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PD-AAC-896-B1

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE ("X" appropriate box)
- [ ] Original
- [ ] Change
- [x] Add
- [ ] Delete

PP 27p

DOCUMENT CODE 3

2. COUNTRY/ENTITY: TA/Bureau RES-RDA #2

3. DOCUMENT REVISION NUMBER: 1

4. PROJECT NUMBER: 931-17-130-580-73

5. BUREAU: a. Symbol TA/AGR; b. Code 5

6. ESTIMATED FY OF PROJECT COMPLETION: FY 80

7. PROJECT TITLE - SHORT (stay within brackets): Barley Improvement

8. ESTIMATED FY OF AUTHORIZATION/OBLIGATION: a. INITIAL mo. 7 yr. 7; b. FINAL FY 80

9. ESTIMATED TOTAL COST ($000 or equivalent, $1 =)

a. FUNDING SOURCE	FIRST YEAR FY 77 b. FX	c. L/C	d. Total	ALL YEARS e. FX	f. L/C	g. Total
AID APPROPRIATED TOTAL	296	-	296	850	-	850
(Grant)	(296)	(-)	(296)	(850)	(-)	(850)
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. 1.						
Other U.S. 2.						
HOST GOVERNMENT						
OTHER DONOR(S)						
TOTALS	296		296	850		850

10. ESTIMATED COSTS/AID APPROPRIATED FUNDS ($000)

a. Appropriation	b. Primary Purpose	c. Primary Tech.	FY 77 d. Grant	e. Loan	FY 78 f. Grant	g. Loan	FY 79 h. Grant	i. Loan	ALL YEARS j. Grant	k. Loan
			296		271		283		850	
		TOTALS	296		271		283		850	
11. ESTIMATED EXPENDITURES			296		271		283		850	

12. PROJECT PURPOSE(S) (stay within brackets) [ ] Check if different from PID/PRP

To increase the nutritive value and the yield level and to decrease losses caused by diseases, germination and seedling failures in the semiarid regions of the world.

13. WERE CHANGES MADE IN BLOCKS 12, 13, 14, or 15 OF THE PID FACESHEET? IF YES, ATTACH CHANGED PID FACESHEET.

[ ] Yes [x] No

14. ORIGINATING OFFICE CLEARANCE

Signature: Leonard H Etto

Title: Leon F. Hesser, Director TA/AGR

Date Signed: mo. 06 day 17 yr. 76

15. Date Received in AID/W, or For AID/W Documents, Date of Distribution: mo. day yr.

AID 1330-4 (7-75)

PROJECT STATEMENT

A. Project Summary

1. Statistical

Project Title: Improvement of the Nutritive Quality and Productivity of Barley for Semiarid Regions of the World. AID/ta-C-1094

New or Extension: Extension for three years.

Contractor: Grants and Contracts, Montana State University

Principal Investigators: Robert F. Eslick, Co-Principal Investigator
Lark P. Carter, Co-Principal Investigator

Duration: Current Contract: March 26, 1974 to March 25, 1977
Proposed Contract: March 26, 1977 to March 25, 1980

Funding to Date : $600,000 to March 25, 1977

Estimated Additional Funding : $849,800 to March 25, 1980

3/26/77 to 3/25/78 - $295,300
3/26/78 to 3/25/79 - 271,300
3/26/79 to 3/25/80 - 283,200

Project Manager: Edward J. Rice

2. Narrative Summary

TA/ACR contracted with Montana State University in 1974 to perform or provide certain services in connection with development of barleys for the semiarid areas of the world. The contract provided for efforts in three areas:

-- nutrition,

-- drought resistance and water use efficiency, and

-- disease resistance.

The principal thrust of the project is to accomplish its objectives by providing the genetic materials to make their respective tasks easier -- to international research centers working with barley and to national barley breeding programs. Necessary back-up research has been undertaken at Montana State and the contractual obligations of the initial three year contract should be completed by March of 1977.

Representatives of the project have visited barley breeders in Turkey, Lebanon, Egypt, Tunisia, Sweden, Denmark, Germany, England, Mexico, Japan, Korea, Taiwan, Hong Kong and the Philippines to develop liaison. The proposed renewal will provide for much greater world-wide visibility of the project and enable Montana State University to assume a position of world leadership in barley improvement.

B. Research Purpose and Expected Products

1. Purpose

Objective A -- To increase the nutritive value of barleys consumed by peoples throughout the world, particularly in the DCs.

Objective B -- To increase the yield level of barley grown in semiarid regions of the world, particularly in the DCs.

Objective C -- To decrease losses caused by barley diseases, particularly in the DCs.

2. Objectives and Expected Products

Research results expected will be those which will bring about barleys with improved nutritive value, viable breeding programs utilizing high yielding lines and varieties under conditions of drought stress, populations with improved resistance to diseases and pathogenic races prevalent in the DCs, and evaluating their usefulness and distributing to DC breeders and international research centers.

Objective A -- Nutritive Value:

Research will be directed at examining barley cultivars found to be of high nutritional value on the basis of protein quantity, protein fractions, amino acid quantity and quality, true digestible protein, biological value of the protein, total digestible calories and development of procedures for accurately predicting these characteristics. Systems will be established for the simple transfer of high lysine genes to existing populations. Broad and narrow-based populations homozygous for high lysine will be developed, increased and distributed for local DC variety development. As new barleys are developed by the plant breeders they are monitored for nutritional quality, stability, palatability and factors related to end-product use.

Objective B -- Drought Resistance, Drought Escape and Water Use Efficiency:

Project will develop a series of varieties or lines of known ranked drought resistance -- a factor required for the success of such studies. Selection of barley varieties with more extensive rooting systems appear to facilitate the development of drought resistant varieties. Indications are that reduction of wind velocity and turbulant transfer over canopies may be one of the easiest means of increasing water use efficiency in semiarid areas. Higher yielding, drought-escaping varieties with good water use efficiency are being sought. A series of yield trials with maturity isogenes will be conducted to determine how early a variety must be to be successfully grown under a given environment.

Objective C -- Disease Resistance:

Barley diseases often are the limiting factor in production and have received little attention by DC barley breeders. This Montana State University research objective will be accomplished by (1) single gene transfer involving translocations and recurrent selection procedures, (2) developing resistance in broad-based populations, and (3) developing broad-based resistance in narrow-based agronomically adapted populations. This research proposes to bring barley stripe mosaic virus (BSMV) under control through disease resistance and the control of the virus through cultural practices. The inheritance of resistance to BSMV to seed transmission is being studied to learn more about the inheritance and to identify chromosomes and alleles responsible for this resistance.

