PD-AAN-102

ISN-27280 931131811/15

Unclassified
CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) — PART I

Report Symbol U-447

1. PROJECT TITLE
Control of Barley Diseases for LDCs
(Montana State University)

2. PROJECT NUMBER
931-1318.11

3. MISSION/AID/W OFFICE
DS Bureau/AGR/FCP

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 80-31

☐ REGULAR EVALUATION ☒ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES
A. First PRO-AG or Equivalent FY 78
B. Final Obligation Expected FY 80
C. Final Input Delivery FY 81

6. ESTIMATED PROJECT FUNDING
A. Total $ _____
B. U.S. $ 723,000

7. PERIOD COVERED BY EVALUATION
From (month/yr.) August 1978
To (month/yr.) August 1979
Date of Evaluation Review August 1-3, 1979

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. Keep USAIDs informed of nursery sites and cooperators.	MSU	Continuing
2. Make provision for more graduate students from LDCs	MSU	"
3. Organize more outreach efforts with collaborating institutions	MSU	"

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS
☐ Project Paper
☐ Financial Plan
☐ Logical Framework
☐ Project Agreement
☐ Implementation Plan e.g., CPI Network
☐ PIO/T
☒ PIO/C
☐ PIO/P
☐ Other (Specify) _____
☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT
A. ☐ Continue Project Without Change
B. ☐ Change Project Design and/or ☐ Change Implementation Plan
C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)
DS/AGR/FCP, RIJackson _____ Date: _____
DS/AGR, MMozynski _____ Date: 1/21/80
DS/AGR, KMByergo _____ Date: 1/21/80

12. Mission/AID/W Office Director Approval
Signature
DAA/DS/FN Tony Babb
Date 2/20/80

13. Summary:

The project's first evaluation contained some suggestions for relatively major changes. At the time of this evaluation, August 1-3, 1979, these changes had been made and the project staff was concentrating its emphasis on disease control for barley grown in the LDCs. The team fully supported the current activities and agreed that the project was moving toward achieving its purpose and goal. There were no major problems encountered.

14. Evaluation Methodology:

At the RAC Meeting held March 30-31, 1978, the following motion was made:

> "RAC is concerned about the work as proposed. RAC approves the proposal only with the following restrictions. Major emphasis should be placed on the plant pathological aspects of the proposal.
>
> Montana State University should:
>
> a. Limit the number of diseases emphasized in the program to perhaps four or five;
>
> b. establish disease nurseries as a service to barley breeders at International Centers and LDCs; and
>
> c. restrict genetic aspects of the proposal to the recurrent selection population, rather than the translocation and primary trisomic work.
>
> A review by AID, with RAC representation on the team, should be conducted toward the end of the first year. Further funding beyond the first year should be contingent upon the results of the review."

It was upon this recommendation of RAC's that the evaluation was held.

The evaluation team was composed of the following members:

Mr. Robert Morrow, Chairman, Agricultural Economist, served in several USAID Missions. He is currently assigned to AID's Near East Regional Bureau.

Dr. Lee Briggle, USDA, SEA/NPS. Leader of small grains programs. Conducts research on taxonomic classification of wheat and wheat improvement.

Dr. George Bruehl, Professor, Department of Plant Pathology, Washington State University. Conducts research on general pathology of cereals.

Dr. Maurice L. Peterson, Member of RAC, Professor of Agronomy, University of California (Davis). Former Chairman of the Department of Agronomy, Director of the Agriculture Experiment Station and Dean of the College of Agriculture.

Accompanied by:
Dr. Robert Jackson, Agronomist
AID Development Support Bureau/Office of Agriculture
AID Project Officer for the Project.

15. External Factors:

Not pertinent at this time.

16. Inputs:

There are no significant problems with commodities, training, or other inputs. No changes are needed at this time in inputs to produce outputs.

17. Outputs:

Montana State University (MSU) has supplied LDCs with barley breeding material resistant to the major barley diseases found in the LDCs. The development of disease resistant varieties takes several generations of the crop; however, the outputs are on target. No changes are needed in the outputs to achieve the project purpose.

