9810621111/A ISN-31316 PD-AAN-084

AGENCY FOR INTERNATIONAL DEVELOPMENT
PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS PART I

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PAF

2. DOCUMENT CODE: 5

3. COUNTRY/ENTITY DS/AGR/FCP RDA-2
Type a. Research

4. DOCUMENT REVISION NUMBER: 1

5. PROJECT NUMBER (7 digits): 931-0621.11

6. BUREAU/OFFICE: A. SYMBOL: DSB; B. CODE: 0

7. PROJECT TITLE (Maximum 40 characters): Spring & Winter Wheat

8. PROJECT APPROVAL DECISION — ACTION TAKEN: A APPROVED; D DISAPPROVED; DE DEAUTHORIZED

9. EST. PERIOD OF IMPLEMENTATION (for 3 year extension): YRS. 03 QTRS 0

10. APPROVED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C GRANT	PRIMARY TECH. CODE D LOAN	E. Thru 9/30/79 F GRANT	E. Thru 9/30/79 G LOAN	H. 1st FY 79 I GRANT	H. 1st FY 79 J. LOAN	K. 2nd FY 80 L GRANT	K. 2nd FY 80 M. LOAN
(1) FN	111 I	963	--	943	--	416	--	434	--
(2)									
(3)									
(4)									
TOTALS				943	--	416	--	434	--

A. APPROPRIATION	N. 3rd FY 81 O. GRANT	N. 3rd FY 81 P. LOAN	Q. 4th FY 82 R. GRANT	Q. 4th FY 82 S. LOAN	LIFE OF PROJECT T GRANT	LIFE OF PROJECT U. LOAN
(1) FN	462	--	0	--	2,255	--
(2)						
(3)						
(4)						
TOTALS	462	--	0	--	2,255	--

11. PROJECT FUNDING AUTHORIZED (ENTER APPROPRIATE CODE(S): 1 = LIFE OF PROJECT; 2 = INCREMENTAL, LIFE OF PROJECT): A. GRANT 2; B. LOAN -

C. PROJECT FUNDING AUTHORIZED THRU FY 81

12. INITIAL PROJECT FUNDING ALLOTMENT REQUESTED ($000)

B. ALLOTMENT REQUEST NO. _____

A. APPROPRIATION N/A	C. GRANT	D. LOAN
(1)		
(2)		
(3)		
(4)		
TOTALS		

13. FUNDS RESERVED FOR ALLOTMENT N/A

TYPED NAME (Chief, SER/FM/FSD)

SIGNATURE

DATE

14. SOURCE/ORIGIN OF GOODS AND SERVICES: ☐ 000 ☐ 941 ☐ LOCAL ☐ OTHER _____

15. FOR AMENDMENTS, NATURE OF CHANGE PROPOSED

This amendment extends the life-of-project by three years (from September 30, 1979 to September 29, 1982) for a total 3 year cost of $1,312,000 there by raising the total life-of-project cost to $2,255,000.

FOR PPC/PIAS USE ONLY	16. AUTHORIZING OFFICE SYMBOL	17. ACTION DATE MM DD YY	18. ACTION REFERENCE (Optional)	ACTION REFERENCE DATE MM DD YY

AID 1000-6 (1-79)

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS

PART II

ENTITY : DS Bureau

PROJECT : Spring & Winter Wheat

PROJECT NUMBER : 931-0621.11

1. I hereby authorize a three year extension (from September 30, 1979 to September 29, 1982), requiring additional funds totaling $1,312,000, for the research project "Spring & Winter Wheat".

2. This contract for the three year project extension will be negotiated non-competitively based on "continuation of activities" with Oregon State University.

3. This project extension will be incrementally funded in FY 1979 with $416,000 for the first extension year, in FY 1980 with $434,000 for the second year and in FY 1981 with $462,000 for the third and final year depending on the availability of funds.

4. This project was reviewed and endorsed by the DSB/TPCA project review committee on March 19, 1979 and by RAC on April 30, 1979.

Tony Babb

Tony Babb
Deputy Assistant Administrator
for Food and Nutrition
Bureau for Development Support

Date: 7.30.79

References:
1. Action Memo Peterson to Babb (attached)
2. PP/Research Proposal for 3 year extension
3. Minutes of DSB/TPCA Meeting on March 19, 1979 and of RAC Meeting on April 30, 1979.

Clearances:
DS/AGR/FCP, RJacksun _____ Date: 5/15/79
DS/AGR/FCP, KByergo _____ Date: 5/18/79
DS/AGR, MMozynski _____ Date: 5
DS/AGR, DPeterson _____ Date: 6/20/79
DS/PO, MRechcigl _____ Date: 7/11/79
DS/PO, RSimpson _____ Date: _____

DS/AGR/FCP, KMByergo:dph
05/17/79

2

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: DS/AGR/FCP RDA-2
Type a. Research

4. DOCUMENT REVISION NUMBER: 1

5. PROJECT NUMBER (7 digits): 931-0621.11

6. BUREAU/OFFICE: A. SYMBOL: DSB; B. CODE: 10

7. PROJECT TITLE (Maximum 40 characters): Spring Winter Wheat

8. ESTIMATED FY OF PROJECT COMPLETION: FY 82

9. ESTIMATED DATE OF OBLIGATION (For 3 year Extension)
A. INITIAL FY 79 B. QUARTER 4 (Enter 1, 2, 3, or 4)
C. FINAL FY 81

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 - (For 3 Year Extension)

A. FUNDING SOURCE	FIRST FY 79 B. FX	C. L/C	D. TOTAL	LIFE OF PROJECT E. FX	F. L/C	G. TOTAL
AID APPROPRIATED TOTAL	416	--	416	1,312	--	1,312
(GRANT)	( )	(--)	(416)	(1,312)	( )	(1,312)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY						
OTHER DONOR(S)						
TOTALS	416	--	416	1,312	--	1,312

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	D. LOAN	E. Thru 9/30/78 F. GRANT	G. LOAN	H. 1st FY 79 I. GRANT	J. LOAN	K. 2nd FY 80 L. GRANT	M. LOAN
(1) FN	111 I	963	--	943	--	416	--	434	--
(2)									
(3)									
(4)									
TOTALS				943	--	416	--	434	--

A. APPROPRIATION	N. 3rd FY 81 O. GRANT	P. LOAN	Q. 4th FY 82 R. GRANT	S. LOAN	LIFE OF PROJECT T. GRANT	U. LOAN
(1) FN	462	--	0	--	2,255	--
(2)						
(3)						
(4)						
TOTALS	462	--	0	--	2,255	--

12. IN-DEPTH EVALUATION SCHEDULED: MM 07 YY 81

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE: Dean F. Peterson *Dean Peterson*

TITLE: Director, Office of Agriculture, DSB

DATE SIGNED: MM 06 DD 26 YY 79

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (3-78)

3

RESEARCH PROJECT STATEMENT

Improvement of Winter and
Facultative Wheat for Developing
Countries, Based on Hybridization
of Spring x Winter Forms

Project Number: 931-0621.11

4

TABLE OF CONTENTS

		Page
I.	Project Summary	1
II.	Background and Accomplishments	2
III.	Research Purpose and Expected Products	10
IV.	Significance and Rationale for the Research	19
V.	Plans to Coordinate and Link Research	20
VI.	Plan to Facilitate Utilization of Research Results	23
VII.	Management Considerations	23
VIII.	Technical Review	24
IX.	Research Project Design and Methods	26
X.	Overall Cost Estimates	32
XI.	Reporting Plans	37
XII.	Initial Environmental Examination	37
XIII.	Women in Development	37

RESEARCH PROJECT STATEMENT

I. Project Summary

Project Title:	Improvement of Winter and Facultative Wheat for Developing Countries, Based on Hybridization of Spring X Winter Forms
New or Extension:	Extension
Contractor:	Oregon State University (Cooperation with International Maize and Wheat Improvement Center - CIMMYT and the International Center for Agricultural Research in the Dry Areas - ICARDA)
Principal Investigators:	Dr. Warren E. Kronstad, Professor Dr. Willis L. McCuistion, Associate Professor
Duration:	October 1, 1979 - September 30, 1982
Total Estimated Cost:	$1,311,923
Funding by Fiscal Years:	FY 1979-80 $415,782 FY 1980-81 $433,616 FY 1981-82 $462,525
Project Manager:	Robert I. Jackson
Prior Funding:	Funding from September 30, 1976 - September 30, 1979 - $943,000

Summary Narrative Statement. The continuation of this project on hybridizing spring x winter wheat is a means of increasing genetic veritability in order to penetrate the apparent yield plateau. The results gained to date from the international nurseries generated by CIMMYT concentrating on spring wheat and OSU focusing on winter or facultative types, clearly suggest that the systematic exchange of genetic materials through hybridization of winter and spring type wheats has resulted in new genetic combinations. Such recombinations have been shown to be superior to cultivars with mainly spring or winter parentage in terms of disease resistance, vigor, adaptability and grain yield. Furthermore, by taking advantage of the nutritional lines identified by the University of Nebraska, materials sent to LDCs in the screening nurseries are not only superior for various agronomic traits but some also have elevated nutritional properties.

The winter x spring concept of increasing genetic variability to improve both winter and spring wheats was developed by CIMMYT. During the past few years, there has been a strengthening of the mutual research activities between CIMMYT and OSU coupled with existing linkages with the program at the University of Nebraska. As superior nutritional strains of wheat are identified and different genetic sources of high protein emerge from the Nebraska project, they are incorporated into the winter x spring program. The winter wheat germ plasm developed in Oregon has then the advantage of including superior nutritional properties in addition to the desired agronomic traits. A similar situation exists for spring type wheats developed through the CIMMYT program.

The spring habit is retained while transferring only the desired attributes from the winter wheat parent. After subsequent evaluation and selection, the advanced lines are disseminated through the existing international nurseries coordinated by CIMMYT to the spring wheat growing LDC programs. The earlier maturity and different disease complexes enable scientists from OSU to collect valuable agronomic information from the plots in Mexico just prior to the crossing season in Oregon, thus providing an additional dimension in determining the most productive crosses to make.

