ANNUAL REPORT

on

Control of Barley Diseases for Lesser Developed Countries of the World

January 1, 1982-March 31, 1983
Report No. 4 - Annual Report
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A. Narrative Summary

This report covers the first year of a current two year contract with the U. S. Agency for International Development and Montana State University 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 onsite 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 cultivation. 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 and the plant breeding phase becomes operational. Although recurrent selection populations have been assembled for seven different diseases of barley, five (scald, net blotch, leaf rust, Xanthomonas streak and barley yellow dwarf virus) 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 three trainees from two different LDC's participated and three foreign graduate students are currently being supported by the barley-AID program. In 1983, three foreign students graduated with PhD degrees and two with M.S. degrees. Of the three PhD awardees, two have returned to their home countries and one has accepted a position with Dow Chemical International, Ivory Coast, Africa. Of the M.S. awardees one has returned to his native country and one is pursuing a

PhD degree at North Dakota State University.

The methods of using male sterile facilitated recurrent selection populations (MSFRSP) have been outlined in detail in a previous annual report (1981). This method has been used for developing broad-based multigenic resistance to a number of common diseases of barley. Several of these populations have a high percentage of resistant plants and have been registered for general release to plant breeders. Furthermore, disease resistances have been combined in some populations to give resistance to more than one disease such as scald and net blotch.

B. Project Objectives

1. Determination of different sources of resistance and linkage relationships for the major diseases of barley.

2. Development of barley populations, both two row and six row, with broad based major gene and minor gene resistance to specific diseases.

3. Development of combined resistances to specific diseases in barley stocks.

4. Assist international programs in development of methods for control of virus diseases of barley.

C. Accomplishments to Date

1. Introduction

A general discussion on progress with the RSP's will precede more detailed information for specific diseases. Fundamental information is required before sources of resistance can be incorporated into RSP's. In several diseases this fundamental work has been completed and different resistances are being actively incorporated into RSP's to form broad-based resistance.

The RSP's are being exploited in several locations. This has occurred by head rowing of specific plants, by combining different single plants from the populations and by crossing single plants from the populations to other cultivars. Undoubtedly new cultivars are being developed by these methods which have broad-based disease resistance and are agronomically suitable for different locations.

2. Recurrent Selection Populations

Good progress was made in the past year on the development of germplasm with multi-genic, broad-based

resistance utilizing male sterile-facilitated recurrent selection populations (MSFRSP's). A summary of the current status of the populations is shown in Table 1.

An additional three of the MSFRSP's are being prepared for general release to barley breeders as Composite Crosses XLI (leaf rust), XLII (powdery mildew), and XLIII (scald and net blotch). We are also preparing to combine two more MSFRSP's, RSP-5 Rpt (net blotch) and RSP-5 Rph (leaf rust), as these two diseases frequently occur in the same barley-growing regions.

As noted in Table 1 the MSFRSP's are being widely distributed and selected for resistance in a diversity of locations. This has been valuable in the accumulation of multigenic resistance. RSP-5 Rrs (scald) is our most advanced MSFRSP and illustrates the development of multi-genic resistance. In 1982 one hundred heads (F_2 seed) were harvested at random and planted in rows in the greenhouse and inoculated with a Montana isolate (low virulence) and a Tunisian isolate (high virulence) of R. secalis. Ninety-four and 96 lines, respectively, were resistant or segregating and only six and four lines, respectively, were susceptible (see Table 2).

RSP-5 Rxt, a MSFRSP for resistance to Xanthomonas bacterial streak, is finally showing gains in resistance. In 1982 RSP-5 Rxt was grown at Aberdeen, Idaho, a "hot spot" for Xanthomonas. About 5% of the plants showed some level of resistance. It appears that resistance to Xanthomonas is controlled by minor effect genes.

RSP-4 Rrs minor and RSP-4 Rpt minor, MSFRSP's for minor gene resistance to scald and net blotch, respectively, are also showing increased levels of resistance. While very few plants are resistant, a significant proportion of plants are intermediate in reaction. Additionally, screening the seed and discarding the smaller seeds has also resulted in small, but significant gains in resistance. In a greenhouse test of random F_2 lines from RSP-4 Rpt minor (1982), 36 out of 100 lines showed transgressive segregation for increased resistance levels above the parents. (See Fig. 1).

3. Scald of Barley

The following barleys introduced from Ethiopia were found to be resistant or intermediate in the seedling stage to three isolates of R. secalis from Montana, California, and Morocco: P.I.# 382282, 382471, 382488, 382509, 382724, 382773, 382944, 383036, 383096, and

383106. There were an additional 35 introductions resistant to one or two of the isolates tested.

Inheritance of Resistance

Inheritance of resistance to *R. secalis* was studied in 14 resistant lines. F_1, F_2, and BC, progeny of crosses of susceptible x resistant and resistant x resistant lines, were evaluated in the greenhouse in the seedling stage with three diverse isolates of *R. secalis* and in the field with a Montana isolate. A total of at least eight genes or alleles were identified.

4. Net Blotch-spot of Barley

Isolates of *P. teres* have been collected annually since 1974 from countries in North Africa and the Middle East (Morocco, Tunisia, Turkey). Seven (out of an approximate total of 50) of these isolates have produced spot-type symptoms when inoculated onto barley seedlings. In 1981 spot-type lesions were observed on irrigated barleys in a nursery and a farmer's field at Fairfield, Montana.

The seven isolates from Morocco, Tunisia, and Turkey were distinct from the Montana spot isolate in seedling inoculations, in that they produced larger lesions on most cultivars. The only previously published report of a net-spot isolate from the North Africa - Middle East region is that of McDonald (1967) in which he studied an isolate collected in Israel. In seedling tests with different cultivars most reactions were in the intermediate category. Indications are that the virulence patterns of these net-spot isolates are different, especially the Montana isolate. At Fairfield, Montana in 1981 the spot symptoms were present on all leaves of most plants in a commercial field of Klages barley and Composite Cross XXXVIII, our net blotch resistant MSFRSP, was mostly susceptible.

We are now focusing our attention on identifying sources of resistance to these net-spot isolates.

5. Leaf Rust of Barley

The genetical characterization of resistance sources which have been incorporated into the RSP was continued. A recessive gene was detected in the variety 'Modjo' (CI 14048) whereas Giza 119/Tannekasse 105 carries a dominant gene. A large number of crosses with the leaf rust resistant material was carried out during the summer of 1982. The F_1 nursery is currently grown in Arizona and segregating F_2 populations will be

available for evaluation during the coming summer.

Heavy disease pressure in the south Texas (Raymondville and San Antonio) nurseries during the winter of 1981/82 provided excellent conditions for selection for leaf resistance in the RSP which was at the time in the third cycle of recombination. In addition to providing material for the fourth cycle of recombination, single superior plants were selected at both nurseries (40 at Raymondville, 10 at San Antonio).

During the winter of 1982/83 RSPs of all cycles (including 4) were grown at both sites. The Raymondville nursery was destroyed by hail in March of 1983. Leaf rust infection in the San Antonio area was moderate to heavy and the different cycles of recombination were rated as described in Table 3.

The headrows grown at the San Antonio nursery were segregating for male sterility as expected and leaf rust resistance in these lines remained high. This indicates that we were able to accumulate a number of resistance genes in homozygous condition. Surprisingly, phenotypic homogenity of many lines indicated the presence of a number of genes in homozygous condition. Superior plants from the headrows will be grown during the summer 1983 at Bozeman. The material will be evaluated for agronomic characters. It should be possible to develop promising adapted varieties for growers in southern Texas and other regions of the world with similar climate.

6. <u>Virus Diseases of Barley.</u>

a. Barley yellow dwarf (BYD) caused by the barley yellow dwarf luteoviruses (BYD-LV).

1. Recurrent selection populations. RSP-BYD.

Began the development of a 6-row population with tolerance to BYD and some resistance to net blotch and scald.

Constituting step in Bozeman.

A mechanical mixture of seeds was made from the following components:

RSP-5 Rrs-Rpt F_2 seed. Contains two sources of the Yd_2 gene for tolerance to BYD, plus some resistance to scald and net blotch.

CCXXXIIIA - F_4 seed. Contains four sources of Yd_2 and genes for short, stiff-straw, and rapid early growth.