3. Progress To Date

Progress during the first two years of the three-year phase of this contract has been according to plan and performance of staff has been excellent. A visual presentation of output is contained in Section H which shows the time phasing of activities over the present contract as well as the contract renewal period.

Montana State University has accomplished or has made progress on the following research activities:

a. Nutrition

1. All two row barleys in the world's collection are being screened for lysine.

2. Refined a fast, accurate lysine analysis method.

3. Demonstrated that value of high lysine for swine, rats and poultry.

4. Demonstrated that all high lysine genes are not equally effective nutritionally.

5. Discovered four additional high lysine genes; there are now 13 total.

6. Initiated support to CIMMYT and Korean MOA nutrition laboratories.

7. Developed ten high lysine lines (40 percent increase) which yield approximately 100 bu/acre.

8. Accomplished double translation of whole gene (3-7) homozygous transfer of yellow dwarf, net bloch, and high protein.

9. Demonstrated that high lysine gene activity is environmentally affected which will allow differentiation of gene use for specific locations.

b. Drought Resistance

1. Found that longer awns decrease water loss by cooling head.

2. Developed numerous isogenetic lines on the basis of plant color.

3. Demonstrated .8 inch water saving under an isogenetically lighter colored canopy of barley because of lower temperature and reduced heat load.

4. Ranked plant characteristics associated with drought resistance.

c. Disease Resistance

1. Found two genes and worked out the transfer mechanism for scald resistance.

2. Made a collection of barley germplasm in the Near East region and screened for disease resistance.

3. Found gene by trisomics for net bloch and found transfer route.

4. Have spent most time on stem rust but have not found gene transfer.

d. Nursery Development

1. Scald resistant nursery by Fall 1976.

2. Recurrent selection nurseries sent to ALADS, Tunisia, Korea, and Dr. Ramage of Arizona State.

3. Isogenic populations to be sent to Cairo and Korea in the Fall of 1976.

C. Significance and Rationale for the Research

1. The Development Problem

This research proposal fits well into A.I.D. goals and policies. Its aim is to increase production of high quality food for humans and feed for livestock. Since barley is grown by small farmers in many of the DCs, increased production will improve both the production and profitability of small farmer output. Greater production will result in more cereal, milk and meat available to the urban poor.

The proposed high lysine barley research is a continuing effort to utilize the high lysine character for the improvement of barley as a human food and livestock feed crop and thereby improve the nutrition of people. Barley is a major crop with which people of the DCs try to meet their nutritional needs. The greatest proportion of barley grown around the world is used for livestock feed. When livestock feed quality increases, livestock production increases and so does human nutrition.

2. State-of-the-art Which Supports This Research Proposal

TA/AGR has long supported research to improve the quality and quantity of wheat, corn, soybeans, other legumes, and rice. The first TA/AGR supported research for barley was instigated under the Montana State University initiated in March of 1974. Barley is an important cereal crop around the world. Its adaptability to a wide array of environments is greater than any other cereal crop. Barley is an important crop in developing countries and nutritionally improving the crop is critical as the "food gap" widens.

Reasons why barley research is important include:

--Need to know which barleys contain the highest quality protein from the human nutrition viewpoint.

--For those for whom barley is a major food item (and processors of human foods from barley) there must be assurance of varietal identity in terms of protein quantity and quality.

--Need to reestablish the effect of variations in soil fertility and plant-water relationship on the nutritional significance of barley in terms of protein quality.

--Because knowledge about the biochemical composition and properties of barley is lacking, this research work on the solubilization of their proteins and their fractionation into pure entitities is important.

--Plant breeders do not know enough about the specific effects of various physiological and morophological features on plant water use efficiency.

--Barley populations must be developed to provide germplasm for use in overcoming establishment problems found in DCs; techniques must be developed which will provide the proper conditions for selection of desired genotypes.

D. Plans to Develop Linkages and to Facilitate Utilization of Research Results

The project calls for quantifying a number of pleiotropic effects in barley isogenes -- effects of particular significance to plant breeders practicing visual selection on a plant basis or row basis. This information will be forwarded to linked DC breeders with Montana's evaluation of the significance in terms of plant breeding.

Montana State University will assist in the establishment of laboratories (perhaps three) in different ecological areas of the world with the capabilities of utilizing the microbiological assay method for lysine determination -- for the benefit of national and international agricultural research centers.

The contractor also will encourage establishment of a central screening facility for seed-borne barley stripe mosaic virus in seed moving between breeding programs. This responsibility has been accepted by the International Board for Plant Genetic Resources sponsored by the Consultative Group on International Agricultural Research -- with Montana cooperating, as requested.

As a service to cooperating International and National Centers the contractor would screen material going into advanced uniform yield trials. The seedling screening (at the international center level on yield trials distributed either by ALAD or CIMMYT) would be for stem rust, leaf rust, scald and net blotch resistance.

As recurrent selection populations are developed, they will be distributed to international centers and DC national breeding programs. Additional plans for utilizing research results are:

--Distribute improved seeds of developed isogenics and varieties upon the requests of DC and international center breeders.

--Supply seed of lines which breeders may be interested in testing or using as parents for distribution by cooperating international centers.

--Forward directly to DC breeders complete details of screening techniques they may find useful and that are proven and are on hand or developed during life of the project.

--At least one "barley breeding" workshop will be conducted during the life of the project; additional workshops may be scheduled on a regional basis.

--As technical information becomes available it will be published in recognized technical journals, as an aid to DC barley breeders.

--Professional staff of the projects, from Montana State University, will be available for short term consulting to the extent permitted by available funds as based on requests.

--Provide training facilities at Montana State and conduct on-the-job short courses for DC barley breeders.

-- Visit barley breeders at National and International Research Centers to exchange information and study breeding results.

--Attend national and international meetings to present papers on progress of barley breeding research.

E. Management Considerations

No unusual management problems are expected to arise in connection with this project. It is similar in concept and design to other centrally funded crop improvement research projects.

Noncontract funded inputs will be substantial. Montana State University will contribute 50 work months, of 12 staff professionals, for the life of the contract. In addition there are 30 other research grants and projects at Montana State University which contractor states will contribute to this project.

Project will be evaluated through a review and evaluation team visit to the campus and by constant review of the project monitor in TA/AGR.

The Contractor will clear manuscripts with TA/AGR monitor before publication of any articles resulting from this research.

F. Project Background Description

Objective A -- Nutritive Value:

Barley is a major source of protein and energy for people in the Middle East and North Africa. The cooler, semiarid environment in this sector of the world permits the production of barley where other cereals are less adapted. Plant breeders and nutritionists must strive to develop barley, as well as other cereals, which has a combination of sound agronomic traits and the desirable nutritional qualities.

