEREAL PRODUCTION IN THE PACIFIC NORTHWEST REGION

Relatively high yields of cereal crops are produced in the Pacific Northwest region (PNW) relative to the amount of precipitation received for two reasons. First, the amount and distribution of precipitation and the other climatic conditions are conducive to storage of moisture in the soil profile. Most of the precipitation occurs as low-intensity, long-duration rainfall or snow during the late fall to mid-spring months when daily evapotranspiration losses are low. When coupled with deep soils (1 to 2 meters) and the appropriate tillage practices to encourage infiltration and reduce run-off, water can be stored in the soil for use during the following growing season. In addition, the potential evaporation during the fallow year is relatively low since generally mild temperatures prevail during the fall and spring, and the hot summer period is short. By using proper tillage to create a dust mulch during the spring of the fallow year, which insulates the soil and reduces evaporation losses, sufficient moisture can be maintained at the 15 to 20 centimeter depth for the establishment of a cereal crop at the end of the fallow season before fall rains start. Timeliness of proper tillage practices such as plowing, sweeping, and rod weeding is critical to maximize the amount of water stored during the fallow year. Secondly, agronomic practices have been developed to efficiently utilize the moisture stored during the fallow year plus the precipitation received during the crop year.

Probably the most critical factor affecting crop yield is the establishment of the crop during the fall. Through use of the deep furrow drill, the seed can be uniformly placed in the residual soil moisture located 15 to 20 centimeters below the soil surface prior to the onset of the fall rains and/or cold winter temperatures. As a result the crop develops an extensive root system and often enters the tillering stage of development prior to going dormant during the winter. This not only reduces winter kill, but permits the crop to develop and mature earlier the following year before the onset of the extremely hot summer.

The loss of water due to consumption by weedy vegetation can be reduced through use of herbicides which control weeds. The amount of crop vegetation is controlled to keep excess transpiration from occuring which could consume the available soil moisture prior to crop maturity.

Proper types and amounts of fertilizer (N, P, S) are used and applied at the proper time to ensure efficient utilization of water without stimulating excessive vegetative growth. Also, the summer fallowing process provides two crop seasons for soil organic matter to release N, P and S for the one crop.

New varieties are continually being developed which are better-adapted to the production area and have greater resistance to the many disease and insect pests which attack cereal crops.

Lastly many types of equipment are readily available for doing the proper tillage, planting, fertilizing, spraying, harvesting, and other agronomic and cultural practices, but perhaps more importantly, the mechanization permits the operation to be done at the proper time.

In summary a complete production system has been developed to permit the most efficient use of the most limiting factor in dryland agriculture -- water.

FACTORS THAT INFLUENCE THE ADOPTION OF A SPECIFIC PRODUCTION SYSTEM

Several factors have an important effect on the crop production system adopted in dryland areas.

(1) Rainfall: total amount, seasonal distribution, and variability in annual rainfall.

(2) Winter temperatures.

(3) Summer temperatures and humidity, and length of the summer dry season.

(4) Soil depth and thus potential for moisture storage during a fallow year.

(5) The need for livestock feed and the potential for supplying part of this feed with winter annual legumes.

(6) Soil fertility needs and possibilities of supplying part of the N needs through N fixation by legumes.

(7) Tillage implements used for initial seed bed preparation, summer fallowing, seed bed preparation and seeding.

(8) Weed control.

Rainfall Distribution and Temperatures

The amount and distribution of rainfall combined with both winter and summer temperatures have the greatest interaction on benefits from summer fallow systems of farming. A dust mulch can reduce the rate at which moisture is lost from the soil; but, it does not stop moisture loss by evaporation. Thus, if the dry season is 5 or 6 months long and if the summer temperatures are high (30-40°C) for extended periods of time, the rate of moisture loss by evaporation will be high and most of the moisture that might have been stored in the surface 60 cm of soil will be lost.

If the summer dry period is relatively short (about 100 days as it is in much of the PNW) and if the number of days with temperatures above 35°C are not excessive (20-30), then, soil moisture can be maintained within 10 to 15 cm of the soil surface. This will allow the establishment of fall wheat with a deep furrow drill before the fall rains are adequate for germination and seedling development. This increased seedling vigor and root development in the fall can be very important in areas where low winter temperatures result in frozen soils and dormant wheat plants for extended periods of time during the winter.

It was evident on the Anatolian Plateau in Turkey that use of a deep furrow drill where soil moisture was adequate for seedling germination and establishment in mid-September is probably the single most critical factor affecting wheat yields in that area. This allowed development of the root system and crown of the plant before freezing temperatures in December stopped plant growth for the winter.

If winter temperatures are mild and freezing temperatures seldom encountered, a fall-planted crop will germinate with the fall rains and continue growth throughout the winter. Thus, a major effort to save soil moisture for seedling development before the fall rains start is not important as it is in areas like central Turkey where the wheat seedlings go dormant with the December freezing weather.

Soil Depth and Potential for Moisture Storage

Adequate soil depth is essential for moisture storage. Many soils have an effective root depth in excess of 2 meters. Soils of these depths will allow for 20-30 cm (8-12 inches) of moisture storage for the succeeding crop. There are probably a limited number of situations where soil moisture storage during a summer fallow season can be effective with soil depths of less than 1 meter. Evaporation during the summer season could lose most of the moisture from a shallow soil; also, the moisture storage capacity of soils with less than 1 meter of depth can generally be recharged with no more than 15-25 cm of rainfall the following winter.

Need for Livestock Feed

Livestock are an essential part of the economy and of society throughout the Mediterranean area. Supplying feed for livestock during the spring and early summer of the year until stubble fields are available for grazing, after harvest, is a critical factor affecting the start of tillage practices on the fallow land. Extensive acreages of shallow, erodable soils throughout the study area could be seeded to permanent cover for livestock feed.

Soil Fertility Needs

Summer fallowing to increase the rate of soil organic matter decomposition and thus the amount of nitrogen and phosphorus available for a succeeding crop can be critical factors affecting yields. However, this cannot be a valid basis for establishment of a summer fallow system of farming. Nitrogen can be supplied by commercial fertilizers and by nitrogen fixation from legumes. The nitrogen fixation from winter annual legumes or spring-planted legumes that could be turned down as a green manure crop would exceed the nitrogen made available from soil organic matter decomposition during the summer fallow year. The increase in phosphorus from summer fallowing would be very small. Phoshorous can be supplied as commercial fertilizer.

Tillage Practices

An optimum combination of tillage practices will maintain a dust mulch during the summertime with most of the crop residue maintained in the surface of the soil to act as a mechanical barrier to both wind and water erosion.

Weed Control

Weed control is essential since weeds compete with the growing crop for both soil moisture and nutrients. Weeds can also result in physical competition with the growing crops.

GENERAL COMMENT ON COUNTRIES VISITED

A common feature found in each of the countries visited was the differences in the concept concerning the term "dryland." Dryland in Morocco and Tunisia means the edge of the desert. In Turkey it generally means all the area of the Anatolian Plateau. In Pakistan, it means all lands not irrigated.

"Dryland," as used in this report, refers to areas which receive between 200 and 350 mm of yearly precipitation, most of which occurs during a cool to cold winter season leaving a 2-3 month summer drought period. Non-irrigated crops grown within these areas are produced on stored soil moisture, and croplands generally are interspersed with non-tilled areas (rangeland).

Another general concept found throughout the region and one that is common in each of the countries visited, is that the present low level of crop production is due solely to lack of water. In reality, the water supply is often not the major cause for low crop yields; instead the crop management system is generally the leading cause of low water use efficiency. Stated another way, the present crop yield levels could be substantially increased throughout the region if more efficient use were made of the admittedly limited water supply. For example, excess weeds, poor tillage techniques and low fertility all reduce yields and thus reduce water use efficiency. Crop management that increases production also increases water use efficiency. Thus, the key to obtaining greater production in "drylands" is to maximize the use of the limited water supply for producing food crops. Any cultural practice that conserves moisture which subsequently becomes available to the crops will increase yield. Conversely, during any given crop or fallow season, any moisture that is lost to weeds, run-off, or evaporation will reduce yields. The general awareness of the value of any moisture conserved, as a factor in increasing crop yields, seems to be lacking among administrative and technical people throughout the region.