18. Purpose:

To decrease losses caused by the major diseases of barley, particularly in the developing countries.

See attached team evaluation for further discussion and comment.

19. Goal - Objectives of Program:

a. Different sources of resistance to the major diseases of barley and linkage relationships will be determined.

b. Barley populations, both 2 row and 6 row, with broad based major gene resistance and minor gene resistance to specific diseases will be developed.

c. Resistance to different specific diseases will be combined into barley stocks.

d. Assistance will be given in establishment of seriodiagnosis programs for detection of barley stripe mosaic virus (BSMV) in barley stocks at the International Centers for barley improvement - CIMMYT and ICARDA.

e. All efforts will be made to develop a simple toxin screening procedure for use with the scald disease caused by Rhynchosporium secalis and with other barley diseases.

MSU has made definite progress toward achieving the goal of the project and more specifically has made a positive contribution toward fulfilling the steps noted immediately above.

20. Beneficiaries:

The immediate beneficiaries of this project are the barley research workers in the LDCs. It has been noted above that resistant barley breeding material has been supplied by MSU to these LDC research workers. The eventual beneficiaries will be the farmers in the LDCs when improved resistant varieties are available for their use.

21. Unplanned Effects:

None at this time.

22. Lessons Learned:

The project at MSU shows such projects can be beneficial to all parties involved; namely LDCs, CIMMYT and ICARDA. The greatest beneficiaries are the LDCs which receive the valuable germ plasm and breeding materials from the contractor for further testing, evaluation and breeding. In some cases after some selection, cultivars can be released for increase and distribution to the LDC farmers.

23. Special Comments or Remarks:

The evaluation team concluded that this project is the type of effort A.I.D. should continue to support. There is a scientific and technological need for additional work. There is a strong potential that the research and developmental work, if carried to its logical conclusion will economically benefit low income families in the developing world.

Attachments:
Annex A - Evaluation Report on Control of Barley Diseases
Annex B - Outline for AID Project Review
Annex C - Publications

ANNEX A

EVALUATION REPORT ON CONTROL OF BARLEY DISEASES

PROJECT 931-1318

I. Summary.

The evaluation was held at Bozeman, Montana, August 1 - 3, 1979. Team members and project staff are listed in the attachments to this report. The project is a relatively small and, as currently designed, a short-term project. The evaluation team found that the project is the type of effort A.I.D. should support. The need for the project exists, the methodology is excellent and the results of the project show considerable potential for it to eventually contribute to increases of barley production in LDC's.

II. Background and Project Purpose.

The project for Control of Barley Diseases was designed as a result of a need to provide better barley varieties and production information to producer in the less developed countries (LDCs). The first project in this area was the Barley Improvement Project No. 931-0580.11 which focused on improving varieties with better protein quality, disease resistance, and drought resistance. This former project was with the same contractor, Montana State University (MSU) as is the project under review. For a number of technical and management reasons, it was recommended that the approach to the barley work be limited, at this time, to an effort on developing disease resistant populations. The Barley Improvement Project was terminated in 1978 and the present project was approved as three-year effort August 15, 1978 to May 31, 1981.

A project with a relatively narrow purpose and, in particular, a project whose outputs are merely intermediary inputs to a larger action program raises at least two questions. One, can the work be held within the limits of the project design, since there are a large number of variables which can be addressed with respect to the broad goal of increasing barley production. The second question is whether it really is useful to confine the effort narrowly, since in the final analysis the test of utility is whether any people in the LDCs benefit from the investment in the project and reaching that objective usually requires a host of companion efforts. The evaluation addressing both the progress toward the specific purpose and the team formed some judgments as to ultimate use of project outputs by farmers in the less developed world.

