BIBLIOGRAPHIC DATA SHEET

1. CONTROL NUMBER: PN-AAH-764

2. SUBJECT CLASSIFICATION (695): AH20-0110-0000

3. TITLE AND SUBTITLE (240)

Control of barley diseases for lesser developed countries of the world; annual report, 1978/1979

4. PERSONAL AUTHORS (100)

5. CORPORATE AUTHORS (101)

Montana State Univ. Plant Pathology Dept.

6. DOCUMENT DATE (110): 1979

7. NUMBER OF PAGES (120): 40p.

8. ARC NUMBER (170): 633.16.M764b-78/79

9. REFERENCE ORGANIZATION (130)

Montana

10. SUPPLEMENTARY NOTES (500)

11. ABSTRACT (950)

12. DESCRIPTORS (920)

Barley
Developing countries
Germplasm
Plant breeding
Crop diseases and pests
Plant pathology
Research

13. PROJECT NUMBER (150): 931131800

14. CONTRACT NO.(140): AID/DSAN-C-0024

15. CONTRACT TYPE (140)

16. TYPE OF DOCUMENT (160)

AID 590-7 (10-79)

633.16
M764b
1978/1979

PN-AAH-76

ANNUAL REPORT on Control of Barley Diseases for Lesser Developed Countries of the World

August 1, 1978—August 1, 1979
Report No. 1—Annual Report
Contract No. AID/DSAN-C-0024
Agency for International Development
Department of State
Washington, D. C.

ANNUAL REPORT

on

CONTROL OF BARLEY DISEASES FOR LESSER DEVELOPED COUNTRIES OF THE WORLD

August 1, 1978 - August 1, 1979

Report No. 1

NOT FOR PUBLICATION

Prepared by:

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Contract No. AID/ DSAN-C-0024

Submitted to:

Agency for International Development
Department of State
Washington, D. C.

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Narrative Summary

In August of 1978, a new contract with the U. S. Agency for International Development and Montana State University was finalized to decrease losses caused by the major diseases of barley particularly in the developing countries. Development under this contract includes a number of facets. First, it was necessary to know the major diseases of barley in the target areas. This information was obtained largely by on-site visits, workshops and discussions with plant pathologists in the area. Several of our people have visited the Middle East area and have become familiar with problems of barley culture. It is also necessary to know the races or strains of pathogens in the target areas and to this end a number of disease isolates have been collected and are used in our evaluation programs in the Plant Pathology Department. These isolates of the different pathogens have been used for identifying genes for resistance in the barley cultivars. Different resistant sources to specific diseases have been sought among the world barley collection and based upon reports in the literature where a specific barley cultivar has been reported to be resistant at some time or place to a specific disease organism.

Other fundamental information is necessary before the resistant sources can be effectively utilized. This includes determining best artificial medium for spore production, best mass inoculation methods and criteria for disease evaluations.

After the fundamental studies have been completed it is possible to effectively utilize the information for developing germ plasm. Male sterile facilitated recurrent selection populations have been used for pyramiding genes for resistance to specific diseases. A base of 15 barley cultivars is used for each 2 row and 6 row barley. The entries used as bases were selected to represent diverse but widely adapted types. The different resistant sources are then crossed into this base population utilizing male sterility. In the case of minor gene accumulation it is believed that additive gene action for greater resistance can be selected from recombinations within the original base population. Each cycle of recurrent selection consists of two parts: (1) selection for disease resistance and (2) recombination. The disease nurseries are grown at several locations in the U. S. as well as in the semi-arid areas of the Middle East and S. Korea. Seed from resistant plants in the nurseries is returned for further recycling in the RSP's. The recombination portion of the cycle consists of growing the resistant portions of the populations in Arizona during the winter and then harvesting only from male-sterile plants thus assuring recombination. By this method we can easily obtain 30,000 or more seeds developed through recombinations. This is a huge amount of recombination at relatively little cost. Each cycle of recurrent selection requires one year. Although recurrent selection populations have been assembled for seven different diseases of barley, three (scald, net blotch and xanthomonas streak) are receiving major emphasis. We have close working relations with CIMMYT and ICARDA and evaluate their crossing block materials each year for several diseases as well as furnishing resistant stocks for their programs.

In addition to development of resistant germ plasm in barley a training program in barley diseases and associated breeding is being conducted. This past year 5 trainees from four different LDC's participated and 3 foreign graduate students are also being supported by the barley-AID program. One of our graduates (M.S. degree) has also been hired as a plant pathologist in cereal diseases with ICARDA at Aleppo, Syria. Details on the various aspects mentioned in this summary are presented in the following sections.

Project Objectives

(a) Different sources of resistance to the major diseases of barley and lineage 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) Resistances to different specific diseases will be combined into barley stocks.

(d) Assistance will be given in establishment of serodiagnosis 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.

Accomplishments to Date

(a) Different sources of resistance can only be identified by utilizing isolates with a wide spectrum of virulence. This has been an important consideration in this project. Thus isolates of specific diseases have been collected from many locations in many countries and used for screening potentially resistant barley lines. Earlier, two and three resistant genes effective against scald and net blotch, respectively, were located by trisomic analysis. In examination of more than 50 isolates of the net blotch fungus, (Pyrenophora teres), using 15 barley cultivars as host differentials, nine virulence types were recognized. Isolates from Montana formed four virulence groups and those from the Middle East, five. (Tables 1 and 2). Evaluation of more than 170 barley cultivars from the USDA world collection and reported resistant sources, revealed 9 barley lines which were resistant to all 9 virulence groups. Fifteen barley lines were resistant to eight of nine virulence groups. (Table 3). Genetic analysis showed that several barley lines contained more than one gene for resistance. (Table 4). At least 6 different genes conditioning reaction to net blotch were indicated in these studies.

Particularly interesting were some studies in which susceptible barley parents were crossed and some resistant progeny appeared in the F_2 (Table 5). This strengthens our belief that minor gene resistance can be obtained by recombination within a base population containing only susceptible plants. Many isolates of Rhynchosporium secalis (Scald) have also been obtained from several countries and used for detecting resistance. The generally known Rh genes have been incorporated into the RSP's as well as other unknown factors for resistance.

In work with the bacterial pathogens, more than 100 isolates of Xanthomonas translucens (bacterial streak) from 3 countries and 3 states were classified into 3 virulence types on the basis of reaction on 15 differential lines of barley. Screening of more than 600 barley lines with these virulence types indicated that about 100 had some resistance to Xanthomonas. Additionally about 400 isolates of Pseudomonas blight have been collected from 8 countries and 4 states.

Within the virus diseases considerable fundamental work is under way which should lead to more effective utilization of genes for tolerance or resistance. (Table 6). The yd_2 gene has been the mainstay for tolerance to barley yellow dwarf virus BYDV but the associated background has major influence on its effectiveness. Another recognized gene for tolerance (yd_1) is weakly effective by itself but may augment the effects of yd_2. Trials are underway to test this hypothesis. The cytoplasmic influence is also unknown and reciprocal crosses of cultivars containing yd_2 with a marked black hulless should furnish information on this aspect. Tolerance is also being evaluated from crosses between yd_2 sources and early and late maturing barleys to determine the effect of growth rate on tolerance. Additionally, a number of Ethiopian barley and others reported to have tolerance to BYDV were planted for seed increase prior to evaluation. Some of the above increased seed will be incorporated into the barley breeding program in South Korea.