In 1968 the first high protein, high lysine barley line was isolated in Sweden from the world collection of barleys. This line is the variety Hiproly of Ethiopian origin and has a 20-30 percent increase in percent lysine This barley has been proven to be of superior nutritional value to mice and rats with increased weight gains, protein efficiency ratios, biological value, net protein utilization and lysine true digestibility. The drawback of this Hiproly line is that there is a 60 percent yield depression as compared with a normal lysine line. Montana State is optimistic on breaking this yield reduction associated with high lysine in Hiproly -- they base this optimism on work done at Oregon, Washington and the University of Alberta (where they have lines with the Hiproly gene which yield equal to the best two row lines). MSU states they they are at the plump, fertile, hi-lysine stage with some of their lines and soon will yield test them.

Objective B -- Drought Resistance, Drought Escape and Water Use Efficiency:

In the last few years the contractor has established that the morphological features which differ in their available isogenic lines of barley have a significant influence on the way in which the plant canopies interact with their environment. Features studied include awns, leaf color and leaf width.

This research has been conducted to increase the yield level of barley grown in semiarid regions, particularly in DCs. Study of rates of radiation reflection from light vs. dark green barley lines indicates that light color may have considerable potential for reducing the heat load imposed upon plant canopies under semiarid conditions. Studies have been initiated to study the influence of leaf area on water use efficiency.

Work is going forward to develop a set of tester varieties which are classified for water use efficiency; to develop a technology applicable for screening plants and selections for drought resistance; to determine the influence of certain genes on water use efficiency and the possibility of utilizing mixtures of tall and short growing barleys to modify evapotranspiration from barley canopies.

Objective C -- Disease Resistance and Control:

The line of approach on this research project has been to place a major resistance gene in an agronomically adapted population by the use of a specially selected translocation. Once the correct translocation is found additional marker genes (e.g., male sterility, seedling markers) can be placed in the same interstitial segment. This allows the resistant gene, in combination with the translocation, to be added to a recurrent selection population without having to screen for resistance in every cycle of selection.

Work on stem rust has centered on locating the proper translocation stock -- it has not been found. Activities will be intensified in 1976 by evaluating additional translocation stocks. Other areas of research include scald, net blotch, leaf rust, covered smut, and barley stripe mosaic virus. Experience with Middle East isolates of scaled, net blotch, leaf rust and covered smut indicates relatively low virulence on differential cultivars. This situation is likely to change rapidly once resistant stocks are introduced in the area. Thus, it is advantageous to anticipate this by developing barley populations containing multiple and diverse sources of resistance to these diseases.

G. Research Project Design and Methods

Objective A -- Nutritional Value:

To increase the nutritive value of barley consumed by people, particulary in the DCs.

--Improve the amino acid balance in barley, particulary lysine by (1) continuing to screen the world barley collection, (2) improving the microbiological assay method for lysine determination, (3) agronomic worth and stability of lysine and protein when grown in diverse environments, (4) determining chromosome location, allelisms and gene action of high lysine genes as they are varified, (5) establishing genetic systems of high lysine transfer which can be simply employed in DCs with limited resources to incorporate high lysine into existing lines, (6) determining the effect of fertilization on nutritive value and relative lysine production, (7) evaluate the feasibility of developing regression equations from animal data and amino acid analysis to predict biological value of barley protein, and (8) continuing to predict biological value of barleys discovered or developed which are known to deviate significantly from the norm of known varieties.

—Evaluate barley protein composition as it relates to protein efficiency ratio, true digestibility, biological value and net protein utilization in laboratory animals by (1) determining and evaluating the composition of protein in barleys selected for high and low protein and/or lysine; (2) investigating the relationship between the Osborne fractions of barley protein, amino acid composition and nutritive value and (3) investigating the use of protein composition and fractionation as selection tools for improving the nutritive quality of barley protein.

--Increase the total caloric content and digestibility energy of barley by increasing the percentage of total lipids to the kernel by (1) determining the total lipid composition of barleys known to deviate in total lipid quantity, (2) measuring the digestibile energy in high and low fat barleys, (3) determining the agronomic worth (10 to 16 locations) and stability of the lipid content and composition and nutritive value of high fat genes in barleys grown in diverse environments, and (4) incorporating high fat and high waxy characters into the high lysine broad and narrow genetic base hull populations.

Objective B -- Drought Resistance, Drought Escape and Water Use Efficiency:

To increase the yield levels of barley grown in semiarid regions, particularly in DCs.

—Develop a set of tester varieties, 25 two-row and 25 six-row, which is classified for water use efficiency. Accumulated yield data, heading dates and plant heights for selected varieties grown in Montana and in regional yield trials from 1935 to 1975 will be tabulated and regression analysis and interpretation applied. Twenty five to several hundred location-years data are available for the various varieties.

--Attempt to develop simple techniques which are applicable to screening large numbers of individual plants and selection for drought resistance by (1) determining dry down rate of rootless tillered barley seedlings, (2) determining depression in number of developed rachis internodes under stress conditions as compared to optimum conditions as an indication of early seedling drought resistance, (3) calculating modulus of elasticity of selected plants, (4) determining transpiration of excised heads, (5) determining plant water potentials, and (6) estimating root growth patterns and water use efficiencies by soil water extraction measurements.

--Attempt to determine the influence of certain genes on water use efficiency and drought resistance by (1) plant color, (2) leaf area and (3) awn barbing.

--Determine the possibility of using mixtures of tall and short isogenes of barley to decrease evapo-transpiration and thus improve water use efficiency.

--Establishing early maturing day length insensitive recurrent selection populations by (1) determining relative date of heading of a number of pure lines; (2) measuring pleiotropic effects on maturity; (3) determining allelism among a series of early maturing genes and establish mode of inheritance, (4) yield testing and interpreting results from a series of maturity isogenes in a number of varieties and (5) assigning non-allelic genes to chromosomes.

Objective C -- Disease Resistance and Control

To decrease losses caused by disease; these activities reflect additions to objectives in the original project:

--Develop for release to DCs one or more barley populations with good levels of resistance for each important disease (stem rust, scald, net blotch, leaf rust, covered smut and BSMV).

--Determine annually the reactions of entries in uniform tests in the Middle East to stem rust, scald, net blotch and leaf rust.

--Research education of barley breeders and plant pathologists in identification and control of seed-borne barley stripe mosaic virus.

Feeding Trials

Feeding trials with weanling rats and growing chicks will be conducted with barleys selected for protein quantity and quality through amino acid and nitrogen analysis and total calorie content through gross energy and fat analysis. Similar trials will also be conducted with barleys grown in different environments (location and nitrogen fertilizer application), pearled barleys, the by-products of pearling and protein fractions of barleys. Biological value, true protein digestibility, net protein utilization, metabolizable

energy and digestible energy will be measured in cultivars proving to have superior nutritional qualities in feeding trials with rats and chicks. Barleys deviating significantly from the norm in the feeding trial results and in nitrogen and energy utilization measurements will be studied by protein fractionation and/or analysis for total fatty acid structure. An attempt will be made to correlate and develop regression equations for biological deviations observed with rats and chicks with the structure of protein and fat, amino acid composition and other chemcial factors.