III. Findings.

A. Methodology and Approach

The project design calls for the contractor to restrict himself to work on four or five diseases; to establish nurseries with disease resistance population as a service to LDCs; and to use the recurrant selection population (RSPs) techniques for developing such populations. The evaluation team found that the contractor was carrying out the work as proposed, and as

contracted for, and that the primary methodology (RSPS) was excellent in both concept and in its implementation. The germ plasm material being used in the basic crosses is considered appropriate and more material, both from the U. S. and worldwide, has been gathered for possible incorporation in the program. Over time, the project might change degrees of emphasis and suggestions for possible changes as contained in the recommendation section. Both the basic methodology and approaches are deemed essentially correct for the present. One exception, a subset of the basic program, was a set of experiments to use ethanal as a gametocide on barley. Direct correspondence on the appropriateness of this technique has been established.

Since breeding or selecting resistance populations may not always be the most expeditious route to reduce losses from all barley diseases, the evaluation team found that the interest in, and minor efforts made toward, investigating safe and acceptable seed treatment potentials with respect to barley stripe and the barley smuts be continued. Modest efforts at developing laboratory methods of screening for resistance to barley stripe also appears appropriate.

B. Progress Toward Objectives

1. Development of Disease Resistant Lines

Considerable progress has been made toward achievement of the project purpose of supplying disease resistance breeding material to LDC breeding programs and to the international institutes responsible for breeding new varieties. While some progress is attributed to the former project the efforts of the past year's work under this project is clearly significant and holds promise for eventual use by the various beneficiaries, i.e., the research/crop development community and ultimately by farmers.

Work on scald, net blotch, and bacterial blight in the RSPs is well along and it appears useful levels of disease resistance exists. It is time the materials are incorporated into breeding programs. The most promising of the materials have been distributed to LDCs, CIMMYT, and ICARDA. The feedback is that some selections are already being made a part of the breeding programs in Egypt and Turkey. This "exposure" is critical to testing the populations for conditions in the target. Seeing that information and plant material is used in LDCs will increase the monitoring burden of the project as will the need to maintain the individual RSP lines at either U.S. or at overseas locations.

The shortage of trained personnel at CIMMYT and ICARDA has prevented the establishment of a seriodisgnostic test for BSMV. MSU has been able able to partially fill this gap by evaluating elite lines and material from the crossing blocks for BSMV.

3.

2. Training

The training sponsored by this project is very good. The Graduate Program has five PhD candidates, three foreigners and two from the U. S. The Masters Program has three M. S. candidates. The six-month trainee program is well developed and currently has six members all from developing nations. Graduate students and trainees funded under this project have been selected with full knowledge of the missions in their respective countries.

In addition to a general orientation on major research being conducted on barley, and the tailoring of work of special interest to individual trainees, the training program allows both staff and students to work on important barley problems not strictly part of the RSP program per se., i.e., work on root rots and soil-borne pathogens. This type of training and work related programs should continue.

Montana provides a very good setting for "short course" and training work during a barley production cycle. The evaluation team suggested that the project staff evaluate the long-term needs for establishing a short course as a regular feature of the universi program.

Student morale appeared to be high and a typically informal western, but highly professional, relationship existed between staff and students. Institutional backstopping and facilities were likewise excellent. Montana State capabilities are well recognized by CIMMYT and ICARDA and it is expected that the supply of trainees and degree candidates will soon tax the considerable capability of the plant pathology and agronomy departments.

3. Developing Linkages for Use of RSPs

The evaluation team found that, up to this point in time and for current requirements, adequate and significant contacts have bee made with potential users of the resistant lines. This has been accomplished through (1) site visits by MSU staff to ICARDA, CIMMYT, and to Near East countries' experiment stations; (2) by building contracts with USAID and Ford Foundation staff; (3) by follow-up activities with former MSU graduate students and by having placed a recent MSU, PhD as the principle barley investigator at ICARDA; and (4) holding of a barl- workshop in Amman, Jordan in 1977.