The use of fertilizer materials on "drylands" in these regions (Turkey may be the exception) is almost non-existent. Crop plants that have nutrient deficiencies may use just as much water as plants that are well-fertilized, but will produce much lower yields. Certainly, dryland crops where the yield potential is lower require less fertilizer (especially N) than irrigated crops. In addition, the balance between phosphate and nitrogen fertilizers is more critical than under high moisture conditions. The use of fertilizers, even though in proper amounts and balances, without attention to other cultural practices such as seedbed preparation or weed control often does not increase the yields.

Heavy weed infestations in both the cropped and fallow lands are common throughout the region visited. Even when weed control is practiced, it generally is not timely and the reduction in yield is still substantial. The application of other improved cultural practices such as high yielding varieties, fertilizers, improved tillage methods or better seedbed preparation without good weed control will generally lead to disappointing yield results. Timely and adequate weed control is the first step in reducing water loss thereby improving yields in the region.

Tillage practices that control weeds and set the stage for good seedbed conditions and produce adequate crop stands is also lacking in the region. The use of "weedy" fallow for livestock grazing leads to disappointing results both for animal and crop production. Stand establishment of the crop at the proper time is an important step in obtaining efficient use of a limited moisture supply. Rough, cloddy, dry seedbeds are common throughout the region. These conditions produce a thin stand of poorly-developed plants which never seem to fully recover during the season. The addition of improved varieties, fertilizers and weed control without attention to improved stand establishment again may produce disappointing results.

The emphasis on increasing production of "drylands" is a relatively recent phenomena in most of the countries visited. Turkey is perhaps the exception since most of the cereal production there is under dryland conditions. There are few trained people with an orientation toward dryland crop production techniques in most parts of the region. Any program to increase crop yields in the dryland regions must be produced by training of local personnel in dryland crop production methods. Modern production methods usually have to be adapted to fit local conditions. Much of the basic information on climate and soils is not presently available. Where such information is present and available, there are no local, trained personnel to utilize the information in developing a production program. Without a strong cadre of local personnel to conduct research and extension activities, there is little chance of a sustained increase in dryland crop production.

Dryland crop production has been most successful when the "package of practices" approach has been used. This means that the best combinations of tillage for moisture conservation and seedbed preparation, selection of adapted varieties, optimum planting rates and dates, fertilizers applied at the proper rates and times in relation to moisture supplies, timely weed control in both fallow and crop seasons and harvesting methods are used. The timing and application of the various components of the package is very important and may vary from one locality to another. The proper package of practices must be determined by extensive, applied field research conducted over relatively long periods of time. Each element in the production package must be done in the right sequence or the advantage of the other elements is often lost. For example, if an improved variety is introduced without the addition of weed control or fertilizers or better seedbed preparation, oftentimes the old, local variety will still yield as well or better. If fertilizers are introduced as an improved practice and weeds left uncontrolled, the weeds may respond more to the increased fertility level than the crop, and may in some cases actually reduce yields. If improved initial tillage practices are introduced, but secondary tillage for weed control and seedbed preparation are neglected, the end result may be worse than the traditional method.

The development of a complete production package for the drylands in the developing countries is not generally possible in the immediate future. Many of the resources (equipment, herbicides, fertilizers, etc.) are not presently available and require considerable time and investment to develop. However, if certain elements of the production package are properly applied and in the right sequence, substantial yield increases are possible. The key to increases in dryland crop yields involves sorting out those practices which give the greatest benefits and can fit into the local traditional systems. As other resources become available and additional field research is conducted, the other elements of the production package can be applied.

Observations during the field survey of the countries visited indicate that the following production practices should be included in any production program that may be planned in the future. The practices are listed in priority order as related to dryland crop production. Certain cultural practices such as the use of well-adapted, disease-resistant crop varieties can be introduced at any point in a production system and some increase in yield expected. However, unless preceded by other improved practices, the magnitude of yield increases may be disappointing. The same is true, for example, for better harvesting techniques. In this case, the benefit is in saving more of the crop produced, not increasing the yield by better use of the limited moisture.

1. Weed Control during the Crop Period

In most of these countries weeds are used as a source of feed for livestock and are manually pulled from among the crop plants. In most cases the reduction in yield from weed competition has already taken place. In other instances, where chemical weed control is being used, the timeliness of control measures is lacking and again the full benefits of herbicide application are not realized. Improved seedbeds, fertilizers or new crop varieties will usually add little to the overall yield if weeds are left uncontrolled or the control measures are not timely.

2. Seedbed Preparation as related to Stand Establishment

Rough, cloddy, dry seedbeds that are planted by broadcasting and then re-plowed or disked usually produce thin, weak stands of crops. Seeding rates are very high to compensate for the poor seedbed conditions. Unless an adequate stand is established, the benefits of other improved cultural practices are lost.

3. Mechanical Seeding Operations

In almost every case where hand broadcast seeding is compared to mechanical seeding, yields are increased when the latter method is used. However, it is important that steps are taken to prepare a good seedbed for mechanical seeding operations. Even broadcast seeding on well-prepared seedbeds produces better yields than on poor, rough seedbeds. Seedbed preparation and mechanical seeding operations are simply two elements in the production system that leads to better, more timely stand establishment. Stand establishment of an adequate number of plants per unit area and at the optimum time is perhaps the first and more critical step in increasing the moisture use efficiency in dryland crop production. Without weed control and adequate, vigorous stand establishment, the addition of improved varieties and fertilizers usually give rather disappointing yield restuls.

4. Fertilizer Use Under Dryland Conditions

It is extremely important that the proper balance of fertilizers is used under dryland conditions. Too often when fertilizer is mentioned, most people tend to think of only nitrogenous nutrients. Most of the area in the Middle East and North Africa is very low in available phosphorus. Unless the phosphorus requirements for a given crop are met, the addition of nitrogen under limited moisture conditions will produce only slight yield increases. Nitrogenous fertilizers will tend to stimulate vegetative growth during periods of adequate moisture which in turn will deplete the available soil water before grain is produced. A good, balanced fertilizer program of phosphorus and nitrogen fertilizers that are applied in relation to the actual and expected moisture supply will lead to increased yields. There is little chance that a blanket recommendation for dryland crop conditions will ever be possible because of the highly variable climatic conditions. The use of fertilizer materials without attention to other elements of the production package under dryland conditions is a dangerous approach for two reasons:

(1) it may not increase the yields, in fact it could reduce yields in some instances;

(2) poor results on farmer demonstration plots may discourage fertilizer use of any kind. An adequate fertility level is an absolute requirement to increase more efficient moisture use and consequently crop yields, but it must be used much more judiciously under dryland conditions.

5. Improved Tillage Practices to Conserve Moisture

This element of the production package usually comes first in the sequence of production practices, but it is often the most difficult to introduce in a developing country's program. It involves a very basic change from traditional cultural practices. Also, the full benefits from improved soil management are not realized unless the other production elements such as weed control, seeding practices, fertilizers, and improved varieties are combined in the package. Once the latter elements are used in the proper sequence and combinations, then the incentive to practice better soil management is greater. With the proper combination of cultural practices, any additional moisture saved in the soil profile will be reflected in greater crop yields. Therefore, it is listed in a lower priority position in the production package, not because of lack of importance in increasing yields, but because it must be followed by other practices if the advantage of conserved moisture is to be realized. Adequate soil management usually requires a greater amount of farm power than is presently used in most developing countries. Improvement in crop yields need not be delayed until all elements of an improved production package are in place. However, the full yield potential under a given set of climatic conditions will not be realized unless improved tillage practices are used.

