Proj. No. 931-0580 (5)
PD-AAL-898

COST REIMBURSEMENT CONTRACT WITH AN EDUCATIONAL INSTITUTION

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AGENCY FOR INTERNATIONAL DEVELOPMENT NEGOTIATED CONTRACT NO. AID/ta-C-1094

NEGOTIATED PURSUANT TO THE FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED, AND EXECUTIVE ORDER 11223	TOTAL ESTIMATED CONTRACT COST $600,000 (See Articles VII & VIII)
CONTRACT FOR: BARLEY IMPROV. for SEMI-ARID REGIONS OF THE WORLD	CONTRACTOR (Name and Address) College of Agriculture
PROJECT NO: 931-17-130-580-73	NAME Montana State University
ISSUING OFFICE (Name and Address) Agency for International Development Office of Contract Management Central Operations Division Washington, D. C. 20523	STREET ADDRESS Bozeman, Montana 59715
	CITY, STATE, AND ZIP CODE
ADMINISTRATION BY CM/COD/TAB	COGNIZANT SCIENTIFIC/TECHNICAL OFFICE TA/AGR/CP
MAIL VOUCHERS (Original and 3 copies) TO: Agency for International Development Office of Financial Management Washington, D. C. 20523	ACCOUNTING AND APPROPRIATION DATA PIO/T NO. 931-17-130-580-73-3147577 APPROPRIATION NO. 72119/1023 ALLOTMENT NO. 402-31-099-00-22-41
EFFECTIVE DATE 31 MAY 1974	ESTIMATED COMPLETION DATE 3-25-77

The United States of America, hereinafter called the Government, represented by the Contracting Officer executing this Contract, and the Contractor, an educational institution chartered by the State of Montana with its principal office in Bozeman, Montana, agree that the Contractor shall perform all the services set forth in the attached Schedule, for the consideration stated therein. The rights and obligations of the parties to this contract shall be subject to and governed by the Schedule and the General Provisions. To the extent of any inconsistency between the Schedule and the General Provisions and any specifications or other provisions which are made a part of this contract, by reference or otherwise, the Schedule or the General Provisions shall control. To the extent of any inconsistency between the Schedule and the General Provisions, the Schedule shall control.

CERTIFIED A TRUE COPY THIS 12th DAY OF June 74
BY Denise Gillet

This Contract consists of this Cover Page, the Table of Contents, and the Schedule consisting of _____ pages, the General Provisions (Form AID 1420-23C), dated _____ and an Appendix "A" (Operational Plan).

NAME OF CONTRACTOR Montana State University	UNITED STATES OF AMERICA AGENCY FOR INTERNATIONAL DEVELOPMENT
BY (Signature of authorized individual) [signature]	BY (Signature of Contracting Officer) [signature]
TYPED OR PRINTED NAME Warren L. Olson	TYPED OR PRINTED NAME V. C. Perelli
TITLE Assistant Controller	CONTRACTING OFFICER
DATE 5/31/74	DATE 31 MAY 1974

Contract No. AID/ta-C-1094

SCHEDULE
COST REIMBURSEMENT CONTRACT WITH
AN EDUCATIONAL INSTITUTION

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SCHEDULE

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GENERAL PROVISIONS

1. The General Provisions applicable to this contract consist of form AID 1420-23C entitled "General Provisions - Cost Reimbursement Contract with an Educational Institution," dated 9-73, which includes provisions 1 through 37; and form AID 1420-23D entitled "Additional General Provisions - Cost Reimbursement Contract with an Educational Institution," dated 9-73, which includes provisions 1 through 18.

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ARTICLE I - STATEMENT OF WORK

Two work plan activities are common to the three major objectives of the project.

1. In cooperation with CIMMYT plant pathologists, survey representative target countries (tentatively Morrocco, Tunisia, Turkey, Egypt, Lebanon and Iran) to evaluate the present varieties for general agronomic desirability, barley utilization , and significance of diseases and other pests. Contacts would be established with possible cooperating personnel.

2. In the second and third years, assist at workshops and seminars which would be held in cooperation with CIMMYT to report on progress of the project, and to exchange information and experiences.

The following objectives will be for the life of the project.

OBJECTIVE A - NUTRITION

1. Compare methods for screening for lysine content including the development of a half-seed method.

2. Continue with the task of screening the world collection of barleys for high lysine lines.

3. Investigate protein fractionation and characterization of fractions as a means of allele identification.

4. Determine a translocation breakpoint that is suitable for transferring the hi-lysine gene of Hiproly into a population without lysine analysis.

5. Determine if amylose: amylopectin ratio of the endosperm has nutritional significance.

6. Develop some fertile, plump-seeded, hi-lysine lines for use as donor parents.

7. Assign the Glacier hi-lysine gene to a chromosome.

8. Initiate evalautions of the biological value of proteins in lines determined to be high in lysine.

9. Initiate studies on protein inheritance, including maternal inheritance.

10. Determine the effect of environment, including soil fertility, on lysine stability across environments.

11. Initiate the development of homozygous hi-lysine composites in heterogeneous populations.

OBJECTIVE B - DROUTH RESISTANCE AND WATER USE EFFICIENCY

1. In cooperation with CIMMYT, survey representative target countries to evaluate those agronomic characters that may be of most value.