As a continuation of current research efforts, this project extension proposes to: 1) accumulate and maintain a genetic pool of wheat cultivars; 2) intercross spring and winter wheats; 3) incorporate superior nutritional properties; 4) insure wide adaption by selecting lines grown under climatic conditions; 5) provide LDCs with the screening nurseries; 6) train young scientists and technicians in cereal breeding and production.

II. Background and Accomplishments

Oregon State University has been engaged in winter wheat improvement for nearly 75 years. Its association with CIMMYT originated ten years ago when scientists from OSU, working under a USAID contract, introduced the semi-dwarf spring type wheats developed by CIMMYT in Mexico into the coastal areas of Turkey. With the subsequent development of the Wheat Research and Training Center by Turkey by the Rockefeller Foundation, a close association between CIMMYT and OSU scientists was established. The OSU team was supported by a USAID grant to develop a package of cultural practices to increase winter wheat production under dryland conditions. Further linkages between these three agencies have been developed through the identification of young, dedicated scientists from many LDCs for graduate training in cereal breeding at OSU. From these associations the various agencies became aware of the potential benefits each could derive from an integrated endeavor to achieve a degree of excellence in wheat improvement with emphasis on small farms which are marginally productive due to environmental stressed conditions.

The winter x spring concept of increasing genetic variability to improve both winter and spring wheats was developed by the late Dr. Rupert, a Rockefeller Foundation scientist assigned to CIMMYT. The initial program was based in Chile and subsequently moved to Davis, California. When it became apparent that the environmental conditions in Oregon were more similar to the winter wheat growing conditions observed in the LDCs and with the associations already established between CIMMYT and OSU, the program was transferred to Oregon in 1971. It was hoped that CIMMYT in Mexico would handle the spring wheat improvement phase while the Turkish national program and OSU would concentrate on the winter dimension. Because of a number of factors, the Turkish program was not able to provide an international scope to the program. As a result, CIMMYT, lacking the sustained support from Turkey and realizing it could not conduct a full international winter wheat program from Mexico, sought a greater involvement by OSU, requesting that it become the center of operation for winter wheat improvement.

With this strengthening of the mutual research activities between CIMMYT and OSU coupled with the already existing linkages with the program at the University of Nebraska, a very positive and complementary total wheat improvement program has been created.

The current winter x spring program takes advantage of the vastly different environmental conditions and disease complexes observed between Oregon and Mexico. The first crosses are made in Toluca, Mexico in May where the vernalization and day-length requirements for winter wheat cultivars can be satisfied, thereby providing the opportunity to nick with spring type wheats. Thus the problem which has historically isolated winter and spring wheats is avoided. Resulting F1 seed is divided and planted in October at Ciudad Obregon, Mexico and Corvallis, Oregon. The F1 material at Ciudad Obregon is integrated into the spring wheat improvement program by top and double crossing to spring type material.

In Oregon, the winter x spring F1 material is top and double crossed back to winter type wheats. In conducting subsequent evaluations, three major testing sites are utilized for screening segregating populations. These include: The Hyslop Agronomy Farm near Corvallis (1000 mm rainfall), Pendleton Experimental Site (500 mm rainfall), and the Sherman Experiment Station (250 mm rainfall). These sites not only provide varying degrees of moisture stress, but also allow selection of winterhardy lines and those resistant to the major diseases observed in the winter wheat producing regions of the world.[1/] In addition, the Sherman Experiment Station allows for selection under summer fallow management systems. This is very critical in dryland areas like the Anatolian Plateau in Turkey which typifies dryland wheat-producing areas in most LDCs. A significant input to the dryland wheat production effort is the awarding of a 211(d) grant by USAID to OSU, thereby strengthening the expertise in dryland agriculture production. This will benefit the breeding program as well since the management system is so vital

1/ To insure adequate levels of leaf and stem rust infection, all segregating winter populations are also grwon in Toluca, Mexico where artifical inoculati are practiced to identify resistant genotypes.

in developing suitable varieties or germ plasm. Further resources in the area of weed control in both dryland and high rainfall areas can be obtained through the cooperative effort between the breeding program and the Internationa Plant Protection Center (IPPC) also funded by USAID and based at OSU.

When considering the three diverse testing sites, it should be noted that through the "material flow" system, the germ plasm in the course of development is alternated and/or simultaneously subjected to various environmental stresses. Thus, successful lines have favorable responses to a full range of requirements. This approach has been the key to the wide adaptation of the materials developed in Mexico for spring wheat. Wheat breeders in Oregon are in a unique position to do the same thing for winter wheats. Nowhere in the United States and few places in the world can such an ideal situation be found for evaluating germ plasm under the many different environmental stresses within such a short distance.

Two hundred and fifty winter and facultative lines representing the F4, F5 and F6 generations are included in the International Winter X Spring Wheat Screening Nursery (IWSWSN) along with suitable check varieties. This nursery is currently sent from Oregon to 48 different countries representing 97 breeding programs. Elite lines identified in Oregon through yearly visits by CIMMYT scientists, along with the screening nursery, are sent back to Mexico for recycling, thus providing additional germ plasm for the spring wheat improvement program. To some of the same LDCs, outstanding early generation populations are also sent, particularly where specific limiting factors have been identified such as aluminum toxicity in Brazil. In 1978, 100 selected F2 populations were sent to 28 cooperators. In addition, crossing blocks and specific cultivars which exhibit desired attributes are sent upon request.

Accomplishments have included: 1) The systematic crossing between winter and spring wheat cultivars ha greatly increased the genetic potential for both winter and spring wheats. The most promising lines now emerging in the CIMMYT program for the improvement of spring wheats have resulted from winter x spring crosses. A similar situation exists for winter wheats in Oregon. 2) The growing conditions observed in Mexico at the Toluca site have permitted the extensive crossing of winter and spring wheat cultivars. 3) The different environmental conditions, disease complexes and growing season observed between Mexico and Oregon have permitted a very efficient program to be conducted for the improvement of both winter and spring wheats. 4) Research activity at the University of Nebraska has identified superior nutritional material and provided a significant linkage to the winter x spring wheat improvement program.

The IWSWSN has served as an effective means of distributing useful germ plasm to all country programs. Data returned by over 70 percent of the cooperators indicate that scientists in developed as well as developing countries are making extensive use of the lines in the screening nurseries either through further hybridization or as direct varietal releases. A few specific examples are as follows:

Afghanistan. Approximately 15 winter x spring breeding lines have been selected each year from the screening nurseries for advancement into yield trials. This germ plasm is especially well adapted to the regions of Kabul and similar high altitudes. The Afghan scientists are hopeful that one of these selections can be multiplied for release.

Algeria. The earlier winter x spring cultivars from OSU are well adapted to the high plateau regions of Setif, Tiaret and Siada in Algeria. The climatic conditions are very similar to those at the Sherman station in eastern Oregon. Selections are being advanced from segregating populations and the IWSWSN.

Argentina. Several selections from the winter x spring program have expressed good disease resistance and contain sufficient frost tolerance and/or winter hardiness for the region of Bordenave, near Buenos Aires.

Brazil. Two different wheat research programs in southern Brazil are selecting the winter x spring germ plasm for resistance and tolerance to a number of important diseases and soil problems; i.e., aluminum toxicity caused by low soil pH similar to the conditions in western Oregon.

Chile. Dr. I. Ramirez (Santiago), Mr. J. Acevedo (Tumunco) and Mrs. L. Aguayo (Chillan) each have several winter x spring wheat cultivars in yield trials. These cultivars exhibit good disease resistance and/or intermediate-to-high levels of winterhardiness.

India. Dr. Sivaminathan, Director General - ICAR, and Dr. M.V. Rao, Coordinator, All-India Wheat Coordinated Program have requested and received winter x spring wheat germ plasm for the major research centers in the Himalaya mountains. They are selecting facultative types with sufficient winterhardiness and earliness for the available moisture provided by the annual monsoon.

Iran. The scientists at the Karaj plant breeding center have selected three cultivars which are now in the second year of yield testing and under preliminary increase. Major emphasis for the winter and winter x spring wheat programs has now been moved to the Tabriz site in the mountains of northern Iran. The 5th IWSWSN was planted for the first time at this site in the fall of 1977.

Jordan. Over 50 advanced lines from the IWSWSN have been included in yield trials and five of these lines are also under preliminary multiplication at Amman, Jordan. These lines are of intermediate maturity and have expressed a sufficient level of frost tolerance.

Mexico. The CIMMYT program is using winter wheat varieties and advanced lines from the OSU winter x spring program as parents in the development of new Winter x Spring F1 single crosses at the Ciudad Obregon site and at Toluca in northern and southern Mexico, respectively. The diverse locations in Mexico provide ideal conditions to screen the germ plasm for resistance to stem rust, leaf rust, and stripe rust. Equally diverse sites in Oregon provide optimum conditions to identify resistance to stripe rust, septoria, powdery mildew, barley yellow dwarf, and the foot rots.

Nepal. Several selections from the IWSWSN have performed well in the Kathmandu regions and have been included in the national trials.

Pakistan. Promising IWSWSN lines are being evaluated in yield trials at Quetta (western Pakistan) and the hill areas in northern Pakistan.

South Africa. The similarity in climate, soils and production problems of South Africa and Oregon has stimulated a desire to exchange germ plasm. The IWSWSN and F2 bulk populations are presently being evaluated at Bethlehe One of their scientists has visited the program to select germ plasm and lea more about management of a plant breeding program. Severe attack of stem rust in South Africa will provide OSU with valuable information as to the best sources of resistance for incorporation into new hybrid combinations.

Spain and Portugal. Both Spain and Portugal are positive about the winter segregants from winter x spring F2 populations and selections from the IWSWSNs. The nurseries are being observed in the northern areas of both countries.