CCXXXIIIB - F_4 seed. Similar to A population but having fewer genes for short, stiff straw.

In May, 1982, seed (F_2) of Sutter/Manchuria (S/M) hybrids, was planted in a nursery along with the seed of the main components. Sutter contains Yd_2 and probably some other factor(s) for tolerance to BYD. Manchuria carried the male sterile gene msg 10. Subsequently hand crosses were made between male fertile plants of the main components and male sterile plants of S/M hybrids. This was done to ensure inclusion of any possible maternal characters for tolerance from Sutter. Also, male fertile plants of S/M were crossed onto male sterile plants of the main components. All hand crossed heads were bagged to prevent out-crossing by stray pollen.

Combination - recombination step in Mesa, Arizona.

During November, 1982, F_1 seed of the following components was planted in a nursery:

1. S/M x main components (bagged seed)
2. Main components x S/M (bagged seed)
3. Main components (ourcrossed seed)
4. S/M (outcrossed seed)

Genetic study.

Yield comparisons of F_2 plants from crosses between S/M and main components and their reciprocal crosses will be made to determine if the apparent additional factor(s) for tolerance to BYD in Sutter is (are) cytoplasmic or maternal in nature. The plants will be infected with the MT-PAV type of BYD-LV using *Rhopalosiphum padi* as the vector species.

Recurrent selection populations CCXXXIIIA and CCXXXIIIB.

In September, 1982, F_5 seed from male fertile plants having tolerance to BYD in El Kef, Tunisia, were delivered to MSU by Mr. Amor Yahyaoui, Central Tunisia Project.

Dr. Peter Burnett, Barley Breeder, CIMMYT, Mexico, requested and was sent seed of each of the two populations for evaluation and possible use.

The RSP-BYD population should eventually replace CCXXXIIIA and CCXXXIIIB (see Table 4 for sources of resistance to BYD.

Status of the international CIMMYT Project on BYD.

Still pending approval of funding, according to Dr. J. M. Prescott, Plant Pathologist, CIMMYT.

b. Barley stripe mosaic caused by barley stripe mosaic virus (BSMV).

Completed the development of Mobet barley germplasm which has resistance to the seed transmission of three Montana strains of BSMV. Germplasm Reg. No. GP61, Crop Science Society of America. Seed may be obtained from MSU or from Curator, World Collection of Small Grins, ARS-USDA, BARC, Beltsville, MD 20705.

c. Other virus diseases.

Yellow stripe disease.

Glutaraldehyde fixed samples of diseased durum wheat collected in Rabat and Merchouch, Morocco, for Dr. Lynn Gallagher, revealed the presence of rhabdovirus in thin sections of some leaf cells. Additional dried leaf samples of durum wheat and barley, exhibiting the same yellow stripe symptom, were used to mechanically inoculate barley and wheat seedlings. No transmission of the yellow stripe symptom was obtained. The rhabdovirus may be a new unnamed virus. Dr. B. E. L. Lockhart, Assoc. Prof., Complexe Horticole, B. P. 438, Agadir, Morocco, is cooperating with us regarding the identification of this virus. He is conducting transmission tests with three different species of leafhoppers. Dried leaf samples of barley and durum wheat from ICARDA, Aleppo, Syria, also displayed the yellow stripe

symptom. Mechanical inoculation tests with those samples were alo negative for symptom transmission. Dr. A. H. Kamel, Plant Pathologist, ICARDA, has been informed of the diagnosis of the ICARDA samples, relative to the Morocco results.

Reviewed the section on viral and mycoplasmal diseases in the working manuscript for the CIMMYT publication entitled: Common Diseases of Small Grain Cereals: A Guide to Identification by F. J. Zillinsky.

7. Bacterial Diseases of Barley

Research involving bacterial diseases of cereal grains and grasses under the AID program is being carried out in several projects. Studies of the pathogens Xanthomonas campestris pv. translucens (XCT) and Pseudomonas syringae were composed of both laboratory and field experiments.

Building resistance to these diseases into populations of barley and wheat via male-sterile facilitated RSP's is of primary interest. Barley RSP's for XCT were tested in several locations in Montana as well as in Minnesota and Idaho. Prior to the 1982 growing season only 1% of the population was designated as resistant to the disease and selected for further recombination. However, during the 1982 growing season, populations of barley in two Montana locations showed high levels of resistance. Approximately 50% of the plants were selected, even after repeated inoculation with the pathogen. At other locations in Montana, Minnesota and Idaho, the levels of resistance were still 1-2%.

Incorporation of resistance to Pseudomonas syringae in barley populations continues at two locations in Montana with slow progress, as do RSP studies in wheat populations with regards to the two bacteria described.

In addition to work involving RSP's, we are searching for the means of overwintering employed by these bacteria. A possible overwintering mechanism was found when both pathogens were isolated from several native range grasses. Host range testing indicated that these isolates were capable of infecting cereal grains and could provide a source of inoculum, especially when grass and grain fields are adjacent.

To make isolations of XCT more definitive a selective medium was developed. This medium excludes most other organisms, both bacterial and fungal, and we are in the process of improving the selectivity by adding an indicator which causes colonies of XCT to turn a bluish color.

Inoculation and subsequent selections were carried out with winter and spring wheat varieties in Montana and Idaho and from barley varieties, crosses and headrows. Seed of resistant sources were saved for incorporation into our barley and wheat RSP's and for use in crossing with other grains with agronomic characteristics but little resistance to bacterial disease. Ethiopian barley lines showing resistance or tolerance to XCT were crossed with Montana varieties. These crosses were inoculated and are currently being tested for resistance in a greenhouse experiment. In addition, a seed assay for seed transmission of the disease on barley was developed in an attempt to keep new Montana varieties free from primary inoculum.

In accordance with the laboratory and field experiments described above, we are developing a method of bacterial strain differentiation using C13 NMR spectroscopy. Preliminary work has shown that each isolate within the pathovar XCT produces a unique descriptive spectrum when intact, washed cells are used as a sample. It is possible to assign classes of compounds to the resulting spectral resonances, and potentially exact compounds occuring in the cells. We are currently developing a technique to reduce the time necessary for data accumulation by uniformly increasing the C13 content of the cells.

8. Other Diseases of Barley

a. Fusarium seedling blight

Purpose:

Field and greenhouse tests were conducted to determine the possibility of selecting barley cultivars with improved resistance to Fusarium seedling blight.

General methods:

Seeds of a cultivar were completely immersed for 1.5 hours in a conidial suspension of Fusarium. (Soaking periods greater than this resulted in decreased

seedling blight). Concentrations of 100,000 and 1,000,000 macroconidia per ml of water result in differential cultivar susceptibility to Fusarium. Seed was air dried and seeded at a rate of 150 seeds per 3 meter row for field experiments and a rate of 100 seeds per flat, in greenhouse experiments. Seed in control treatments did not need to be soaked in water nor in autoclaved conidial suspensions and were planted directly in the soil.

In field experiments planting of infested barley should be done at a date corresponding to good agronomic practices. A later seeding date of 1.5 months had no effect on seedling blight.

Counts of plant emergence in field and greenhouse experiments was some at the full appearance of the second leaf in the control cultivars. In greenhouse studies this occurred 14 days after planting and resulted in cultivar differentiation to seedling blight which was not apparent at 11 days.

The cultivars chosen for study were considered good agronomic types representative of two and six row barleys. The seed was sieved and air blown to remove light weight and broken kernels. A selection from the following cultivars was used in field and greenhouse experiments: Clark, Hector, Klages, MT 547123, Piroline, Shabet, Compana, Larker, Unitan, Glenn, and Steptoe.

The Fusarium isolates were collected from fresh plant tissue or recently transferred cultures. With new isolates single spore technique was used to identify the species. Identification of the Fusaria species and group was made by consulting: Fusarium, A Pictorial Guide and The Genus Fusarium. An accurate identification of the two groups of *F. graminearum* is assisted by growing cultures under a combination light source involving both cool white and black light fluorescence on a 12 hour on-off cycle. The crown rot form, or group 1, does not form perithecia upon artificial media, whereas the scab form, or group II, forms bluish perithecia with ascospores after 3-4 weeks.

Fusarium culmorum, isolate #409 from spring barley grown in Montana, was used in the majority of our tests.