2. Screen barley varieties by use of the "elastic modulus" technique for drouth resistance.

3. Determine the effect of plant color on reducing heat loads, including conditions of extreme heat loads.

4. Determine the influence of leaf area on water use efficiency and the relationship of leaf area to "photosynthetic sink".

5. Determine the influence of moisture stress on the function of the awn.

6. Identify and determine the inheritance of day length insensitive gene (or genes) in barley.

7. Grow isogenes for some of the desirable traits as determined in No. 1 above, to verify conclusions.

8. Initiate the production of a homozygous day-length insensitive composite segregating for other characters.

OBJECTIVE C - DISEASE RESISTANCE

1. In cooperation with other interested agencies, survey representative target countries for prevalence of plant diseases, collect samples, and identify races.

2. Establish contacts for field evaluations of specific diseases.

3. Initiate work on homozygous combined stem rust, smut resistant composites segregating for the other characteristics.

4. Distribute disease resistant-susceptible isogenes for evaluation of economic importance of certain diseases.

5. Initiate work on at least one more disease based on survey in target countries.

ARTICLE II - REPORTS

A. At the conclusion of each year of performance under the Contract, Contractor will provide a Progress Report in English, in accordance with the "Guidelines For Preparation of The Research Annual Report" which is attached to and made a part of this Contract.

B. At the end of each six month period of performance, Contractor will provide six copies of a separate report showing expenditures under the contract to date, estimated expenditures to the end of the second year of the contract, and to the end of the third year of the contract.

ARTICLE III - KEY PERSONNEL

A. The key personnel which the Contractor shall furnish for the performance of this contract are as follows:

Key Personnel:

Robert F. Eslick Co-Principal Investigator

Dr. Lark P. Carter Co-Principal Investigator

B. The personnel specified above are considered to be essential to the work being performed hereunder. Prior to making any change in the key personnel, the Contractor shall notify the Contracting Officer reasonably in advance and shall submit justification (including proposed substitutions) in sufficient detail to permit evaluation of the impact on the program. The listing of key personnel may, with the consent of the contracting parties, be amended from time to time during the course of the contract to either add or delete personnel, as appropriate.

C. The Contractor shall obtain A.I.D.'s approval to change co-principal investigators or to continue the research work during a continuous period in excess of three months without the participation of the approved co-principal investigators.

D. The Budget is based on 425 man-months of effort for the three year contract. Contractor states that they will furnish an additional 63.6 man months of professional/technical services without charge to the contract. These additional 63.6 man months should be reasonably distributed between each year of contract effort.

ARTICLE IV - LEVEL OF EFFORT

It is agreed and understood that the estimated cost of this contract has been developed on the basis of the Contractor's estimated expenditure of a maximum level of effort of 15 Professional and 84 Non-Professional man-months for the First year, 15 Professional and 126 Non-Professional man-months for the Second year, and 17 Professional and 168 Non-Professional man-months for the Third year. In the event the total estimated cost of this contract will support a level of effort in excess of the man-months set forth above, the Contractor is authorized to expend additional man-months as necessary relative to the objectives of the contract, to the extent performance schedule and fund limitations permit.

ARTICLE V - Changes In Research Methods, Procedures and Objectives

A. The co-principal investigators may change the methods and procedures employed in performing the research without making special reports on proposed actions or obtaining A.I.D. approval. However, significant changes in methods or procedures shall be reported to the Government in periodic or final technical reports. In the event the methodology or experiment is stated as a specific objective of the research work, any changes to either fall within the scope of paragraph B. below.

B. The stated objectives of the research effort shall not be changed, except with the prior approval of the Contracting Officer.

ARTICLE VI - PERIOD OF CONTRACT SERVICES

The effective date of this Contract is the execution date by the Contracting Officer and the estimated completion date of work, including final report(s), under this Contract is March 25, 1977.

ARTICLE VII - ESTIMATED CONTRACT COST

The total estimated cost of this contract to the Government is $600,000, funds approved for the first two years only in the amount of $350,000. Funding for the third year of the program, if approved, will be implemented by contract modification. Contractor is not to incur any third year costs without A.I.D. authorization.

ARTICLE VIII - BUDGET

A. The Contractor may not exceed the grand total set forth in

the budget hereunder. However, within the grand total the Contractor may adjust individual line item amounts not to exceed 15% as reasonably necessary for the performance of this contract. The Contractor shall obtain Contracting Officer approval in writing prior to making any adjustments exceeding 15%.

Budget

	First Year	Second Year	Total	Unfunded Third Year	Proposed Total
Salaries & Wages	$ 61,705	$ 89,887	$151,592	$124,059	$275,651
Fringe Benefits	6,613	8,292	14,905	9,487	24,392
Equipment	28,560	19,690	48,250	13,350	61,600
Travel and Per Diem	5,000	12,200	17,200	10,100	27,300
Publications	200	1,600	1,800	1,550	3,350
Other Direct Costs	3,515	4,515	8,030	5,300	13,330
Indirect Costs	44,407	63,816	108,223	86,154	194,377
	$150,000	$200,000	$350,000	$250,000	$600,000

B. Anticipatory Costs

The allowable cost of performance of this Contract shall include all allowable costs which have been incurred by the Contractor in anticipation of this Contract on or after March 25, 1974, but prior to the

execution date hereof, and which, if incurred after the date of this Contract would have been considered as items of allowable and allocable costs provided, however, that such anticipatory costs shall not exceed $6,000 unless such amount is subsequently increased in writing by the Contracting Officer.