6. Crop Varieties

A crop variety that will respond to different climatic conditions under a dryland situation is essential if yields are to be improved. Presently, most varieties being used in developing countries yield well below their genetic yield potential. However, as production practices improve, the use of better-adapted crop varieties becomes more and more important. Varietal improvement programs should be an integrated part of any dryland production project. Under dryland conditions the introduction of new, high-yielding varieties without changing traditional production methods has always led to disappointing results.

7. Improved Harvesting Practices

Improved harvesting methods will not improve the level of production per se, but it will allow one to save that which is produced. Much of the crop in developing countries is lost between the field and market due to primitive methods of harvesting and handling. Estimates of this loss run to 40 percent. Any program designed to increase crop yields should also include a component to improve the harvesting and handling methods. The primary consideration is to get more food into the people's hands. It is disheartening to observe loss and waste of food after going through the effort to produce it.

8. Animal and Forage Production

Several similar characteristics of the rangeland-animal systems exist in the Middle Eastern countries. They are:

(1) Heterogeneous climates and soils
(2) Deteriorated condition of rangelands with deterioration increasing at an accelerated rate
(3) Emphasis on sheep production (primarily fat-tailed varieties) with only minimal emphasis on cattle and goat production
(4) Transportation problems for marketing animals
(5) Few facilities or equipment for haying or storing hay
(6) Essentially no facilities for stored or frozen meats
(7) High emphasis on number of animals owned with little regard for quality of the animals
(8) Animal owners of two types:
    (a) migratory people (nomads)
    (b) villagers

The potential for forage production was much higher than expected except on areas which have lost soil through hundreds of years of erosion. The number of people and animals has increased considerably the past twenty years, and the abuse of rangelands in general has accelerated. Governmental personnel appeared to have an interest in using a considerable amount of dollar revenue generated from sales of natural resources for increased agricultural development. Most feel that the next twenty years will be crucial for improving their food production.

Work in similar ecological situations in the United States has shown that range production can be increased considerably through proper timing of use and especially through reseeding programs. Many forage species have been successfully established in our dryland areas and have increased available animal unit months (AUM) considerably. The few locations which have been experimenting with adapted species in these countries have been very successful. Implementation of these types of improvements has been slow primarily due to lack of communication and to the failure of the people of these countries to change from traditional production systems.

COUNTRY REPORTS

Morocco Dates of Visit, April 14-17

Travelers - Miller, Jackson, Bolton

Itinerary

April 14 morning	Visited with Dr. Moline, Head of Crop Production. Toured facilities of Crop Production Division and visited with staff.
afternoon	Visited with Dr. Gerald Neptune and USAID officials including the Mission Director, Dr. Albert Disdier. Reviewed USAID published materials.
April 15 morning and afternoon	Field trip to Casablanca, La Jadida and Settat.
April 16 morning	Discussed proposed participation of OSU in Morocco dryland project. Copy of document obtained.

Individuals contacted -

Dr. Albert Disdier	Mission Director USAID
Dr. Gerald Neptune	Agr. Officer USAID
Mr. Larry Burgett	Project Officer USAID
Mr. Eugene Webb	Project Officer USAID
Mr. Hamad Hanafi	Interpreter USAID
Mr. Orvill Godman	FAO Agr. Officer
Mr. Abdellatif Behmehdi	Dryland Agronomist, MA
Mr. Khalil Brahim	Soils Scientist, MA
Mr. Bennis Abdelhadi	DPA, MA
Mr. Nadame Jouve	Chief of Large Crops, DPA, MA
Dr. Moline	Chief, DPA

The Situation in Morocco

Morocco imports 1,000,000 tons of wheat each year. Local price of wheat is supported above the world market price to encourage wheat production. Imports of milk and milk products cost about $25,000,000 annually. About half of the sugar is imported, and Morocco has the highest per capita consumption of sugar. Agricultural imports cost more than petroleum imports. Citrus and phosphate fertilizers are two of the main exports.

Many small farmers are encouraged to join cooperatives and participate in land consolidation. Being a part of a cooperative is necessary to receive some of the government subsidies available to farmers.

The major non-irrigated wheat growing areas in Morocco are west of the Hart Mountains and south of the Rif Mountains. Rainfall varies from 250 mm in the south to 500 to 600 mm in the north. Soil depth apparently varies from 30 cm to 2 m. throughout the area. There were extensive areas of shallow (30 cm) and rocky soils that would have low moisture storage capacity throughout the areas south and east of Rabat that we visited.

It seemed evident from the short visit and limited contacts during our visit that good agronomic practices - seedbed preparation, use of drills, weed control, fertilization, and improved varieties - should result in marked yield increases. Most of the wheat is broadcast and covered with a disk. We saw no evidence of weed control and apparently fertilizer is not used on non-irrigated crops. Correcting these problems should double or triple present yields.

The winters are mild with freezing temperatures being unusual. This means that wheat plants start developing with the fall rains and grow throughout the winter. The dry period in summer is long, and temperatures are relatively high. Temperatures of 37 to 40°C are common during July, August and early September throughout the proposed project area. In 1974, the last rains were in early May and with the first fall rains in November the length and intensity of the evaporation gradient probably eliminates the possibility of a dust mulch holding soil moisture within 12 cm of the soil surface that would support seed germination and seedling development before the fall rains start. The benefits from summer fallow, as practiced in the PNW, would be in storage of sub-soil moisture that would supply a part of the moisture requirement during grain ripening. This will probably require soils with 1 m. or more of rooting depth.

The possible benefits from the PNW moisture conserving summer fallow system would have to be evaluated in comparison with annual crop production, especially that from winter annual or early spring-planted legumes that could be grown as an alternate crop with wheat.

At the present time, weeds (some of them legumes) and volunteer wheat provide spring and early summer feed for livestock. Thus, the date of the first tillage on summer fallow will be critical. Forage or edible legume production might continue until soil moisture has been used to a depth of 50 to 60 cm without materially affecting the amount of sub-soil moisture that would be stored on soils over 1 m. in depth. Seedbed preparation, to allow optimum time of seeding after fall rains start will be important and should be completed by early October to take advantage of early fall rains.

The CIMMYT wheat production program was started in 1968-1969 with the import of 500 tons of seed wheat from Mexico. Professional counterparts were not available to work with the foreign agronomists. Wheat varieties introduced were susceptible to septoria and had limited success. The time may be right to build a solid foundation for a continuing wheat-forage-livestock production economy.

Unemployment is presently high. Large numbers of workers have immigrated or are working in Europe. These workers provide a major source of supplemental income to villages and families.

Price controls exist on most agricultural inputs and on cereals. The present price of wheat is $150/ton which is above the world price. Subsidies by the government are available on many agricultural inputs.

Previous French land holdings (750,000 hectares) are being distributed to the landless. Farmers are required to produce at a government-established level, or they are removed. Government-inspected cooperatives are also required to be organized by land recipients. The average land holding in the country is eight hectares with fourteen percent of the holdings being less than five hectares.

The government and USAID/Rabat are very interested in improving productivity of drylands. USAID/Rabat has prepared a proposal for research and extension for this purpose. Oregon State University should become involved in the effort if approved.

Tunisia - Dates of Visit, April 18-24

Travelers - Miller, Bolton, Jackson
Ullery, Winward and Booster

Itinerary

April 19 morning	Visited Mr. James, AID/Director Mr. LeMelle, Director, Ford Foundation and Hassan Belkhodja, Minister of Agriculture

afternoon	Ford Foundation library/Discussssion of agriculture in Tunisia - Ford Foundation/CIMMYT and USAID participation. Courtesy call on Mr. Boulaaba, Director, Office of Cereals.
April 20 morning	Met with Dr. Skouri, Director of OEP and Mr. Ammar, Director of Accelerated Livestock Production Project and his technical staff. Met at IRAT with Mr. Belkhodja, Dean of Ag. School, Agronomy lab Heads.
afternoon	Met with Mr. Sta-M'Rad, Director of INRAT and his technical staff; Met with Mr. Mouaffak, Director, Technical Division of Office of Cereals and his technical staff.
April 21 morning	Entire team plus Butchart, Mahjoub and Doolette took full-day field trip to Enfida Medicago stocking rate trials. Kairouan - CIMMYT Barley Project Site. Tunisia Min. of Agric./FAO/INRAT Station Return to Tunis via Maktar and Siliana. Messrs. Daaloul and Meddeb accompanied. Lunch at Kairouan.
April 22	Departed on field trip of Messrs. Butchart, Jackson, Ullery, Winward, Mahjoub and Doolette to Smindja, Pont du Fahs and Bou Arada. Messrs. Mouaffak and Hedri (INRAT) accompanied.
April 23	Winward met Mr. Harzallah, OEP and INRAT representatives, engineers involved in rangeland matters. Ullery met GOT Water and Soil Conservation Service representatives.