Syria. Close linkage has been established with ICARDA. Dr. J. Srivastava has requested and received the F2 bulk populations (250 entries) and the IWSWSN for selection in the zones of lower winter temperatures.

Tunisia. A number of cultivars from OSU are doing well in the higher altitudes of western Tunisia where late frost and occasional freezing temperatures occur. This is a region where production of spring wheats is frequently damaged by frost.

Turkey. Very close linkages with the Turkey wheat program and OSU for several years has provided winter x spring germ plasm to all winter and intermediate wheat zones. Both OSU and CIMMYT provided teams of scientists to develop a nationally coordinated wheat research program and winter x spring germ plasm has also been disseminated from the Turkey program.

Korea. The desire for earliness to facilitate double cropping with either ric or soybeans is a major breeding objective. Two advanced lines which look extremely promising and will be released as new varieties are Suweon #215 and #216. These lines resulted from the cross Strampelli/69D-3607/Jokwang. The parent 69D-3607 was a selection they obtained from the 1st IWSWSN. In addition, 12 lines from the IWSWSN are being used extensively for mildew resistance and 10 lines for stem rust resistance

There is a definite potential for increasing yield levels in many LDCs. When yields of lines in the screening nursery are compared to the yield of the local check grown in the same trial, several spring x winter lines exceed the local check significantly.

Graduate training is an area that has benefited greatly from the spring x winter program. Many young scientists from LDCs who received their training at OSU have now returned to their country programs where they are assuming leadership roles and are making significant contributions in the area of wheat improvement. Many are now cooperators in the IWSWSN and return complete and extremely useful data annually.

Many theses problems have been a direct spin-off of the spring x winter program. Factors effecting emergence and stand establishment have been studied. Earliness and winterhardiness in winter x spring crosses have been evaluated as well as the inheritance and association of earliness and grain yield. A study is currently underway of vernalization and photoperiod responses as related to earliness in wheat. Also in progress is an evaluation of breeding methods in certain spring x winter populations.

One important measure of the effectiveness of the program has been in the linkages established. Because of the prominance and worldwide reputation of the program based at OSU, many scientists from all over the world come to Oregon to interact with OSU staff and graduate students and to make selections in the breeding material for their country programs. Young trainees who have completed a course of study at CIMMYT frequently spend time observing and interacting in the program at OSU before returning home. This exposure has proved a definite benefit as it has increased the completeness and accuracy of the data returned from these country programs.

The program has been effective in establishing lines of communication and germ plasm exchange with countries such as the People's Republic of China and the USSR where political considerations had previously made such an exchange possible.

Publications

Oregon State University Cereal Team. 1974, 1975, 1976 and 1977. Results of the International Winter X Spring Wheat Screening Nursery. OSU-CIMMYT

Kronstad, W. E., W. L. McCuistion, M. L. Swearingen and C. O. Qualset. 1977. Crop Selection for specific residue management systems. ASA monograph

Scott, N. H., W. E. Kronstad and W. L. McCuistion. 1978. An electronic weighing and data processing system for field use in a small grain breeding program. Crop Science. Vol. 18, July - August, p. 684-685.

Kronstad, W. E. 1977. Wheat in the People's Republic of China. Wheat Delegation - National Academy of Science. CSCPRC report No. 6.

Oregon State University Cereal Team. 1978. Wheat Cultivar Abbreviations (Winter and Spring) Agricultural Experiment Station.

Vahabian, Mohammad. Factors influencing stand establishment of winter wheat under dryland conditions. 1976. Ph.D. Thesis.

Conway, Michael. The relationship between ATP and early germination in wheat. 1977. M. S. Thesis.

Yakar, Kamil. Earliness and winterhardiness in winter x spring crosses. 1977. M. S. Thesis.

Firat, Ertug. Inheritance and association of earliness and grain yield in four winter x spring wheat crosses (Triticum aestivum L. em Thell). 1977. M. S. Thesis.

Camargo, C., W. E. Kronstad and R. J. Metzger. 1978. Heritability estimates and associations of different height levels with aluminum toxicity and grain yield in wheat. Crop Science. In Press.

Martinez, C. 1977. Aluminum toxicity studies in rice (Oryza sativa) Ph.D. Thesis. Manuscript in progress.

Harrabi, M. 1978. Estimates of genetic variance and heterosis in F1 winter x spring barley crosses (Hordeum vulgare) M. S. thesis.

Lopez, A. 1977. Influence of aluminum toxicity in intergeneric crosses of wheat and rye. Manuscript in progress.

Participation in Meetings

Technical Advisory Committee review of CIMMYT and all related international programs, Ciudad Obregon, Mexico. April, 1976. Presentations by Drs. W. E. Kronstad and W. L. McCuistion.

Moore, D. P., W. E. Kronstad and R. J. Metzger. 1976. Screening wheat for aluminum tolerance. In: Proceedings of workshop on plant adaptations to mineral stress in problem soils. Beltsville, Maryland p. 287-295.

An International Symposium on Rainfed Agriculture in Semi-Arid Regions. April, 1977. University of California, Riverside. Participant, Dr. W. L. McCuistion.

Regional Barley and Wheat Workshop. Amman, Jordan. April, 1977. Presentation on the OSU W & S Wheat Program by Dr. W. L. McCuistion. "The OSU International Nursery Program".

International Agricultural Development Service organizational meetings. Airlie House - Warrenton, Virginia. June, 1977. Presentation on Cereal Production in North Africa by Dr. W. L. McCuistion.

The Fifth International Wheat Genetics Symposium. February-March, 1978. Presentation by Dr. W. L. McCuistion. "Development in the W X S Wheat Program during the Past Six Years."

Conferencia Regional de Cereales. CIMMYT-INIAP-CIDA. May, 1978. Quito, Ecuador. Presentation by Dr. W. E. Kronstad. "The International W X S Wheat Research and Graduate Training Programs at OSU."

National Academy of Science Wheat Studies delegation exchange with People's Republic of China. Dr. W. E. Kronstad presented four seminars on various aspects of wheat breeding and genetics.

Country Program Reviews

The People's Republic of China. Dr. W. E. Kronstad was a member of a Wheat Delegation reviewing the national wheat program during the months of May and June, 1976.

Jordan. The national wheat program of Jordan. Dr. W. L. McCuistion reviewed the national and university programs during and following the Regional Barley and Wheat Workshop during April, 1977.

Syria. Review of planned research sites and offices of ICARDA - Aleppo, Syria. Dr. W. L. McCuistion toured the research sites and interacted with new staff members to discuss future coordination of regional and international nurseries.

Iran. The wheat research team at the Karaj Plant Breeding Center spent four days with Dr. W. L. McCuistion reviewing the present field goals. They are relying on strong support from the new winter wheat station established by ICARDA at Tabriz, Iran.

Afghanistan. Representatives of the Ministry of Agriculture, the Agricultural University at Kabul and the Food and Agricultural Officer of USAID provided complete support to Dr. W.L. McCuistion in reviewing their present wheat research. They also requested suggestions on future direction of the national research program. The overlapping visit of Dr. F. Zillinsky with Dr. McCuistion allowed additional discussions on coordination of international nurseries.

India. The visit of Dr. W.L. McCuistion with Dr. M.V. Rao, Coordinator of the All-India Wheat Coordinated Program permitted time to develop a detailed outline of India's requirements for winter wheats in the northern Himalaya mountains.

Pakistan. An extensive field tour was arranged for Dr. McCuistion by Dr. M. Tahir, the newly appointed National Wheat Coordinator. The winter wheat nurseries will be grown in western and northern Pakistan.

Korea. The Korean Ministry of Agriculture invited Dr. W.E. Kronstad to participate as a team member in reviewing the National Wheat Research Program. The team members prepared a summary report providing suggested modifications and additions to the existing program.

III. Research Purpose and Expected Products

A. Project Goal

To assure that LDCs, where winter wheat is a major food grain, can obtain and effectively take advantage of the latest improved winter wheat varieties and technologies suitable for increasing yields of high quality grain, especially on small farms and in environmental conditions which now are marginally productive.

B. Research Objectives

The major objectives of this project are as follows:

1. Develop, evaluate for superior agronomic traits and maintain a germ plasm bank of superior winter wheat cultivars for hybridization.

2. Create greater genetic diversity for the improvement of winter and spring type wheats.

3. Improve nutritional quality in winter wheat by making crosses to lines with known superior nutritional properties.

4. Apply suitable selection pressures to identify superior winter wheat germ plasm with improved yield adaptation and disease resistance.

5. Disseminate early generation breeding stocks to selected LDC cooperators for further selection under their local conditions for specific adaptation requirements.

6. Distribute superior agronomic lines and fixed varieties to all cooperators through the IWSWSN with LDCs receiving first consideration.

7. Determine those attributes necessary in winter wheat cultivars to insure maximum soil erosion control, productivity and stability in concert with improved dryland cultural practices.

8. Train dedicated young scientists who will have prime responsibility for adaptive research in their LDC institutions.

9. Establish new relationships and expand those already existing between LDC agencies and institutions, U.S. universities, USDA-SEA, USAID missions, the Rockefeller Foundation, CIMMYT, FAO and other international and regional plant breeding centers.

10. Conduct in-country (LDCs) training and seminar programs in cooperation with USAID missions and CIMMYT and ICARDA research staff in selected countries.

C. Description

In order to continue current research toward meeting the overall objective in the spring x winter wheat hybridization project, the contractor will perform the following services:

1. Germ Plasm Bank

In order to make crosses directed toward specific objectives, it is necessary to accumulate and maintain a working genetic pool made up of superior winter wheat cultivars which cover a wide range of adaptability. Through the network of cooperation that has already been formed between LDC agencies and institutions, U.S. universities, USDA-SEA, USAID missions, the Rockefeller Foundation, CIMMYT, FAO and other international and regional plant breeding centers, superior varieties and advanced lines are being exchanged. Information from the country of origin as well as local observations concerning combining ability, yield potential, adaptation, resistance to various diseases, and responses to other limiting factors will be catalogued. Utilizing the computer to record and cross reference such information a data bank will be compiled to give the plant breeder ready access to the names of varieties or lines which can be effectively utilized in crosses directed toward a particular goal. From this winter germ plasm bank the winter crossing block for both CIMMYT, where the single crosses are made, and Oregon for top crossing will be developed.