ARTICLE IX - NEGOTIATED OVERHEAD RATES

A. Establishment of Postdetermined Indirect Cost Rates

Pursuant to the clause of the General Provisions of this Contract entitled "Negotiated Rates", a rate or rates shall be established for each of the Contractor's accounting periods during the term of the Contract. Pending establishment of final indirect cost rates for the initial period, provisional payments on account of allowable indirect costs shall be made on the basis of the following provisional rates applied to the base(s) which are set forth below:

Rate	Base	Period
65%	Salaries & Wages & Fringe Benefits	FR: 3-25-74 TO: 3-25-77

Postdetermined indirect cost rates for subsequent periods shall be established in accordance with the terms of the "Negotiated Overhead Rates" clause of this Contract.

ARTICLE X - SPECIAL PROVISION

Prior to making any visits to LDCs, the Contractor will review his plans with TA/ASR, Contractor will keep AID missions in countries to be visited fully informed of proposed visits, ask them to provide

any advice they wish regarding timing and content of the visits and to participate if they desire, and will inform the Missions of the outcomes of consultations. Contractor will make his own appointments and logistics arrangements directly. Upon completion of any project funded travel, a copy of the trip report will be provided to the TA/AGR Project Manager. The report format will be established jointly by the Contractor and the Project Manager.

ARTICLE XI - MODIFICATIONS TO THE GENERAL PROVISIONS AND/OR ADDITIONAL GENERAL PROVISIONS

In accordance with paragraph (a) of Additional General Provision No. 3, entitled "Personnel", whereunder the Contractor may not send individuals outside of the United States to perform work under the contract without the prior written approval of the Contracting Officer, the Contracting Officer does, hereby, provede said approval for those individuals required to travel outside the United States; provided, however, that concurrence with the assignment and/or travel of any and all said individuals outside the United States is obtained, in writing from the Cognizant Technical Office of A.I.D. prior to their assignment and/or travel abroad.

This approval by the Contracting Officer, shall not apply to any other clause or provision of this Contract which specifically requires Contracting Officer approval.

January 20, 1972

GUIDELINES FOR PREPARATION

OF THE

RESEARCH ANNUAL REPORT

The attached guidelines suggest the format and the detail for annual research reports that are required in all research contracts. The research contractor will submit thirty-five copies of the report with appendices to the A.I.D. Project Manager. The A.I.D. Project Manager will submit two copies to TA/RUR and two copies to the A.I.D. Reference Center.

The outline should prove useful to the contractor in preparing the report, and provide an improved basis for annual project reviews. The contractor is encouraged to develop a self-contained report as outlined below in approximately fifteen double-spaced pages. Additional material may be annexed as necessary for a comprehensive report. The fifteen page report is intended to provide a bareboines statement of the effectiveness of research resources and methods in producing research results according to annual work plans, and the significance of these research results for the solution of the problem being addressed. Annexed material is essential for a critical review of assertions regarding findings, significance, etc.

REPORT SUMMARY 1/

A. 1. Project Title and Contract Number:

2. Principal Investigator, Contractor and Mailing Address:

3. Contract Period (as amended): 2/ from _____ to _____

4. Period covered by Report: from _____ to _____

5. Total A.I.D. funding of contract to date:

6. Total expenditures and obligations through previous contract year: 3/

7. Total expenditures and obligations for current year: 3/

8. Estimated expenditures for next contract year:

B. Narrative Summary of Accomplishments and Utilization

(In this space provide a concise statement of the principal accomplishments during (1) the period of the report and (2) life of the project in relation to research objectives and actual or potential operational significance.

This information does not substitute for a full discussion of the same points required in the body of the Annual Research Report as outlined below.)

1/ "Report Summary": Statistical Information (Item A) and the Narrative Summary of Accomplishments (Item B) should be reported on a single page. This page will be for general public use as well as project management purposes, and should be written for a general rather than a technical audience.

2/ Item 3 - Contract Period (as amended): Report the original date of the contract and closing date as prescribed by the contract or any amendment thereto.

3/ Items A 6-8: These items refer to expenditures including firm obligations by the contractor. Obligations are the contractor's legal but unpaid commitments, i.e., subcontracts, purchase orders, etc.; and other related accruals through the end of the reporting period. A "contract year" is one between anniversary dates of the contract.

ANNUAL RESEARCH REPORT

A. General Background

Prepare a concise statement that provides the background and rationale that led to the initiation of the project. This summary should state the nature and importance of the problem to which the research is addressed, and the rationale that links the research activity to the problem.

B. Statement of Project Objectives as Stated in the Contract

The purpose of this section is to record in a precise and concise way the objectives of the research project. The objectives as stated in the contract may have been interpreted, expanded or further defined in other documents and mutually agreed to by A.I.D. and the contractor. This section should reflect the contractual objectives as modified by these supplementary understandings.

C. Continued Relevance of Objectives

Does your research to date, or other circumstances, indicate a need for modification of project objectives as stated in the contract? If so, in what respects?