Results:

Yield data collected from field tests for seedling

blight did not differentiate between reactions to various concentrations of Fusarium conidia. Even though there were differences in plant stand among cultivars these were not reflected in row yield. Increased tillering in adjacent plants resulted in a yield increase on a per plant basis.

Counting seedling emergence at the second leaf appearance accounts for both seedling survival and recovery of plants from early infection. Counts at the earliest emergence or at the first leaf appearance did not differentiate between cultivars. At the high concentrations of Fusarium macroconidia under field conditions, Compana, Clark, Hector, and Shabet had significantly lower plant emergence in comparison to their controls. The emergence of Glenn, Klages, Piroline, Unitan, and Larker was not reduced under field conditions with high macroconidial concentrations.

The correlation between field results and greenhouse results of seedling blight was not significant. The greenhouse experiments displayed greater differentiation among cultivars. The variation within experiments was much higher in the greenhouse as compared to the field experiments with coefficients of variation of 22% and 12%, respectively. There also appeared to be a greater degree of disease pressure exerted on the greenhouse grown seedlings as all of the inoculated treatments were significantly reduced in seedling emergence when compared to their controls.

In spite of the greater variability in greenhouse experiments, this technique did differentiate between closely related cultivars. In a study involving four cultivars, the two progeny, Clark and MT 547123, were intermediate in percentage of seedlings emerging as compared to their parents, Hector and Klages. Hector was most resistant and Klages was the most susceptible of the four cultivars. In a study of 11 cultivars, Hector, Klages, Clark, and MT 547123, held their same relative ranking. Klages was the most susceptible and Steptoe the most resistant of the 11 cultivars. Glenn and MT 547123 were moderately susceptible; Clark, Hector, Shabet, Larker, Compana, Unitan, and Piroline were moderately resistant.

Differences in pathogenicity among Fusarium species and isolates to barley seedlings were detected in the greenhouse utilizing Clark, Hector, Klages and MT 547123. Two *Fusarium culmorum* isolates from fresh barley tissue or recently transferred cultures were

more virulent than a F. culmorum isolate from long term storage on artificial media. A crown rot isolate of F. graminearum Group I, isolated from infected plant tissue collected at Kairouan, Tunisia in 1981, was similar to the most virulent F. culmorum isolate in causing seedling blight. A 'scab' isolate of F. graminearum Group II, isolated from spring wheat, had little effect on seedling emergence and was similar to F. avenaceum, isolated from turf, and the uninoculated control.

Conclusions:

The relative performances of cultivars or near homogenous lines to seedling blight could be evaluated by infesting seed with a Fusarium macroconidial suspension and determining the percentage of surviving seedlings at the second leaf stage. In the case of heterogenous populations, such as a composite cross or a recurrent selection population, selection of individual plants or bulk harvesting of the surviving kernels could be easily handled. Not only would the weaker seedlings be eliminated from the population but those exhibiting good recovery from early infection would be selected. A population could also be screened for both seedling blight and foliar diseases, such as leaf spot, to speed the development of germplasm.

b. Powdery mildew

Conservation of Powdery Mildew Resistance Genes in Three Composite Cross Populations of Barley

The barley *Erysiphe graminis* f. sp. *hordei* host-parasite system was used as a model to evaluate the potential of barley composite cross populations for conservation of disease resistance. The objective was to determine if increases in resistance to powdery mildew could be detected over periods of time in composite cross populations developed in California, where the disease might have had a selective influence on the populations, and the same populations grown in Montana, where no selective influence of powdery mildew was expected. Four isolates of *E. graminis* f. sp. *hordei* were used to monitor the frequencies of specific mildew resistances through early, intermediate and late generations of three composite cross populations (CC II, CC V, CC XII) grown at Davis, California, and Bozeman and Moccasin, Montana.

Following artificial inoculation with the powdery mildew cultures in a controlled environment, the barley seedlings were classified as resistant or susceptible according to their reaction types. The number of resistant seedlings was computed for each treatment combination in each replication and converted to a percentage form, on which statistical analyses were performed.

Changes in frequencies of plants resistant to four isolates were observed between generations in all populations from the three locations. Increases in the frequency of resistant plants were detected by inoculations with culture 59.11 in CC II from Bozeman and CC XII from Bozeman and Moccasin, and by inoculations with cultures 63.12 and MT from the California CC XII. The largest increases in frequency of resistance were detected by inoculations with culture 59.11. CC XII revealed the most and largest increases in resistance of the three barley populations. Trends in the frequencies of resistance are discussed in relation to selection pressure applied by powdery mildew. It is suggested that associations with gene complexes other than resistance to *E. graminis* might help to explain the increased resistance observed in these studies.

c. The Inheritance of Resistance of Barley (*Hordeum Vulgare* L.) to *Pyrenophora Graminea* ITO *et Kurib*.

Barley stripe disease, caused by the fungus pathogen

Pyrenophora graminea ITO *et Kurib*, causes significant losses to the barley crop in Turkey and the U.S.A. This research was initiated to study crosses between some important Turkish barley cultivars and some American barley cultivars that had been identified as resistant to *P. graminea*. A major goal of the research was the understanding of the inheritance of resistance to *P. graminea* in barley.

Because of the nature of barley stripe, it was necessary to improve laboratory and greenhouse techniques for culturing the fungus and for inoculating populations of the host. In the course of these studies, three inoculation techniques were used, modified and improved. These were the barley kernel method, the layered mycelium method, and the soil inoculation method.

Five American barley cultivars and seven Turkish barley cultivars were crossed reciprocally and progeny were increased to the F_2 generation. Populations of F_2 progeny were inoculated with selected cultures of *P. graminea* and ratios of resistant to susceptible reactions were analyzed to determine the numbers of genes acting and the mode of gene action.

A very high level of variability was revealed in cultures of *p. graminea*. In some cases, a remarkable loss of pathogenicity was observed. Some ideas as to causes of the variability were discussed. It is also speculated that some variable results reported in the literature may have been due to variation in the pathogen.

Analysis of the F_2 barley populations revealed several different genes for resistance to *P. graminea* exist in the American and Turkish barley studied, and that several different kinds of gene action may also be present in the hybrid progeny.

9. Agronomic Improvement

The basic rationale and objectives for this past year's (1981-1982) research in agronomic improvement of the disease populations were briefly outlined in the 1980-1981 annual report.

Photoperiodism and relative varietal heading dates have recently been described as being crucial characters for adaptation in given latitudes for several crops (Qualset, 1979; and Quimby, 1975) including barley (Smail and Eslick, 1978; and Yasuda 1978). The photoperiod and heading date gene systems control plant

adaptation so strongly that sister lines, or even isogenic lines which are similar in other agronomic characters will not express similar patterns of yield adaptation, if they differ in these two hormonally controlled characters.

It is crucial therefore that selection indices be developed which will allow a rapid adjustment of the photoperiodism and heading date response of the disease resistant populations towards the photoperiod and heading of response of adapted varieties in a region. This selection should enhance the usability of these populations for rapid varietal development upon distribution. Unfortunately, photoperiod genetic systems and heading date genetic systems react synergistically preventing accurate selection for either in one environment. A tandem selection must occur in multiple environments which will allow the differentiation of the two gene systems.

Beecher is the variety recommended by ICARDA for Syria, Lebanon, Jordan, Egypt and Turkey. Martin is recommended for coastal Tunisia and Morocco. Consequently, these two varieties were chosen to represent the adapted varieties of the semi-arid middle east in the selection of the most advanced disease resistant populations to appropriate photoperiod and heading date responses typical of varieties found in the cooperating countries.

Beecher, Martin and a Syrian local winter barley were planted as check rows with the 11 selected sub-populations of both naked and covered CCXXXVI (RSP5-Rrs) harvested in 1980-81 Arizona, and planted at Bozeman in 1981. Table 5 describes the visual classification of each Rhynchosporium resistant (RSP5-Rrs) sub-population and the weight of seed selected from the sub-populations for each of Beecher and Martin photoperiod responses.