This collection is now being further enriched by the exchange of germ plasm with the People's Republic of China which was facilitated by recent visits by CIMMYT staff and OSU principal investigator.

2. Genetic Diversity

There is a concern that future improvement in yield levels and daptability will be only minor if scientists are limited to the use of xisting germ plasm and are restricted to intracrossing in the spring or inter types.

However, results have shown that a much greater genetic diversity can e achieved through the intercrossing of the two types. Spring wheat arental sources are carefully chosen to incorporate important characters uch as a wide maturity range, head fertility, agronomic type, new dwarf enes, and genes for disease resistance not available in the winter wheats. he winter wheat parents provide new genetic sources for winterhardiness, rost and drought tolerance, yield potential and stability, shattering esistance, bread making quality and different types of disease resistance ot presently available in spring wheats. Results from the international urseries developed by both CIMMYT and OSU have clearly demonstrated that roducts from spring x winter crosses do represent superior germ plasm.

3. Incorporation of Superior Nutritional Properties

Selected F1 populations resulting from spring x winter single crosses made in Mexico are top and double crossed in Oregon to high protein cultivars previously identified by the University of Nebraska. Lines with exceptional nutritional properties are identified and evaluated under the diversified selection pressures in subsequent generations to insure that lines with enriched nutritional properties will have wide adaptation. Prior to entry into the IWSWSN, selected lines are further evaluated by the quality laboratory recently established at the Hyslop Agronomy Farm located near the OSU campus for improved nutritional properties. This information, along with the agronomic data obtained in Oregon will be provided to the scientists in the LDCs receiving the IWSWSN seed. With this background information, scientists in the LDCs can more effectively identify promising lines.

4. Selection Pressures

Specific climatic conditions and those factors which limit winter wheat production in the LDCs can be found somewhere within the State of Oregon. There are over 400 different soil types varying from strongly basic to strongly acidic. Winter temperatures in coastal areas are mild enough to accomodate the growing of fall-sown spring wheats, but in eastern Oregon are severe enough to require a moderate level of winterhardiness. The rainfall pattern is predominantly a mediterranean type with annual amounts varying from less than 250 mm to over 1000 mm. In the dryland areas, drought resistance is an important consideration and the development of cultivars in relation to an exacting management system is required. Every major disease attacking winter wheat is present with the exception of stem rust, thus, all early generation material is also sent to Toluca, Mexico where it can be effectively screened for stem rust resistance. Data already obtained from the entries.

in the first five IWSWSNs also suggest that many of the physiological races of major diseases present in LDCs are found in Oregon.

To insure wide adaptation, superior progeny from segregating populations are grown and selected simultaneously in all four sites. Due to the large environmental differences observed between sites, the resulting germ plasm is exposed to many of the limiting factors common to winter wheat areas of the world. It should be noted that advanced lines which have been selected for their yield potential under Oregon conditions do in fact have wide adaptation as evidenced by their superior performance across locations in the LDCs.

5. Early Generation Breeding Stocks

The F1 top and double cross populations are selected on an individual plant basis using the pedigree method. In addition, superior populations are bulked following plant selection and sufficient seed is available for further testing as F2s at a number of locations.. Each F2 bulked population is planted at the three major Oregon experimental sites. The remaining seed is disseminated to selected LDCs where facilities and staff are available for further selection under local conditions.

Cooperators in areas with particular problems consistently limiting wheat production, such as special types of winter killing, late spring frosts, drought conditions, specific disease attacks, etc., will be asked to assist in screening additional genetic material for resistance to those limiting factors. Providing these early generation stocks is extremely important to the cooperator and can also benefit the OSU and CIMMYT programs as data are returned indicating the best populations under unique conditions. Programs in developed countries, particularly in eastern Europe, are not only providing useful agronomic data as a result of growing the IWSWSN, but are also providing valuable germ plasm for incorporation into the winter x spring program. As a consequence of this exchange, superior germ plasm previously inaccessable is now finding its way into the LDCs.

When early generation quality screening is used along with agronomic and pathological selection, a higher percentage of the lines have desirable quality in the advanced generations. The wheat quality evaluation of lines starts with the F4 individual selections (seed from F3 selected plants) and is continued through the F5 and F6 generations. Quality considerations involve nutritional properties rather than end product use factors.

In making winter x spring crosses, tremendous variability in gluten strength results due to the wide variation in germ plasm. Following harvest, seed of all selected plants are first tested for grain type and only those with plump kernels are maintained. Advanced generation material is then evaluated for gluten strength using a mixograph. Only lines with acceptable gluten strength in keeping with hard or soft wheat types are retained for further evaluation.

6. Screening Nurseries

Selections from preliminary yield trials at the three Oregon sites are advanced to the IWSWSN for evaluation in many winter wheat areas. In Table 1 is presented the number of entries, cooperators and countries receiving the six IWSWSNs that have been distributed to date. With the identification of additional nursery sites in the People's Republic of China, and the mountainous regions of northern India, all the major winter or facultative wheat growing areas are covered.

TABLE 1. TOTAL NUMBERS OF ENTRIES, COOPERATORS AND COUNTRIES RECEIVING THE SIX IWSWSNs, 1973-1979

IWSWSN NURS. NO.	NO. OF ENTRIES	NO. OF COOPERATORS	NO. OF COUNTRIES	CROP SEASON
1	360	38	24	1973-74
2	450	52	30	1974-75
3	448	63	33	1975-76
4	250	69	40	1976-77
5	250	80	46	1977-78
6	250	97	48	1978-79

Return of the experimental data following harvest is essential for proper evaluation of the material. Response from cooperators thus far has been very encouraging. Personal contact through visits to different cooperators will improve the quality and amount of data returned. Receipt of all data is requested prior to the end of the year in which the nursery is grown. The data are completely summarized by computer and superior lines are identified. A printed copy of the results is returned to the cooperator by mid-February of the following year. This provides the cooperators with the complete summary of data from all locations prior to their crossing period. This summary is also a valuable tool for OSU and CIMMYT in planning their crosses for new bybrid combinations.

Advanced lines with proven general adaptation from the IWSWSN or with special attributes will make up the new International Winter X Spring Replicated Yield Trial. This nursery will complement the IWSWSN and will be sent to a limited number of cooperators with emphasis on those LDCs which cannot take full advantage of the screening nursery due to limited breeding programs.

7. Variety X Management Interaction

Since the majority of the winter wheat production in the LDCs is under limited rainfall conditions, a management system to conserve moisture must be employed if successful yield levels are to be obtained. The summer fallow system of the Pacific Northwest has been modified and successfully introduced into Turkey. Experience has shown that if maximum production is to be achieved, varieties must be developed in keeping with the particular system. Furthermore, such a variety x management interaction is even more critical in preventing or reducing soil erosion either by wind or water. With the awarding of the 211(d) grant to OSU for strengthening dryland agriculture production technology, it is possible to utilize this resource in the breeding program in a complementary fashion.

One cultural practice which has been clearly identified as being significant in dryland management systems is that of seeding early in residual moisture. This not only results in higher yield levels, but is a major deterrent to soil erosion. However, if this practice is to be effective, cultivars must be developed which have certain attributes not found in existing varieties. These involve factors which influence stand establishment including rapid emergence in warm, relatively dry soils, semi-erect seedlings having a proper balance of tillers and leaves to lessen damage by wind, improved winterhardiness, varieties that efficiently use limited water supplies, greater ability to compete with weeds, emergence through compact, residue covered soil and greater resistance to pathogens.

In the winter wheat producing LDCs, the need for developing cultivars in keeping with management systems to reduce soil erosion either by wind or water cannot be overstated. These areas have already lost a substantial amount of an irreplaceable resource base which they can ill afford in terms of present food needs to say nothing of future requirements.

8. Training

The ongoing cereal research program at OSU provides a faculty and staff concerned with extending scientific knowledge and dedicated to the training of young people.

The scope and size of the winter x spring hybridization program is ideal for training qualified young scientists and technicians in cereal breeding and production. The program has been developed to provide an educational base for those young people who will be expected to assume leadership roles in their respective national programs. The students work directly in the winter x spring research project receiving assigned responsibilities, thus becoming familiar with all practical aspects of wheat breeding. They learn to disseminate information by being exposed to the philosophy and techniques employed in extension systems. That there is dignity in getting one's hands dirty is another important learning experience. The students are expected to assume leadership roles and discuss their phase of the program with visiting scientists and with farmers during field days.

Theses problems for students from LDCs are selected in keeping with their personal interests and with regard to the type of research experience which will be most beneficial upon their return home. Some students currently enrolled in the program are completing their course work at OSU and doing their research in cooperation with CIMMYT and at the International Rice Research Institute.

A positive result of the program has been the lasting relationships which have developed between LDC students and the faculty and staff at OSU. Contacts are maintained through a quarterly newsletter and, in some instances, faculty members are able to visit programs in various countries and assist in developing objectives. Such visits not only reinforce the young scientist's confidence in himself, but frequently road blocks can be removed by visiting with government officials in the particular country. Several graduates of the program are now cooperators in the winter x spring research effort in their respective countries. The in-country training program proposed in this renewal request addresses itself to this need for continuation of the backup support for the LDC scientists.

There are a substantial number of gifted young people, from the U.S. many of whom are former Peace Corps volunteers, who want to become involved in international programs. Unfortunately, there is very little support for such people in terms of assistantships. In this proposed renewal three assistantships are identified for U.S. students with interest in international agriculture. The need for well trained scientists for international assignments is very acute. This aspect of the winter/spring program addresses itself to this need.