Two composite cross populations, CCXXXIIIA and CCXXXIIIB, developed by Rex K. Thompson of Mesa, Arizona were received for evaluation. These populations were developed mainly for BYDV tolerance and short stiff straw. In successful BYDV nurseries at Bozeman, MT. and Pullman, WA the symptomatic plants were rogued. Seed from these tolerant plants will be sent overseas to ICARDA for evaluation in that area. Attempts are also underway to accumulate minor genes for BYDV tolerance in separate RSP base populations of 2 row and 6 row barley not containing the yd_2 gene.

A limited amount of work is underway on root rots of barley. The work on this project is conducted primarily by Mr. William Grey, a graduate student in Plant Pathology who is working on a Master's degree. The project has several goals including identification of pathogens involved in barley root rot in the Middle East, development of procedures to screen barley lines and selections for resistance to root rot, and evaluations and selections of barley germplasm for resistance to root rot.

I. Identification of pathogen involved: Barley plants showing symptoms of root rot have been collected by various staff members in several Middle East countries, Tunisia, Turkey & Syria to date, the main pathogens which have been isolated are Fusarium graminearum, Fusarium culmorum, and Helminthosporium sativum.

II. Procedures for screening for resistance: Field plots were established at Bozeman, Montana to evaluate various methods of inoculating plants and/or plots with Fusarium graminearum and/or Helminthosporium sativum. The following methods were used:

(1) Soaking the seed in a conidial suspension followed by seeding within 24 hours.

(2) growing the pathogen on autoclaved oat kernels which are dried, packaged and added to the seed furrow simultaneously with the seed.

(3) same procedure as above except that the pathogen is grown on sterile wheat straw.

(4) Oatkernel technique similar to above procedures but with the addition of soil above the seed and inoculum to simulate deep planting.

These four techniques were used to inoculate four barley lines believed to differ in susceptibility to root rot. Two seeding dates and four replications were planted in inoculated versus non-inoculated paired rows. Stand counts were made shortly after emergence. During the growing season visual observation on growth of the barley plants was made with the hope of identifying subtle above ground symptoms to a root problem. At maturity, a 60 cm section of the plot row was pulled with roots intact. The plants were evaluated for severity of crown discoloration, number of tillers per plant and yield. The remainder of the plot was cut and threshed for yield. The data is not yet available.

III. Cooperating with the Barley Scald and Net blotch resistance program, individual lines were evaluated for root rot susceptibility. Root rot sites in Montana have been observed this summer for their potential use in screening barley lines as an alternative to artificial inoculum. It was also at this time that techniques were explored to assess the yield loss caused by cereal root rots. Two sets of data are not yet available on yield in fumigated versus non-fumigated plots nor from survey work.

Mr. Grey is developing techniques which an investigator might employ when dealing with a root rot problem. The impact on yield loss and the establishment of a standard inoculation procedure will aid the plant breeder in his effort towards increasing the level of resistance to cereal root rots.

A minor effort in this contract also involves powdery mildew of barley.

Composite cross populations can provide an effective method of conserving genetic variability. Genes for powdery mildew resistance carried by the parents of these populations can be identified through the use of specific races of E. graminis f.sp. hordei and their frequencies can be monitored from generation to generation in each population.

Several samples of early, intermediate and late generations of six different composite cross populations (CC 1, 2, 4, 5, 12) were planted this year at the experimental station in Huntley for test of their germinative ability and for seed increase. Arrangements have been made to receive seed of the most recent generations from California.

In Bozeman, different isolates of the pathogen, collected all over Montana, are conserved as pure cultures, which will be identified and tested on the barley populations.

Techniques are being developed for the inoculation and preservation of the fungus population.

Some trials have been set up to build new populations of barley by means of male gametocides. The first product tested is Ethrel and it might be a useful tool in a breeding program.

(b) Male sterile facilitated recurrent selection populations (RSP's) have been assembled for seven different diseases in six row barley and are in various stages of development. In two row barley, RSP's have been initiated with three diseases. The base varieties for the six row and two row RSP's are shown in Tables 7 and 8. The various RSP's and their present status of development follows.

1. RSP-5 Rrs: 6 row scald resistant

This is the most advanced population and is presently in the fourth cycle of recurrent selection. The population is highly resistant under Montana conditions. Two years of selection have been performed in California which has high levels of scald and a broad spectrum of virulence types. This past year approximately one-third of the plants showed resistance at Davis, California. Seed from resistant plants has also been received from RSP nurseries in Georgia, Maryland, Turkey, Tunisia and Korea.

2. RSP-4 Rrs: 2 row scald resistant

This population was first assembled in 1979 and resistant plants were selected at Bozeman (20% resistance).

3. RSP-4 Rrs minor: 2-row minor gene scald resistant

This RSP is in the first cycle and selected at Bozeman. It consists solely of the 2-row base varieties which are susceptible to scald. "less" susceptible plants have been selected in an attempt to accumulate small-effect genes for resistance. Further recombination and selection should result in effective resistance.

4. RSP-5 Rpt: 6-row net blotch resistant

This RSP is presently in the second cycle. Additional resistant germ plasms were added in 1979. Seed of resistant selections has been returned from nurseries in California, Tunisia, Korea and Morocco.

5. RSP-4 Rpt: 2-row net blotch resistant

Newly assembled in 1979, this population was screened at Bozeman (67% resistance).

6. RSP-4 Rpt minor - 2-row minor gene net blotch resistant. Identical to RSP-4 Rrs minor

7. RSP-5 Rph: 6 row leaf rust resistance

This population is in the first cycle and has been selected in Morocco, Egypt and Texas. It is planned to extend work on this disease as it is considered to be a major factor reducing barley production in many areas of the Middle East. Additional sources of resistance will be identified and incorporated in the RSP.

8. RSP-4 Rph: 2 row leaf rust resistant

This population is newly assembled and unselected.

9. RSP-5 Rxt: 6 row Xanthomonas resistant

This population is in the second cycle and has been selected at Bozeman and Sidney and as seedlings in the greenhouse. Additional resistance sources are needed and will be incorporated as identified.

10. RSP-5 Rps: 6 row Pseudomonas resistant

This population is in the second cycle and has been selected in the seedling stage at Bozeman. Additional resistant sources are required.

11. RSP-5 Ruh: 6 row covered smut resistant

This population is in the second cycle and has been selected four times at Bozeman. We have also selected for resistance in composite cross 30-F six times. Assessment of progress is difficult because a number of escapes occur with the partial vacuum method of inoculation. In many areas of the Middle East chemical control is not feasible due to cultural and other factors. Thus this population will be continued, even with the "escape" problems. Little effort is required to inoculate and select resistant plants.

12. RSP-5 RPG: 6 row stem rust resistant

We are presently in the third cycle of recurrent selection with this population. Selection has been done at Bozeman in the stem rust nursery. However, we have found no other location in the semi-arid areas of the Middle East where stem rust is a significant problem. Work on this population will be downgraded and possibly discontinued.

It is obvious that RSP's have been established for a number of diseases. Emphasis is being placed on a few diseases such as scald, net blotch and leaf rust, virus diseases and Xanthomonas. The others are receiving more limited input but it is deemed important that they not be completely disregarded. Plant diseases are dynamic and constant vigilance is required. A disease of minor importance at present may become a major consideration later; particularly as competitive disease organisms are controlled.