D. Accomplishments to Date

1. Findings: Provide a statement of the principal and significant findings and other accomplishments for the reporting period as they relate to the anticipated results in the year's work plan. (See material for the year similar to that requested in G.1. below for the coming year.)

Discuss the operational significance of the findings of the current year's research for attainment of project objectives as stated in Section B above. The discussion should include reference to existing knowledge, recent research findings by others, and cumulative findings and accomplishments of this project.

Also discuss side effects of the work, positive or negative. For example, do the findings to date suggest unexpected complications for the application of findings; do they suggest the need for more direct approaches to the problem than were originally anticipated; or is the research developing information and insights not expected in the scope of the work?

2. Interpretation of Data and Supporting Evidence:

Summarize briefly the evidence and analysis that support the findings cited above. To permit a critical analysis of the evidence and analysis, expand as necessary in an appendix to each copy of the report.

3. Research Design: State briefly any significant modifications made in the research design prior to the current reporting period.

Are the present techniques, instruments or mode of inquiry appropriate and/or optimal for the study design? In view of the findings of the past year or your experience with the research measures employed, do you recommend modifying (1) the research design or (2) research techniques? For example, have there been special problems of data availability, sampling, data processing, or ineffective techniques? Have research findings revealed technical relationships that suggest a continuation of present methods or do they suggest a new approach?

E. Dissemination and Utilization of Research Results

1. Briefly describe efforts made under the contract to disseminate the results of the research project. Attach as appendices two lists: (1) a bibliographic list and an abstract not exceeding 200 words of papers and publications developed under the contract and (2) a list of short statements that identify each known use of materials produced by the project for seminars, conferences, translations, or as background material for speeches, policy statements, etc.

2. Cite evidence and cases known to you that findings of the research project are being used in LDCs, the U.S., or both, in training, direct application to the problem, etc.

3. Has the experience of the past year suggested new or more effective ways to expand the use of research results? If so, discuss the experience and as appropriate include proposed steps in the work plan (Item G below). Indicate whether your proposals can be carried out under current provisions of the contract, or would require new contract arrangements by A.I.D.

4. Discuss the extent and nature of considerations to involve LDC personnel and/or institutions as an appropriate activity of the project. If judged appropriate, discuss the kind and extent of LDC involvement in (a) planning the project, (b) the execution of the field work, (c) the analysis and reporting of results. Plans to involve LDCs in the future should be reflected in the work plan in Item G (4) below.

5. Under separate cover forward four copies of publications, seminar reports, translations and other materials representing efforts to disseminate results of the research project, and evidence of the results being utilized by LDC or U.S. people or institutions.

F. Statement of Expenditures and Obligations and Contractor Performance

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Identify significant problems or accomplishments in the progress of the project related to the volume, effectiveness, or scheduling of the manpower, equipment, travel, etc., made available by these expenditures.

Discuss significant changes or modifications in project management, in the staffing pattern, physical facilities, institutional environment, etc.

G. Work Plan and Budget Forecast for Coming Year

Taking into consideration the past year's progress and expenditures and the work remaining to be done over the life of the project, present a work plan and budget for the coming year.

1. anticipated accomplishments for the coming year.

2. procedures to be used and activities to be carried out.

3. significant factors that you anticipate that will promote or impede accomplishments.

4. a plan for dissemination and utilization of the expected results of the research in the U.S. and in LDCs as applicable.

5. a budget statement that shows planned expenditures for each of the major inputs (personnel, equipment, travel, LDC involvement, etc.) according to the major accomplishments, or work targets that are planned for the coming year's work.

H. Appendices

Reports of technical data and analyses (Par. D. 2)
A bibliographic list with abstracts of papers and publications (Par. E. 1)
A list of uses made of research findings and reports (Par. E. 1)
Other appendices as appropriate.

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PROJECT STATEMENT

A. PROJECT SUMMARY

Date: October 1, 1973

1. Statistical:

Project Title:	Improvement of the Nutritive Quality and Productivity of Barley for Semiarid Regions of the World
New or Extension:	New
Contractor and Address:	Montana State University Bozeman, Montana, 59715
Principal Investigator:	L. P. Carter and R. F. Eslick
Duration:	5 Years with Review at End of Second Year
Total Estimated Cost:	Funding for 24 months: 1974 - 1st yr. $150,000 2nd yr. 200,000 Other: 1976 - 1978 750,000
Technical Specialist:	Dr. Russell Desrosiers
Alternate:	Dr. Samuel Litzenberger

2. Narrative:

Barley is probably grown under more extremes of climate, altitude, latitude and soils than any other cereal crop. Furthermore, under the less favorable environments where barley is the most extensively grown cereal, as in the Middle East and North Africa, it is doubtful that varieties of any other cereal can be developed that will equal or exceed barley in the production of total available nutrients per acre. At present barley is the major source of food for millions of people living in the cooler, semiarid areas where other grains are less adapted. For the benefit of these people, it is basic that barley be improved both in productivity and in nutritive quality.