Priority will be given to those barleys demonstrating superior nutritional qualities or potential value. Recommendations for seed increase and/or release of genetic material to DCs will be dependent upon genetic stability of (a) nutritional quality, (b) superior agronomic traits, (c) environmental adaptability and (d) acceptance by the target DC.

H. Time Phase Work Plan

The following eight pages list, by outputs, the activities of this project (work plan) and include charts which show the time phasing of activities over the present contract as well as the contract renewal period.

AIa (1) All 2-row barleys currently in world collection will have been screened for lysine.

AIb (2) Microbiological assay screening method developed to the point it is a reliable technique.

(3) Microbiological assay screening method improved until reliability is approximately equivalent to that of the amino acid analyzer.

(4) Training of personnel and establishment of a laboratory to utilize the technique in connection with international research centers or in developing countries, monitoring of established laboratories.

(5) Neotec Grain Quality Analyzer calibrated for protein samples made available for calibrating to Kjeldahl protein percentages.

(6) Reliability of the Grain Quality Analyzer for barley protein determinations established. Leaflet on reliability, operation precautions, trouble-shooting prepared.

(7) Grain Quality Analyzer calibrated for barley fat determinations, samples for calibration made available, limitations determined, results included in above leaflet.

AIc (8) Completed for the variety Betzes; as a technique.

AId (9) Completed for Betzes seg 1 seg 1, Hiproly, and High Amylose Glacier.

(10) Completed for Riso mutants 1508, 29, and 86.

(11) Completed for Riso mutants 7, 8, 9, 13, and 56.

(12) Other genes as they are found.

AIe (13) Hiproly gene assigned to chromosome 7.

(14) Betzes seg 1 seg 1 assigned to chromosome 1.

(15) Hi-amylose Glacier gene assigned to chromosome.

(16) Risco 1508 gene assigned to chromosome.

(17) Risco 7, 8, 9, 13, 29, 56, and 86 assigned to chromosomes.

(18) Allelism of the above genes established.

AIf (19) Genetic transfer system established for Betzes seg 1 seg 1.

(20) Genetic transfer system established for Hiproly.

(21) Genetic transfer system established for Riso 1508.
(Time schedules for 19, 20, 21 can only be approximate.)

AIg (22) 1st recurrent selection population (narrow base) with hiproly gene available for distribution.

(23) Improved population with broader genetic base available for distribution.

(24) Hulless form available for distribution.

(25) Narrow genetic gase recurrent selection population with Betzes seg 1 seg 1 gene available for distribution.

(26) Narrow genetic base recurrent selection population with Risco 1508 gene established.

AIh (Completion dates are dependent upon completion of AIf when "broad base" is interpreted to mean the world collection or CCXXX.)

(27) Complete transfer of seg 1 seg 1 Betzes to broad based genetic population.

(28) Complete transfer of Hiproly gene to broad base genetic population.

AIj (29) Complete evaluation of Hiproly and Hi-amylose Glacier.

(30) Complete evaluation of Riso 1508.

A1j	(31)	First prediction equation developed.
	(32)	Improvement on equation as more information becomes available.
A1ke	(33)	Complete fcr Hiproly.
	(34)	Complete for H-amlose Glacier.
	(35)	Complete for Betzes seg 1 seg 1.
	(36)	Complete for Riso 1508.
	(37)	Completions for other Risogenes and others.
A2a	(38)	Complecion for Hiproly.
	(39)	Completion for 25 varieties in MSG series.
	(40)	Completion for 11-hi-lysine mutants.
	(41)	Completion for other hi-lysine mutants.
A2b	(42)	Using accumulated data.
A2c		
A3a		
A3b	(43)	Completion with initial set of 15 barleys varying from high to low fat
	(44)	Other barleys found to be high fat and a comparison of pearled and pearlings from high and low fat barleys.
A3c		
A3d	(45)	Two years data (10-16 locations) available for summary.
	(46)	High and low fat lines from three locations have been fed fro determination of digestible energy.
A3e	(47)	Plump, hulless, high lysine lines available.
	(48)	Hulless, high lysine waxy endosperm lines developed and waxy hulles high fat lines developed.
	(49)	Hulless, waxy endosperm, high fat, high lysine lines developed.
	(50)	Increase and start evaluation.

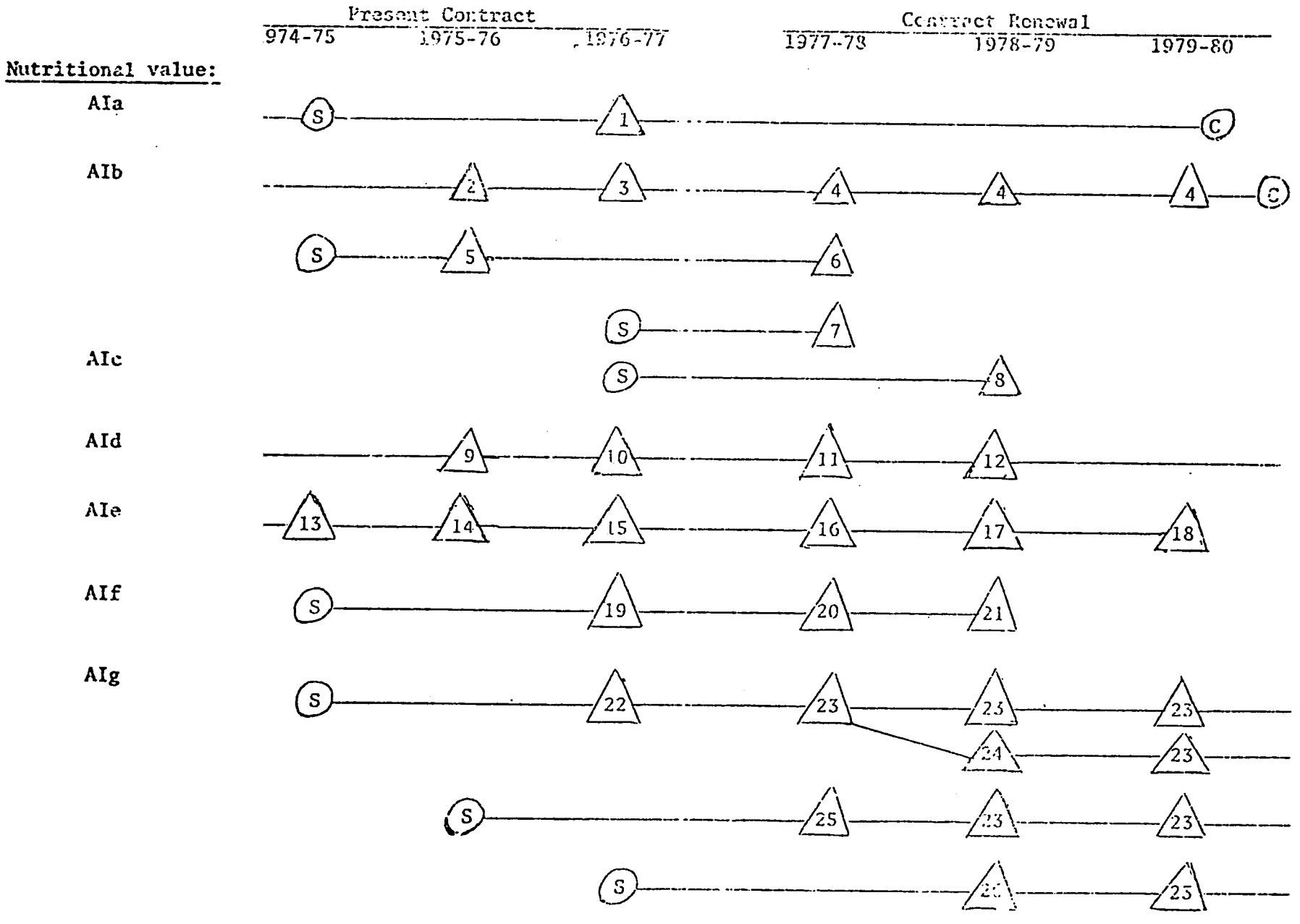
Drought Resistance, Drought Escape, and Water Use Efficiency.