In 1978-79 RSP disease nurseries were at the following locations: Bozeman, Fairfield, Ft. Benton and Sidney, Montana; Georgia; California; Texas; Mexico; Korea; Morocco; Tunisia; Egypt; Syria; Turkey and Kenya. Seed from resistant plants has not yet been received back from all of these nurseries due to various reasons. We rely on natural infection at the outlying locations and sometimes insufficient disease develops for meaningful ratings. As our outreach program expands through the training program in barley diseases we expect to obtain higher success ratios on this aspect.

Tables 9 to 18 illustrate the resistant sources which have been identified for the different specific diseases and that have been incorporated into the RSP's. In many cases we do not yet know if these different sources of resistance are due to different resistance genes but continual investigations are being made to clarify the situation.

Agronomic Improvement of disease Resistant Recurrent Selection Populations

As initially stated, one of the objectives of this project is to improve the Agronomic characteristics of the disease resistant male sterile facilitated recurrent selection populations. The purpose being to increase the probability of a plant breeder selecting successful lines from these populations.

This improvement should not begin until the disease resistant genes are well established throughout the population in order to not eliminate any disease resistant genes through genetic drift.

A second chance for elimination of desirable, or included genotypes can occur if the number of plants selected to continue a population is too small. We have used "500 gr. of seed" as our minimum population size to move from one generation to the next. This amount should vary in number from 12,000-15,000 seed or genotypes.

The recurrent selection populations under this program were typically established with 15 selected parental varieties. To incorporate the disease resistant genes it was necessary to introduce a number of undesirable genes. Introduction of the disease resistant sources also introduced the two row gene into basically a six-row genetic background. We have shown, in our isogenic work, that a six-row genetic background is not a desirable background for the two row gene. Also that the 6-row genotype vvii is much inferior to the 6-row vvII genotype. The former is recognized by pedicelled lateral kernels and the latter by the sessile lateral kernels. The sessile condition is recessive and thus one accurate classification can eliminate the vvii genotypes from the population. Our work with isogenics also confirms the work of others that the smooth awn rr gene is not desirable from the standpoint of yield.

At this point in time only the Rsp 5 Rrs scald resistant population is considered sufficiently advanced to begin agronomic improvement. During this past year early maturing spikes were selected from this population in Arizona planted at Bozeman. Screening for scald resistance was repeated, the remaining population was pulled and all black and purple seed types, all two row, VV and Vv, genotypes, and all pedicelled lateral plants were eliminated from the population. The population was divided into hulless, nn, and covered, NN and Nn, populations. These two populations will be grown in Arizona, winter 79-80, and only male steriles harvested.

The above procedure will be followed with the net blotch resistant population, Rsp 5 Rpt, starting this spring.

Pending the advancement in generation of these populations we have been exploring methods of increasing yields, particularly of early populations on dryland. Management variables have included:

1. selection for early heading
2. selection for shortened period from heading to maturity
3. sieving for large seed when
   a. grown under severe drouth stress
   b. grown at exceptionally high rates of seeding (IDX).

We are also evaluating a number of maturity isogenics for physiological responses to the environment (15) as exposed by yields and yield components. Using six maturity isotypes in the 6-row variety Titan it appears that selection for seed per spike, in an environment limiting seed no. per spike would be the most genetically effective means of increasing yields in the early isotype. The other yield components are more under environmental influences.

An accurate, rapid method for free proline determinations has been developed during the past year and we are attempting to determine if free proline in the seed is in any way related to the stress a seed is under at the filling stage. This may be expressed as observed seed weight when grown under stress divided by the genetic potential for seed weight (defined as maximum seed weight observed, presumably under non-stress conditions as the seed fills).

We have also determined that, in certain environments, early isotypes do not deplete soil moisture to as great a depth as late isotypes.

Work will continue on methods of agronomically improving the recurrent selection populations.

(c) In general, the RSP's for resistance to specific diseases have not yet been developed to the stage where combined resistances in one population are possible. The scald population is furthest along in development and incorporation with resistance to net blotch can probably be initiated in the not too distant future. Additionally, RSP's developed for resistance to a specific disease are sometimes quite heavily attacked by another disease of barley. Whenever this occurs within a disease nursery we obtain readings and selections on the disease that is prevalent. Thus the scald RSP, for example, has also had some selection for powdery mildew and leaf rust resistance.

(d) It was originally proposed that our virologist, Dr. Carroll, assist the International Agricultural Organizations CIMMYT and ICARDA in establishment of seradiagnosis programs for detection of barley stripe mosaic virus, BSMV, in different barley stocks. BSMV is a seed transmitted virus and can be readily detected in barley embryos and thus can be controlled by a seed testing and virus-free certification program. Although CIMMYT and ICARDA are concerned about BSMV, for the present they are unable to furnish personnel for such a program. In lieu of this we have evaluated each year their regional crossing block nurseries and other elite lines for the presence of BSMV. Invitations have also been extended to survey and identify virus diseases in many of the LDC's. During yearly trips to the Middle East barley plants exhibiting virus-like symptoms have been collected and later identified. BYDV and BSMV have been identified from several countries. Until such time as ICARDA and/or CIMMYT decide to develop a control program for BSMV, it is recommended the regional crossing block nurseries continue to be planted at Bozeman for the purpose of checking for seedborne BSMV. The procedure would entail roguing symptomatic plants, and assaying specified seed and/or seedlings. Virus-free seed from known infected entries would be returned to the respective international organization.

In 1979, the combined crossing block nursery from CIMMYT & ICARDA consisted of 229 barley entries. These were evaluated for BSMV and aphid transmitted BYDV. To date, only BSMV infections have been recorded. Six entries had confirmed infections with BSMV.

(e) If a pathogen induced toxin could be obtained which would correspond to reactions obtained with the pathogen, this would greatly speed-up and enhance screening for disease resistance. Current emphasis is now on isolating toxin from Pyrenophora graminea - the causal agent of the Helminthosporium stripe disease of barley. Although amenable to control by chemical seed treatment, this disease is widely prevalent throughout the Middle East and S. Korea. It generally produces few spores in culture so a useable toxic solution may circumvent this problem.

Several monospore isolates from barley showing stripe symptoms have been obtained from Korea and the Middle East. Simple broth cultures have generally been better standardized and suited for toxin isolation. Preliminary studies into the possible effect of light temperature and humidity during the cultivation of the fungus have been conducted to determine possible change in toxin production. Cultures held at a temperature of about 20°C have consistently produced more toxicity than those at 13°C. This may correlate with the observation that the appearance of the disease symptoms is favored by a change from low to high temperature although initial infection is favored by realtively low temperature (10-16°C). Initial investigations into the accumulation of toxin(s) in the culture filtrate with regard to age of the culture have commenced. Present data support harvest of the culture between 10-18 days after inoculation of the medium.

Establishment of an appropriate assay system for phytotoxicity

has progressed from initial screening for inhibition of seed germination to various methods and location of inoculating excised leaves or intact seedlings (one-leaf stage) have shown the greatest differential between symptoms produced by culture filtrates and controls.