9. Linkages

Communication and cooperation between agencies and programs throughout the world forms the cornerstone of success in an international wheat improvement program.

Genetic stocks, experimental lines, and research information are exchanged with other organizations engaged in international activities, such as CIMMYT, FAO, The Rockefeller Foundation, the University of Nebraska and Michigan State University to insure rapid progress in the improvement of winter wheat.

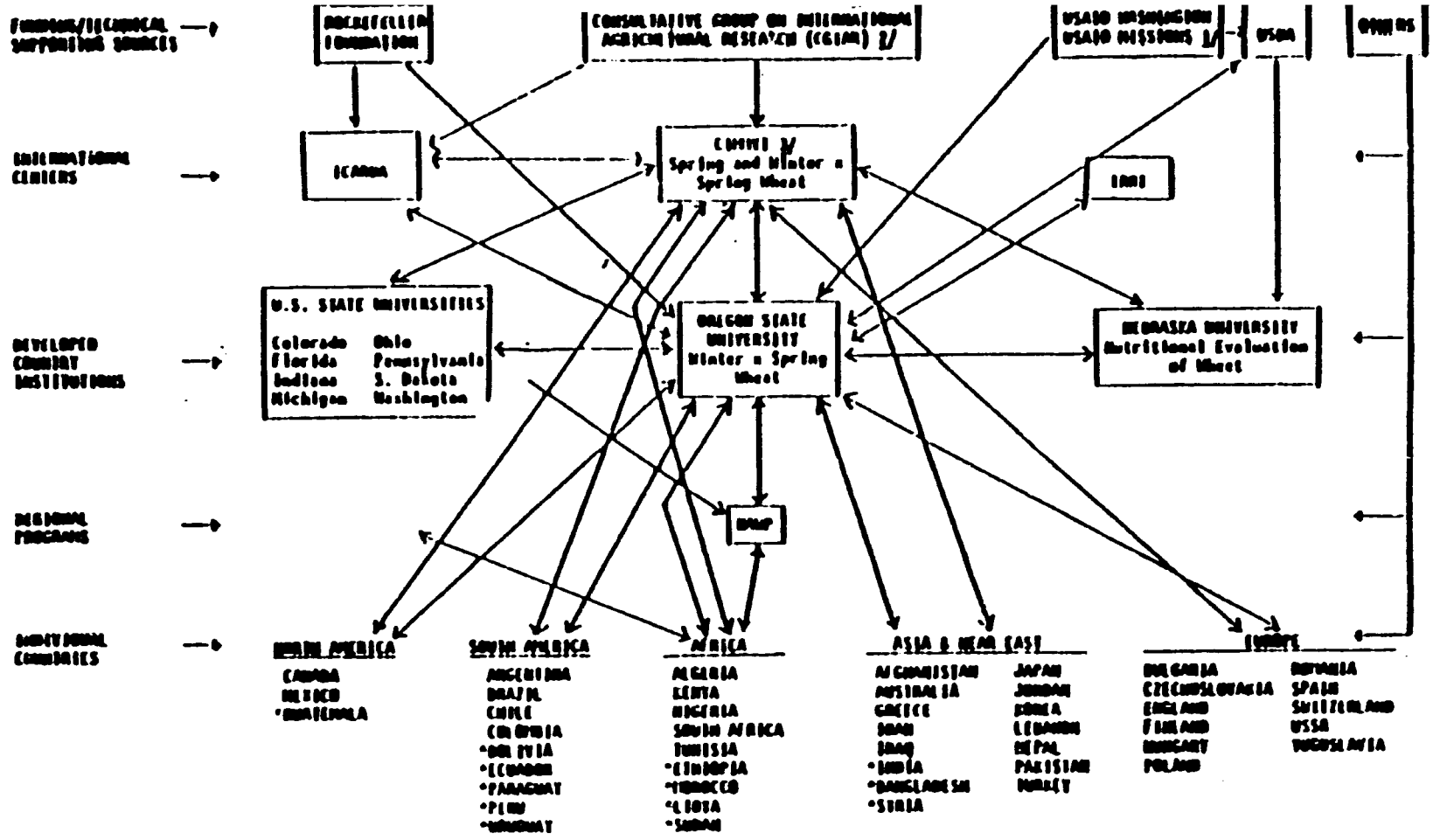
Visits between institutions and cooperators are made to avoid duplication of effort and to coordinate the exchange of material and information. Personal contact through visits to countries where the IWSWSN is being grown will improve the quality and amount of data returned.

OSU will assist and participate in national and international workshops and conferences in cooperation with the above mentioned agencies. Furthermore, upon request and funding by USAID missions OSU scientists will provide inputs to LDCs to strengthen national cereal research programs as a part of the proposed in-country training program.

10. In-Country (LDCs) Training and Seminar Programs

There is a need to relate to specific country programs regarding all aspects of cereal production. In concert with USAID Missions, in-depth reviews in the form of seminars and discussion groups will be held involving LDC staff graduates, national scientists and selected resource people. These sessions will focus on research needs of specific countries and will not be conducted in the broad format of an international conference where overall general country papers dominate the proceedings. The in-country training programs may involve several days to several weeks, depending on the needs and availability of resources of individual countries. Included with formal presentations will be also on-site visits to the major research institutes within the countries to review research programs and priorities. All aspects of cereal research will be discussed including breeding, production, economics and extension practices. Target countries will be identified based on the various USAID Mission and CIMMYT outreach staff requests. Such a program would not only acquaint the spring x winter staff with the needs of individual countries, but it would also reinforce the national scientists in terms of program development and establish closer linkages between the spring x winter program and LDC activities. It would also serve as a means of identifying prospective students for the graduate training program.

Table 2



1/ AID IS SHOWN APART IN ORDER TO INDICATE FUNDING LINKAGES TO U.S. RESEARCH INSTITUTIONS. AID ALSO CONTRIBUTES THROUGH BILATERAL ARRANGEMENTS TO INDIVIDUAL COUNTRY PROGRAMS. OTHER DONOR MEMBERS OF CGIAR HAVE CORRESPONDING ADDITIONAL FUNDING LINKAGES.

2/ THE DONOR MEMBERS SUPPORTING CIMMYT ARE CGIAR, FORD FOUNDATION, ROCKEFELLER FOUNDATION, GERMANY, UNDP AND IDRC. OTHER CGIAR DONORS INCLUDE BELGIUM, DENMARK, FRANCE, JAPAN, KELLOGG FOUNDATION, NETHERLANDS, NORWAY, SWEDEN, SWITZERLAND, UNITED KINGDOM. ALL CGIAR MEMBERS ARE POTENTIAL FUNDERS OF OPERATIONS LINKAGES WITHIN THE NETWORK.

3/ THE LINKS BETWEEN CIMMYT AND THE INDIVIDUAL COUNTRIES TAKE THE FORM OF INFORMATION AND MATERIALS EXCHANGE, THE CONDUCT OF SEMINARS AND WORKSHOPS, COOPERATIVE RESEARCH PROJECTS, ADVISORY SERVICES AND TRAINING

* FUTURE COOPERATORS

IV. Significance and Rationale for the Research

Problems of world hunger and malnutrition in developing countries are becoming more intense as a result of food deficits and population growth. Despite some optimistic reports for specific countries and with world food production increasing about 2.7 percent per year, the rate of production growth for cereals in developing countries actually decreased from 2.50 percent per year for the overall period 1960-1974 to 1.69 for the last eight years of this period. 2/

Famines in the LDCs will be even more acute in the future because food production is unstable and resources are poorly organized and virtually indeveloped. The urgency of the situation is underlined by the fact that world food production must reach 6.6 billion metric tons by 2015 to feed the additional four billion people. This feat must be accomplished in only 40 years, whereas, it took 10,000 years (to 1974) to reach an annual production of 3.27 billion tons of food.

In the final analysis, only the LDCs can provide the answers to their food problems. These countries must develop and sustain their own technological research and educational capabilities to prevent major famine. The magnitude and diversity of resources needed to implement and sustain a comprehensive program to increase food production in the LDCs requires the experience, expertise and facilities which are available at various international centers, USAIDs, foundations, FAO-SEA, and U.S. universities. However, to be effective, linkages among these agencies and LDCs must be established through a multitude of efforts on missions. One such cooperative effort has been achieved through the development of the Spring X Winter Wheat Research and Training Project. A.I.D., the Rockefeller Foundation, CIMMYT, ICARDA, OSU are contributing their expertise in using wheat improvement as the vehicle to develop meaningful and responsive agricultural programs in certain LDCs. Such a program takes advantage of the importance of cereal grains and provides a model to increase total food production. The underlying foundation of the program is the development and dissemination of improved wheat germ plasm with relevant training and extension activities welded together to provide an effective delivery system within the LDCs.

Wheat is the most widely adapted and most efficient source of both calories and protein among the major food crops. That wheat can effectively serve as a model for adaptation of new technology was clearly demonstrated with the development and distribution of semi-dwarf, day-length insensitive spring type wheat and rice cultivars in the 1960s which gave rise to the so-called "Green Revolution". Unfortunately, improvements have been much less spectacular in the major cereal producing regions where winter or facultative type wheats are required and various environmental stresses are more severe.

2/ Meeting Food Needs in the Developing World, International Food Policy Research Inst., Research Report No. 1, February 1976.

As a result, millions of hectares are still devoted to a subsistence level of wheat culture, particularly in the winter-rainfall, summer-drought areas of the Middle East, North Africa, Northern Asia, certain Latin and South American countries and in such countries as the People's Republic of China where 80 percent of the total wheat acreage (28 million hectares) is of the winter type. Due to the vastness of these areas, and the lack of stability of yield, modest and consistent improvements in yield levels would result in substantial increases in world food production.