B1	(51)	Ranking developed.
	(52)	Seed available for distribution.
B2a, b,c,d, f,i	(53)	Two years data, on spike and seedling and down rate, number rachis internodes, seed weights, height, transpiration from excised heads, and per culm leaf area obtained from several locations where water stresses are different.
B2e	(54)	As above for own silica content.
B2g	(55)	Minimum two years data available for refinement of technique.
B2h	(56)	Minimum two years data available for interpretation.
B3a1	(57)	Data summarized and distributed.
B3a2	(58)	Summary of two year's yields.
	(59)	Yield trials of Golden Liberty vs. Liberty at a number of locations.
	(60)	Yield trials of early yellow plant color di-isotypes.
B3a3	(61)	Measurements completed and information used for follow-up work.
B3a4	(62)	With mono-isotypes only.
B3a5	(63)	Di-isotypes of early yellow plant colors developed for several genes in 1 or more varieties.
B3a6	(64)	Completion of development of several recurrent selection populations for plant color, an f4f4 population will be the first.

B3b3	(65)	Detailed Studies of three leaf width isogenes in two varieties completed.
	(66)	Represents minimum of 12 station years data available for summarization.
B3b4	(67)	Pleiotropic effects of leaf widths in Hannachen and Petzes completed to be followed by Compana, Titan, Glacier isotypes.
B3c1	(68)	Examination of seed-stocks on hand and develop as a complete set of own-roughness isogenes as possible.
B4	(69)	Two years yield data available.
B5d	(70)	Complete ailelism tests.
f	(71)	Broad based population with early gene homozygous.
g	(72)	Effect on population determined.

Disease Resistance and Control.

C1	(73)	Gene or genes located with trisomics.
	(74)	Crosses to translocations to identify proper translocation for gene transfer.
	(75)	Effect gene transfer into recurrent selection populations.
C2	(76)	Recurrent selection population based on resistance from accumulated minor genes available with yearly increments of improvement.
	(77)	Recurrent selection populations based on accumulated major gene resistance available.
C3	(78)	Narrow-based recurrent selection population of agronomically desirable parents containing identified major genes for resistance available.
	(79)	Improvements on the basic populations each year available for distribution.
C4	(80)	Seedling reaction to several diseases available on entries in international nurseries.
C5	(81)	Some measure of control of barley stripe mosaic in effect for seed moving in international nurseries from country to country.
	(82)	Distribution of agronomically improved genotypes carrying resistance to BSMV.
	(83)	Methods of sero-diagnosis of BSMV comparisons complete.