Individuals contacted

Mr. Ullmont James	Mission Director/USAID
Dr. D.W. Butchart	Assist. Agr. Off., USAID
Mr. Dalton Comeaux	Pasture Demonstrations/USAID former Co. Agt. Louisiana
Mr. Don Landry	Forage Advisor/USAID former SCS from Louisiana
Mr. Henry Rosenbaum	Exec. Officer/USAID
Mr. Abraham Hirsch	Rural Development Off/USAID
Dr. Wilbert LeMelle	Director/Ford Foundation
Dr. Werner Kiene	Economist/Ford Foundation
Mr. John Doolette	Agronomist/Ford Foundation
Mr. John Douglas	Seed Prod. Proj., CIMMYT
Mr. Walt Nelson	Wheat Prod. Proj., Algeria CIMMYT
D. H. Belkhadja	Minister of Agriculture
Dr. M. Belkhodja	Dean, School of Agriculture
Mr. Sta-M'-Rad	Dir. of INRAT, Tunisia
Mr. Sifaoui	Agronomy Lab
Mr. Hedri	Economist
Dr. A. Daaloul	Office of Cereals
Mr. H. Ketata	Genetics and Plant Impr.
Mr. Ghadhene	Plant Path. (WSU)
Mr. Halila Habib	Soil Fertility (Utah State)
Mr. Meddeb	Office of Cereals
Mr. Mouaffak	Director, Technical Division Office of Cereals
Mr. Hadead	Edible Legumes
Mr. Selami Ahmed	Mgt., date of seeding, weed control
Mr. Boulaaki	Dir. of Office of Cereals
Dr. Skouri	Dir. of OEP
Mr. Amman	Dir. of Accelerated Livestock Production Program

The dryland cereal production area of northeast Tunisia is on the coastal plains, inland valleys, and foothills of the various mountain ranges. Annual precipitation ranges from a maximum of over 600 mm near the Mediterranean coast to less than 250 mm several hundred kilometers inland which is the lowest limit which can support cereal grain production. Associated with the decrease in precipitation is a general increase in elevation. Nearly all of the precipitation occurs during the months of November through April. Temperatures during the dry summer are high (30-35^{o}C), in the winter the temperatures seldom drop below 0^{o}C.

The soils used for cereal grain production are quite variable, not only on a regional basis, but also on a local basis. Most of the soils were derived from limestone parent material. Soils located in the coastal plains and in the mountain valleys are generally deep (2 meters plus), clay-textured, and fertile except for phosphorus and nitrogen. In localized areas where drainage is restricted, salinity is a problem. One of the greatest soil management problems associated with these soils is being able to till the heavy clay-textured soils to provide a good seedbed or to create a dust mulch to reduce evaporation losses during the fallow year. Coupling this with the relatively long, hot summer raises the question as to whether sufficient moisture can be stored during the fallow year to justify an alternate year cereal production system.

The soils located within the interior of the country, exclusive of the flat, narrow alluvial valleys adjacent to the streams, are generally clay-textured, shallow, rocky, and gently rolling to steep in topography. Because of the slope and the production practices used, erosion is very severe on nearly all soils for two reasons. First, as the demand for agricultural production has increased because of the expanded population, more and more of the steep, shallow soils used for rangeland at one time are being cultivated and used for crop production. In addition, the common rangelands are severely overgrazed because of the ever-expanding size of the sheep herds. Many of these soils are inherently low in productivity as far as cereal grain production is concerned, and it would seem logical that as production on the deeper soils is increased, a permanent vegetation should be established on the steep, shallow areas to provide pasture for the livestock.

Fertilizer use has been practiced on the larger farms for a number of years. Mr. Habib, soil fertility research worker, reported that it is unusual to measure a response from P on most of the large farms. Response from N is evident under a wide range of conditions and can be related to previous cropping practices that affect the availability of soil N and to rainfall which is a major factor controlling yield potential. Some program of soil testing should be started to evaluate residual carry-over of both N and P from previous crops and to be used as a basis for predicting response from both N and P.

Spring cereal crops in the fallow system are grown exclusively because of the mild winters. In reality, however, a crop is being produced every year since the volunteer grain and weeds are permitted to grow during the fallow year to provide the much-needed livestock feed. Cereal crop yields will continue to be low as long as this practice is continued.

The question of benefits from moisture conservation from summer fallowing needs thorough evaluation. Soil moisture may not be maintained with a dust mulch for seeding with a deep furrow drill before fall rains start. Also, the benefits from early seeding of fall-planted wheat in areas with mild winters are limited.

Recent work by Doolette and others of CIMMYT in Tunisia have shown that the Australian system of producing cereal crops in rotation with shallow-rooted winter legumes (medics) is very adapted and productive from the standpoint of producing both a cereal and forage crop.

The adoption of improved and intensive medic or other legume production would be a relatively simple change in agricultural technology. The production of improved legumes during the mild winter months would substitute for volunteer wheat, weeds and unimproved legumes. With early maturing legumes, seed could be set during the later part of the spring rainy season and before a significant amount of soil moisture, especially soil moisture below 50 cm, was used by the crop. Thus an improved, higher-yielding legume forage with a significant amount of nitrogen fixation would be substituted for a much lower quality livestock feed. The advantages of the system are numerous:

(1) medics are much more productive than native annual grasses and weeds and are of high quality,

(2) medics are shallow-rooted and if properly managed, utilize primarily the moisture which would be lost through evaporation during the fallow summer,

(3) medics are nitrogen-fixers and thus provide a relatively inexpensive source of nitrogen for the cereal crops,

(4) medics are relatively easy to grow because they produce seeds which are easily germinated once the fall rains begin if a cereal crop is not seeded. Considering the high productivity level of the medics, the demand for livestock roughage, the difficulty of tilling the clay-textured soils and creating an effective soil mulch, and the difficulty of storing the moisture in the surface 30 cm of soil during the long, hot, fallow summer, the Australian system appears to be a very attractive system for increasing the total production of cereal crops and livestock forage in Tunisia.

In Tunisia approximately one third of the livestock are owned by non-land owners. Livestockmen rely heavily on rented pastures and crop aftermath. Although the rangelands are under government administration, essentially no controlled livestock management system is being used. Forage on these lands is used on a first-come, first-served basis. Few perennial species remain and those that do are either low in palatability or are extremely grazing resistant (low-growing or spiny). Most of the forage on these areas is from annual species and these seldom get an opportunity to achieve an optimum growth rate since they are utilized by animals as soon as they begin growth.

Mountainous rangelands have little potential for improvement by re-seeding since most of the soil mantle has been lost. On the other hand, most alluvial slopes at the base of nearly all mountains have a high potential for improvement. Many of these are being cultivated for cereal production with minimal success. Likewise, many of the shallow soil areas within the valleys are in cereal production. Sanfoin, alfalfa, oats, medics and trefoils have been established successfully on these areas on a few research stations, but their adoption by the farmers and villagers has been nil so far. Sheep production on these improved areas has increased from 1 to 3 sheep per hectare. On one area Brown Swiss steers were returning more dollars per hectare than were similar areas planted to wheat.

Apparently little work has been done in this country with establishment of perennial grasses such as tall fescue, perennial ryegrass, orchard grass, timothy or brome grasses. These grass species are adapted to the climate of this country and likely could increase forage production in Tunisia considerably.