Nothing can be reported at this time on the lowest effective concentration or dosage to produce typical disease symptoms. Some preparations have exhibited differential activity among the cultivars following the relationship to disease susceptibility quite well, others poorly. To date, the fractionation procedure includes acetone precipitation of protein, subsequent concentration, followed by chloroform extraction. The remaining aqueous phase has exhibited the best activities (tip necrosis in excised leaves within 8 hrs.) thus far obtained.

Demonstration of toxic activity within the diseased plant has not been approached, but would be considered following standardization of the assay system and isolation procedure. Nor has any attempt been made to determine the relative pathogenicities of the various isolates and thus correlate the degree of toxin production *in vitro* with the pathogenic nature of the isolates. In regard to the various isolates; however, a great difference in growth rates, colony morphology, pigment production, and degree of sporulation exists. Some isolates may be *P. teres* rather than *P. graminea*. Use of the recently reported method to induce sporulation in culture would allow for the testing of a cultures capacity for leaf infection thus possibly firmly establishing its identity.

Outreach Program

Central to our outreach program and dissemination of results on decreasing losses from barley diseases are the annual trips to the Middle East to evaluate the various RSP disease nurseries and discuss problems and progress with scientific personnel in the various countries. In April - May of this year, Sands and Sharp made the trip and the report is included in the appendix. We cooperate closely with CIMMYT and ICARDA. During the winter of 1978-79 entries in the barley nurseries distributed from the above were tested for seedling reactions to scald and net blotch. This information was returned to CIMMYT and ICARDA in early 1979. A brief summary of the results is shown in Table 19. See also appendix for copies of letter received.

In December of 1978, three members of our department - T. W. Carroll, A. L. Scharen and E. L. Sharp met with ICARDA personnel in London to develop a plan of work and set priorities for diseases of cereals. About 8 other plant pathologists and plant breeders from other countries were invited to this 4 day meeting. A resolution coming out of the meeting that a barley breeder be hired and stationed at ICARDA headquarters, Aleppo, Syria has since become a reality. Dr. Sands of our department was recently invited to Mexico (CIMMYT) to advise on bacterial problems and show how their various plots could be evaluated for bacterial diseases. Additionally, he has developed a simple assay system for determining free lysine in barley. In our laboratory 7700 mutants were compared in a period of 3 weeks. The assay kit has been sent to ICARDA (Aleppo) and to Turkey. Kits will also be sent to workers in Egypt and to CIMMYT (El Batan).

One of our graduates in Plant Pathology, Michael Bjarko, completed his M.S. degree work in March, 1979 and initiated work as a plant pathologist with ICARDA (Aleppo) in April. Among other duties he will work with the barley breeder in disease work.

During the past year the following people visited the department primarily in relation to barley diseases.

Santiago Fuentes----------CIMMYT - Mexico

Enrique Torres----------CIMMYT - Mexico

L. W. Briggle----------SEA West Beltsville, MD

Robert L. Jackson----------AID Washington

Robert Morrow----------AID Washington

G. W. Bruehl----------Washington State University

Aristed Acosta----------Mexico

R. G. Timian----------North Dakota University

Training Program

Under the training portion of this program 3 graduate students and 4 trainees from the LDC's were accommodated this first year. One of the original graduate students (GRA) had problems from an academic standpoint and was moved into a training schedule. The GRA's and trainees participating this last year were as follows:

GRA's from LDC's

Guy De Smet----------Morocco

Hee Kyu Kim----------S. Korea

Trainees

Elias Elias----------Syria

Omar Jarikji----------Syria

Kyung Soo Min----------S. Korea

Ashok Srivastava----------India

Bertan Suzen----------Turkey

The GRA's were assigned thesis problems with barley diseases and were otherwise accommodated as any other graduate student. The trainees were generally here for a 3 month period from June 15 to September 15 which covered disease development on barley in the field. One of the trainees, Kyung Soo Min, spent 3 months working with barley RSP populations at Tuscon, Arizona before coming to Bozeman. The trainees had opportunity to work with all the major diseases of barley from a laboratory and field standpoint. This included diseases caused by fungi, bacteria and virus with some supplemental instruction on nematodes. They were given mini courses in each of these subject areas, followed by a written examination. The main emphasis, of course, was with a "hands-on" approach in field work. The training included isolation and identification of pathogens, inoculation of artificial medium and host plants (including mass field scale), evaluation of various diseases and selection of the best appearing resistant plants. Additionally, they became familiar with use of RSP's and the associated recombination through use of male sterility. All trainees prior to departure received a certificate verifying participation in a training period on barley diseases and associated plant breeding. As an example of a mini-course offering, an outline of information presented in Plant Virology is given below.

PLANT VIROLOGY

Mini - Course

Dr. Carroll

LECTURE TOPICS LIST

Summer, 1979

1. History and scope of plant virology
2. Symptomatology
3. Nature of plant viruses
4. Some plant viruses and their names, virus nomenclature
5. Experimental transmission: mechanical inoculation, graft and dodder transmission
6. Transmission by vectors and in other natural ways
7. Effects of viruses on plants: pathological anatomy, histology, cytology, and physiology
8. Movement of viruses in plants: cell-to-cell movement; long distance movement
9. Diagnosis: Methods of detection, symptoms, transmission, host range, routine sap tests, serology, light microscopy and electron microscopy
10. Virus ecology
11. Ways of preventing crop losses
12. Virus diseases of cereals

9/12/79

The training of Barley Breeding associated with plant pathology conducted by Plant pathology Department of S. U. Bozeman is really very appreciated. Dr. E. L. Sharp, Dr. J.L. Seharen, Dr. T. W. Correl & Dr. D. Sand planned this training programme in a very nice manner. We all learned well & benefitted by this training. They used to illustrate all theoretical backgrounds of Breeding & diseases of crops by delivering Lectures to us, then take us to field for practical observations, we used to bring disease samples to Laboratory for culture & study. We also used to do inoculations of spores (diseases) to crops in green houses & experimental fields, thus we get a very practical knowledge of Breeding & disease cycle.

Three months training period is quite reasonable because we observe all the stages of a crop.

I think this training programme is essential for those fresh candidates which are going to start their Carrier in Agricultural Experiment station.

Ashok Srivastava
Barley trainee
INDIA

Montana-AID Barley Project 931-1318

Middle East Trip Report

April 10 - May 9, 1979

E. L. Sharp & D. C. Sands

Project Title: Control of Barley Diseases for LDC's of the World

Purpose of trip:

1. Evaluate barley disease nurseries in Morocco, Tunisia, Egypt, Syria & Turkey.

2. Obtain isolates of various barley disease organisms in the above countries to facilitate incorporation of resistance to diseases in the target areas.