Present Contract
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1975-76
1976-77
Contract Renewal
1977-78
1978-79
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Nutritional value:
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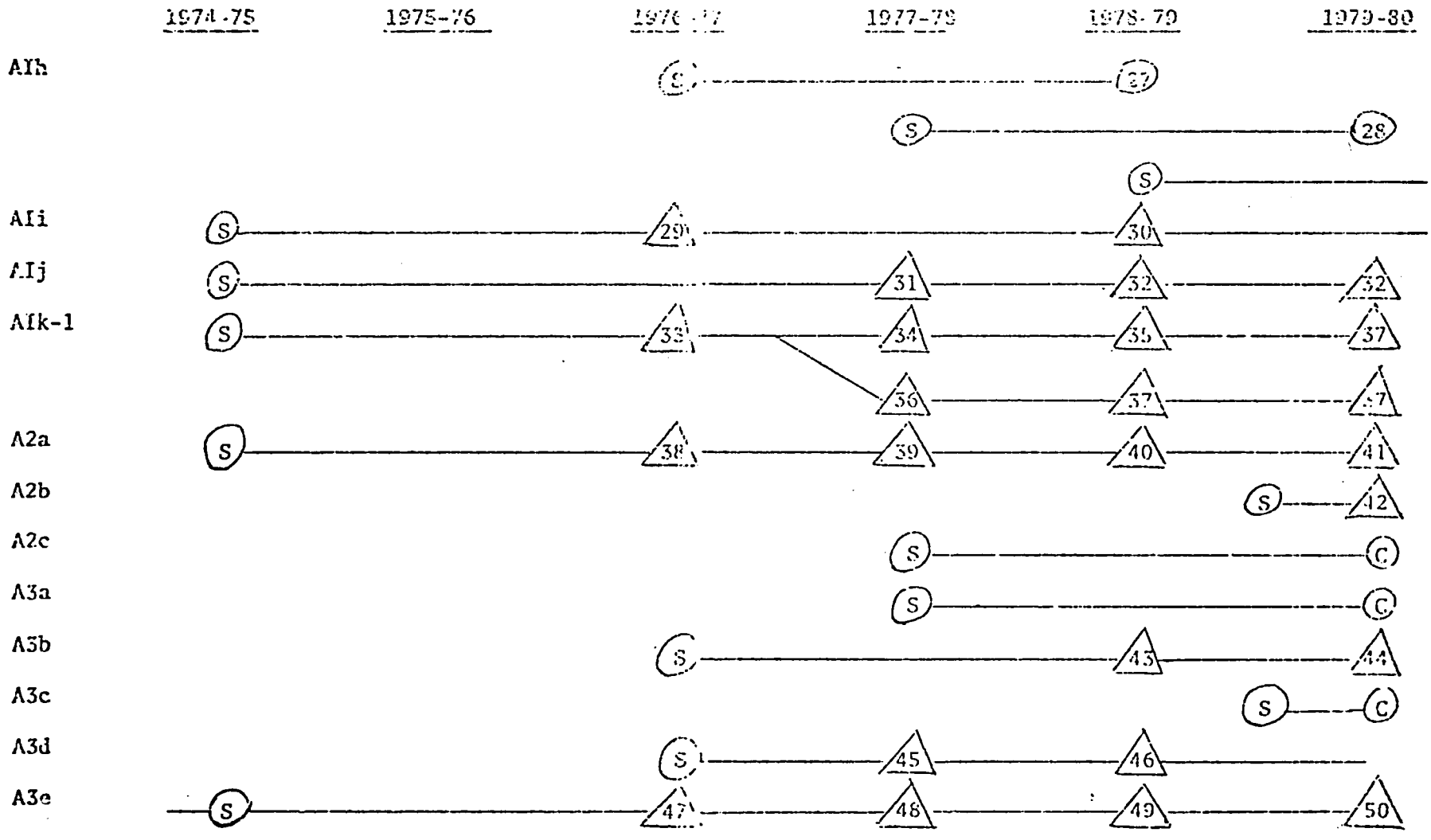
1974-75
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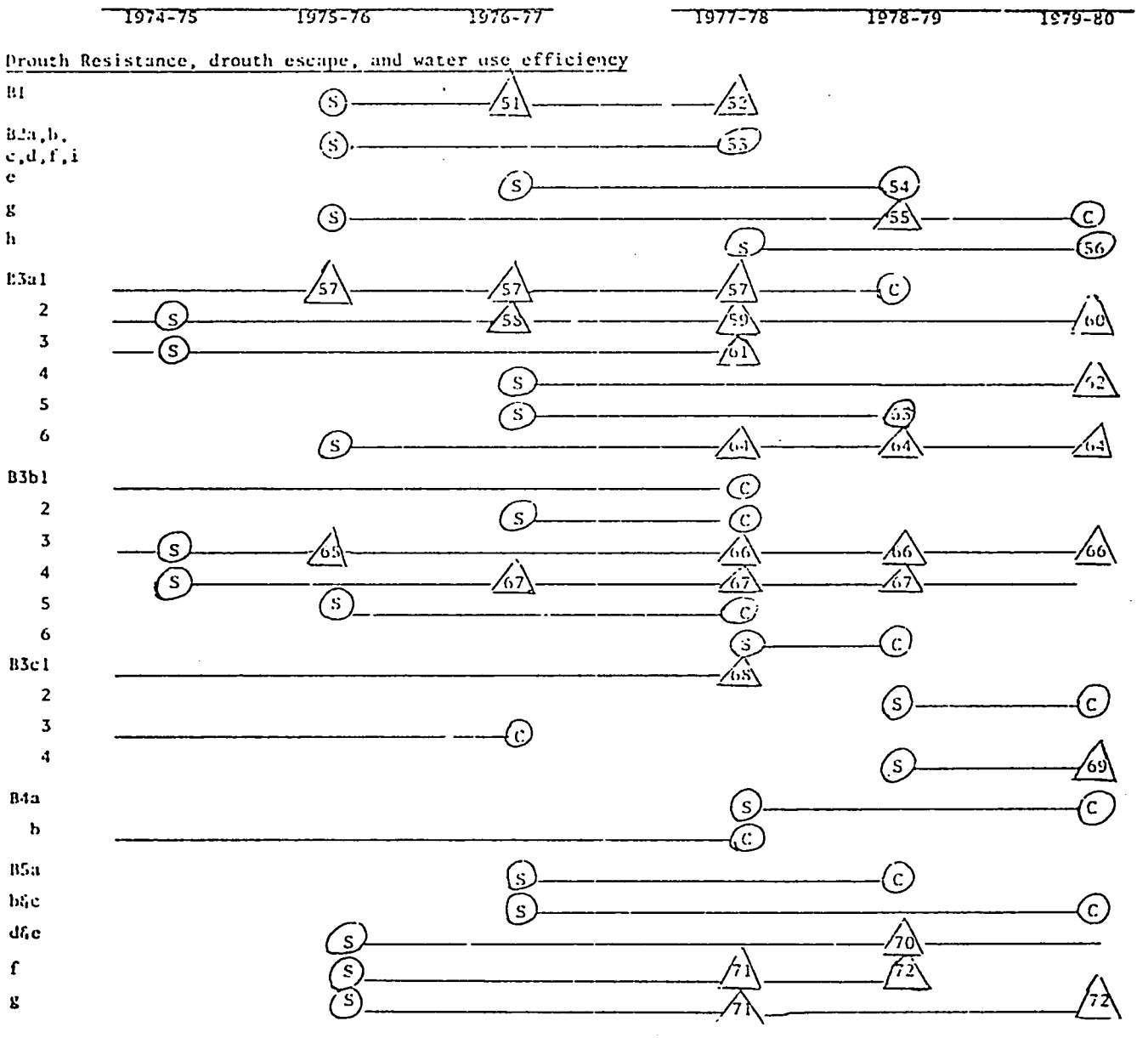
1974-75
1975-76
1976-77
1977-78
1978-79
1979-80
Drouth Resistance, drouth escape, and water use efficiency
B1
B2a,b,c,d,f,i
e
g
h
B3a1
2
3
4
5
6
B3b1
2
3
4
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B3c1
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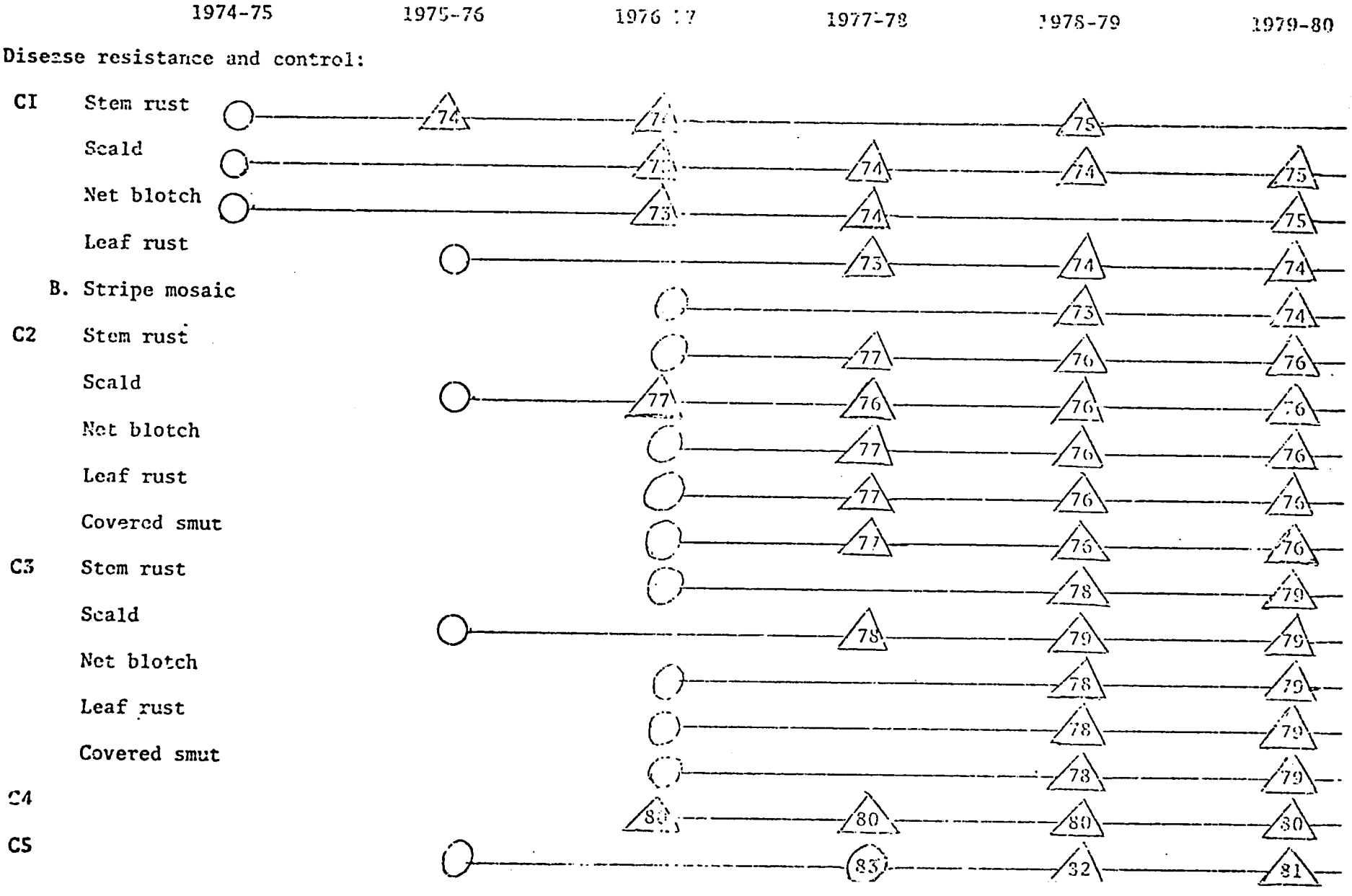
B4a
b
B5a
b&c
d&e
f
g