In a number of the countries of the Middle East and North Africa, barley represents a major portion of the total cereals produced (see Attachment A). Turkey, India, Morocco, Ethiopia, the Republic of Korea and Iran are also fairly large producers of barley. In Morocco, Ethiopia and Libya, among the developing countries, barley is the leading cereal crop. AID Technical Series Bulletin No. 8, "Increasing Food Production with Emphasis on High Protein Crops" (March, 1973), states: "Of the major food crops currently cultivated by man through the world, cereal grains are the most extensively grown. Among these, wheat easily tops the list in area planted (33%) followed by rice (18%), millet and sorghum (16%), maize (15%), barley (10%) . . . .". Even though barley is grown on an area somewhat less than that devoted to wheat, rice, sorghum and millet, and maize, it should be pointed out that on the basis of protein yield per hectare, world barley yields have been highest, for example barley averaged 150 kilos of usable protein per hectare while for wheat, maize and rice protein yields averaged 121-123 kilos. For grain sorghum and millet the averages were only one-fourth that of these crops.

Comparative data from the Montana Agricultural Experiment Station show that for the 38 year period 1929 to 1967, barley yielded about 30% more than spring wheat on dryland. Considering that the hull of barley contains 10% more fiber than that of wheat, barley showed a 20% yield advantage over spring wheat under these conditions. Under irrigation, with the hull considered, the yields of spring wheat and barley were about equal.

B. EXPANDED NARRATIVE STATEMENT

1. Project Description and Background:

Barley is an important component of the diets of millions of people living under dryland conditions, often the transition zone between the areas normally planted to wheat and the desert. This for the most part involves areas with low rainfall, relatively low soil fertility, uncontrolled barley diseases and insects and low grain yields. The opportunities for irrigation under these conditions are also minimal.

Some barley selections have been developed in Montana with genetic potential for significantly higher protein content than ordinary varieties. Other lines have been identified, including the "Hyproly" varieties developed in Denmark, that appear to have great potential for producing not only more protein but protein with higher lysine content than commonly used varieties. Superior barley populations can be developed for the less developed regions of the world which incorporate these factors for higher protein content and better balance of amino acids, especially increased lysine, together with factors favoring increased grain yield.

The development of the most efficient varieties for any given location is dependent upon knowing and being able to identify and accumulate in a population those characteristics that respond favorably to that environment. The project supports three major areas of research, all considered essential to the production of maximum yields with optimum nutritional value for both human or animal consumption. These areas of study, upon which the genetics and plant breeding resources of the University will be brought to bear, include:

a. Nutritional Balance of Barley Grain: Breeding lines with improved protein content and quality have already been developed by European plant breeders. Further improvements in the nutritional value of barley as a food crop, equal or superior to those already developed in wheat, maize, sorghum and rice by AID-financed research projects, can be expected.

b. Water Use Efficiency and Soil Fertility: Available soil moisture is possibly the most serious single factor limiting crop production in the semi-arid areas of the world. Although barley is already classified as one of the most drought-resistant species of the cereals, further improvement in the water use efficiency of the plant is essential if optimum production in the drier, less fertile environments is to be realized. Early maturing, heat tolerant types would no doubt be of importance. Several morphological

characters of the plant may be modified by genetic manipulation to improve the efficiency of the plant's water economy.

A variety of soil fertility problems, including pH and salinity, may also arise under the dryland conditions where barley is grown and may seriously limit production. These, and their interaction with water use economy, will be studied.

c. Disease and Insect Resistance: Diseases and insects are factors which often seriously limit barley production in the LDCs. The identification and isolation of germ plasm resistant to these, so that this resistance may be efficiently transferred to barley populations is necessary to increase and maintain grain yields at an optimum level for those living in the more marginal areas.

2. Relevance to AID Objectives:

This project is aimed at improving the quality of life of the poorest of the poor in the more adverse low rainfall, semiarid regions in the lesser developed countries of the world where barley has proven to be the most advantaged crop grown. The production of nutritionally better balanced foods in these regions is essential to improve the health and quality of life of the people subsisting in these regions.

3. Objectives:

The objective of this project is to improve the productivity and nutritive quality of barley in the semiarid regions of the world by:

a. Improving the nutritional balance in barley grain in terms of increased protein quantity and improved quality through amino acid balance.

b. Improving the water use efficiency of the barley plant.

c. Isolate basic genetic stocks for resistance to limiting diseases and insects, tolerance to drought, extremes of temperature and drying winds, and improved nutrition into populations having the other desired characteristics.

d. Development of broad based barley populations that would potentially meet specific nutritive and adaptation needs of LDCs in the semiarid regions.

e. Making selected genetic stocks and improved plant populations available to the LDCs and other cooperating countries and international research institutions.

4. Other Related Research:

Currently AID has three centrally funded research projects which deal with the problems of improving the protein content and quality of cereal grains. The University of Nebraska has responsibility for the research on wheat, while Purdue is responsible for that on sorghum and maize. In addition to the work on cereals, AID is responsible for research on selected pulses, especially beans and cowpeas, through the University of Puerto Rico and a project on soybeans for food at the University of Illinois with the cooperation of the University of Puerto Rico. CIMMYT carries on an extensive research program in wheat and maize, as well as moderate improvement programs with triticale and barley (started in 1973), and collaborates closely with the AID-financed university programs referred to above. CIMMYT will also collaborate very closely with the Montana program in barley. In fact, it is expected that, through CIMMYT, the Montana barley improvement project would be directly tied in with the North African Regional Cereal Project, the Arid Lands Agricultural Development Project (ALAD - Lebanon) and the Turkey Cereal Improvement Program (cooperative with Oregon and Nebraska), all locations where CIMMYT now has strong outreach programs under way. (See Attachment E).