Two major problems were encountered in the area of cereal-forage rotation. Annual species, especially oats and annual ryegrass, sprout each year and consequently become a problem during years when the areas are in wheat production. Secondly, deep furrow plowing for wheat production buries the seed of annual medic species too deeply for survival. As a result, many areas have lost their potential for medic production. This not only eliminates natural nitrogen fixation on these sites, but also reduces the forage supply during non-wheat years and in the stubble period following wheat harvest.

Only minimal work is being done in livestock breeding. Some Holstein-Friesian cattle are evident. Purebred Brown Swiss cattle are grown on the government farms both for demonstration and to supply villagers with genetic stock for improving their own herds. Although this has proved to be successful, little improvement is being implemented at the village level. Likewise, with sheep, no wide-scale breeding improvement program is in progress in Tunisia. Some improvement is occuring, however, by and large, livestockmen continue to produce their "local purebred" cattle and fat-tailed sheep even though these animal breeds produce considerably less than the cross-bred animals.

Unemployment is a problem both in the urban and rural sectors. However, no real concern was expressed about employment by the researchers, even though the problem is given ample attention in the Tunisian 5 year Development Plan. This may be because of the outflow of Tunisian workers to the European labor market.

All major agricultural inputs and product prices are controlled by the government. Wheat, for example, must be sold to the government. Several important products that are uncontrolled are fruits, eggs, hay, and straw. Several inconsistencies in policy exist which interfere with production incentives and technological change.

Production cooperatives are held in low esteem both by the government and by farmers. Previous experience has been poor. Several service cooperatives are in operation.

In summary, the production of cereal grains and forages for livestock can be increased substantially through the adoption of technology.

Some preliminary adaptive research is needed tc determine the exact components of several alternate dryland production systems. However, the most critical factor restricting the production may not be establishing the technology, but rather creating the environment which will permit and allow the farmers to adopt the new technology. The sociological, economic and institutional factors are major obstacles which may determine whether the technology is actually adopted.

Turkey - Dates of Visit, April 24-May 1

Travelers - Miller, Bolton, Jackson
Ullery, Winward and Booster

Itinerary

April 24, 6:30 p.m.	Arrived in Ankara, Turkey, by airplane
April 25	Tour city of Ankara
April 26, 8-12 p.m.	Briefing session with the directors of Agriculture Research and the Wheat Research and Training Center (WRTC), USAID, Rockefeller, and CIMMYT personnel.
1-5 p.m.	Tour of WRTC Research Station at Ankara.
April 27-29	Tour of dryland agriculture in central Anatolian Plateau including visits to numerous research, adaptive research, and demonstration plots, farmer fields, and four state farms (Polatli, Altinova, Malya, and Gozlu).
April 30, 8-12 a.m.	Debriefing session with directors of Agriculture Research and the Wheat Research and Training Center, USAID, Rockefeller, and CIMMYT personnel.
afternoon	Visits with professional contacts.
May 1, 9 a.m.	Depart from Ankara by airplane.

Individuals Contacted

Bill Wright, WRTC, Director of Rockefeller Project
Mike Lindstrom, WRTC, Agronomist with Rockefeller Project

Mike Prescott, WRTC, CIMMYT Pathologist
Art Klatt, WRTC, CIMMYT Cereal Breeder
Stan Samuelson, USAID, Agricultural Officer
Mehmet Kiroglu, Director of Agricultural Research, Turkey
Charles Mann, Rockefeller Foundation
Dr. Resat Aktan, University of Ankara
Dr. Taner Kiral, University of Ankara
Dr. Mehmet Bulbul, University of Ankara
Ahmet DeMirlicakmark, Director, WRTC
Alpaslan Pehlivanturk, Asst. Dir. of Agric. Research
Basri Halitligil, Agronomist, WRTC
Mengu Guler, Agronomist, WRTC
Nadir Izgin, Agronomist, WRTC
Nazmi Ulgen, Asst. Dir., Soils and Fertilizers Research Institute
Nejat Erkenci, Director, Topraksu

Comments

The Central Anatolian Plateau is the major wheat production area of Turkey and currently accounts for the bulk of the annual 10 to 14 million ton production of wheat. Physiographically the area consists of a gently to severely rolling landscape interspersed with occasional mountain ranges and broad, flat valleys. Elevation ranges from 750 to 1200 meters. Annual precipitation varies from 250 to 450 mm, with nearly all of the precipitation occurring in the months of November through May. Winters are cold with temperatures below $-10^{o}C$ common while the summers are relatively warm with temperatures frequently exceeding $30^{o}C$.

Wheat is the predominant crop of the dryland area, although small acreages of other cereal crops, edible legumes and various forage legumes are grown. The fallow system is used exclusively because of the low annual precipitation which is the primary factor controlling yield levels.

Livestock production (sheep) parallels wheat production in importance since it is not only the prime source of meat and wool for family use, but also is one of the farmer's marketable products. Grazing of the stubble during the fall and winter after wheat harvest constitutes a major source of roughage for the sheep. The use of the stubble for grazing and straw accounts for nearly one-third of the value of the wheat crop. Unfortunately, the demand for livestock roughage is so great that weeds and volunteer grain are permitted to grow during the spring and summer of the fallow year. As a consequence wheat yields are substantially reduced because the soil moisture is utilized by the weeds rather than being stored for the following crop of wheat.

Interspersed among the cultivated lands are large acreages of common range land. These are very unproductive primarily because of extensive overgrazing and general lack of proper management. In addition, most of the soils are shallow and little attempt has been made to replace the natural species with more productive species such as the wheat grasses.

The soils of Turkey are generally well-adapted for producing cereal grains. Most of the soils are derived in place from limestone parent material. Although the soils were perhaps at one time very deep and productive, much of the soil profile has eroded away because of the steep topography and the use of poor soil management practices. Severe water and wind erosion occur on most of the crop land, especially on the more sloping lands. In many areas wheat is being grown on shallow soils which do not store enough moisture to merit producing wheat and hence should be returned to a permanently vegetated rangeland. The soils of the broad, flat, alluvial valleys are very deep and have a very high production potential. Soil management hazards associated with these are minimal other than the use of good conservation practices to assure maximum storage of soil moisture.

Nearly all of the soils contain more than 30% of expanding type clays, are low in organic matter, and generally have poor structure. This combination of characterisitics makes it difficult to create a soil mulch or to create a good seedbed for establishing a crop. It is difficult to pulverize this soil to establish a soil mulch for retarding the loss of water by evaporation during the fallow summer. The surfaces also seal in and form a hard crust after a rainfall. The result is often poor infiltration or poor seedling emergence. Increasing the organic matter through incorporation of crop residue and utilization of stubble mulches to retain a portion of the residue on the surface would be a desirable practice as a means to partially solve these problems.

During the past ten years the dryland production capacity of Turkey has improved markedly. This improvement is primarily a result of the OSU, USAID, CIMMYT, and Rockefeller projects in dryland agriculture. Through a combined adaptive research effort, a complete dryland cereal production system was developed utilizing the principles and practices currently being used in the Pacific Northwest. The system is gradually being adopted by the local farmers, and the payoff has been substantial--wheat yields have been increased from 70 to 200 percent. The production practice incorporates all of the following components:

(1) Conservation of moisture during the fallow year by creating a soil mulch which reduces evaporation losses and controls weed growth.

(2) Utilization of a deep furrow drill to place the seed uniformly in residual moisture to ensure a good establishment of the crop.[1]

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[1] It was evident that a properly-established and maintained dust mulch to conserve moisture and allow early seeding with a deep furrow drill will result in marked yield increases. However, it was also evident that use of a deep furrow drill on a dry seedbed results in complete stand failure.

(3) Utilization of new varieties which have higher yield potential and are more resistant to diseases and insects.

(4) Elimination of competing weeds for the limited soil moisture during the crop year by proper use of herbicides.[2]

(5) Fertilization with nitrogen and phosphorus at levels in balance with the amount of available moisture.[3]

(6) Utilization of new equipment on a scale to permit timely tillage, planting and harvesting as needed.