Disease resistance and control:



I. General Appraisal

The project renewal has been given high priority by the Crop Production Division. The proposal is sound in design and cost estimates are appropriate to the level of effort intended.

A detailed review of the project should be conducted before the end of the first threee year period of operations -- to assess progress and to determine any possible need for redirection.

The contractor has a strong staff with excellent experience in barley breeding in some of the DCs. Equipment needed for the renewal of the project is available with the exception of those items listed in the budget. Field facilities and equipment for breeding nurseries, screening lines and introducing germplasm, conducting agronomic trials, and growing grain for feeding trials are all available at Bozeman and outlying stations.

J. Environmental Considerations

No adverse environmental problems are anticipated from the proposed renewal of this research project, nor from the adoption of the improved germplasm or cultural practices. The main thrust of this project is the breeding of superior protein quality, disease resistant, drought tolerant barley varieties for the DCs.

This activity is not deemed a Major Federal Action (Section 1500.6, CEQ Guideline) because the project will have no significant effects which adversely affect such aspects of the human environment as air, water, land, flora, fauna, and socioeconomic conditions.

The Threshold Decision is negative constituting a negative determination because project activities are restricted to controlled experimentation exclusively for the purpose of research and as such is confined to small areas which are carefully monitored.

K. Budget Information

	77-78	78-79	79-80
Salaries	104,700	112,200	120,200
Benefits	13,300	14,000	14,800
Travel			
Domestic	4,700	5,800	6,900
International	22,000	24,000	26,000
Workshop	38,600	-	-
Equipment	10,200	6,600	-
Materials & Supplies	5,600	5,900	6,200
Publications	1,000	2,000	2,500
Other Costs	5,500	6,000	6,300
Overhead	89,700	94,800	100,300
	295,300	271,300	283,200

Work Months

Category	3 year total Work Months
Professional	9
Post Doctoral	36
Research Assistants	171
Technicians	96
Graduate Assistants	120
Labor	66
TOTAL	498

Equipment

1977-78

1 top loading scale	$600	Obj. A
12 hi-cor quantum sensors	2,480	Obj. B
1 three point hitch, 6 row, automatic Seed Nursery Drill	7,200	Obj. A,B,C
TOTAL	$10,200	

1978-79

12 rat cages for biological value determinations	800	Obj. A
6 net radiometers	3,000	Obj. B
1 infrared thermometer	1,800	Obj. B
1 feed grinder	1,000	Obj. A
TOTAL	6,600	

Montana State University Contribution:

(Professional Staff and time allotted to this contract yearly)	Percent of Time
1. Dr. Jarvis H. Brown, Associate Professor of Agronomy (crop physiology - Obj. B)	.55
2. Dr. Thomas W. Carroll, Professor of Plant Pathology (virologist - Obj. C)	.20
3. Dr. Lark P. Carter, Associate Dean of Agriculture (administration - Obj. A, B, C)	.25

4.	Dr. A. M. El-Negoumy, Professor of Agricultural Biochemistry (Protein Chemistry, Obj. A)	.45
5.	Prof. Robert F. Eslick, Professor of Agronomy (Genetics and Plant Breeding, Obj. A, B, C)	.60
6.	Dr. A. Hayden Ferguson, Professor of Soils (Soil Physicist, Obj. B)	.50
7.	Dr. Eugene A. Hockett, Research Agronomist, USDA, ARS (Genetics and Plant Breeding, Obj. A, B, C)	.40
8.	Dr. Charles F. McGuire, Associate Professor of Agronomy (Cereal Chemistry, Obj. A)	.15
9.	Dr. B. P. Moss, Associate Professor of Animal Nutrition (Animal Nutritionist, Poultry and Dairy, Obj. A)	.20
10.	Dr. C. Walter Newman, Professor of Animal Science (Animal Nutritionist, Swine, Obj. A)	.30
11.	Dr. Eugene L. Sharp, Professor of Plant Pathology and Dept. Head (Plant Pathology, Obj. C)	.20
		4.05