3. Renew contacts and extend cooperation with participating countries.

4. Arrange for obtaining barley disease resistant germplasm from Israel and review pertinent research on barley.

Organizations & persons contacted:

Morocco:

Lawrence "Tex" Ford - AID Agricultural Officer, Rabat

Lynn Gallagher - Agronomist with Minnesota-AID program, Rabat

M. Wassef - Plant breeder & field foreman, Directorate for Agronomic Research, Rabat

Directors of research stations:
Jemaat Sieme Station, Marrakech Station, Tadla Station, Merchouch Station

Tunisia:

John Fliggenger, AID Agricultural Officer, Tunis

Mouffak Tasaad, Director General, Office of Cereals, Tunis

A. Daaloul, Director, Institute of Grandes Cultures, El Kef

M. Harrabi - Cereal breeder

H. Halila - Soil fertility

M. Bouslama - Legume breeding

Egypt:

E. E. Saair - CIMMYT pathologist

Abdul Hak - Professor, Plant Pathology - Giza

Rashadi Abdo - barley breeder

A. Bassoiouni - pathologist, Sakha Station

A. Gacida - wheat breeder, Sakha Station

Syria:

H. Darling, O. Brough, Administrators, ICARDA, Aleppo

J. Srivastava - Director, Cereals Section, ICARDA

M. Mekni - Barley breeder, ICARDA

A. Kamel and M. Bjarko - Pathologists, ICARDA

I. Nagi - Agronomist, ICARDA

Turkey:

J. M. Prescott, CIMMYT pathologist, Ankara

Ayhan Antepliogla, General Director, Agricultural Research Institute Ankara

Basri Devioglu - Director Cereals Branch, Agricultural Research Institute, Ankara

T. Ergun - Cereal Pathology & Breeding, Agricultural Research Institute, Ankara

B. Suzen - Cereal Pathologist - Breeder, Eskisihir

M. Enginel - Cereal Breeder, Eskisihir

K. Temiz - Director of Research Station, Izmir

F. Dimirkan - Barley Breeder, Izmir

C. Dutlu - Cereal Pathologist, Izmir

Israel:

A. Blum - Head, Plant Protection, Volcani Institute, Tel Aviv

Z. Amitae- Cereal Pathologist, Volcani Institute

A. Grama - Cereal Breeder, Volcani Institute

Ms. Volcani - Bacteriologist, Volcani Institute

I. Wahl - Head, Plant Pathology Department - University of Tel Aviv

Z. Eyal - Cereal Pathologist, Department of Plant Pathology, University of Tel Aviv

I. Barash - Pathologist, Department of Plant Pathology, University of Tel Aviv

Accomplishments and Impressions

Morocco:

We arrived in Rabat in the afternoon of April 11 and were shortly thereafter contacted by Lynn Gallagher. In the afternoon we went to the barley plots at the research station there and began tagging of desirable plants in the net blotch and scald recurrent selection populations, (RSP's). The following day we completed our work there and met with Tex Ford, the AID officer. He set up a time to meet with us again after visiting other barley locations in Morocco. At Rabat, it had been quite dry but the following diseases were noted in the nurseries: scald, net blotch, powdery mildew, leaf rust, helminthosporium stripe, covered smut and barley yellow dwarf virus plus a ringspot disease which we couldn't identify. The most disease was noted in other plots outside the RSP's.

On April 13 we departed with Gallagher for Marakech where we stopped several times to survey barley fields and also the research station at Jemaat Sieme. At this station, leaf rust and net blotch were particularly severe in spite of relatively dry conditions. Evaluations were made to identify barley lines or cultivars having some resistance. On April 14 we visited the Marakech research station. Barley was suffering from drought conditions but there was still plentiful net blotch and adequate disease evaluations could be made. That night we stayed in Beni Melal and the following day we surveyed several barley fields and the Tadla and Merchouch research stations before returning to Rabat. Leaf rust, net blotch and scald were the main diseases noted. On the evening of April 15 we met again with Tex Ford and discussed our impressions of barley problems in Morocco and also discussed a proposed $5-6 million AID dryland project for Morocco and the need for trained personnel and opportunities with AID. There is some question about the feasibility of training and courses in the U.S. for Moroccans followed by thesis work and granting of degrees in Morocco.

Tunisia:

Arrived in Tunis at 1630 on April 16 and we were met at the airport by Moncef Harrabi, (who will be coming to Montana State University in September, 1979 as a PhD candidate), H. Halila and M. Bouslama. That evening A. Ghodbane (INAT) was waiting for us at our hotel. On April 17 we traveled by car to Le Kef with the three mentioned above and surveyed several barley fields enroute. Le Kef contains a 2 year college for students in agriculture. At Le Kef we visited with the Director, A.

Daaloul, visited the experimental plots and both Sands and I gave informal seminars on our research with barley. On April 18, we drove to Kairouan with M. Harrabi surveying several farmer's fields of barley and research plots. A farmer about 30 km. south of Tunis requested that we diagnose a problem in his barley. The barley was badly infested with hessian fly; many tillers contained at least 3 pupae. The most prevalent diseases on barley were net blotch, helminthosporium stripe, covered smut, root rots and barley yellow dwarf virus. On April 19, we visited some of the teaching and research laboratories at INAT and INRAT and met with John Fliggenger, AID agricultural officer.

Egypt:

On April 20, we arrived in Cairo, were met by a CIMMYT representative and then taken to the CIMMYT-Ford Foundation guest house in Garden City. The following day we discussed barley culture and diseases with Professor A. Hak and Rashadi Abdo, barley breeder. On April 22, we went to the Sakha Experiment Station where we evaluated the RSP's and other barley nurseries. The staff there had done a good job in tagging resistant plants within both the net blotch and leaf rust RSP populations. Rashadi Abdo is a very enthusiastic barley worker and should be an excellent cooperator for our project. Both leaf rust and net blotch were severe on susceptible cultivars and selections. We made leaf rust readings on about 8,000 barley lines and cultivars from the USDA collection and only 26 indicated some level of resistance. Seed from these lines will be incorporated as resistance sources into our leaf rust RSP's. That evening we met with E. E. Saari in Cairo. Since April 23 was a holiday in Egypt, we departed for Athens, stayed overnight there and left the next day for Damascus, Syria.

Syria:

We arrived in Damascus on the evening of April 24 and stayed overnight in the ICARDA guest house. The next morning we left by car for Aleppo. In the afternoon we joined the Review Board in a tour of the research farm at Le Harria. ICARDA shows much development over the past 2 years from its initiation. Several professionals have been employed and the plots were well tended. A 2.5 meter high link-chain fence surrounds the entire farm to exclude grazing animals. The organization consists of several divisions: cereal crops, oil crops, legume crops, farm practices, farm machinery. On April 26 we surveyed and evaluated the barley plots at Le Hattia with A. Kamel, M. Mekni, M. Bjarko and several trainees. M. Mekni from Tunisia has been recently hired as the barley breeder by ICARDA and M. Bjarko is a recent graduate (M.S.) in Plant Pathology from Montana State University who has recently begun employment with ICARDA. The most prevalent diseases were scald, net blotch, powdery mildew, bacterial blight and yellow dwarf virus. Dr. Sands illustrated a technique for bacterial blight. Bacterial blight was particularly severe on Triticale at this location. On April 27 we accompanied Issom Nagi and M. Bjarko on a survey of various off-station

barley nurseries and some very dry areas of barley culture. In the off-station nurseries two land race barley cultivars, Arabie Abied (white glumes) and Arabie Aswan (black glumes), were planted for comparison with several other barley cultivars and lines selected for various traits. Some of the selected lines and cultivars appeared promising under real stress conditions. Interestingly enough, particularly net blotch, and scald, to some extent, were prevalent and even severe in some areas having less than 100 mm of precipitation. Thus airborne diseases can still be a problem under very dry conditions. On April 28, we surveyed barley fields enroute and barley plots at the Lattakia Station on the sea. The latter area has been reclaimed from the sea. Diseases were the same as those noted earlier for the dry areas but the severity was not as high even though the precipitation amount was several times greater. This land was newly reclaimed and therein may lie the explanation. We returned to Damascus that evening and left the next morning for Istanbul and Ankara.