Five hundred grams of four of the 'Beecher' selections were sent to Egypt for parallel selection in that adapted environment in 1981-82. 750 grams to 1500 grams of each type of selection listed in the table above were planted in the 1981-82 Arizona nursery. Male-sterile, Beecher or Martin maturity plants, were reselected from each sub-population under a short day photoperiod regime. An additional sub-population of the double-disease resistant population selected to Gem (36 degrees latitude) was also planted and reselected in Arizona. The bulked seed from each sub-population was then replanted at Bozeman in 1982, and these sub-populations were again reselected for Beecher, Martin

or Gem heading date responses. In addition, selections for the photoperiod/heading date response of barley varieties CM67 and Steptoe were initiated to include adaptation for 38 and 46 degrees latitude in the selection program. Seed from all selected sub-populations was again replanted in the 1982-83 Mesa, Arizona nursery for reselection of the appropriate photoperiod response.

With the addition of Gem, CM 67 and Steptoe barley varieties the regions of adaptation being selected for ranged from 33 to 46 degrees latitudes and included fall (short day) and spring (long day) planted environments. Following three full selection cycles, approximately 1000 individual plants selected at random from each phase of sub-population selection should be utilized in population genetic studies to determine the effectiveness of selection, and degree of shift in the populations towards the appropriate heading date and photoperiod response. These selected plants, once brought to homozygosity, might also be used for regionally located yield tests to verify the relative effectiveness of this selection scheme on yield performance in each adapted region included in this selection scheme.

Future plans also include continuing this selection process on new disease resistant populations, as they become available. In addition, a tandem selection scheme for a maximum spike weight/kernel weight indice will be performed on disease resistant populations to further enhance the immediate useability of each population upon distribution to cooperating countries. The development of photoperiod and heading date isogenics in recommended varieties is also being continued. The Betzes heading date isogenic series reported previously is nearing completion and are being studied in multiple environment yield trials in 1983 for yield, heading date and photoperiod response stability.

Multiple stress physiology trials are being planted at four Montana locations using isogenics for heading dates, leaf areas, chlorophyll/spike mutations, and plant heights. These are designed to further detect easily selected characters for drought improvement of the disease resistant R.S.P. s. This research is being conducted in cooperation with Egyptian trainees from the Egyptian Major Cereals Improvement Project/USAID/CID/Egypt MOA.

D. 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 nurseries and discuss problems and progress with scientific personnel and administrators in the various countries. In April-May of 1982 Dr. Sands and Mr. Douglas Yount made this trip and their report is included in another section. We cooperate closely with CIMMYT and ICARDA not only in sending out our RSP nurseries to them but also in evaluating their crossing blocks and elite lines to barley diseases. Additionally, members of our department are often involved with CIMMYT and ICARDA in International meetings and workshops. (See Visits and Presentations section).

Several thousand copies of the "Field Manual on Common Barley Diseases" completed in 1981 have been distributed to barley workers and requests are still coming in. This past year we completed a Spanish translation of the manual and 500 copies have been sent to CIMMYT. Furthermore, we have made arrangements for the manual to be translated and prepared in Arabic and are negotiating for another translation into the Turkish language. The demand for this manual in different languages indicates its utility and wide acceptance in both the LDC's and other countries.

Our staff and graduates continue to receive offers for cooperative research, employment and consultation in International Agriculture both on a short and long term basis.

E. Training Program

Under the training portion of the Montana USAID contract three trainees participated in 1982 and there are five graduate research assistants presently in the program as follows:

Trainees:

Ahmed Salhi----------Tunisia
Maher Noaman Mohamed---------Egypt
Ismail Abdel Moneim Ahmed----Egypt

GRA's:

Chandra Karki----------Nepal
Richard Ruff----------USA
Segenet Kelemu----------Ethiopia
Jim Crosslin----------USA
Gurbutz Mizrak----------Turkey

Two other foreign GRA's supported by other funds but participating in our cereal program are:

Ricardo Madariaga----------Chile
Amor Yahyaoui----------Tunisia (MIAC)

The GRA's were assigned thesis problems with barley diseases and were otherwise subject to the same rules and regulations as resident GRA's. The trainees were generally here for a 3 month period from June 15 to September 15. This time sequence covered disease development on barley in the field. 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 of resistance genes 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.

During 1982, six students doing research on barley completed their advanced degrees:

Cahit Konak----------M.S. (Turkey)
Elias Elias----------M.S. (Syria)
Douglas Yount----------M.S. (USA)
Guy de Smet----------PhD(Morocco-Belgium)
Hee Kyu Kim----------PhD (South Korea)
Moncef Harrabi----------PhD (Tunisia)

All of the above except Moncef Harrabi, who was funded by AID-Tunisia, received financial support from the Montana-AID program. Titles for their thesis dissertations are given under the Publications section.

We continue to have more applicants than we can accommodate.

F. Trip Report

Dr. David Sands and Mr. Douglas Yount

April 9 - May 11, 1982. Middle East Trip.

April 9. Flew from Bozeman - Minneapolis - London - Casablanca. Arrived in Rabat by taxi.

April 10. Met with Lynn Gallagher and went to the Rabat Station (IAV Hassan) and proceeded to read 3 of our RSP's.

RSP5 pt: Tagged 200 plants, saw very little Net Blotch (NB) in the population but some of Matchett's lines nearby were heavily hit. The most prevalent disease was Powdery Mildew (PM) and selection was made on the basis of (1) no NB, and (2) no PM on top two leaves. Agronomic quality, big heads, stiff straw, were also considered. The incidence of PM in the population was about average compared to other plants around.

RSP5 eg: Tagged 200 plants, saw good selection pressure for PM. All plants selected showed relatively little PM. Overall, the population was not much more resistant to PM than RSP5 pt population but there was higher agronomic quality in it. Selection critera were (1) PM, (2) NB, (3) Agronomic (big heads and stiff straw) and, (4) leaf rust (not much selection pressure).

April 11. Went with Lynn to Merchouch Station. Tagged plants in Ramage's RSPs (some 26 of them). Good selection for (1) *Pseudomonas syringae* (PS), (2) agronomic, and (3) Net Blotch. We were able to find clean plants with very good agronomic quality. We tended to pick later maturity groups where symptoms were easier to read. Snapped 200 heads to bring back for a PS population. Collected samples with NB, PS, and *Xanthomonas translucens* (XT) from Ramage's populations (2nd year in Morocco). At Merchouch Station Lynn is selecting for agronomic qualities with disease resistance selections made in Rabat. Saw his advanced lines for irrigated and dryland production. His dryland selections had a bleached streaking at leaf curve - reminiscent of *P. syringae* - could be a problem.

Ouassou Abdullah showed us his durum problem. Yellow interveinal streaks on several varieties but not in all replications. We collected samples from the varieties Acsad 2, and Acsad V2 or V4. Also saw a fungal problem on some new line, to be released to replace durum line. Both have the same foliar leaf pathogen problem - maybe an *Ascochyta* or *Septoria*.

Coming back to Rabat saw a safflower line with no spines, 4 feet high or at least 3 1/2 feet. No disease on it (was a seed plot for the station). Also saw oats on Prince's farm. Observed H. victoriae like symptoms and crown rust, but H. victoriae was most severe.

April 12. Tagged plants in RSP4 pt 2 row population. Was lodged and looked pretty dismal. Very little net blotch in it, but a lot of mildew. Found maybe 50 fairly clean plants, selecting for (1) NB and (2) PM (not on flag leaf) and filled out with plants with halfway decent head size and somewhat stiff straw. The RSP4 pt population is not nearly as far along as RSP5 pt for Net blotch resistance.

In Rex Thompson's yellow dwarf population CC33A + CC33B tagged for (1) Yellow Dwarf (YD), (moderate selection) (2) PM and (3) NB. 50 plants were tagged.

In USDA cc 35 and cc 35a population - few tags used-selection primarily for PM. Looked like a narrow based population with a lot of male sterility in it. Also tagged maybe 6 plants in Ramages populations. Although they were the same populations as in Merchouch they looked very strongly stricken with PM, NB and quite a bit of incipient leaf rust. Agronomic type not so good - planted late and low fertility with heavy rain in sandy soil.

Ouassou took us to Institute for Agronomic Research. Met a new young PhD out of Samson's lab (Angus France) only there 3 weeks. Gave him subsamples of PS, XT and some unknowns mentioned above from wheat and barley, (yellow and bleached streaks respectively). Gave him a possible P. coronafaciens from oats.