Budget Distribution of Outputs	Percent of Total
Research Objective A (Nutritional Value)	50
Research Objective B (Drought Resistance & Escape, Water Use Efficiency)	30
Research Objective C (Disease Resistance & Control	20

AID 1020-28 (1-72)

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Improvement of the Nutritive Quality and Productivity of Barley for Semiarid Regions - AID/ta-C-1904

Life of Project:
From FY _____ to FY _____
Total U. S. Funding _____
Date Prepared: _____

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. To increase production of high quality food for humans and feed for livestock.	Measures of Goal Achievement: 1. Significant increase in per capita production of barley in developing countries. 2. Improvement of nutritive quality of barley grown in semiarid areas.	1. Official production & population statistics (DC, FAO, Foreign agricultural service estimates). 2. Improvement of nutritional quality serveys in DCs. 3. Import and export statistics from individual DCs.	Assumptions for achieving goal targets: 1. Staffing with highly competent professionals. 2. Active cooperation of national, regional and international agencies. 3. Continuing interest in barley as food for humans and feed for livestock. 4. Nutritional quality can be improved without major constraints on yield.
Project Purpose: To increase the nutritive value and the yield level of barley grown in the semiarid regions and to decrease disease losses and losses caused by lack of drought tolerance.	Conditions that will indicate purpose has been achieved: End of project status. New, superior, resistant varieties available to farmers. Research and development activities in barley effectively taken over by DC agencies and international centers and linked through a communications network.	1. Publications and reports of DC governmental agencies, on-site inspections of seed supply and planted acreages and harvests. 2. On-site inspection and review by AID/W personnel, contractors and consultants.	Assumptions for achieving purpose: 1. Contractor and cooperating groups will find solutions to major constraints. 2. Local extension agencies able & willing to promote improved varieties and practices. 3. DC, regional and international research institutions develop adequate capabilities.
Outputs: 1. Breeding stocks useful for further DC breeding programs. 2. Widely-adapted, stress tolerant varieties suitable for use under marginal conditions. 3. Diverse genetic material and techniques for use in DC's barley improvement programs. 4. Well trained staffs in the DCs. 5. Effective research and informational linkages. 6. Training &technical assistance services	Magnitude of Outputs: 1. At least five superior varieties developed. 2. Minimum of one test located in each major barley growing country. 3. Total of five DC technicians trained at Montana State. 4. Linkages with at least two international centers and at least six DC institutions. 5. Conduct 1 barley breeding workshop.	1. Reports by contractor. 2. Reports by contractor, USAIDs, DCs and cooperators. 3. Same as above. 4. Contractor reports. 5. Communications and reports from DCs, contractor and international and regional agencies.	Assumptions for achieving outputs: 1. Research findings will be availab and DCs will request assistance. 2. DCs will cooperate fully. 3. Interest and resources exist in the DCs. 4. Collaboration of international centers. 5. DCs posssess or are willing to train qualified personnel.
Inputs: 1. AID/W provides financial support and project guidance. 2. Contractor provides qualified personnel, facilities, coordination & training. 3. Participating personnel & cooperation provided by DCs, USAIDs and other U.S. institutions.	Implementation Target (Type and Quantity) 1. AID/W funding approximately $300,000 per contract year. 2. MSU will contribute 50 workmonths of 12 professional staff.	1. AID/W records. 2. Contractor reports and on-site inspections and studies. 3. USAID reports & on-site verification.	Assumptions for providing inputs: 1. AID/W funding will be available. 2. Contractor will have qualified personnel and needed facilities available to the project. 3. DCs, USAIDs, international centers and regional institutions possess the personnel and resources to support barley research.

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Improvement of the Nutritive Quality and Productivity of Barley for Semiarid Regions - AID/ta-C-1904

Life of Project: From FY _____ to FY _____
Total U.S. Funding _____
Date Prepared: _____

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
ram or Sector Goal: The broader objective to this project contributes: increase quantity and nutritional ue of food crops in developing ntries. ncrease production of high quality l for humans and feed for livestock.	Measures of Goal Achievement: 1. Significant increase in per capita production of barley in developing countries. 2. Improvement of nutritive quality of barley grown in semiarid areas.	1. Official production & population statistics (DC, FAO, Foreign agricultural service estimates). 2. Improvement of nutritional quality serveys in DCs. 3. Import and export statistics from individual DCs.	Assumptions for achieving goal targets: 1. Staffing with highly competent professionals. 2. Active cooperation of national, regional and international agencies. 3. Continuing interest in barley as food for humans and feed for livestock. 4. Nutritional quality can be improved without major constraints on yield.
t Purpose: ncrease the nutritive value and the d level of barley grown in the arid regions and to decrease disease es and losses caused by lack of ght tolerance.	Conditions that will indicate purpose has been achieved: End of project status. New, superior, resistant varieties available to farmers. Research and development activities in barley effectively taken over by DC agencies and international centers and linked through a communications network.	1. Publications and reports of DC governmental agencies, on-site inspections of seed supply and planted acreages and harvests. 2. On-site inspection and review by AID/W personnel, contractors and consultants.	Assumptions for achieving purpose: 1. Contractor and cooperating groups will find solutions to major constraints. 2. Local extension agencies able & willing to promote improved varieties and practices. 3. DC, regional and international research institutions develop adequate capabilities.
s: eeding stocks useful for further DC ing programs. dely-adapted, stress tolerant ties suitable for use under nal conditions. verse genetic material and tech- s for use in DC's barley improve- programs. ll trained staffs in the DCs. fective research and informational ges. aining &technical assistance service	Magnitude of Outputs: 1. At least five superior varieties developed. 2. Minimum of one test located in each major barley growing country. 3. Total of five DC technicians trained at Montana State. 4. Linkages with at least two international centers and at least six DC institutions. 5. Conduct 1 barley breeding workshop.	1. Reports by contractor. 2. Reports by contractor, USAIDs, DCs and cooperators. 3. Same as above. 4. Contractor reports. 5. Communications and reports from DCs, contractor and international and regional agencies.	Assumptions for achieving outputs: 1. Research findings will be available and DCs will request assistance. 2. DCs will cooperate fully. 3. Interest and resources exist in the DCs. 4. Collaboration of international centers. 5. DCs posssess or are willing to train qualified personnel.
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