5. Project Program:

Montana State University possesses major competence in the field of barley improvement as a result of research already in progress. Genetically superior high yielding broadly adapted disease resistant varieties, as well as material having high protein and high lysine characteristics, already exist, these being either developed at Montana or introduced from other research institutions. Additional introductions and evaluations of them, in satisfying specific needs to meet project objectives, will be effected. The work plan of the project is appended as Attachment B.

During the first year, the contractor will commence working on all research phases of the project at Montana. He will survey the ecological environments where barley is most extensively grown in the LDCs for disease and insect problems and physiological factors affecting the growth of the plant. He will also arrange with CIMMYT for winter nurseries and other facilties. Arrangements will also be made with regional research institutes as well as national agricultural research and development programs for cooperative field work.

During the second year, the overseas operations of the project will expand to include uniform field trials of newly developed populations and lines and their evaluation for yield, adaptability to the ecological conditions of the several producing areas, resistance to diseases and insects, and nutritional quality.

6. Evaluation of Contractor Competence:

This is a new program. The contractor has a highly competent and energetic staff with abundant competence in the field of barley improvement and allied areas of research. Their record of barley improvement under the most adverse conditions of the U.S. cannot be equaled by any of the State programs.

7. Utilization of Project Results:

Although this is a new program, information and materials exist, derived from research in progress at Montana State University and other institutions, which should make possible rather rapid advances towards the realization of the objectives of the project. The University has the "Hyproly" high protein and high lysine material, as well as other sources of these nutritional characteristics under study and also has investigations in progress of numerous factors affecting the efficiency of soil moisture utilization and resistance to limiting diseases and insects. Of course, it will take several years to incorporate these characteristics into broad based populations with high yielding ability for introduction to cooperative agencies in the LDCs.

8. Technical Evaluations:

The contractor possesses needed experience, knowledge, and capability, as well as most of the facilities to make possible superb performance.

9. Participation by U. S. Missions and Foreign Institutions:

It is intended that the Montana project will be integrated into the international research network system of CIMMYT and active participation by USAIDs and national research institutions of the developing countries concerned. It is expected that regional institutions in the Middle East and North Africa, as well as selected countries in Asia and South Americam will be deeply interested in cooperating with the project and accordingly develop close linkages with the Montana State activity.

10. Budget Analysis:

The budget presented by the contractor is reasonable in the light of the plan of work. Salaries make up the greater portion of the cost. Overhead, which is established by university regulation, is within the acceptable range. The contractor's proposed budget is appended as Attachment C.

11. Internal and External Review

Reviews of the contractor's proposal to date, both within and without the Agency, have been favorable with regard to the merits of the proposed research.

This project was approved by the Interbureau Technical Committee, October 4, 1973 and by the Research and Institutional Grants Committee (RIGC) October 18, 1973.

12. Proposing Office General Evaluation and Recommendation:

This project is oriented towards the direct solution of the food shortage and malnutrition problems of a distinct segment of the world's population which resides in the semidesert areas of the cooler environments where barley is the most efficient grain producer. Improvement of the crop will directly increase the nutritive value of the grain itself, lysine yielding ability, resistance to limiting diseases and insects and broad adaptation. The Office of Agriculture considers this project of high priority in view of the nature of its expected benefits to the subsistance farmer, the man and his family who depend on their own produce for their food supply in an environment where barley has been and will probably continue to be the most efficient grain producer, satisfying tens of millions of people.

Approval of the project is recommended.

Omer J. Kelley
Director
Office of Agriculture
Bureau for Technical Assistance

Russell Desrosiers
Project Manager

S. C. Litzenberger, Chief
Crop Production Division

John B. Cordaro
Chief, Program Division

ATTACHMENT A

IMPORTANCE OF BARLEY
AMONG THE LEADING BARLEY PRODUCTING COUNTRIES
OF ASIA, AFRICA AND SOUTH AMERICA

(Source: 1971 FAO Production Yearbook Vol. 25)

Country	Area (1000 Hectares)	Production (1000 metric tons)	Yield (Kilos/ha)	Cereal Crops Exceeding Barley in Area Planted (1,000 Hectares)
World*	82,200	152,400	18.5	Wheat 217,200; Rice 134,900; Sorghum-Millet 113,400; Maize 112,900
India	2,597	2,865	11.0	Rice 38,800; Millet 20,500; Wheat 17,892; Sorghum 17,500; Maize 5,480
Turkey	2,750	4,000	14.5	Wheat 9,000
Morocco	2,100	2,210	10.5	
Ethiopia	1,770	1,550	8.8	
Iran	1,300	850	6.5	Wheat 5,000
Korea	930	2,000	21.5	Rice 1,200
Algeria	880	620	7.0	Wheat 2,250
Iraq	744	509	6.8	Wheat 1,387
Syria	725	262	3.6	Wheat 1,208
Argentina	490	525	10.7	Maize 4,066; Wheat 3,750; Sorghum 2,393
Tunisia	420	170	4.0	Wheat 830
Libya	350	100	2.9	
Afghanistan	315	310	9.8	Wheat 2,000; Maize 550
Pakistan	194	132	6.8	Wheat 6,103; Rice 1,125; Millet 760; Maize 634; Sorghum 560
Peru	185	175	9.5	Maize 382

*Approximately 75% of the world production is from Europe and North America

WORK PLAN FOR 2 YEAR PERIOD

1. Screen barley collection for high dye-binding capacity and quantitative differences in lipid content.

2. Determine protein quality of selected samples by complete amino acid analysis and to screen for lysine variance.

3. Pursue the possibility of locating genes showing simple inheritance for the components of yield and intercross those types thought most likely to produce desirable segregates and recombinations, including the use of genic or cytoplasmic sterility to induce increased variability.