Turkey:

We arrived in Ankara in the evening of April 29, were met by a driver from CIMMYT, and taken to our hotel. On April 30 we went with J. M. Prescott to the Regional Agricultural Research Institute, Ankara, where we met with several of the staff, discussed disease problems in barley and toured the facilities. In the afternoon we visited the Haymana Research Station and surveyed the barley plots and some nearby barley fields. At this high plains area the barley was in an early stage of development but helminthosporium stripe, net blotch and scald were evident.

On May 1 we traveled by car to Eskisihir. May day was a holiday in Turkey but M. Enginel, cereal breeder and B. Suzen, cereal pathologist-breeder, met us at the station. B. Suzen will be coming to Montana this June as a trainee in barley diseases and breeding. Helminthosporium stripe was widely prevalent in the plots with a lesser amount of scald, net blotch and what appeared to be barley yellow dwarf virus. We also traveled about 50 Km north to Alpu to look at a disease problem on Besostaya wheat. This appeared to be a soilborne transmitted virus which will be further ascertained. We then returned to Ankara by car and left that evening for Izmir. At Izmir we were met at the airport by K. Temiz, Director of the Research Station and had a full crew the next day for evaluating the RSP disease nurseries. In addition to our own RSP's, F. Dimirkan, barley breeder, had also planted several of T. Ramage's RSP's. There was a wealth of disease resistant and other desirable types within these populations. The main diseases at Izmir were leaf-rust, scald, net blotch, barley yellow dwarf, bacterial blight, and bacterial streak.

Israel:

On May 3 we departed Izmir for Tel Aviv via Istanbul. On May 4 we met with A. Blum, A. Grama and Z. Amitae at the Volcani Institute where

we surveyed the cereal plots and discussed the use of different sources of resistance to combat diseases of barley and wheat. Particlularly interesting was the work on identification and utilization of resistance genes from wild progenitors of barley and wheat.

The following day, May 5, we went on a field trip in Northern Israel with Z. Amitae and A. Grama where we visited various research plots and collection sites for wild barley and wild emmers. This was a most enlightening experience.

On May 6 we visited the University of Tel Aviv, saw their facilities for plant pathological research and held informal discussions with the staff on barley diseases. Dr. Wahl briefly reviewed a cooperative project he has with G. Fischbeck (Germany) on different types of resistance to powdery mildew in natural populations of Hordeum spontaneum. He would like us to cooperate with them on this project. The following day we returned to the Volcani Institute, reviewed some of their inoculation methods and pathogenicity experiments with various cereal diseases compared to our methods. In the afternoon we went back to the University of Tel Aviv and presented seminars on our methods of utilizing RSP's for developing broad-based resistance to diseases of barley. On May 8, we departed Israel, stayed overnight in Minneapolis and arrived in Bozeman on May 9.

Overall, the trip was well-timed in relation to plant growth and disease incidence, we were met at all sites and the hospitality was outstanding. We collected many disease specimens, particularly in newer areas, to add to our virulence pool for incorporating broad-based resistance. The interest in and acceptance of our methods for developing broad-based resistance to diseases of barley shows continual improvement.

ICARDA

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THE INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

المركز الدولي للبحوث الزراعية في المناطق الجافة

P. O Box 5466, Aleppo - Syria, Tel. 50405 & 21750 Cable : ICARDA Telex 31208

February 14, 1979

Dr.H.Bockelman
Montana State University
College of Agriculture
Plant Pathology Department
Agricultural Experiment Station
Bozeman, Montana 59717
USA

Dear Dr. Bockelman:

We are very happy to receive results of seedling tests for scald and net blotch reactions on the entries in the Regional Barley nurseries. We are in the process of making crossing plans and the information provided by you is extremely useful as the resistant lines will be used as donars. I am circulating this information to Barley workers in the region for use in their programs.

We realize that it must have taken lot of your time and resources to test all the entries in Regional Barley nurseries during such a short period. We greatly appreciate your help and the data provided by you is of considerable importance to us in ICARDA as well to the national Barley Programs in the region.

Sincerely Yours

J.P.Srivastava

J.P.Srivastava
Cereal Improvement Program Leader

JPS/id

C.C.Dr.F.Sharp
Dr.H.S.Darling
Dr.A.H.Kamel

ICARDA

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THE INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS

المركز الدولي للبحوث الزراعيـــة في المناطق الجافـــة

P. O. Box 5466, Aleppo - Syria, Tel. 50465 & 21750 Cable : ICARDA Telex 31206

July 16, 1979

Dr. H. Bockelman
Montana State University
College of Agriculture
Plant Pathology Department
Agricultural Experiment Station
Bozeman, Montana 59717
U S A

Dear Dr. Bockelman:

I circulated your information to a number of scientists in the region and they were happy to have this information. One of the letters I have received is enclosed as an example.

Sincerely Yours

J.P.Srivastava

JPS:id

ESTAÇÃO DE MELHORAMENTO DE PLANTAS
ELVAS - PORTUGAL

Dr. Jit P. Srivastava, Director
ICARDA
P.O. Box 5466
ALEPPO - SYRIA

Elvas, 19.JUN.1979

Dear Dr. Srivastava,

Many thanks for "the News from ICARDA" and the information obtained by Dr. Harold Bockelman on scald and net bloch reactions in barley lines included in ICARDA trials.

At Elvas in this cropping season Rhynchosporium secalis developed into an agressive epidemic which caused serious damages on barley fields. That disease was really the most serious as barley crop is concerning. Then I think the field notes taken in the trials carried out at Elvas can provide something of useful to you and your cooperators. Here-enclosed I am sending a table including the barley lines that showed highest resistance to scald in this season at Elvas.

Comparing the results of Dr. Bockelman with our field notes regarding to scald, we can see the positive response in both tests of the following lines:

→ please see page 2

ESTAÇÃO DE ...ELHORAMENTO DE PLANTAS

Nursery	Entry No	Variety or cross	Reaction to scald	
			Montana	Elva Sc,O-1
8th PON-B	26	H 252 300M-5010-0Y-0SK	I	2
" "	52	Herawi	I	1
" "	69	CM67 - Troli CMB72A-29-4L-1L-S--4057-0AP	R	2
" "	102	Cholo	I	1
" "	114	Centinela	R	1

As concerning to Beecher reaction we have observed a pronunciated variation ranging from 2 to 5.

From those results it seems to me that Rhynchosporium spectrum race in Portugal is a very wide one.

Now we are at harvesting time and as soon as I get the field books filled I will send them to you.