Although linkages to date are adoquate, there is concern that more planning and perhaps more formal arrangements may be needed in the future to best insure testing and use of the project outputs in developing countries. It is understandable that formalistic procedures or protocols with cooperating institutions have not been developed yet given the short life of this project, the slow

transfer and indefinite status of the barley work which is still divided between CIMMYT and ICARDA due to insecurity in Lebanon and the newness of the main experiment station in Aleppo, Syria. The caution for perhaps greater need in the "linkage" area is not a criticism of work to date but is a recognition that in the later stages of the project this facet should assume greater importance than was seemly recognized in the project proposal as submitted to, and funded by, A.I.D. In addition to the institutions mentioned MSU could work with the USAID contractor in Morocco (Mid-America International Agricultural Consortium) and with CID/New Mexico in Egypt. USAID/Tunisia is also planning some work with barley but the contractor has not been selected yet.

IV. Recommendations a· Conclusions.

A. Major Emphasis

The evaluation team recommends that the main research thrust on this project remain on the development of the RSPs. However, it is felt that the work to actually affect reduction of losses in barley production due to diseases must, of course, go beyond development of disease resistant lines and that the project should begin to organize to the extent possible more outreach efforts with collaborating institutions.

Because barley is an important, but secondary, crop in all of the nations where it is grown, it suffers from lack of attentiou relative to major crops, hence there is a need to give added attention to this crop. To achieve its substantive purpose of reducing losses caused by diseases there is a need to (1) collect better information on the location, frequency, severity, and combinations of diseases; (2) provide the latest information to research administrators; and (3) establish both formal and informal work arrangements with cooperating scientists. The current project design does not really provide substantial resources for these activities perhaps because the rate of progress achievable was underestimated in the project design.

It appears to be time to address additional levels of effort. Until there is a clearly defined and operationally effective internations effort in barley improvement, the project does not appear to be an appropriate candidate for incorporation into an international cants program at this time.

The evaluation team noted in the minutes of the project approval documents that the short, three-year, life span of the project was questioned. Because progress may have exceeded expectations, the validity of the questions have been proven. It is simply not

possible to make a very significant contribution to crop improvement objectives in three years. Even if A.I.D. had intentions to fund extensions, or follow on new projects, the development of project papers, approval documentation, and contracts attendant to such extensions seriously invades on substantive work. Short-term projects create excessive uncertainty for personnel, both staff and degree candidates. With the exception of length of term, the project design has several commendable points. The research and developmental problem is well stated, the approach to the problem was scientifically well formulated, thus allowing staff and other resources to be assigned in an efficient manner[1/]. Significant side benefits are occurring from the project. These are the strengthening of the institution for international work, excellent training of personnel for either domestic or international work and the development of disease resistant barley lines and other scientific work which might very well impact positively on U. S. barley production.

The evaluation team concludes that the project is the type of effort A.I.D. should continue to support. There is a scientific and technological need for additional work. There is a strong potential that the research and developmental work, if carried to its logical conclusion, will economically benefit low income families in the developing world.

[1/] This type of relatively small research project may, in the opinion of some, be preferred to strengthening grants or research/service projects wherein the division of effort is often poorly stated.

OUTLINE FOR A.I.D. PROJECT REVIEW

August 1 - August 3, 1979

Sharp, E. L.

1. Introductory remarks
2. Underlying philosophy on barley disease research and extension
3. Outreach program, CIMMYT, ICARDA, other
4. Training program - GRA's and trainees
5. Information prerequisite to the breeding program of male-sterile facilitated recurrent selection populations (MSFRSP) for broad-based disease resistance.

Bockelman, H. E.

1. Male sterile facilitated recurrent selection populations
   a. objectives
   b. components
   c. procedures
   d. results to date with barley scald and barley net blotch

Carroll, T. W.

1. Fundamentals of common virus diseases of barley
2. BYDV - use of MSFRSP's for control
3. BSMV - pertinent control measures

Sands, D. C.

1. Bacterial disease problems of barley and applicable control measures

Scharen, A. L.

1. Helminthosporium stripe of barley and possible control measures
2. Tentative studies with powdery mildew

Strobel, G. A.

1. Possible uses of phytotoxins for rapid screening for disease resistance

Eslick, R. F.