Significant progress is being made toward getting farmers to use the production systems; however, only a small effort is being made to improve the forage production on rangelands interspersed with the cultivated lands.

[1 cont.] Bill Wright and Mike Lindstrom estimated that present summer fallow techniques used on farm demonstrations should make it possible to use a deep furrow drill and establish good stands of wheat in early September about 50% of the time. Yield increases more than justify the expense of proper tillage practices used. This will require maintenance of two sets of drills: one set of deep furrow drills to use where seedbed moisture is adequate and one set of regular drills to use for late seeding after fall rains start or about November 1 when a decision has been made to go ahead and seed shallow in a dry seedbed.

[2] Weed control is evident on many farms. Several planes and ground equipment sprayers were seen applying herbicides to wheat and there is apparently much greater awareness of optimum time of herbicide application. There is apparently real competition to buy herbicides even though only 10 to 15% of the acreage is covered. This is a big start and acceptance of herbicide use is evidently widespread.

[3] Fertilizer use has increased. Phosphorus use is widespread and use of N is apparently expanding on the Anatolian Plateau. There is still room for expanded use of fertilizer. Use of soil tests to identify fields that have received adequate P fertilizers should be started. Apparently soil analyses by the Soils and Fertilizer Research Institute show that many fields on State Farms have adequate levels of P for wheat production. However, State Farm managers, by directive, use one standard rate of fertilizer application.

There is essentially no use of soil tests by private farmers to adjust the rate of P applied. As yields are increased and more straw is incorporated into the seedbed, N fertilizer requirements will increase. This makes it important to expand the use of NO_3-N soil testing as a basis for predicting N needs.

Sheep are mainly of the Karagol (fat-tail) breed, and cattle are again referred to as "local purebreds." Sheep production is poor with low daily gains and less than a 65 percent lamb crop. Starvation is common during the summer dry season and often accepted as "natural death." Some effort is being made to cross the native Karagol sheep with imported Merinos, but it has not been accepted well since the Turks prefer the fat-tailed sheep and the fine wool of the Karagol breed.

The sheep are grazed on crop aftermath and on interspersed, non-cultivated land through the fall, winter and spring seasons. A majority of the flocks are moved onto the mountainous rangelands during June, July and August. The mountain ranges are in a more degraded condition than those in Tunisia. Erosion has left bedrock protruding through a high percentage of the areas. Essentially 100 percent of these areas are utilized by both the village and nomadic flocks. Consequently, annuals and unpalatable perennials make up most of the vegetation. Again, no potential for improvment exists through reseeding work on these areas. Only through a system of use where livestock are controlled seasonally can increased meat production be accomplished on these areas.

However, the foothills and marginal valley bottoms again hold high potential for improved forage production. The Forage, Pasture and Animal Institute in Ankara has tested over 2500 plant varieties for establishment on these areas. Intermediate wheatgrass is considered the "champion" for most of the plateau. Also, sanfoin and alfalfa plantings have proven to be successful. Various annual forage species seeded in early fall and harvested by mid-May have provided an average of 215 kg/ha of forage without interfering with alternate year wheat production. Also marginal wheatland has been successfully planted to perennial grass, primarily wheatgrasses. Several state farms have extremely successful seedings of intermediate and tall wheatgrass for grazing and sanfoin and alfalfa for haying.

Some of the extremely shallow soil areas on the foothills and valley floor have a cover of grass species similar to our Sanberg's bluegrass. Seedings into crowns of this grass (both in the U.S. and in Turkey) are unsuccessful due to competition from the existing low-producing bluegrass. No attempt was being made to first eradicate this highly-competitive grass before planting; consequently, open spots were prevalent after the seeding process. We have developed special machinery to cope with the problem here in the U.S. which may be of value in areas of Turkey where this situation occurs.

A major problem exists in areas where fallow wheat programs are in progress. Farmers leave the weeds which emerge in wheatlands during the fallow season for animal forage. This results in late plowing, excessive trampling and loss of moisture through transpiration, all of which can potentially reduce subsequent wheat yields.

Wheat research in Turkey has shown that a 3-4 fold increase in production is possible through proper preparation and management. Limited research has shown that the same could be true for livestock production.

Iran - Dates of Visit, May 1-6

Travelers - Winward, Booster and Jackson

Itinerary

May 1, afternoon	Leave Ankara for Tehran, Iran (Pan Am 110). OSU team members arrive Tehran. Dr. N. Keith Roberts, CID Director, and Dr. Jim Thomas, CID Dryland Specialist, met the plane and provided transportation to the Victoria Hotel.
May 2, morning and afternoon	Meeting at CID headquarters with Drs. Keith Roberts, Jim Thomas, and Vearl R. Smith, Mr. B. Azimi Zonooz, Soil and Water Conservation Division of the Soil Institute and Mr. Palizban, Regional Director, Kermanshah Region, Ministry of Cooperation and Rural Affairs.
May 3, morning	Meeting with Dr. Duane L. Goodwin (UNDP/FAO/IRAN Watershed Cooperative Project). Leave Tehran for Kermanshah.
afternoon	Field trip to the Cheshmeh Sohrab Corporation Farm located about 55 km east and south of Kermanshah.
May 4, morning	Leave Kermanshah for field trip to the Varleh Corporation Farm approximately 45 km north of Kermanshah. Visited the Kamyaron Corporation Farm about 65 km north of Kermanshah.
afternoon	Leave Kermanshah for Tehran.
May 5, morning	Meeting with Mr. E. Otad, Research Institute for Forests and Ranges, and tour of Experiment Station and reforestation trials near Tehran.

afternoon	Meeting with Dr. P. Mehdizadeh, Chief, Research Institute for Forests and Ranges, in his office. Luncheon meeting with Mr. E. Otad and Dr. Malekpoyr, Chief, Range Section, Research Institute for Forests and Ranges. Meeting with Subminister Hoghoughi, Ministry of Cooperation and Rural Affairs.
May 6, morning	Debriefing meeting with Dr. Keith Roberts. Leave Tehran for London.

Individuals Contacted

Keith Roberts, CID/USU Director
Jim Thomas, CID/USU Dryland Specialist
Vearl R. Smith, CID/USU
B. Azimi Zonooz, Soil and Water Conservation Division
Mr. Palizban, Ministry of Cooperation and Rural Affairs
Duane L. Goodwin, UNDP/FAO
E. Otad, Research Institute for Forests and Ranges
P. Mehdizadeh, Chief, Research Institute for Forests and Ranges (RIFR)
Dr. Malekpoyr, Range Section, RIFR
Dr. Hoghoughi, Ministry of Cooperation and Rural Affairs

Comments

We entered the country of Iran believing that it was one of the most developed countries we were to visit. As it turned out, this was true for industry and urban life. However, agricultural development was the lowest of all countries visited, both for cereal and livestock.

Iran's major agricultural areas are in the mountains of western Iran and along the Caspian Sea. Farms in western Iran are located mainly in rather narrow valleys. Usually there is a stream flowing through the valley that provides water for irrigating some of the crop land on the valley floor. The steeper uplands are not irrigated. Many farms have both irrigated and non-irrigated land. It is estimated that about one half of the available irrigation water is lost because of poor on-the-farm delivery systems.

Each year there are approximately 4.5 million hectares under dryland farming practices and about 7.8 million hectares under fallow. About 54 percent of the dryland is in the 1000 to 2000 m. elevation range. Much of the land is quite steep with some having slopes in excess of 50 percent. Most of the stubble is grazed after harvest leaving little crop residue on the land. The soils are generally low in organic matter and have low infiltration rates. Rainfall ranges from

300 to 400 mm in most of the crop land regions of western and northwestern Iran.[4]

The black fallow system of managing dryland areas is responsible for many of the soil erosion problems. Mr. Azimi Zonooz would like to see some green cover on the land during the summer to help control erosion. Research is under way to identify species of native peas, lentils, and other legumes which would be suitable for providing the desired land cover. The peas and lentils are planted in the spring. Preliminary results are encouraging from an economic standpoint. These crops can provide green cover, add nitrogen to the soil, and produce seed for future plantings as well as food for the people. No information on this research has been published to date.