4. Initiate preliminary agronomic evaluation of high lysine lines coming from the world collection screening program.

5. Initiate allele testing of high lysine lines as additional sources of high lysine are detected.

6. Continue and accelerate the development of backcross isogenes that will be the most useful for accomplishing the objectives of this project.

7. Increase and provide seed stocks of basic germplasm and improved lines and populations to participants in support of the various aspects of this project.

8. Develop a quick method for screening barley lines for nutritive value, based upon the relationship of hormonal and enzyme activity to physiological processes of the seed.

9. Develop a technique for readily determing day length insensitivity, determine inheritance and isolate stocks with day length insensitivity and establish methods of gene transfer.

10. Develop a method of gene transfer of the plump, nonsemi sterile <u>lysl</u> <u>lys</u> <u>1</u> gene that can be accomplished without lysine testing.

11. Evaluate the quantity and pattern of water use by isogenes of barley with different morphological features under dryland conditions. The following studies will be included with the view to develop populations of superior performance under moisture stress.

   a. Evaluation of the radiation energy exchange in canopies with different morophological features.

   b. Evaluation of the relative contribution of awns and leaves to photosynthetic activity under various conditions of soil-plant-water stress.

c. Determination of the effects of leaf width on light distribution and net photosynthesis within barley canopies.

d. Determination of the effect of leaf color and leaf width on the production of dry matter and grain.

12. Investigate the possible effect of soil fertility and plant water relation on alteration of the compositional and physico-chemical qualities of proteins as well as yield.

13. Determine influence of soil fertility levels, primarily N. P. and K (and S or micronutrients where soil levels may be deficient), on:

a. Grain yield of selected promising varieties from world barley collection.

b. Protein content of a broad selection of barley varieties.

c. Amino acid content (particularly lysine) as influenced by K levels in the soil and plant.

d. Other agronomic and quality factors relating to the nutritive quality of the barley.

14. Determine natural variations in nutrient mineral contents of selected varieties of the world barley collection.

15. Survey the diseases present in the target areas and collect isolates as well as determine their relative importance.

16. Develop barley stock homozygous for stem rust resistance. Puccinia graminis, but heterozygous for other characters.

17. Develop barley stock homozygous for scald resistance, Rhynchosporum secalis, but heterozygous for other characters.

18. Screen barley collection for resistance to the most important diseases and insect pests and develop multiresistant populations for release to LDCs for breeding and testing.

19. Evaluation of the nutritional value of barleys related to protein quality and quantity differences due to variety of isogenic line with laboratory animals.

20. Evaluation of nutritional qualities of barley associated with varietal and isogenic starch differences with laboratory animals.

21. Confirm the nutritive value of barley varieties and isogenic lines with domestic farm animals at no cost to project.

ATTACHMENT C.

BUDGET ESTIMATE

	Budget Category	1973-74	1974-75
A.	Salaries	$ 8,260	$ 8,665
	Post Doctorates	10,000	10,500
	Graduate Students	7,200	28,800
	Technicians	18,000	19,400
	Wages	8,695	15,480
	Employee Benefits	5,029	7,046
	Total Salaries, Wages and Genefits	$57,184	$89,891
B.	Consulting	2,000	1,000
C.	Nonexpendable equipment	35,016	29,933
D.	Expendable equipment	8,700	6,600
E.	Travel and subsistence		
	Foreign	4,000	2,000
	Domestic	1,700	2,000
F.	Publication costs	450	601
G.	Other direct costs	3,780	9,507
H.	Allowable indirect costs	37,170	58,468
I.	Subcontracts		
	Total	$150,000	$200,000

ATTACHMENT D

PROJECT PERSONNEL

Jarvis H. Brown, Associate Professor of Agronomy (Crop Physiology)

Robert F. Eslick, Professor of Agronomy (Genetics and Plant Breeding)

Hayden Ferguson, Professor of Soil Physics (Coordinator of soils, photosynthetic efficiency, water use efficiency sections of the project)

Kenneth D. Hapner, Assistant Professor of Chemistry (Inhibitor and Protein Chemistry)