1. How to agronomically improve the various barley populations and their most effective utilization under different environments

Aug 2

Tour of field plots and facilities (Plant Pathology and Plant & Soil Science staff)

1. Threshing, seed packaging and seed storage areas, Floor 1, Johnson Hall

2. Plant Pathology laboratories and research facilities, Floor 5, Johnson Hall

3. 19th Avenue plots - barley net blotch and RSP nurseries

4. Horticulture Farm - barley scald - RSP's and other barley nurseries

5. Main Agricultural Experiment Station Farm - Review barley disease work with BYDV, root rots and bacterial diseases & various agronomic studies with barley

---

Aug 3 - Room 215, Linfield Hall

1. Closed session of review team

2. Review team meets with principal investigators. Criticisms, comments, suggestions

PUBLICATIONS

ANNEX C

Bockelman

Bockelman, E. L. Sharp, and R. F. Eslick. Development of Barley Scald Resistant Germplasm Using Male Sterile-Facilitated Recurrent Selection. Submitted to Agronomy Abstracts. 1979.

Bjarko, M. E., E. L. Sharp, H. E. Bockelman. Resistance in barley to net blotch. 1978. Barley Newsletter Vol. 22. p. 30.

Carroll:

Carroll, T. W., P. L. Gossel, and D. L. Batchelor. Use of Sodium Dodecyl Sulfate in Serodiagnosis of Barley Stripe Mosaic Virus in Embryos and Leaves.

Sands:

Sands, D. C., G. Warren, D. F. Myers, A. L. Scharen. Plasmids as virulence markers in Pseudomonas syringae. Proc. 4th Int. Conf. Plant Path. Bact. Angers. 1978. pp39-45.

Sands, D. C. & A. L. Scharen. 1978. A selective medium for the Pseudomonas syringae group of plant pathogens. Phytopathology News. 70th Annual Meeting Program issue. (abstract). page 137.

Sands, D. C., S. D. Perkins, R. F. Eslick, and C. E. Fastnaught-McGriff. A half-seed screening technique for high free-lysine mutants. Submitted to Crop Science. 1979.

Langhans, V. E., D. C. Sands, G. de Smet, and A. L. Scharen. Plate Assay for Plasmid Curing Agents in Plants. Papers to be presented Aug. 6 at the International Congress of Plant Protection Dissemination of Pseudomonas syringae by rain.

Sands, D. C., A. L. Scharen, G. Warren, & U. Matern. Plate Assay for Plasmid Curing Agents in Plants.

Scharen

Mertz, Sally G. and A. L. Scharen. 1979. Potential for the development of Pyrenophora graminea on barley in a semi-arid environment. Plant Disease Reporter 63(8). In Press.

Sharp

Sharp, E. L. Genetic diversity, parasite survival and disease control & Resistance in barley to net blotch. Papers given at the Meeting of the International Congress of Plant Pathology

Sharp, E. L. 1979. Breeding for stable resistance; a realistic objective? Invited Symposium paper. IX International Congress of Plant Protection & 71st Annual Meeting of the American Phytopathological Society. Wash. D. C. August 5-11.

Sharp, E. L., H. E. Bockelman and R. F. Eslick. 1979. Male sterile facilitated recurrent selection populations for developing broad-based resistance by major and minor effect genes. IX International Congress of Plant Protection & 71st Annual Meeting of the American Phytopathological Society. Washington D. C. August 5-11.

Sharp, E. L. 1978. Changing Virulence Patterns in Stripe Rust of Wheat and Barley and possible Measures for Disease Control. (in "Summary of Seminar Delivered by Wheat and Barley Consultants" Office of Rural Development Wheat and BArley Research Institute, Suweon Korea. pp. 32-37

Eslick, R. F., R. A. Nilan, R. T. Ramage, E. L. Sharp. 1978. Report of the barley research task force. Report publ. by Office of Rural Development. Suweon, Korea. pp. 31-66.