It now appears that yield plateaus have been reached in many of the major crop species including wheat. With the development of such outstanding wheat varieties as Centurk, Bezostaia, Gaines and Hyslop among the winter types and varieties from the 8156 cross (Siete Cerros) and Anza representing the spring types, additional breakthroughs in yield and adaptation have not materialized in wheat in recent years. A much greater degree of genetic diversity must be created within both winter and spring type wheats if this apparent "yield plateau" is to be penetrated.

It should also be emphasized that the Spring x Winter Research Project serves as an excellent format for the training of gifted young people from LDCs. It is in this area that the real solution to world food problems will be found. A significant factor in the dramatic increase in wheat production in Turkey was the program developed by USAID, OSU, the Rockefeller Foundation and CIMMYT which provided not only the necessary technology and delivery system, but left in place a group of well-trained scientists to continue the program. These scientists are the key to the continuity of this program. The lack of trained people in the LDCs remains at the most critical need. In response OSU has accepted the commitment to maintain a strong, relevant graduate training program to complement the Spring x Winter Research program.

There is also a need for stronger linkages to be established between research and training institutions in LDCs and programs such as the winter x spring project. Such linkages could be achieved and strengthened by developing in-service training programs for specific LDCs. This might involve an in-depth review of all aspects of cereal production within a country using the combined expertise of USAID personnel, CIMMYT, ICARDA and OSU. Seminars, on-site visitations to various research projects, and meetings with appropriate government officials might provide not only the necessary institutional building incentives, but also reinforce the confidences of the scientists including follow up contract with previous OSU and other university graduates.

V. Plans to Coordinate and Link Research

Approximately 98.0 percent of the food is produced on the land with cereal grains contributing the largest segment (41.0 percent of the total). In terms of metric tons, wheat, followed by rice, maize and barley, are the most important. Wheat is also the most widely cultivated of all cereal crops in the world occupying about 17 percent of the total cultivated land. Under the direction of CIMMYT,

the major thrust of the Green Revolution has been on spring wheats, and therefor , confined to the subtropical zones. An important statistic that is ofta. overlooked, however, is that winter wheats occupy 66 percent of the total world wheat acreage. Also of importance is the fact that 75 percent of the acreage is fall-sown. Both wheats with true spring habit and facultative types are fall-sown when possible to take advantage of a longer growing season.

The present local varieties being grown in the LDCs are generally tall, late and low yielding because they do not have the genetic potential to respond even under optimum growing conditions. Introduced varieties with higher yield potential often lack seed quality, disease and insect resistance, winter-hardiness, or other adaptation to climatic conditions. A large acreage within each of the LDCs belongs to small farmers working in marginally productive areas where yearly yield levels are totally dependent on the environment. If these farmers are to benefit from improved technology, the institutions of selected LDCs with major responsibility for adaptive research and extension of wheat improvement to the rural populations must be strengthened. The training of dedicated young scientists in conjunction with providing them access to superior germ plasm is the most direct means of accomplishing this objective.

Through OSU's distribution of the IWSWSN, a worldwide network of cooperators has been formed which insures that the LDCs can obtain and effectively take advantage of the widely adapted materials develored through the combined efforts of OSU and CIMMYT.

The 6th IWSWSN is currently being evaluated in most of the major winter wheat growing areas of the world. Additionally, selected F2 populations have been sent to those countries with the scientific personnel necessary to use such materials. The close linkage of OSU with international and national research organizations will accelerate the efforts to produce and distribute new improved advanced lines and varieties for use in the LDCs.

The winter wheat improvement program at OSU is closely aligned with the spring wheat program conducted by CIMMYT in Mexico and their various outreach activities. Both programs are production oriented and utilize the same breeding procedures. The unique geographic locations, easy travel between programs, and complementary environmental stresses maximize the progress achieved in the winter x spring program for the benefit of both winter and spring wheat production areas in the LDCs.

The International Center of Agricultural Research for Dry Areas (ICARDA) has also joined OSU and CIMMYT in the development and screening of germ plasm. The International Rice Research Institute (IRRI) is also participating by assisting in graduate training.

The two programs currently funded by USAID at OSU, which include a 211(d) grant for development of expertise in dryland agriculture production and the International Plant Protection Center (IPPC) for weed control, will be valuable assets to the winter x spring program. The combined thrusts of these three programs will be to develop improved varieties and a package of cultural practices to protect the existing natural resources while improving the quality of life by maximizing winter wheat production in the LDCs.

Linkages in addition to germ plasm exchange have also been established with several institutes in developing and LDCs as follows:

1) The Government of Tunisia Accelerated Cereal Project - Tunis, Tunisia

2) The Turkey Wheat Research and Training Center - Ankara, Turkey.

3) The Wheat Research Program at the University of Jordan - Amman, Jordan

4) ITGC - The Algerian Institute for Development of Cereal Production and Companion Crops - Algiers, Algeria

5) The Agricultural Research Council for the Government of Pakistan - Islamabad, Pakistan

6) The Ministry of Agriculture and Irrigation - Kabul, Afghanistan

7) The All-India Wheat Coordinated Program - New Delhi, India

8). Wheat and Barley Research Institute - Suweon, Korea

9) Institute de Investig. Agropec - Casilla, Santiago, Chile

10) Programa de Cereales, Universidad Nacional Agraria-
Lima, Peru

11) Organization of the National Agricultural Research Institute-
~~Quito, Ecuador~~

VI. Plan To Facilitate Utilization of Research Results

The six aspects for facilitating the utilization of the results are: (1) The IWSWSN made up of superior lines is an excellent way to disseminate germ plasm which is being used effectively by the LDCs. The screening nursery also serves as a worldwide surveillance nursery for the identification of new insect and disease problems and in surfacing new sources of resistance. (2) Results from the first five screening nurseries suggest that the germ plasm selected in Oregon retains the desired attributes when grown in the LDCs. These nurseries have also demonstrated the major limiting factors to increased production for specific countries such as certain diseases, soil problems, and earliness. (3) The positive response of cooperators and the overwhelming requests for the nurseries give a very strong indication of the value placed on the winter x spring program by the scientists in the LDCs. Not only is the nursery providing a mechansim for the exchange of germ plasm and information, but in concert with the University of Nebraska program and CIMMYT, it has opened up lines of communication between the winter and spring wheat breeders throughout the world. (4) The program has a built-in means of verifying how extensive the germ plasm is being used in LDC programs and this has reflected very positive results. (5) Through the use of the computer and the development of a useful format for summarization of data at OSU, results of each IWSWSN have been returned to the cooperators during the same year and prior to their crossing season. (6) The strong breeding program has provided an ideal milieu within which to train students from the LDCs at the graduate level. Currently 30 foreign students and 14 U.S. students with an interest in international agriculture have been, or are now participating in this research program. Many have returned home after completing the M.S. or Ph.D. degree and are now cooperators in the winter x spring program in their respective countries. It is apparent that without the program strength as background, the university's ability to train young, dedicated scientists from the developing countries would be only partially effective.

VII. Management Considerations

Because of the cross-linkages involved in this research, as already outlined in Section V, careful consideration has been given to the management of the contract. The past experience has shown that management has performed in a very satisfactory manner in carrying out the previous contracts.

The two principal investigators are very much respected and have world-wide reputations as foremost wheat breeders. They have had extensive experience which includes field research, technical assistance, teaching and advising to policy makers of government agencies and major foundations.

VIII. Technical Review

Among the major food crops, wheat is the most widely adapted and the most efficient source of both calories and protein. With the introduction of the semi-dwarf, day-length insensitive characters into agronomically desirable spring type wheats, progress made in wheat improvement has resulted in a substantial increase in the world food supply. Of particular significance is that as the result of day-length insensitivity, wheat is now a major food crop in many of the subtropical Less Developed Countries (LDCs) rather than remaining solely a crop restricted to the temperate zones. Furthermore, this technological breakthrough has been largely independent of farm size as increased yield levels have benefited both the large and small farmer. Unfortunately, improvements have been much less spectacular in winter type wheats which are generally grown under less productive environments. As a result, millions of hectares, particularly in the winter-rainfall, summer-drought areas of the Middle East, North Africa, Northern Asia and certain Latin and South American countries, are still devoted to a subsistence level of winter wheat culture. Due to the vastness of these areas, and the lack of stability in production, modest and consistent improvements in yield levels would result in substantial increases in food production. In order to improve the quality of life for the people innabiting these now marginal areas, there is a pressing need for the development and dissemination of superior varieties and the improvement of production technology. This would lessen the gap in wheat production between the more favorable spring growing areas and the less favored sites growing winter wheat.

There is a concern that with the development of such outstanding semi-dwarf varieties as Gaines and Hyslop among the winter types and varieties from the 8156 cross (Siete Cerros) and Anza representing spring-types, future yield and adaptation breakthroughs will be difficult utilizing existing germ plasm. Much of the success of the semi-dwarf varieties arose from the crosses made between diverse germ plasm sources. It is apparent that a much greater degree of genetic diversity must be created within both winter and spring type wheats if further major improvements are to be made. There is solid evidence that such diversity can be achieved by the intercrossing of winter and spring type wheats. Historically such crosses were only attempted when the plant breeder was desperate for a new source of disease resistance or some other attribute not found within the particular type he was developing. This reluctance was in part the result of difficulties in crossing due to the vernalization required by winter type wheats. As a consequence, spring and winter wheats have diverged from one another in an evolutionary fashion. It is noteworthy that several of the major breakthroughs in wheat breeding, such as the variety Thatcher, resulted from winter x spring crosses. Even the semi-dwarf spring wheats originally developed in Mexico obtain their short stature from the dwarfing source found in Norin 10-Brevor 14, a winter type wheat.

The results gained by CIMMYT and the winter wheat project conducted by OSU indicate that new genetic combinations resulting from the systematic crossing of winter x spring types are superior to either the winter or spring parent. In addition to greater vigor and wider adaptation, desirable characteristics lacking in one group can be transferred from the other. Such factors as good sources of stripe rust and drought resistance found in winter wheat can be transferred into spring types while spring varieties can contribute superior sources of stem rust resistance and early maturity (Table 3).