Present dryland wheat production practices involve the use of moldboard plows for initial tillage and the disk harrow for secondary tillage. Disking is usually done up and down the slopes rather than on the contour thereby contributing to increased erosion problems. There are no rod weeders in Iran. Chisel plows and sweeps can be successfully used, but are few in number.

Seeding is usually a hand broadcasting operation since there are very few grain drills in Iran. Seeding rates for wheat range from 60 to 150 kg/ha. High seeding rates are used on the poorer lands and may range from 100 to 150 kg/ha. There apparently are no standard seeding rates. The disk harrow is used to cover the seed. Emergence is often poor because much of the seed is covered too deeply.

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[4] Non-irrigated wheat production apparently averages 1 m T/ha (15 bu/A) in areas with 350 to 400 mm of annual rainfall. Seedbed preparation is accomplished with a disk plow. Seed is broadcast and disked to cover. Neither herbicides nor fertilizers are used. The winters are milder than for the Anatolian Plateau except for the NW corner of Iran near the Turkish and Iraqi borders. The spring rains frequently stop in early May leaving a dry summer season of 5 months with high temperatures. Rainfall and temperatures for critical periods for Tabriz, Kermanshah, Shiraz and Tehran are given in the following table.

The following tables provide data on seasonal precipitation and temperature patterns for Tabriz, Tehran, Kermanshah and Shiraz.

	Location			
	Tabriz[1]	Kermanshah[2]	Shiraz[3]	Tehran[4]
	Rainfall in mm			
Total (annual)	216	416	416	208
April	49	56	23	31
May	42	34	17	14
June	24	2	1	2
July/Aug/Sept	20	1	tr.	3
October	17	7	tr.	5

[1]1949-58, [2]1943-58, [3]1950-58, [4]1943-60

Critical Temperatures for Tabriz, Tehran, Kermanshah, and Shiraz.

	Location			
	Tabriz[1]	Kermanshah[2]	Shiraz[3]	Tehran[4]
	°C			
Mean Min Dec.	-4.5	-1.1	2.0	-5.6
Mean Min Jan.	-6.6	-3.1	0.5	-7.1
Mean Min Feb.	-5.2	-2.7	1.5	-7.1
Mean Max. June	27.0	32.7	34.8	38.1
Mean Max. Jul/Aug	31.4	36.3	36.3	39.6
Mean Max. Sept.	28.1	32.1	33.1	36.1

[1]1949-58, [2]1943-58, [3]1950-58, [4]1943-60

With these moisture and temperature conditions summer fallowing can conserve moisture in the sub-soil on the deeper soils, but there will probably be few years when a dust mulch will conserve moisture close enough to the soil surface to establish a satisfactory stand before the fall rains start.

Harvesting is done by combines in the larger fields and by hand in the smaller fields. Wheat yields range from less than 100 kg/ha to more than 1000 kg/ha. Yields of 400 to 500 kg/ha are about average for the country.

Tractors are relatively plentiful. The Rumanian Universal tractor assembled in Iran is the most prevalent. Most of the tractors are in the 45 to 65 hp range. Farmers having small land areas (2 to 3 hectares) use animal power or hire custom operators. The current rate for moldboard plowing is 500 rials/ha (1 US dollar = 70 rials).

Fertilizers are used on the irrigated lands but very little on the non-irrigated land. The rainfall distribution makes fertilizer application timing critical. Some research is being conducted on the use of fertilizers on dryland wheat. A typical application would be 20 kg/ha of nitrogen and 50 to 60 kg/ha of P_2O_5. The fertilizer is broadcast by hand.

Weeds are a major problem in all crops. The use of herbicides is a relatively new practice in Iran. Herbicides have been used in the Kermanshah region for about 3 years, for example. Herbicides are not yet readily available to the farmers. More research is needed in all phases of herbicide usage.

Seed wheat is produced by the Seed and Plant Improvement Institute located at Karaj 40 km west of Tehran. The Institute production is not sufficient to meet the needs of the farmers. Consequently, many farmers have to grow their own seed.

Soil erosion is one of Iran's most serious problems. Erosion has been a problem for many years, but has accelerated quickly during the last 10. Hills that were green even 10 years ago are now bare. Twenty years ago flocks of sheep were trailed between Isfahan and Shahre Kord, two cities approximately 450 km south of Tehran. The flocks are now trucked the 75 km between these two cities because there is not enough forage to permit trailing.

When the land reform program was initiated, a farmer could own any land that was under cultivation. Consequently, any land that could be plowed was plowed. Mr. Palizban feels that much of the dryland wheat should be put back into permanent pasture. He feels steps should be taken to ensure that these new pasture lands should not be grazed for several years to allow the forage crops to become re-established. He advocates government financial assistance so the land owner can afford not to farm or graze the land. Research is necessary to test this proposal, however.

There are several kinds of farms in Iran--those owned by individuals, farm corporations, and farm cooperatives. A farm corporation is one in which 55 percent or more of the land owners in an area agree to pool their land holdings so they can be farmed as a unit. Land owners have a number of shares in the corporation that is proportional to their original holdings. The government hires a manager and several other key personnel. Long term interest-free or low-cost loans and other financial advantages accrue to the corporation shareholders. The shareholders have the choice of retaining ownership of their livestock or merging them with the corporation flocks. Two to ten villages may be included in a farm corporation. Ultimately, corporation housing will replace the present villages. Some 68 farm corporations are now in existence with more than 30 under construction or in the planning stages.

A farm cooperative is comprised of a group of land owners who have joined together to form a buying and selling organization. The land owners retain possession of and farm their own lands. Farm cooperatives do not have the same loan privileges and government financial support as the farm corporations.

Farm corporations vary in size from 1,000 to 20,000 ha. From 10 to 90 percent of the land is irrigated. Basin irrigation is used. Water is obtained from rivers and wells. Several farms have wells 50 m deep.

The Planning Board of the Ministry determines the crops that will be grown on the corporation farms. It is not unusual for a single farm to have 10 or 12 crops. Winter wheat, barley, alfalfa, and sugar beets are examples of commonly-grown, irrigated crops. In some areas opium poppies, corn, sunflowers, clover, sanfoin, potatoes, watermelons, and rice are grown.

Irrigated winter wheat yields range from 1500 to 4000 kg/ha. Some press drills are used to seed the wheat. Drag chains are used for covering. The rest is broadcast by hand. Nitrogen is applied at rates up to 200 kg/ha along with appropriate amounts of P_2O_5. Potassium is deficient in a few, small areas. The government subsidizes the use of fertilizers on irrigated lands, but not on drylands. The soils are alluvial, and the subsoils have quite a bit of clay.

Both Dr. Roberts and Dr. Thomas feel that by using good cropping practices, the irrigated lands could produce enough wheat to meet the needs of the people. The drylands could then be re-established as pasture lands.

Dr. Thomas' work has been almost exclusively with dryland crop production although he has had requests to work in irrigated areas.

Some of his work has been in the Kermanshah region in western Iran. In this dryland region, the rainfall averages 250 to 300 mm annually. There is usually snow on the ground from late November to the middle of March. The rains usually stop by the end of March, but in some years have continued until May. January is the coldest month.

Wheat is harvested in July in the Kermanshah region. Yields range from 400 to 600 kg/ha. All of the wheat is fall-seeded, usually in November. The average temperatures in July and August are 38°C. They have difficulty seeding in moisture before the fall rains start because there is usually 15 to 20 cm of dry soil. Also, there normally is not enough moisture available between a spring planting date and harvest time to mature a crop. Dr. Thomas usually uses a seeding rate of 80 kg/ha when planting with a grain drill.