R. F. Eslick

Biggerstaff, D. R. and R. F. Eslick. 1979. Combining cytogenetics and mutagenesis to recover unusual genotypes. Abst. of paper presented at 10th North Amer. Barley Workers Conference. 1978 Barley Newsletter 22:13.

Biggerstaff, D. R., and R. F. Eslick. 1979. Combining genetics, mutagenesis, and cytogenetics to induce and recover haploviable mutants in barley. Agron. abs. pp 55-56.

Bockelman, H. E., E. L. Sharp, and R. F. Eslick. 1978. Observed recombination between T3 translocation stocks and scald resistance loci. BGN 8:17-20.

Bockelman, H. E., E. L. Sharp, and R. F. Eslick. 1979. Development of barley scald resistant germplasm using male sterile-facilitated Recurrent Selection. Agron. Abs. 56.

Bruckner, P. L. and R. F. Eslick. 1979. Germination differences between waxy and non-waxy barley isogenes. Agron. Abs. pp. 14.

Eslick, R. F. 1978. Barley Improvement around the world. Fourth Regional Winter Cereal Workshop - Barley, Volume II:26-31.

Eslick, R. F. 1978. Male Sterile facilitated recurrent selection - advantages and disadvantages. Fourth Regional Winter Cereal Workshop-Barley Volume II:84-91.

Eslick, R. F. 1978. Evaluation of Korea's barley production problems and potentials. pp. 20-26. (in "Summary of Seminar delivered by Wheat and Barley Consultants" Office of Rural Development, Wheat and Barley Research Institute, Suweon, Korea, pp.1-68.

Eslick, R. F., 1979. Barley breeding for quality at Montana State University pp. 2-25.(publ. in "Proceedings of Joint Barley Utilization Seminar" Korea Science and Engineering Foundation, pp1-156.)

Eslick, R. F., R. A. Nilan, R. T. Ramage, E. L. Sharp. 1978. Report of the barley Research Task Force Report publ. by Office of Rural Development, Suweon, Korea. pp. 31-66.

Fastnaught, C. E., S. E. Ullrich, and R. F. Eslick. 1979 Evaluation of male sterile facilitated recurrent selection populations for plump, high lysine barley. Agron abs. pp. 60.

Fox, G. J. and R. F. Eslick. 1978. Alpha-amylase activity in non-germinated barley seed and its effect on waxy barley starch. Western Soc. Crop Sci. abst. p. 18.

Fox, G. J. and R. F. Eslick. 1979. Effect of several genes on speed of maltose production in germinating barley. Agron. abs. pp128.

Newman, C. W., R. F. Eslick, C. C. Calvert, and A. M. El-Negoumy. 1978. Comparative Nutritive value of Glacier and High Amylose Glacier Barley. Jour. Am. Sci. 47:448-455.

Newman, C. E., R. F. Eslick, G. J. Killen, J. E. T. Stobard, and S. E. Ullrich. 1978. Genetic and environmental effects on the nutritional quality of barley protein. Abst. of paper presented at 10th North American Barley Workers Conference. 1978. Barley Newsletter 22 67-68.

Newman, C. W., R. F. Eslick and J. W. Pepper. 1978. Performance of pigs fed hulless and covered barleys supplemented with or without a bacterial diastase. Proceedings, Western Section Am. Soc. Anim. Sci. 19:

Ries, M. N., and R. F. Eslick. 1978. Soil moisture removal by brachytic type barleys and their normal isotypes. Western Soc. Crop Sci. Abst. p.23

Sands, D. C., S. Dull, and R. F. Eslick. 1978. A simple, nondestructive and direct single seed assay for lysine. Western Soc. Crop Sci. Abst. p. 19.

Smail, V. W., and R. F. Eslick. 1979. The effect of genetically different maturation rates on residual soil moisture and yield component responses in 26 isotypes of barley. Agron. abs. pp. 77-78.

Smail, V. W. and R. F. Eslick. 1979. Pleiotropic effects of genetic differences in maturity in two and six row isotypes. Abst. of paper presented at 10th North Amer. Barley Workers Conference. 1978. Barley Newsletter 22:65.