TABLE 3. SELECTED AGRONOMIC CHARACTERISTICS OF EACH WHEAT GROUP THOUGHT DESIRABLE FOR INTERCROSSING.

WINTER WHEATS	SPRING WHEATS
Winterhardiness	Early Maturity
Frost Tolerance	Agronomic Type
Dwarf Source	Dwarf Sources
Drought Resistance	Yield Potential
Yield Potential	Yield Stability
Yield Stability	Light Insensitivity
Shattering Resistance	Spike Fertility
Quality	Stem Rust Resistance
Stripe Rust Resistance	Yellow Dwarf Virus Resistance
Mildew Resistance	Septoria Resistance
Leaf Rust Resistance	Leaf Rust Resistance
Root Rot Resistance (Cercosporella, Ophiobolus, Fusarium, etc.)	
Yellow Dwarf Virus Resistance	

The cooperative program between CIMMYT and OSU is providing the necessary geneti diversity to substantially improve both winter and spring wheats and in currentl making such germ plasm available to the scientists in the LDCs through internati screening nurseries.

IX. Research Project Design and Methods

A. Germ Plasm Bank

Approximately 5000 winter wheat cultivars have been evaluated for their agronomic worth. These lines were obtained from every major winter wheat producing area in the world and represent mainly advanced materials from the more progressive breeding programs. Nearly 200 new entries are received each year and evaluated in the miscellaneous crossing block. The most promising genotypes are then advanced to the main crossing block the following year for hybridization in the top crossing program in Oregon and for the single crosses made in Mexico. Information is catalogued on such factors as yield potential, combining ability, disease reactions and other important agronomic properties. Those lines found to be superior for various desired traits are made available to the cooperators upon request. By 1979 an information sheet will be made available to all the cooperators identifying the attributes of each of the more promising lines.

Approximately 200 new entries are received each year from nearly all the major winter wheat breeding programs. For the past two years collections have also been received from the People's Republic of China. Since earliness is a major factor needed in many parts of the world, 75 of the very earliest maturing lines from the collection in Suweon, Korea are being sent for use by Oregon this year. Particularly promising lines for earliness and winterhardiness have been obtained from the USSR, Yugoslavia, Romania and Turkey. Sources for aluminum tolerance have been obtained from Brazil. Materials from Argentina and South Africa are being obtained as new sources of stem rust resistance. It should also be noted that the high protein and high lysine screening nursery from Nebraska is grown each year and utilized in the crossing program.

B. Genetic Diversity

Data from the 97 cooperators currently receiving the screening nursery suggest that the concept of creating greater genetic diversity through the systematic crossing of winter x spring wheat cultivars is valid. Thirty percent of the advanced lines currently being increased at CIMMYT originated from winter x spring crosses. These not only represent some of the best spring cultivars but when it is realized that the winter x spring program has only been underway since 1972, it is most impressive. Similar observations have been made in Oregon when progeny from the winter x spring program are compared with strict winter x winter crosses.

C. Incorporation of Superior Nutritional Properties

The most promising lines in the high protein, high lysine screening nursery from the University of Nebraska have been used in top crosses. The nutritional information provided by the University of Nebraska and local agronomic evaluation is utilized in making the desired crosses. Selected progeny from such crosses were to be sent to Nebraska for subsequent screening; however, with the reduction in the Nebraska program, this phase of the program will be carried at Oregon State University in the new Quality Laboratory.

D. Selection Pressures

The simultaneous selection within segregating populations across three diverse testing sites has been positive in developing lines with wide adaptation. Certainly the results returned from the screening nurseries substantiate that most limiting factors in developing countries can be found at the three testing sites in Oregon. Leaf and stem rust epidemics are an exception; therefore, in addition to the three sites in Oregon, all the winter segregating populations are also grown at Toluca, Mexico where they are artificially inoculated and meaningful selection can be carried out.

E. Early Generation Breeding Stocks

In addition to the IWSWSN, selected F2 and later generation populations which have special attributes are sent to selected developing countries. For example, populations where short stature has been combined with different sources of aluminum tolerance have been sent to Brazil for their evaluation or selection. Early generation materials exhibiting extreme earliness have been sent to Korea. Such materials can be effectively utilized in developing countries where positive breeding programs are being conducted. This has the benefit of providing elite materials much earlier to these programs rather than waiting until the F5 or F6 generation when such material might reach them through the screening nursery. It should be noted that early generation materials selected in the various developing countries are then recycled through the winter x spring program.

F. Screening Nurseries

The 7th IWSWSN is made up of 250 lines from F4, F5, and F6 populations and is being distributed to 97 cooperators representing 48 different countries where winter or facultative wheat is being grown. Testing sites have now been identified in the People's Republic of China, Northern India ~~and~~ Bangladesh, thus expanding coverage to all of the major winter wheat producing areas of the world.

Lines in the screening nursery have been selected over a wide range of environments within the state of Oregon. Many are selected with strengths in certain problem areas known to exist in the LDCs such as specific disease resistance, earliness and drought tolerance. Some lines are useful to the cooperators as germ plasm to be incorporated in crosses with local adapted varieties. On the other hand, several countries including Iran, Jordan, Turkey and Afghanistan have indicated that they are increasing several lines from the screening nursery for direct varietal release.

In an effort to provide the most beneficial data summary, the IWSWSN is sent six months earlier to cooperators in the southern hemisphere so that all data on the current screening nursery can be returned in time for inclusion in the annual summary. Such a practice will provide a more complete picture of the performance of lines across a wide range of environments.

Testing sites have been divided into three rainfall zones: Low (<400 mm), intermediate (400-650 mm), and high (>650 mm and irrigated sites) in an effort to better summarize data and pinpoint lines which are most suitable to a specific area.

After harvest, cooperators return data to Oregon where they are coded and keypunched for analysis by computer. Data are accepted for inclusion in the current summary up until January 30. Data received after that time are included as an addendum in the following year's summary.

The computer facilitates the handling of thousands of bits of information on the 250 lines in the screening nursery. A complete catalog of all data received for each line is printed, enabling the cooperator to view the performance of a particular line across a wide range of environments and growing conditions. Utilizing weighted scores obtained by ranking all of the lines for nine agronomic traits, the best 25 lines are identified and results printed for each location. Subsequently, the best 25 lines over all locations reporting are identified for yield potential, earliness, winter-hardiness, stripe rust, leaf rust, stem rust, septoria, and powdery mildew. Therefore, lines are identified with strengths in these areas so the cooperator can make use of them in his breeding.

program. Finally, based on weighted scores from all locations reporting in the low, intermediate, and high rainfall zones, a table is printed of the 25 lines in each rainfall zone which exhibited adaptation for particular areas and may be useful to the cooperator either for reselection or direct release.

By the first of March, the summarization is complete and printed in book form. It is in the hands of the cooperators prior to the subsequent crossing season so they may make the most effective use of the information. Because of the timely return of the data, there has been an excellent response from the cooperators. Approximately 70 percent of all those who receive the nursery return data to be included in the summary. This is of extreme importance and serves to increase the value and usefulness of the summary. It should be noted that the summary books are available to those other than just cooperators who might be interested in specific germ plasm.

Variety X Management Interaction

Under dryland wheat production moisture conservation is a critical factor. Through the development of various management practices, successful winter wheat production has been accomplished with 200 mm of annual rainfall. It is very apparent that to maximize grain yield under such conditions, new cultivars must be developed in keeping with specific management systems. At the Sherman Branch Experiment Station germ plasm is being evaluated under such practices as mold board plowing, stubble mulching, minimum and no tillage. Important plant attributes such as germination and emergence under low moisture and high temperature conditions and other factors associated with stand establishment are being evaluated.

With the minimum and no tillage practices, erosion control is the main consideration. Wheat cultivars have been identified that germinate under lower moisture conditions and higher soil temperatures, emerge rapidly, and have a spreading growth habit and prolific root branching patterns for holding the soil. Adequate levels of winterhardiness and increased spring vigor have also been observed. Greater problems with pathogens and insects can be anticipated; therefore, more work must be completed to identify specific problems and find tolerance or resistance to these limiting factors. With the existing genetic variability it is possible to develop cultivars with the desired attributes to fit into management systems which can help to control wind and water erosion. This will be an important feature of the winter x spring program when making future crosses.

Training

An integral part of the winter x spring wheat research program at OSU is a graduate training program where young scientists can receive appropriate training leading to M.S. and Ph.D. degrees. The program has been developed to provide an educational base for those young people who will be expected to assume leadership roles in their respective national programs.

A student who first joins the program is assigned responsibility on the research project. As a result, students become familiar with the practical aspects of the research program through actual participation. He is expected to take the leadership and discuss phases of the program with visiting scientists and with farmers during field days. The importance of the team approach to research is stressed and the student has the opportunity to participate as a team member. As the individual progresses through the program, the research effort will turn toward the M.S. or Ph.D. thesis problem which often, its very nature, is more specific than the work on the cereal research program. Theses problems are selected in keeping with the student's interest and with regard to the type of research experience which will be most beneficial upon his return home. A program has been developed where, under certain circumstances a student may complete his academic work at OSU and conduct his thesis research at one of the international centers. Currently three Ph.D. students are doing their theses research in Mexico with the assistance of CIMMYT scientists. Another student is working on a thesis project in rice at the International Rice Research Institute in the Philippines.

The scientific approach, integrity in reporting data and dedication are stressed. It is equally important that the student learn to disseminate information, therefore, he is exposed to the philosophy and techniques of extension systems. Furthermore, he comes to realize that there is dignity in getting his hands dirty as he works beside faculty members in the field.

A positive result of the program has been the lasting relationships which have developed between the former students and the faculty and staff. Contacts are maintained through a quarterly newsletter and, in some instances, faculty members are able to visit various countries and assist in developing programs. Such visits not only reinforce the young scientist's confidence in himself, but frequently road blocks can be removed by visiting with government officials either in the particular country or while the officials are touring the United States.