April 13
Applied for Algerian Visas. Left passports overnight at United Arab Emirate's embassy.

Met with Mr. McSwain the AID mission in Rabat - He asked about expanding the research and training programs. He asked what we thought was needed. I said: 1. students that return, and 2. students trained in integrated agriculture.

Then to field and read 450 of Matchetts lines, on a 0-5 scale for Net Blotch. 2% were 1's, 20% were 2's, 70% 3's, 8% 4's no 5's or 0's. Tried to compensate for lateness. Some of symptoms were probably the spot form of net blotch. About 5% had P. syringae. Schaller's material - F_3 and F_2 couldn't find much that was mildew

resistant and/or NB resistant.

Heard Ogadir had 150 mm of rain in 2 days. Need barley that could go in fast and make some grazing tissue or leaves.

Met George Vorghees and Mekni at hotel and disussed disease problems with them and also Hessian fly (HF). HF causes plants to clump and maybe throw off only 1 or 2 small tillers. They were uncertain as to the type of HF that attacks wheat and barley, whether the species are the same or different.

April 14.
Solidarity Day - Proclaimed by King - Shut down all businesses etc. Went with Lynn to Rabat IAV Hassan and read oat plots - early and mid season oat nurseries. Found crown rust, yellow dwarf, powdery mildew, some sterility, and 2 other diseases. One probably was H. victoriae, symptoms were small red net blotch lesions. The second was possibly bacterial - maybe P. coronafaciens spots on folded part of leaf - sometimes with ring like bleaching farther out.

Had dinner with Gus Hall and Fran Young - Americans.

April 15
Drove to Meknes where Boleif is at ENA Agric. Univ. - saw facitities built by French in 1945, 350 students - courses 8-6 daily. Laboratories were adequate but empty. Saw his U. of Minn. PhD (advisor Wilcoxson) thesis project in 1st of 2 years on Helminthosporium gramineum (HG).

His two objectives:

1. Pathogen virulence assay and identification of races.
2. Determine genes for resistance in host. He developed a method (modified from S. Peterson) of sandwiching seed between agar inoculation, put in cold for 14 days, then planted. He got plots into no water, hand watered - had problem with sprouting. We discussed all this - talked about his taking S. Metz's data for selective medium. They have her paper.

Saw CIMMYT disease survey nursery. Saw Boleif's crosses R x S, M X S, SS, RR, and found in the greenhouse, diseases (fungal) and aphids (corn leaf aphid and oat, bird cherry aphid). Also saw pupae of predator insects.

On road 1/2 way back from Meknes to Rabat stopped to look

at a barley land race. Saw mostly net blotch, root and crown dark tan and plant weak at crown, suggestive of dryland root rot.

Received telex from Prescott advising not coming to Izmir nurseries flooded - drowned out.

Annoceur Stn. 15 to 20% of barley grown in Morocco at high altitude. This station at low end. Saw Ramage's winter /spring populations and early spring. Also Enrico Rodrigue's CIMMYT winter types. Some were heading - ranged a lot from population to population. Planted December 15. Tagged all fully headed plants if agronomically good and showing no signs of frost. Mildew was the main disease. No PS, no NB, no RS, no rust.

April 16. Flew to Algiers - on Saudi Arabian Airlines. Contacted the American Embassy and a lady in the cultural center (library) made a phone call to I.D.G.C. Found the Station director Lounes Hachemi was on vacation so H. Nazari helped us. Put us with Khaldoun Abdelhamed who is in cereals working with an Engineer degree from Algeria. Speaks good English, spent 1 week in O.S.U. and trained with CIMMYT. Populations were planted at Setif, Constantine, Gelmaand, Sidi, and Belames.

Barley was not studied in research fields at IDGC but at branch stations. It would be a good place to study diseases, YD, NB, PM, LR, RS, PS, FC, HG,. Looked at Prescott's trap nursery, data included, and 11 lines of theirs (Algerian). Only line 111 of Prescott's was showing unsual symptoms - large dark irregular blotches on 10% of plants - maybe seedborne. On stem (actually leaf sheath) as well. Rust and aphids on leafy spurge. Both were damaging it. Aphids were killing seed pods. Rust - looked like crown infection, lesions followed by leaf uredia and telia.

Khaldoun mentioned that his government has the money to send him to States to visit, if he receives a hand written letter. Also he would be willing to sign any statement saying he would come back. Wants MS, and has already done traineeship at CIMMYT.

April 18 Flew to Constantine. Met Station director (Mostefa Abdullah LAABASSI), 1979 Graduate of Churchill College - Cambridge. His thesis was Genetic Male Sterility in Wheat. Cytogenic Analysis and Application to Breeding Procedures. He was a student of Mr. J. Bingham. PBI Cambridge. He gave us a polite interview and was very interested in recurrent selection and has a durum system started. Said Bingham has a hexaploid male sterile system if we want it.

Met with breeder of wheat and barley and toured plots. Barley diseases seen. Raining heavily. Scald just starting but heavy.

PM - heavy; PS - None; LR none; NB - trace, YD - slight, HG - again a problem in most segregation and breeding lines, especially their own. Prescott's entries were free.

Populations were close planted - maturity was later than their adapted lines. They may have been planted later. Seed from populations may get infected with HG.

Populations NB and LR showed no symptoms of those diseases, and only traces in other lines. Should have had PM and RS there. Next year IDGC should be told to space plant, and given PM, RS, NB and LR, enough for four stations. Then they can handle the populations without us.

Saw the collective (state) farm where certified seed is grown. They had a big versatile tractor and lots of other fine equipment. In comparison, the research facility had very little. Met with Mr. Neziani Larri, Station Experimentale, El-Khroub, Constantine, Algeria, a weed scientist. Met with legume worker. I get the impression that IDGC in Algiers runs the show, the station researchers are to do as told.

April 19. Flew to Tunis a day late. Met with Warren Prawl (Extension), John Flickinger (Tunis Flood and Agr. St. Dept.) Bob Jackson and Willie McCuiston (OSU).

1. AID pulling out - completely by 1986.
2. They discussed methods various countries use to keep returning students. These include bonding (but who pays?); Khadaffi himself gives diploma upon return of students; incentive to return (in Tunisia people don't get paid for one year when they return), blacklist if they don't.

April 20. Amor picked us up at noon, went to Daaloul's office and met Harrabi there. Lunch with Moncef. He is first to come back and his treatment has not yet been worked out by government as yet.

Drove to LeKef, then south to Sabiata. Stopped at barley fields. Saw much Martin barley grown.
*Root Rot - considerable probably *Fusarium* possibly *Helminthosporium* (*- principal problem)
* Hesian Fly (*at least 10%* - probably 20%)
* Covered smut - considerable
Mildew - very little,

Net Blotch - trace.
H.G.
* Unknow White Striping disease infecting 5-30% of plants depending on field. Not always to all tillers. Saw it in oats and durum as well.

Night at Sabaita at Sofitel.

April 21 Back through Kasserive to Le Kef. Same disease situation as above.

At Le Kef saw the populations.
Net Blotch - looked excellent in terms of resistance to NB. Also looked good agronomically with some plants clean (leaf wise) and at same stage as Martin but with bigger heads. Tagged 200 for clear (leaf wise) and at the same stage as Martin but with bigger heads. Powdery mildew was main selection criterion.

Scald - very low incidence of scald there, needed warmer weather. Students will rogue for cleanliness of leaves and for agronomic type.
Leaf Rust - no symptoms
Yellow Dwarf A and B - low incidence of infection.

Drove back to INAT, arrived there at 4 PM, and gave seminar on Genetic Engineering in Agriculture. Daaloul translated, and was very good at translating.

April 22 - Went to INAT plots at Tunis with Moncef and a plant virologist (U. of Arizona PhD in saguaro cactus virus and vegetable viruses). Moncef and I went to Flickinger's office. I reported that we hoped M.H. would team-up with young INAT researchers and that we could try to help with references etc. to enable them to drum up some support. Hoped Flickinger would do some. RSP-5 pt, RS, PH nurseries and BYDV 33 A & B population were free of disease symptoms except for powdery mildew. RSP's looked good agronomically, but shorter at Tunis than at LeKef. Scald was just appearing especially in highly susceptible lines. Saw Ascocyta, Rust, and Broadbean Mosaic in Vicia faba.