The Pacific Northwest concept of dry farming has never been used in Iran. Land scheduled for dryland wheat is fall-plowed to a depth of 12 to 15 cm using a moldboard plow. Oftentimes, the plows are not properly adjusted. Usually the dryland is left idle for 2 or 3 years between cropping seasons. There is some question about the desirability of summer fallowing the land. In areas receiving less than 250 mm of rainfall, it is estimated that a good summer fallow program including weed control could conserve 20 percent of the moisture.

Dr. Goodwin is involved in developing watershed management programs. A primary objective is stabilizing the soil to keep it in the mountains and out of the reservoirs. Cultivated lands are a big problem in watershed management because of erosion. Developing a watershed management program involves the following:

(1) analyzing the status of the watershed conditions,
(2) evaluating how much soil erosion has occurred,
(3) identifying the various kinds of agricultural enterprises in the watershed area, and
(4) making recommendations for improved practices. Twenty-one watersheds have been identified to date.

Three foreign consulting firms have conducted watershed studies in Iran. The Dez Watershed Resource Management Plan was prepared by the Development and Resources Corporation of Sacramento, California.

Some rangeland re-seeding projects are under way. Fall plowing to a depth of 15 cm with a standard disk plow followed by a spring disking constitutes the usual seedbed preparation. Seeding at rates of 6 to 10 kg/ha is accomplished with a John Deere grain drill. The project has a Caterpiller D-6 and D-7 as well as several wheel tractors available for the tillage and seeding operations. _Bromus_ sp., _Agropyron desertorum_, _Agropyron intermedium_, and _Agropyron cristatum_ are the crops seeded. _Medicago_ and _Trifolium_ species are native to this area.

Dr. Goodwin does not recommend the use of fertilizers in conjunction with rangeland re-seeding because it represents another cost for a practice that has not yet been accepted. Fertilizer distributing equipment has caused many problems, also. It should be recognized, however, that adequate phosphate fertilizer will probably be essential to obtain adequate stands of productive legumes to provide enough nitrogen to produce a good stand of grass.

A major emphasis has been placed on feedlot fattening of both sheep and cattle by foreign consultants. Little work is being done on range-impoverished land which produces the weaners and maintains the parents of the stocker animals.

Work is being done on sheep disease problems. Vaccinations are being demonstrated for reduction of entrotoximia and black leg. Also docking of the fat-tail and castration of the males has proven to be successful. The Iranian people are hesitant to accept these practices. The fat-tail has traditionally been a part of the diet and reserves in the tail are used to carry animals through the dry season. Research has shown that the tail is not necessary where adequate forage is available and conversion to meat is greater without it. Yet, currently, tradition and lack of forage in the dry season requires that lambs be left undocked.

The Iranian people have a tradition to eat only male sheep unless the female is sick or has reached an age of lowered productivity. Their method for identifying males in the market is the presence of testicles left hanging on the carcass. To overcome this traditional concept research has shown that short sack castration, i.e., placing an elastic on the scrotum, but leaving the testicle up in the abdominal cavity accomplishes the benefits of castration (controlled breeding and increased growth rate), yet still leaves the testicles available for display at the market. Whether this will catch hold is not known at this time.

Another severe problem in sheep production is the over-wintering of sheep in enclosed barns or sheds during the winter. Iranians feel that the animals cannot tolerate the cold temperatures, so leave the animals to breathe the stale air and wallow in the wet sheds. Research has shown that animals in sheds with open windows and doors have reduced pneumonia and parasites, but this concept is too new at this time to be accepted.

Essentially no work is being done in the coordination of cereal and livestock production. Opportunities mentioned in Turkey also appear to be available here.

Pakistan - Dates of Visit, May 2-9

Travelers - Miller, Bolton and Ullery

Itinerary

May 2, 9:40	Arrive Rawalpindi, met by Dr. E.T. Bullard
May 3, morning and afternoon	Met with USAID agricultural staff and Dr. Mumtaz Ali, Commissioner of Agriculture.
May 4, morning	Met with FAO representative to Pakistan and World Bank staff.
afternoon	Met with Chaudhry Sultan Ali, Special Agricultural Assistant to the Prime Minister.
May 5, morning and afternoon	Travel to and participated in field day at Mardan.
May 6, morning	Visited Maize and Wheat Research Institute, NWFP.
afternoon	Visited NWFP Agriculture Research Institute at Tarvali.
May 7, morning	Met with Mr. Nazir Mohammed Khan, Director of Agriculture for NWFP. Met Lal Mohammed Khan, Project Director of the Dryland Agriculture Development Project.
afternoon	Returned to Islamabad.
May 8	Prepared draft report, left at Islamabad.
May 9	Left Islamabad for Corvallis.

Individuals Contacted

Dr. Mumtaz Ali, Commissioner of Agriculture
Chaudry Sultan Ali, Special Agric. Assistant
Dr. Horst Curting, FAO Country Representative in Pakistan
M. H. Shah, Director of Ag. Research, NWFP
Mr. Nazir Mohammed Khan, Dir. of Agric., NWFP

Dr. E.T. Bullard, USAID
Dr. R. Newberg, USAID
Joseph Wheeler, Mission Director
Garland Wood, Ford Foundation
Malik Ashraf, Ford Foundation

Comments

Agriculture is Pakistan's most important industry. Seventy percent of the people are rural, and they produce over thirty-seven percent of the GNP. Wheat production in 1975 was approximately seven million metric tons and tentative 1980 targets are 12.7 million metric tons. At present 0.9 million metric tons of wheat are produced on approximately 3.9 million acres of barani lands.

A major dryland program is in action in Pakistan to increase production to one ton of wheat per acre. New varieties of wheat seed are to be used, plus about 75 lbs. of nitrogen and 50 lbs. of P_2O_5 per acre. The present average yield is approximately 300 kg per acre.

Rainfall in the barani land is between 130 mm to 1.3 meters. The higher rainfall lands are to the south and west of Islamabad.

Recently a Barani Commission has been established in the National Science Council to encourage research and improve productivity of barani lands. This reflects an awareness on the part of the government of the potential of this area.

Ordinarily both a summer (wet) and a winter (dry) crop are grown on the higher rainfall barani lands. Generally the crop would be wheat for the winter period and corn, or vegetables for the summer period. As the rainfall decreases, farmers generally specialize in the production of wheat during the dry period. Occasionally, they will alternate with a summer crop.

The average holding in the barani area is extremely small, often being less than one-half acre. It is also leveed (by "bunds") in an attempt to capture run-off. As the bunds are often one to two meters high, mechanization as performed in the U.S. appears unfeasible.

A technical, viable farm unit has been identified as 5 ha, but the legal division of land allows division below this minimum. Some effort has been expended in the past to consolidate lands since land holdings are often fragmented. Generally, this has been unsuccessful due to the failure to identify lands of similar quality. Farmers refused to give good land for poor.

No evidence of a custom service was encountered. Village hostility, within and between, is a major obstacle to progress. Improvement in barani agriculture will require considerable additional research on production systems, as well as improved quantities of agricultural inputs, ie., seed, fertilizer, small equipment and credit. Inadequate price incentives and marketing difficulties also plague the barani lands.

At least two areas of concern were identified through our visit as a team. First, weed control is a major problem not adequately being handled. Yields are greatly reduced by weed infestation. At times competitive crops are seeded with the cereals to provide domestic oil and forage for livestock. This appears to be a dubious practice and should be the object of research. Second, the nitrogen recommendation (82 kilos/hectares) appears to be extremely high for dryland agriculture. While initial economic evaluation of the trial results show that the suggested practices proposed by the dryland project are profitable, experience suggests that lower nitrogen rates could achieve greater production increases.

Animals are important in Pakistan. Thirty percent of farm income is derived from animal products. They are also the source of much of the non-human power in agriculture. Their nutritional and production levels are very low. Since green forage is limited and expensive, animals are allowed to eat weeds during the off-seasons. As stated previously, weeds are often encouraged to provide feed for them during critical periods. The interrelation between the two enterprises should be the focus of a major research effort. Crop refuse, as animal feed, is of considerable importance to farmers. The price ratio between straw and grain is often two to one.

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