With my best wishes and regards,

Yours sincerely,

Manuel T. Barradas

Manuel T. Barradas

Table 1:
Virulence Groups of Montana Isolates in Relation to 15 Different Barley Varieties. (Net Blotch)

Virulence Group	Varieties 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Group A	R	R													
Group B	R	R									R	R	R	R	
Group C	R	R		R							R	R	R	R	R
Group D	R	R									R				

1. Unitan R or I to all
2. Steptoe R or I to all
3. Shabet
4. Hypana
5. Dekap
6. Ingrid
7. Betzes
8. Firlbecks III
9. Mona-Arivat
10. Arimont
11. C.I. 7584
12. C.I. 9776
13. C.I. 9819
14. C.I. 5791
15. Tifang

Table 2:
Virulence Groups of Middle East Isolates in Relation to 15 Different Barley Varieties. (Net Blotch)

Virulence Groups	Varieties 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Group A	R	R									R	R	R	R	R
Group B	R											R	R	R	
Group C	R	R	R			R							R	R	
Group D	R	R	R	R		R	R	R			R		R	R	R
Group E	R		R			R	R				R	R	R	R	R

1. Unitan
2. Steptoe
3. Shabet
4. Hypana
5. Dekap
6. Ingrid
7. Betzes
8. Firlbecks III
9. Mona-Arivat
10. Arimont
11. C.I. 7584
12. C.I. 9776
13. C.I. 9819
14. C.I. 5791
15. Tifang

Table 3:
Barley lines resistant to all 9 or 8 of 9 Virulence Groups. (Net Blotch).

Barley Lines with resistance to:

All nine virulence groups:

C.I. 1615	C.I. 5401	C.I. 9768
C.I. 4207	C.I. 5845	C.I. 10421
C.I. 5298	C.I. 7208	C.I. 13262

Eight of nine virulence groups:

C.I. 5404	C.I. 7272	C.I. 9698
C.I. 5822	C.I. 7296	C.I. 9699
C.I. 6388	C.I. 7297	C.I. 9831
C.I. 6475	C.I. 7504	C.I. 12860
C.I. 6496	C.I. 9440	C.I. 13727

Table 4:
Possible Numbers of Genes for Resistance in Each Barley Line (Net Blotch)

Steptoe	2(3)	C.I. 1197	2	Firlbecks III	1
Unitan	2(3)	C.I. 2230	1	C.I. 9776	1(2)
C.I. 5791	2(3)	C.I. 4544	1	C.I. 7584	1(2)
C.I. 9819	2(3)	Betzes	1	Georgie	1
Tifang	2	C.I. 2235	1		

Table 5: Evidence for Additive Resistance to *P. Teres*.

Cross	F_1 reaction	F_2 reaction type 1	2	3	4	Isolate
Tifang (4)[1] x Georgie (4)	4	1[2]	6	18	158	Mt 77-1
Betzes (4) x Georgie (3,4)	3,2	0	7	40	254	Mt 77-6
Georgie (3,4) x Firlbecks III (4,3)	3,2,4	25	65	126	155	Mt 77-6
Betzes (4) x Firlbecks III (4,3,2)	4,3	0	13	28	328	Mt 77-7
Tifang (4,3) x Firlbecks III (3,4)	3,2	4	69	136	182	Mt 77-51

[1]Parental Reaction Type in Parentheses.
[2]Indicates Number of F_2 Plants in Each Reaction Type.

Table 6:
Barley Yellow Dwarf Virus-Genetic Studies of Host Tolerance

A. Evaluation of tolerance obtained from yd_2 x yd_1 crosses. (additive resistance?)

1. CI2376 (yd_2) x Rojo (yd_1)
2. CI3208-2 (yd_2) x Rojo (yd_1)
3. CI3208-4 (yd_2) x Rojo (yd_1)
4. CI3902-2 (yd_2) x Rojo (yd_1)
5. CI3906-1 (yd_2) x Rojo (yd_1)
6. CI3947 (yd_2) x Rojo (yd_1)

B. Evaluation of tolerance obtained from crosses between yd_2 sources and early and late maturing susceptible barleys. (growth rate)

1. Erbet (early) x CI3208-4 (yd_2)
   " " x CI3906-6 (yd_2)
   " " x Coracle (yd_2)
   " " x CI2376 (yd_2)
   " " x CI1227 (yd_2)

2. Betzes (late) x CI3208-4 (yd_2)
   " " x CI3906-1 (yd_2)
   " " x Coracle (yd_2)
   " " x CI2376 (yd_2)
   " " x CI1227 (yd_2)

3. Early Titan x CI3208-4 (yd_2)
   " " x CI3906-1 (yd_2)
   " " x Coracle (yd_2)
   " " x CI2376 (yd_2)
   " " x CI1227 (yd_2)

4. Titan (late) x CI3208-4 (yd_2)
   " " x CI3906-1 (yd_2)
   " " x Coracle (yd_2)
   " " x CI2376 (yd_2)
   " " x CI1227 (yd_2)

C. Evaluation of tolerance obtained from reciprocal crosses between different yd_2 sources and susceptible black hulless barley. (cytoplasmic influence?)

1. CI3208-4 (yd_2) x Black hulless
2. CI3906-1 (yd_2) x " "
3. Coracle (yd_2) x " "
4. CI1227 (yd_2) x " "
5. BR 626-43-19 (yd_2) x Black hulless

Nursery planted 5-4-79, 5-23-79.

Table 7: Base varieties for RSP's - 6 row barley

RSP-5 Base Varieties

Manchuria msg 10	Galt
Gem	Steptoe
Unitan	Nude Vantage
Arimont	Nude Glacier
Waxy Titan	Minn. 21
Nordic	Athenais
Atlas 68	Atsel
Beecher	CM 67

Table 8. Base varieties for RSP's - 2 row barley

RSP-4 Base Varieties

Compana msg 10	Waxy Compana
Herta	Union
Ingrid	Vireo
Bruens Wisa	Summit
Zephyr	Maris Mink
Erbet	Nude Compana
Dekap	Cumhuriyet 50
Hector	Toonucier

Table 9: Resistant Germplasm in RSP-5 Rrs - 6 row scald population

Trebi	C.I. 935	Bey
Jet	C.I. 1218	La Mesita
Kitchin	C.I. 1257	C.I. 8158
Steudelli	Osiris	C.I. 8159
Atlas 46	Ellis	C.I. 11577
Modoc	C.I. 3940	C.I. 11579
Nigrinudum	Atlas	McNair
Turk	C.I. 4354	C.I. 11628
C.I. 668	Little Ben	C.I. 11839

Table 10: Resistant Germplasm in RSP-4 Rrs - 2 row scald population

Jet	Modoc
Ellis	C.I. 8158
C.I. 4354	C.I. 8159
Steudelli	Nigrinudum
C.I. 3940	C.I. 11577
Atlas	C.I. 11628
Bey	Turk
La Mesita	

Table 11: Resistant Germplasm in RSP-5 Rpt - 6 row scald population

OAC 21	C.I. 9776	C.I. 5298
C.I. 2235	Tifang	C.I. 5401
C.I. 2750	C.I. 9819	C.I. 5822
C.I. 4544	Manker	C.I. 5845
Oderbrucker	C.I. 1197	C.I. 6388
Harbin	C.I. 1615	C.I. 6496
C.I. 5791	C.I. 4207	C.I. 7208
C.I. 7584	C.I. 5296	C.I. 7272
C.I. 7296	C.I. 9647	C.I. 9825
C.I. 7297	C.I. 9698	C.I. 10379
C.I. 7447	C.I. 9699	C.I. 12821
C.I. 7504	C.I. 9702	C.I. 12860
C.I. 8332	C.I. 9751	C.I. 13262
C.I. 9440	C.I. 9758	C.I. 14023
C.I. 9505	C.I. 9768	