April 22 Flew to Cairo - Stayed at Hotel Concordia - met at airport by AID driver - took 1 hour to get visa.

April 23. Friday Holiday - Virgil and Nan took us to local market.

Saturday April 24. Gemminza Egypt Station Field Day - heard politicians (Gov. of State and Ministry of Agriculture) - very few farmers maybe 40. After speeches, farmers weren't seen. Toured plots, no plot

book so it took time to find RSP's. RSP's were #5 RS and PT and PH. Very little RS and PT in any barley but some PH. in all. More disease pressure at Sakha so didn't rogue or tag these plots. Looked at Virgils RSP's after two generations of sieve selections (2% largest). Agronomically this RSP 1980 scald population looked very much better than 1982 RS population. No indication of disease increase due to selection but no disease pressure.

Rat damage high in wheats. Sakha 01, Giza 15 and Starbess were all heavily favored by rats (suggested that it would be nutritional). Virgil also mentioned problem of mole crickets in barley seedlings after maize. I said we would send taste repellant.

Aphid problems - S. graminun. R. padi were evident but not overwhelming.

Gemiza station had a cv of 5% whereas other stations had 15-20% variation.

Barley breeding only done at Sakha, not Gemiza, Giza or Sids.

RSP5 rs for earliness was observed - about 7 days earlier than normal.

April 25 Stayed at Sakha Hilton (guest house) along with mosquito guests. This is high alkaline area as evidenced by onion tip burn.
Tagged 6 RSP's
RSP5 - RS - Rust was principle selector with some selection for agronomic character.
RSP5 - Ph - agronomic.
PH had least rust - moderate on the average
RSP5- Pt - Pt & RS about the same - plants in these 2 populations had already been tagged for PT resistance. No scald was seen. Scald is seldom seen at Sakha. Too much rust to be sure of other diseases.

Selected early plants with low level of rust in several of Virgil's populations.

Read their F_4 "yield" trials - 90 of them. They were still segregating (head type and resistant reaction). Some had ratings of 2 for rust, snapped heads of all 2's and some 3's including two 2-row 3's. Agronomically they were very good and in terms of rust resistance or tolerance they were excellent in comparison with all the IPON lines (about 1000) from ICARDA.

Lots of aphids at Sakha. Maybe it would be good for a

set up with aphid spreader rows planted earlier. Giza would be good as would Sids. PM and PT were present and can be serious here (especially PT), but until rust is taken out it is difficult to see. PS was very common but not enough for selection nursery. Their F_4 have not been selected for this and there were big differences between lines.

April 26. Giza. Gave an hour-long seminar. Doug Yount on Recurrent Selection Populations, Dave Sands on Various Aspects of Genetics and Fast Screening methods. Met with Gomaa (Director of EMCIP and discussed progress and problems associated with choosing trainees and with getting the plant physiological screening lab off of dead center.

Doug toured barley nursery there, found yellow dwarf, PM, NB and some RS. Barley program there is limited, with larger trials going to Sakha, etc.

April 27. Went with the Drs. Gomaa and Dr. Rashad to Sids. There we saw a well run station but mostly durum breeding with some very advanced lines in terms of agronomic type. For barley, only the advanced line yield trials. Not much disease there. Lots of aphids even though they had sprayed three times. PS was in fairly high amounts.

Met Mr. Maher Noamid, a plant breeder - agronomist who expressed a real interest in being a trainee. Sayed was also there but because of his language problems, he was at a distinct disadvantage. Maher eventually wants to go to grad school.

May 1, Nicosia Cypress met with Dr. Hadjichristodoulou and Mr. Andreas Karis (BS level breeder) at the Agriculture Institute. Toured lab facilties and 4 field plots in Nicosia and surrounding area.
Principal diseases were:

- Leaf Rust - no resistance except in Athenais.
- Net Blotch - traces to moderate
- RS - heavy on some varieties
- PS - big difference in varieties.
- BYDV - Very little, few aphids, did see corn leaf aphid.
- PM - some - said to be worse earlier.

Athenais is most common variety, in fact was only variety until new line Cantata was put out 5 years ago. Athenais is resistant to rust and scald, and scald was almost non-existant when Athenais was only variety. Net blotch was Athenais' problem (and PM). Cantata was then introduced, resistant to net blotch, but RS susceptible. We suggested that the RS maybe a single race, but no

evidence pro or con.

As far as breeding work is concerned, they have an excellent effort, but are having trouble finding lines that out yield Athenais or Cantata. Their interests are yield stability and plasticity, as they have a very variable climate.

We mentioned our RSP's for scald, and leaf rust and he was very interested. Also he would like to read Virgil's thesis, as he thinks the science of plant breeding requires component analyses and is heading his program in that direction. He has a summer F_1 nursery high in mountains with irrigation.

Principal cereal crop is barley. Wheat is 10%. 90% of barley is dryland. 150-500 mm rainfall.

Andreas Karis is interested in MSU grad school and has nearly completed application. He is married, two children, and would certainly return to continue his effords here. His English is halting but he is an excellent prospect otherwise.

May 2. Visited ABCE trials (advanced selection yield trials in progressing years) near Larnica airport.

Saw (plants were early and nearly dry) considerable scald (up to 40% of leaf area), leaf rust, and net blotch (up to 20%). Root rot was prevalent, maybe F. culmorum.. All lines had Hessian fly pupae. Incidence was high, sometimes the first plant examined.

May 3. Arrived in Damascus. Visited USAID mission, reported in to them, then left by taxi for Aleppo, 4 hours, 8 stops for "passport control".

May 4 & 5. Met with Mekni, Kamel and Yup. Mohammed Masrief took us through RSP's. In two days we looked at 9 RSP's at Tal Hadia

RSP5-Pt - No net blotch, selected for PM, and agronomic characters.
RS - No scald or very little, selected for PM and agronomic
PM - Selected for PM, good agronomic and PS
PH - No leaf rust, medium selection pressure on stripe rust so selected for that and agronomic, and for PS.

Agronomic F_2 backcross into RSP

RSP5 - Pt crossed to 3 Agronomic lines in F_2
Some net blotch selected for PM

RS - Crossed Agronomic in FL
Some scald, selected for PM
PM - Lost some resistance
PH - didn't do anything with possible BSMV in some of their populations, Have samples.

Salt Tolerance RSP - planted in uneven ground, all were short and early. Suggested that he bulk the population, and put in a salty area.

Notes - RSP's (uncrossed ones especially) - generally looked very good agronomically. Powdery mildew was the chief problem in them, but there was some yellow rust starting and PS starting. Saw some BYDV, but no real uniform pressure. Mohammed works these populations, often after hours. He is becoming the technician in charge of seed production.

Met that evening with Williams a cereal quality man (Winnipeg) and Walt Nelson a CIMMYT worker on durums in the region. Both were very interesting. Attended the Seed Technology Workshop Award Banquet, presided over by Jit Srivastava and Dr. Nour.

Later that evening we went to Srivastava's house where we discussed future direction of RSP work, of trainees, of pathological problems etc. He wants to hire a physiological geneticist to work with his breeders. His big interest appears to be in salt tolerance and drought resistance and development of fast and efficient screening techniques to detect tolerant germplasm.

May 6. We gave seminars to ICARDA staff at Tel Hadia at 7 A.M. Seminars titled Recent Progress with Recurrent Selection Populations, and Prospects for Genetic Engineering. There was a lot of discussion. Then with Youp and Altounji we drove to Latakia. Before leaving we found Xanthomonas in barley, and found a virus problem in durum. We demonstrated a simple mechanical transmission experiment. Also suggested seed testing and soil testing and aphid testing for transmission. Walt feels he has seen this problem in Obregon, CIMMYT station. Saw at Tal Hadia seed production fields. There was tremendous variability in the field (in durum). Drove to Latakia. Visited station South of town, where the barley was pretty far along. Powdery mildew, (on late plants), stripe rust on wheat, but no Xanthomonas and very little net blotch, and very little BYDV was observed. Station was not irrigated (800 mm of rain). Quite a few weeds.

Local fields had lots of leaf rust, some root rot problems, and very little else. Collected Septoria samples from durum and breadwheat. Also some unusual

spot blotch symptoms on durum and triticale.