Ullrich, S. E. and R. F. Eslick. 1978. Protein and lysine maternal inheritance effects in the high protein and high lysine barley mutant Hiproly BGN 8:108-109.

Ullrich, S. E. and R. F. Eslick. 1978. Allelism evidence for barley high lysine shrunken endosperm xenia (sex) mutants. BGN8 109-112.

Ullrich, S. E. and R. F. Eslick. 1978. Evidence for assigning the high amylose locus amol of Glacier barley to chromosome 2. BGN 8:112-113.

Ullrich, S. E. and R. F. Eslick. 1978. Chromosome location for Risø induced high lysine shrunken endosperm mutants of barley. BGN 8:114-125.

Ullrich, S. E. and R. F. Eslick. 1978. Protein and lysine characterization of spontaneous shrunken endosperm mutants of barley. Crop Science 18:809-812.

Ullrich, S. E. and R. F. Eslick. 1978. Inheritance of the associated kernel characters - high lysine and shrunken endosperm - of the barley mutant Bomi, Risø 1508. Crop Science 18:828-831.

Ullrich, S. E. and R. F. Eslick. 1978. Lysine and protein characterization of induced shrunken endosperm mutants of barley. Crop Science 18:963-966.

Ullrich, S. E. and R. F. Eslick. 1979. Effect of environment on protein and lysine content in seventeen barley shrunken endosperm mutants. abst. of paper presented at 10th North Amer. Barley Workers Conference. 1978. Barley Newsletter 22:69.

Ullrich, S. E. and R. F. Eslick. 1979. Effect of latitude on kernel weight, and protein and lysine content in normal and shrunken endosperm mutant isotypes of barley. Agron abs. pp 80.

APPROXIMATE PER 'CENT OF PROJECT FUNDS		TIME SPAN
25	Sharp, E. L. Principal Investigator, Coordinator (Receives 25% of his salary from the grant but no salary is paid the co-investigators) Studies of rusts, net blotch.	25%
15	Carroll, T. W. Co-invesitgator Plant virology - barley yellow dwarf virus, barley stripe mosaic virus.	20%
10	Scharen, A. L. Co-investigator Leaf diseases helminthosporium stripe, powdery mildew	15%
10	Sands, D. C. Co-investigator Bacterial diseases - Xanthomonas streak, Pseudomonas blight	20%
10	Mathre, D. E. Co-investigator Soil-borne diseases. Helminthosporium & Fusarium root rot.	15%
10	Strobel, G. A. Co-investigator disease physiology phytotoxins - scald & helminthosporum stripe.	15%
20	Eslick, R. F. Co-investigator Barley breeder and geneticist. Agronomic considerations.	20%
	Bockelman, H. E. Postdoctoral Research Associate In charge of assembling and maintaining the recurrent selection populations. In charge of disease resistance selection for scald, net blotch, stem rust, and leaf rust. In charge of assembling and distributing the RSP's to the disease nurseries outside of Montana. In charge of seedling tests of CIMMYT and ICARDA nursery materials.	100%
	Langhans, Victor Postdoctoral Research Associate Work on all phases of Xanthomonas translucens (Bacterial blight) on barley. Time is also spent working with Pseudomonas syringae developing inoculation and screening techniques, devising controls, working with the RSP and providing assistance to grad student.	100%
	Biggerstaff, Dan Technician Does the planting - harvesting - separating seeds - etc.	100%
	Grey, Bill - Grad Student	50%
	Bordelon, Bruce - Grad Student	50%
	de Smet, Guy - Grad Student	50%
	Kim, Hee Kyu - Grad Student	50%
	Zaske, Susan - Microbiologist II	33 1/3%

Jarikji, Omar----Trainee---------6 months
Min, Kyung Soo---Trainee---------6 months
Elias, Elias-----Trainee---------3 months
Suzen, Bertan----Trainee---------3 months
Srivastava, Ashok Kumar - Trainee- 3 months
Konak, Cahit - coming in September
Harrabi, Moncef - coming in September