Table 12: Resistant Germplasm in RSP-4 Rpt - 2 row net blotch population

Steptoe	C.I. 7272	C.I. 9776
Unitan	C.I. 7296	C.I. 9825
C.I. 1615	C.I. 7744	C.I. 9831
C.I. 4207	C.I. 7504	C.I. 11631
C.I. 5298	C.I. 9440	C.I. 12821
C.I. 5401	C.I. 9505	C.I. 13262
C.I. 5822	C.I. 9698	C.I. 13727
C.I. 5845	C.I. 9702	C.I. 14023
C.I. 6388	C.I. 9758	Tifang
C.I. 7208	C.I. 9768	

Table 13: Resistant Germplasm in RSP-5 Rph - 6 row leaf rust population

Horsford	Titan
Kwan	Rivale
Weider	Proctor
C.I. 4974	Julia
Reka I	Carre 180
Austral	Vada
Lechtaler	

Table 14: Resistant Germplasm in RSP-4 Rph - 2 row leaf rust population

Horsford	Reka I
Kwan	Austral
Carre 180	Lechtaler
C.I. 4974	Julia

Table 15: Resistant Germplasm in RSP-5 Rxt - 6 row Xanthomonas population

Nigrinudum	OAC 21
Wapana	Peatland
Summit	C.I. 5810
Nupana	Mars

selections from RSP-5 Rpg and RSP-5 Rrs

Table 16: Resistant Germplasm in RSP-5 Rps - 6 row Pseudomonas population

CM 67 - Godiva
CM 67 - U. Sask. 1800 x Por. - CM 67
Mezquite - Godiva
Blanco Mariout - Mezquite
Arivat
Mona
Selections from RSP-5 Rpg

Table 17: Resistant Germplasm in RSP-5 Ruh - 6 row covered smut population

Lion	Excelsior
Himalaya	Pannier
Hannchen	Ogalitsu
Nepal	Trebi
Jet	

Table 18: Resistant Germplasm in RSP-5 Rpg - 6 row stem rust population

Black Hulless
Chevron
Peatland
Valentine
Selections from CC-30-F

Table 19: Scald & net blotch evaluations on various barley nurseries received from ICARDA & CIMMYT

ICARDA Nurseries 1978-79

		R	I	S
9th RCB (Regional Crossing Block)	scald	8	10	209
	net	143	56	24
9th RBYT (Regional Yield Trial)	scald	6	2	15
	net	18	1	1
8th PONB (Preliminary observation Nursery)	scald	14	23	132
	net	49	59	62

CIMMYT Nurseries 1978-79

1st IBYT (International Yield Trial)	scald	3	3	18
	net	17	5	2
6th IBON (International Observation Nursery)	scald	63	104	188
	net	90	123	133
CB-B 78 (Crossing Block)	scald	22	48	284
	net	66	162	126

R = Resistant, I = Intermediate, S = Susceptible

VISITS AND PUBLICATIONS

CARROLL: Visits

1. C. W. Schaller and C. Qualset. University of California, Davis. Discussed their breeding programs on tolerance to barley yellow dwarf virus (BYDV). Also discussed their linkage to CIMMYT and the BYDV screening of both barley and wheat at Davis, CA and Santiago, Chile. May 10, 1979.

2. C. C. Gill. Agriculture Canada, Winnipeg. Visited field plot, greenhouse and laboratory that are used for BYDV research. Discussed methods applied to field screening of barley lines for tolerance to BYDV. Obtained information relative to the transmission, virulence, culture, and diagnosis of BYDV.

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1. An invited speaker for the Seed Pathology Symposium sponsored by the society of Commercial Seed Technologists and the Association of Official Seed Analysts. Spoke on the topic "Methods for Detecting Seedborne Plant Viruses". June 20, 1979, Saskatoon, Saskatchewan, Canada.

BOCKELMAN: Presented a paper at American Society of Agronomy meeting. Ft. Collins, Aug., 1979. Development of Barley Scald Resistant Germplasm using Male Sterile-Facilitated Recurrent Selection.

SANDS: Talks given

University of CA, Riverside, short course in plant bacteriology, 4 lectures, 2 discussion sessions on bacteria, barley, recurrent selection populations and lysine.

Tel Aviv University - Seminar with E. L. Sharp on Barley Diseases, recurrent selection populations and lysine.

Edison Foundation lecture, MSU. Non-Protein solution to worlds Protein problem.

American Phytopathological Society Meetings, Washington, D. C. (2 papers)
(1) Dissemination of *Pseudomonas syringae* by Rain.
(2) A Plate Assay for Plasmid Curing Agents.

Western Montana College - Future of Genetic engineering in agriculture as applied to barley.

MSU. Plant Science Colloquim with University of California. Barley the *E. coli* of the plant world.

Aleppo, Syria - ICARDA - Research on barley diseases and recurrent selection populations.

Agriculture College, Tunisia - Research on barley diseases and recurrent selection populations.

Ankara, Turkey - Research on barley diseases and recurrent selection populations.

Sigma Xi lecture, MSU - A Novel Approach to the World Food Problem.

Oregon State University, 2 lectures, one discussion session.
(1) Lecture to Crop Science Department - Genetic engineering as it related to future crops, diseases and nutrition.
(2) Lecture to Plant Pathology and Botany - Bacterial diseases of barley.

SHARP: Papers presented:

3rd International Congress of Plant Pathology, Munchen, August, 1978.
(1) Resistance in barley to net blotch, August 17.
(2) Genetic diversity, parasite survival and disease control August 21

Quito - Changing Virulence Patterns in Stripe Rust of Wheat and Barley and Possible Measures for Disease Control

IX International Congress of Plant Protection and 71st Annual Meeting of The American Phylopathological. Washington D.C.
(1) Breeding for Stable Resistance: A realistic objective?
(2) Male Sterile Facilitated Recurrent Selection Populations for Developing Broad-based Resistance by Major & Minor effect Genes.

Seminars on recurrent selection populations for developing broad-based resistance to barley diseases at Le Kef, Tunisia and Tel Aviv, Israel

Bjarko, Michael E. 1979. Sources of and genetic action of resistance in barley to different virulence types of Pyrenophora teres, the causal agent of net blotch. M.S. thesis. Plant Pathology, Montana State University.

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

Carroll, T. W., P. L. Gossel, and D. L. Batchelor. 1979. Use of Sodium Dodecyl Sulfate in Serodiagnosis of Barley Stripe Mosaic Virus in Embryos and Leaves. Phytopathology 69:12-14.

Carroll, T. W., P. L. Gossel, and E. A. Hockett. 1979. Inheritance of Resistance to Seed Transmission of Barley Stripe Mosaic Virus in Barley. Phytopathology 69:431-433.

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, pp. 1-156).

Metz, Sally G. and A. L. Scharen. 1979. Potential for the Development of Pyrenophora Graminea on barley in a semi-arid environment. Vol. 63, No. 8, Plant Disease Reporter. pp 671-633.

Sharp, E. L. Aug. 21, 1978. Contribution to the Panel Discussion on Parasitic Survival: Genetic Diversity, Parasite Survival and Disease Control. 3rd International Congress of Plant Pathology. Munchen, pp. 93.

Sharp, E. L., M. E. Bjarko, and H. E. Bockelman. Aug. 17, 1978. Resistance in barley to net blotch. 3rd International Congress of Plant Pathology, Munchen. pp. 283.

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. abst., pp. 77-78.