May 7. Drove inland to the irrigated Valley - El Cob station. Beautifully kept station. A station employee had died of herbicide poisoning - antidotes were not written in Arabic, so doctor gave 2 aspirin. Youp has all antidotes translated.

Saw crossing blocks. IPON, etc. In 1200 lines found 1 variety with *Xanthomonas*. It was spreading to several lines 5 m away. XT Symptoms were severe. Also saw it on bread wheat and durum, but on very few lines. Other diseases at El Bob were PM, RS, PS severe on some, not much rust, net blotch or yellow dwarf.

ALGERIAN BARLEY ENTRIES RATED FOR THE INCIDENCE OF DISEASES [1/]

Barley Entry	YD	NB	PM	LR	BLB	RS	HG	FC/FG
1	+	-	-	-	-	+	-	-
2	+	+	-	-	+	+	+	-
3		+	-	+	+	+	+	-
4	+	+	HR	-	+	+	-	-
5		+	+	-	+	+	-	+
6	+	-	+	-	+	+	+	-
7	+	+	+	-	+	-	+	-
8	+	+	HR	-	+	-	+	+
9	+	-	-	-	+	-	-	-
10	-	-	+	-	+	-	-	-
11	+	+	HR	-	+	-	-	-

1/ A + or - indicates the particular diseases was present or absent in the barley entry respectively. HR represents a hypersensitive plant reaction to powdery mildew infection.

2/ YD = barley yellow dwarf; UB = net blotch; PM = powdery mildew; LR = leaf rust; BLB = bacterial leaf blight; RS = barley scald; HG = barley stripe; FC/FG = Fusarium Root Rot.

DISEASE RATINGS FOR BARLEY ENTRIES IN THE CIMMYT REGIONAL DISEASE TRAP NURSERY[1/]

Barley Entry	Diseases[2/]							
	YD	NB	PM	LR	BLB	RS	HG	FC/FG
91	-	-	-	-	+sl	-	-	-
92	-	+	+	-	+	-	-	-
93	+	+	-	-	+	-	-	-
94	+	+	-	-	+	-	-	-
95	+	+	-	-	+	-	-	-
96	-	-	HR	HR	+	-	-	-
97	-	-	HR	-	+	+	-	-
98	+	+	HR	-	+	+	-	-
99	+	-	-	-	+	+	-	-
100	+	-	HR	-	+	-	-	-
101	+	-	HR	-	+	+	-	-
102	+	+	-	-	+	-	-	-
103	+	+	-	-	+	-	-	-
104	+	-	-	-	+	-	-	-
105	+	+	HR	-	-	-	-	-
106	+	-	HR	-	+	+	-	-
107	+	-	HR	-	+	-	-	-
108& 109	+	-	-	-	+	-	-	-
110	+	+	-	-	-	-	-	+
111	+	-	+	-	+	-	-	-
112	+	-	-	-	+	-	-	-
113	+	-	-	-	+	-	-	-
114	+	-	-	-	+	+	-	-
115	+	+	-	-	+	-	-	-
116	+	-	+	-	+	-	-	-

1/ A + or - indicates the particular disease was present or absent in the barley entry respectively.

2/ YD = barley yellow dwarf; NB = net blotch; PM = powder mildew; LR = leaf rust; BLB = bacterial leaf blight; FS = barley scald; HG = barley stripe; FC/FG = Fusarium Root Rot.

G. Visits and Presentations

T. W. Carroll

Gave a presention entitled "Sensitive Serological Detection of Barley Stripe Mosaic Virus in Barley Seed" for the workshop on the serological detection of viruses and bacteria in seeds. Annual Meeting of the American Phytopathological Society at Salt Lake, August 8-12, 1982.

Presented an invited paper on Certification Schemes Against Barley Stripe Mosaic at the International Symposium on Seed Pathology, Copenhagen, Denmark, October 11-16, 1982.

Visited three agricultural experiment stations in Chile to assess the research project on breeding wheat for tolerance to barley yellow dwarf.

Valerie N. Hall (Sands)

Presented paper entitled "Bacterial Leaf Streak of Cereal Grains" at CIMMYT in Ciudao Obregon, Mexico and assisted in setting up a selection program for *X. translucens* resistance, April 3-8, 1983.

Presented paper describing Bacterial Crown Rot by *Pseudomonas syringae* at Crop Science Dept., Oregon State University, Corvallis, Oregon. Assisted in arranging further experiments with the disease as it relates to wheat: April 13-17, 1983.

D. C. Sands

Visited University of Idaho Experiment Station, Aberdeen, Idaho, to select for resistance to *X. translucens* in barley: August, 1982.

A. L. Scharen

Agristars - Ft. Worth. Report included reflectance differences in BYD inf and Control.

E. L. Sharp

Co-author of paper presented at 1982 National Meeting of American Phytopathological Society. Reinhold, M., E. L. Sharp and H. E. Bockelman. Virulence patterns of *Puccinia hordei* in Texas and sources of resistance in barley.

Consultative trip to Tunisia in May, 1982 on diseases of barley. Funded by Mid-America International Agricultural Consortium.

Organized external review of Department of Plant Pathology, M.S.U., Bozeman, March 1982. Review by External plant pathologists and CSRS.

H. Visitors

Discussions included barley disease work and associated breeding

April 13-14, 1982

Kamil Yakar - Ankara, Turkey
Fobri Altay - Eskisehir, Turkey
A. Erlug Firat - Diyarbakir, Turkey

August 20, 1982

Ron Barnett - University of Florida, Quincy, Florida
Darrell Morey - Univ. of Georgia
Tifton Small Grain Breeders

October, 1982

Dr. Mike Prescott, CIMMYT (Mexico). Discussed CIMMYT projects relating to plant pathology.

H. Q. Kaback, Germany

David J. Hass - Great Falls, Montana

Fred Maelsen - Knoxville, Tennessee

August 3, 1983

Carlos R. Pierson, Ufpel - Pelonas RS, Brazil

Jose Mauricro Fernandes - Embraia - Passo Fundo - RS, Brazil

November 4, 1982

Louis P. Reitz, Sun City, Arizona

January 25, 1982

Philip J. James - Fremont, Nebraska
Philip E. Dorr - Decatur, Alabama
John Phillips - Omaha, Nebraska
George Harfer - El Dorado, Arkansas
Steve Hull - El Dorado, Arkansas

I. Publications

Bockelman, H. E., D. C. Sands, and A. L. Scharen, 1982. An inoculation technique for *Pseudomonas syringae* on seedling barley. American Phytopathological Society Abstracts.

Bockelman, H. E., E. L. Sharp, and Bjarko, M. E., 1983. Isolates of *Pyrenophora teres* from Montana and the Mediterranean region that produce spot-type lesions on barley. Plant Disease 67:In press.

Bockelman, H. E., M. Reinhold, E. L. Sharp, and R. F. Eslick. 1983. Registration of leaf rust resistant barley composite cross XLI. Submitted to Crop Science.

Bockelman, H. E., E. L. Sharp, R. F. Eslick, and R. T. Ramage. 1983. Registration of powdery mildew resistant barley composite cross XLII. Submitted to Crop Science.

Bockelman, H. E., R. F. Eslick, and E. L. Sharp. 1983. Registration of scald and net blotch resistant barley composite cross XLIII. Submitted to Crop Science.

Bockelman, H. E., E. L. Sharp, D. C. Sands, A. L. Scharen, D. E. Mathre, T. W. Carroll, J. Riesselman, and R. F. Eslick. Spanish translation of Field Manual of Common Barley Diseases.

Carroll, T. W., S. K. Zaske, and R. H. Brlansky. 1982. Separation of Montana isolates of wheat streak mosaic virus on Michigan Amber wheat. Plant Dis. 66:916-918.

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Krupinsky, J. M., and A. L. Scharen. 1983. A high humidity incubation chamber for foliar pathogens. Plant Disease. 67: No. 1.

Mathre, D. E. 1982. Compendium of barley diseases. American Phytopathological Society, St. Paul, MN. 78 pp.

Miller, R. V., W. W. Esty and D. C. Sands. 1982. A mathematical formula for predicting plasmid loss. Phytopathology 72:1001. Abstract.

Reinhold, M. and E. L. Sharp. 1982. Virulence types of Puccinia hordei from North America, North Africa and the Middle East. Plant Disease 66:1009-1011.