If a solution is to found to population-food supply problems, it will be only after there is a sufficient number of highly motivated young scientists with the desired level of training to make the necessary contributions. It will not be possible for any country or organization to provide enough support to the developing countries to solve the food problem. The goal should be the strengthening of the national programs which can only be achieved if there is enough expertise in a given country to get the job done. The need for strong training programs at the M.S. and Ph.D. levels to complement the training received at the various centers such as CIMMYT must receive top priority for this is the ground work upon which to build strong national programs that can meet existing and future requirements for food. The graduate training program at OSU addresses itself to this need.

Best Available Document

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Improvement of Winter Wheat for Developing Countries, Based on Hybridization of Spring x Winter Forms

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal: The broader objective to which this project contributes: To increase quantity and nutritional value of food crops in developing countries.	Measures of Goal Achievement: 1. Significant increase in per capita production of major food crops in LDCs. 2. Improvement of nutritional quality of major LDC food crops.	1. Official production and population statistics (FAO, Foreign Agricultural Service estimates). 2. Nutritional quality surveys in LDCs.	Assumptions for achieving goal targets: 1. LDCs will actively attempt to expand food crop production. 2. Nutritional quality can be improved without major constraints on yield.
Project Purpose: To make available to LDCs high-yielding, nutritious varieties of wheat with multiple resistance to moisture and temperature stresses, diseases and insects, together with improved practices for their cultivation.	Conditions that will indicate purpose has been achieved: End of project status. 1. New, superior varieties available to farmers in LDCs. 2. Research and development activities in wheat effectively assumed by LDC agencies and international institutions and linked by communications network.	1. Publication and reports of LDC governmental agencies; on-site inspections of seed supply. 2. On-site inspection and review by AID/W personnel and consultants.	Assumptions for achieving purpose: 1. Solutions can be found to major constraints. 2. Agriculture extension services are able and willing to promote proven practices. 3. LDC research institutions develop adequate capabilities.
Outputs: 1. Identification of superior germ plasm. 2. Incorporation of desirable traits into broadly-adapted varieties suitable for LDC use. 3. Evaluation of improved varieties and practices in LDCs. 4. Training of LDC personnel in wheat research. 5. Establishment of effective linkages with LDC agencies.	Magnitude of Outputs: 1. Not quantifiable. 2. At least 2 superior varieties for each major agroclimatic region. 3. At least 1 test location in each major winter wheat growing LDC. 4. Total of 20 LDC trainees completing training. 5. Linkages with 2 international centers and at least 10 LDC institutions.	1. Reports by contractor. 2. Reports by contractor, USAIDs, LDC cooperators, and international agencies. 3. Same. 4. Contractor reports. 5. Contractor reports, communications and reports from LDCs and international agencies.	Assumptions for achieving outputs: 1. LDCs and USAIDs will seek out technical assistance; research findings will be available. 2. Cooperation of LDCs. 3. Interest and resources exist in LDCs. 4. Collaboration of international institutions. 5. Sufficient interest among LDCs and qualified personnel.
Inputs: 1. AID/W provides financial support and project guidance. 2. Contractor provides qualified personnel and backstopping facilities. 3. Participating personnel and cooperation provided by 1) LDCs, 2) USAIDs, and 3) international organizations.	1. AID/W funding at approximately $425,000/year. 2. 24 worker months/year technical personnel; adequate laboratory facilities; 10 or more acres field research area. 3. Not directly quantifiable.	1. AID/W records. 2. Contractor reports, on-site inspections. 3. USAID reports, on-site verification.	Assumptions for providing inputs: 1. AID/W funding will be available on schedule and in quantity agreed upon. 2. Contractor will have adequate qualified personnel; adequate facilities will be available to project. 3. International organizations, USAIDs, and LDCs will have personnel and resources to support

36

X. Overall Cost Estimates

Duration: From October 1, 1979 through September 30, 1982.

Organization: Crop Science Department, Oregon State University

Principal Investigator: Warren E. Kronstad

A. SALARIES AND WAGES 1	1979-80	1980-81	1981-82
1. Kronstad[2] (Professor .50)	-	-	-
2. McCuistion (Associate Prof. 1.00)	30,000	32,100	34,347
3. Metzger[2] (Plant Geneticist,SEA .10)	-	-	-
4. Research Associate	22,000	23,540	25,188
5. Technician (Field Operations 1.00)	16,000	17,120	18,318
6. Technician (Quality Laboratory 1.00)	15,000	16,050	17,173
7. Technician (Graduate Training and Field Operations 1.00)	13,000	13,910	14,884
8. Technician (Seed distribution-Computer aid 1.00)	13,000	13,910	14,884
9. Administrative Assistant (.50)	5,250	5,617	6,010
10. Secretary (1.00)	9,130	9.769	10,453
11. Hourly Wages[3]	20,000	21,400	22,878
12. OPE (19%, 20%, 20%, Retirement, Social Security)	27,242	30,683	32,827
SUBTOTAL 1	170,662	184,099	196,962
B. TRAVEL AND SUBSISTENCE			
1. International	10,000	11,000	12,000
2. Domestic	10,000	11,000	12,000
SUBTOTAL II	20,000	22,000	24,000
C. RESEARCH OPERATIONS SUPPORT			
1. Capital Equipment[4] (see page 35)	11,220	-	
2. Maintenance of Equipment	1,750	1,750	1,750
3. Experimental Site Preparation & Care	10,000	10,500	11,000
4. Freight&Mailing for Nurseries	18,000	18,500	19,000
5. Computer Costs	3,000	3,300	4,000
6. Supplies (see page 36)	20,000	20,500	21,000
7. Publications	5,000	5,500	6,000
SUBTOTAL III	68,970	60,050	62,750

	1979-80	1980-81	1981-82
D. GRADUATE TRAINING PROGRAM			
1. Three Graduate Assistantships[5] (.50 each)	13,500	14,445	15,456
2. Thesis Research Support[6] (10 M.S. and Ph.D. students)	15,000	16,000	17,000
3. Travel and Subsistence	2,500	3,000	3,500
SUBTOTAL IV	31,000	33,445	35,956
E. COUNTRY TRAINING IN LDCs			
1. Travel and Subsistence	20,000	21,000	22,000
2. Local Committee Expenses	2,000	2,500	3,000
3. Publications	500	500	500
SUBTOTAL V	22,500	24,000	25,500
TOTAL DIRECT COSTS	313,132	323,594	345,168
INDIRECT COSTS (34% of TDC excluding equipment)	102,650	110,022	117,357
GRAND TOTAL	415,782	433,616	462,525
Three-Year Total		$1,311,923	

[1]An increase of 7% has been allowed for each succeeding year's budget; however, actual salary adjustments will be based on university-wide adjustments.

[2]Salary contributed to OSU or SEA.

[3]Represents approximately 7,300 man hours.

[4]Non-recurring expenses.

[5]For U. S., students interested in international agriculture.

[6]Graduate stipends to be paid by sponsoring institution or government.

Proposed Budget by Inputs ($000)

Inputs	1980	1981	1982
Salaries and Wages	171	184	197
Travel & Subsistence	20	22	24
Research Operations Support	69	60	63
Graduate Training	31	33	36
Training in LDCs	22	24	25
Indirect Costs	103	110	117
TOTAL	416	433	462

EQUIPMENT LIST FOR 1979-80

1.	Flat Bed Trailer	$3,500
2.	Tape - 300 feet and 100 m (S150 each)	300
3.	Two Plant Threshers (S1,100 each)	2,360
4.	Two Seed Cleaners (S280 each)	560
5.	Suzue Binder	2,500
6.	Shelving and Storage Facilities	2,000
	TOTAL	$11,220

SUPPLY LIST	1979-80	1980-81	1981-82
1. Fertilizer and Chemicals	5,400	5,900	5,900
2. Field Planting and Harvest	7,300	7,300	7,300
3. Seed Preparation and Shipment	4,300	4,300	4,300
4. Computer Supplies	1,000	1,000	1,000
5. Office Supplies	2,000	2,000	2,000
TOTAL	$20,000	$20,500	$21,000

XI Reporting Plans

An annual substantive report covering the status of the work, indicating progress made during the year, and outlining plans for the ensuing period will be submitted to the AID project manager. An annual review will be held if deemed necessary by the AID project manager.

Scientific reports and manuscripts will be prepared and presented at various symposia, conferences and professional meetings. In addition to departmental reviews of publications, the investigators will allow a pre-publication review by AID. Therefore each of the proposed publications will be submitted to the DSB/AGR/FCP Senior Agronomist (one copy) and to the Contracting Officer (one copy) no later than the date of their submission to the publisher.

XII. Initial Environmental Examination

The activities of this project fall into the area described in environmental procedure regulations paragraph 216.2(c) "Analysis, studies, academic or investigative research, workshops and meetings." These classes of activities will not normally require the filing of an Environmental Impact Statement or the pareparation of an Environmental Assessment. It is possible that an output of this project will be a set of procedures, guidelines or research results which when used would require such as assessment. However, the project itself only proposes research and directly supportive activities. Under these guidelines, this activity clearly qualified for a Negative Determination at the time when a threshold decision is determined.

XIII. Women in Development

It is the goal of this project to encourage the widest possible participation of wheat workers, broadly defined, in the design and implementation of problem solving in wheat production, protection and use. The current research contract, AID/TA/C-1352, employs women professionals in the Department of Agronomy actively supporting the research work. A continuation of these strategies under this proposed research project is assumed. Overall program requirements to advance knowledge in human nutrition in the development of wheat foods adapted to specific cultures and their acceptance in LDC diets hold great promise for the increased utilization of women in those areas where they have traditionally played a major contributing role.

Oregon State University has an aggressive affirmative action program to assure opportunities of employment for qualified personnel, including minorities and females, in compliance with Title IX. Oregon State University has an officer responsible for program implementation.