Charles F. McGuire, Associate Professor of Agronomy and Cereal Technology

A. M. El-Negoumy, Professor, Agricultural Biochemistry (Department of Animal and Range Sciences)

E. L. Sharp, Professor of Plant Pathology

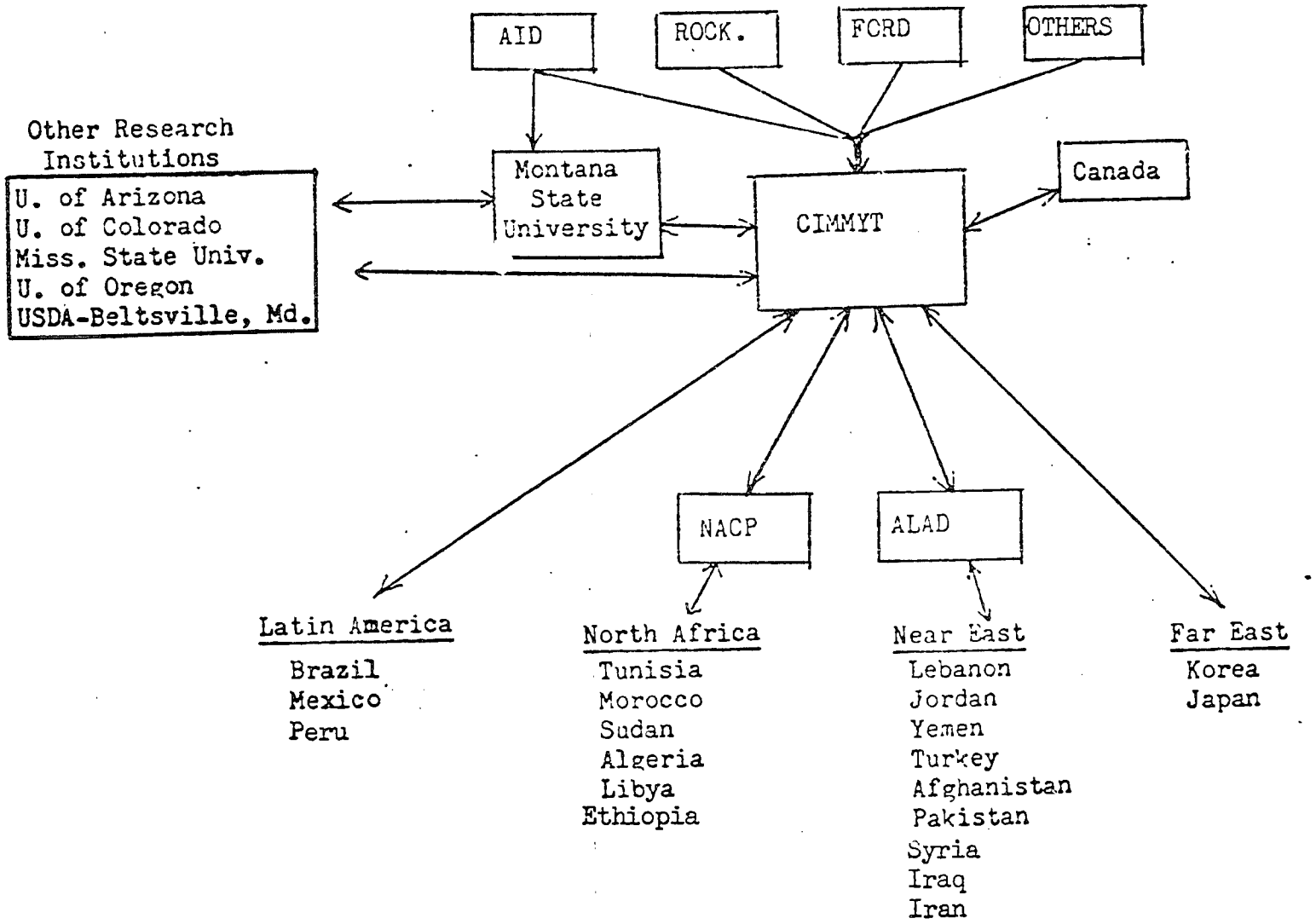
Earl Skogley, Professor of Soils (Soil Fertility & Plant Nutrition)

Loren E. Wiesner, Assistant Professor, Agronomy (Seed Technologist)

ATTACHMENT E

INTERNATIONAL BARLEY RESEARCH NETWORK

Major Linkages



Project Review Report - RIGC (10-18-73)

Project: Improvement of the Nutritive Quality and Productivity of Barley for Semiarid Regions of the World

Project Manager: Russell Desrosiers

Discussion Highlights

1. Montana State University as a Potential Resource Base: In response to a RIGC question on this subject TA/AGR responded that this is not planned as an objective, although TA/AG would not be opposed to such a plan were it proposed. In this instance, the University will be a part of the International Barley Improvement network and will cooperate with CIMMYT and LDCs in this research.

2. Training of Local Scientist: Selected LDC's scientist will be provided opportunity for research experience at Montana State and at CIMMYT.

3. Duration of Project: Several RIGC Members got the impression from the project statement that research on barley as conceived by TA/AGR to be of indefinite duration. TA/AGR responded that plant breeding is more or less an open-ended activity, but it is hoped that in the next few years an International Center might be able to take over this activity.

4. Acceptability of Barley as Food by LDCs: After a brief discussion among RIGC Members and TA/AGR staff it was brought out that Montana and CIMMYT will test newly developed strains for consumer acceptability and nutritional value. It was pointed out that some countries will also certainly use barley for feed.

5. Interactions with LDCs Institutions: RIGC suggested that TA/AGR monitor Montana State University to assure full cooperation with national research institutions. TA/AG agreed to follow through on these matters.

Motion: RIGC recommends project approval

Moved by: Dr. Cooper; seconded by Dr. Sperling

Vote: Unanimous