Scharen, A. L., J. M. Krupinsky, and D. A. Reid. 1983. Photosynthesis and yield of awned versus awnless isogenic lines of winter barley. Canadian J. of Plant Sciences 63 (2). In press. April, 1983.

Sharp, E. L. 1982. Breeding for pest resistance in barley. Invitational chapter for ASA monograph on barley. In press.

Sharp, E. L. and M. Reinhold. 1982. Sources of resistance to Puccinia hordei in barley. Plant Disease 66:1012-1013.

Yount, D. J. and T. W. Carroll. 1983. Barley yellow dwarf luteoviruses in Montana cereals. Plant Disease (Accepted, subject to minor revision).

J. Literature Cited

Gildow, F. E. and Rochow, W. F. 1983. Barley yellow dwarf in California: Vector competence and luteovirus identification. Plant Disease 67:140-143.

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Quimby, J. R. 1975. The genetics of sorghum improvement. J. Heredity 66:56-62.

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Table 1. Description and current status of the barley recurrent selection populations for disease resistance, Spring 1983.

Name	Resistance to Disease	2 or 6 row	C.C.#	cycles	Locations where selected: Montana	California	Georgia	Maryland	Texas	Mexico	S. Korea	Morocco	Tunisia	Egypt	Syria	Turkey	France	Idaho
RSP-5 Rrs	scald	6	36	6	✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	
RSP-5 Rpt	net blotch	6	38	5	✓	✓				✓	✓	✓	✓	✓	✓		✓	
RSP-5 Rrs-Rpt	Scald & net blotch	6	43	2	✓	✓												
RSP-5 Rph	leaf rust	6	41	4					✓	✓		✓	✓	✓	✓	✓		
RSP-5 Reg	powdery mildew	6	42	3	✓					✓		✓		✓	✓		✓	
RSP-5 Rxt	bacterial streak	6	-	4	✓					✓						✓		✓
RSP-5 Rps	bacterial blight	6	-	3	✓													
RSP-5 Ruh	covered smut	6	-	3	✓													
RSP-4 Rrs	scald	2	-	2	✓													
RSP-4 Rpt	net blotch	2	-	2	✓													
RSP-4 Rph	Leaf rust	2	-	2								✓						
RSP-4 Rrs minor	scald	2	-	3	✓													
RSP-4 Rpt minor	net blotch	2	-	4	✓													

Table 2. Reactions of 100 random F_2 lines from RSP-5 Rrs (1982) to two isolates of *R. secalis* in the greenhouse.

	Number of lines	
Reaction	Isolate Hfn(MT)	Isolate 81 Beja(Tun)
Resistant	38	15
Segregating	56	81
Susceptible	6	4

Table 3. Reaction at different recurrent selection cycles at San Antonio.

Cycle	percent plants resistant	susceptible
Base population	35	65
1	50	50
2	60	40
3	80	20
4	85	15

Table 4. Sources of the Yd_2 gene and male sterile genes for RSP-BYD.

RSP-5 Rrs-Rpt

Atlas 68 (Yd_2 from 3920)
California Mariout 67 (Yd_2 from CI 2376)

CCXXXIIIA and CCXXXIIIB

CI 1227 (Benton)
CI 1237
CI 2376
CI 14119 (Abate)

California Mariout - msg 1
CCXXXII - msg 2

Sutter/Manchuria

Sutter (Yd_2 from CI 1237)
Manchuria - msg 10

Table 5. *Rhynchosporium* resistant sub-populations selected for adapted photoperiod and heading date responses using Beecher and Martin check varieties, in Bozeman, 1981.

Pop No.	Population phenotype: Seed type		Fertility		Maturity		photoperiod classification		
	covered	naked	fertile	sterile	very early	early	Beecher (grams harvested)	Martin (grams harvested)	Normal (grams harvested)
1		X	X			X			
2		X	X			X	1550	1836	
3		X		X		X	1550		
4		X		X	X				4230
5		X	X		X		818	1459	
6	X			X	X				
7	X			X		X	1050	2050	
8	X		X			X	1936	2444	
9	X		X			X			
10	X		X		X		953	1697	
11*	X		X			X	2389	816	

* 1980 Bozeman drought selection subpopulation of RSP5.
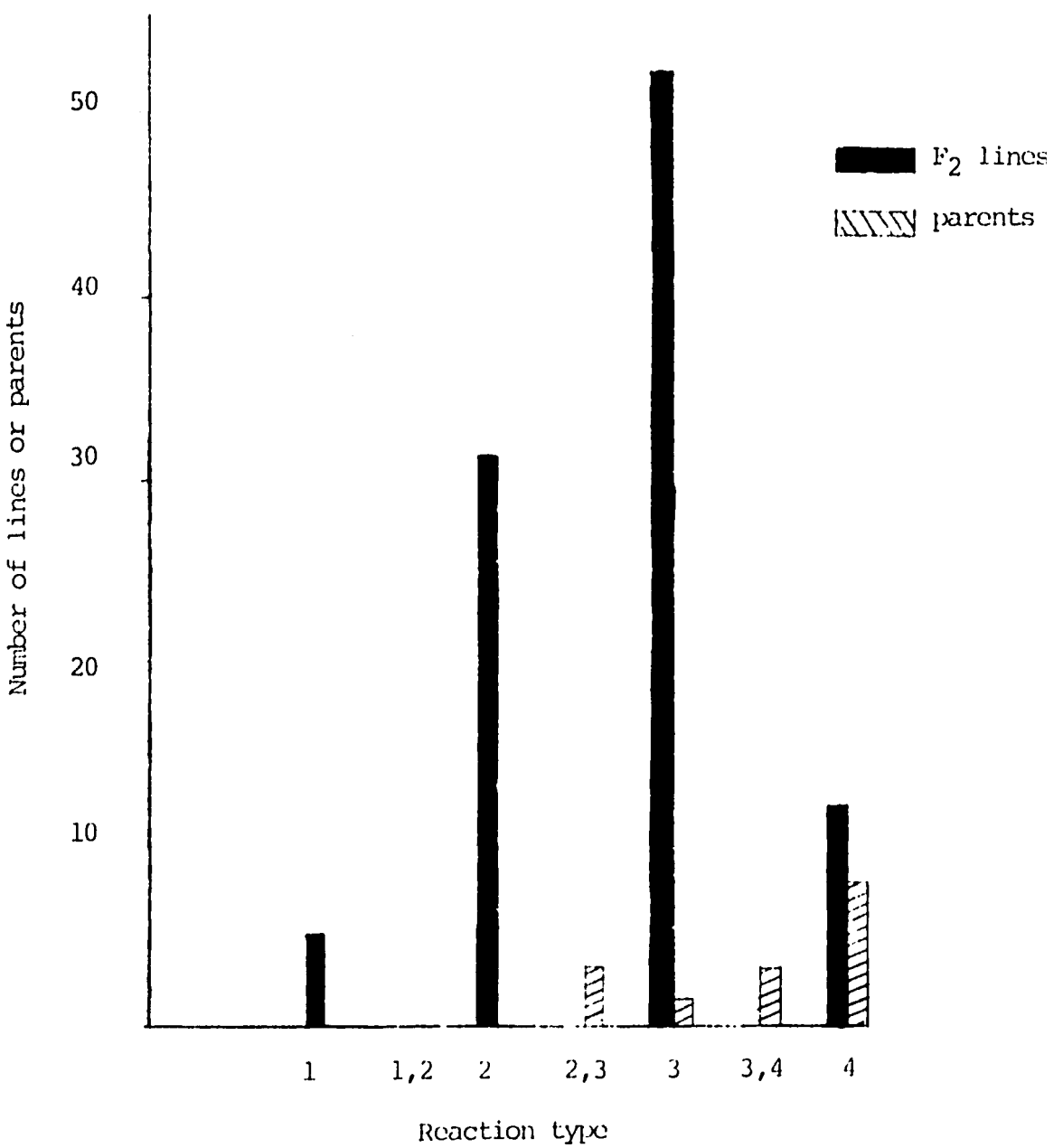
Figure 1. Lowest reaction types of parents and 100 random F_2 lines from RSP-4 Rpt minor (1982) inoculated with a Montana isolate of P. teres in the greenhouse.