Improvement of Winter Wheat for Developing Countries Based on Hybridization of Spring x Winter Forms

Annual Report

July 11, 1980 through July 10, 1981

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for the period

July 11, 1980 through July 10, 1981

Oregon State University

Contract AID/ta-c-1352

Summary Statement

Materials presented in this annual report reflect the accomplishments made since the major project review conducted from July 8 to 11, 1980.

Three major categories are discussed under the plan of work. They include: 1) the spring x winter wheat hybridization, evaluation and dissemination activity; 2) the graduate training program; and 3) the in-country training program.

A summary of publications, participation in meetings and country reviews, past and present graduate students, evaluation of the effectiveness of the program and plans for the coming year are also provided. Included in the Appendix are: germ plasm received this past year, list of cooperators, linkages and 1980-81 visitors to the program.

Annual Report (8/11/80 - 8/10/81)

Improvement of Winter Wheat for Developing Countries Based on Hybridization of Spring x Winter Forms

Contract AID/ta-c-1352-Research

July 10, 1981

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I. Project Statement

Statistical

Contractor

Oregon State University
Corvallis, Oregon 97331

Principal Investigators:

Dr. Warren E. Kronstad
Professor, Plant Breeding and Genetics

Dr. Willis L. McCuistion
Associate Professor, Plant Breeding and Genetics

Dr. Fred A. Cholick
Research Associate, Plant Breeding and Genetics

Duration: September 30, 1979 - September 30, 1982

Funding by Fiscal Year:

FY 79-80	$301,000
FY 80-81	$400,000
FY 81-82	$496,141
TOTAL	$1,197,141

Personnel

ADMINISTRATION

Robert MacVicar	President, Oregon State University
Leo Parks	Dean of Research
John Ringle	Dean of Graduate School
Ernest Briskey	Dean of the School of Agriculture
John Davis	Director, Agricultural Experiment Station
Wilson Foote	Associate Director, Agriculture Experiment Station
Dale Moss	Head, Crop Science Department

DOMESTIC AND INTERNATIONAL CEREAL BREEDING AND GENETICS PROGRAM

		% Financial Contribution		
		OSU	AID	ARS
Warren Kronstad	Professor - Project Leader	100		
Willis McCuistion	Associate Professor, International Outreach		100	
Fred Cholick	Research Associate, W X S Program		100	
Mary Verhoeven	Instructor, Barley and Wheat Breeding	90	10	
Nan Scott	Instructor, Data Processing	75	25	
Patrick Hensleigh	Research Assistant, Field Operations	80	20	
Colleen Mork	Research Assistant, Seed Distribution	10	90	
Tom Fairweather	Research Assistant, Field Operations	10	90	
Rebecca White	Research Assistant, Grain Quality Analysis	10	90	
Ann Corey	Research Assistant, Barley and Wheat Breeding	70	30	
Kathleen Miller	Administrative Assistant, Budgets and Accounting	50	50	
Kathleen McCarthy	Secretary, Correspondence, Seed Shipments		100	
John Frederickson	Graduate Research Assistant (.5 Assistantship)		100	
Byung Han Choi	Graduate Research Assistant (.5 Assistantship)		100	
Michael Marciniak	Graduate Research Assistant (.15 Assistantship)		100	

COOPERATORS

Bob Metzger	Professor (USDA), Cytogenetics and Triticale			100
Chuck Rhode	Professor, Cereal Breeding - Columbia Basin Ag Res. Ctr.	100		
Mathias Kolding	Senior Instructor, Triticale and Barley - Columbia Basin Ag Res. Ctr.	100		
Michael Glenn	Research Associate, Dryland Agriculture	100		
Robert Powelson	Professor, Plant Pathology	100		

II. PLAN OF WORK

A. Spring X Winter Program

1. Germ Plasm Bank

Currently 1900 entries make up the winter wheat germ plasm bank. These lines represent material which have been received from cooperators located throughout the world. The material is first grown in an observation nursery grown on the Hyslop Farm. Each line is evaluated and classified for its desired attributes. In contrast to the germ plasm collections maintained by the USDA or FAO, this material represents a working collection of superior strains or cultivars which can be used directly to provide promising segregating populations. Exotic or older varieties and progenators including samples of this collection will be sent to the USDA germ plasm centers for long term preservation.

Each year this germ plasm collection will increase as new introductions are received, evaluated and cataloged as to their strengths. Through the network established by the spring x winter wheat program over 2500 new lines or segregating populations are being received each year. A list of such material received this past year is provided in the Appendix Table 1. There appears to be very little problem with political concerns in the sharing of germ plasm with various countries at this time. Mr. Heng-li Wang, a senior scientist from the People's Republic of China (PRC) spent a year with the program. He brought 50 experimental lines and cultivars from the PRC to incorporate in to the spring x winter program. This material is far better agronomically than that previously received from the PRC. It is characterized by early maturity and excellent winterhardiness, a combination which has been difficult to achieve in most wheat breeding programs. The most promising selections from this material will be sent to South Korea and other countries where earliness is needed in multiple cropping systems. Thirty of the most promising lines will be placed in the germ plasm collection this year.

As improved selections are developed through the parent building phase of the program, they will also be included in the germ plasm bank for subsequent dissemination. This aspect of the program involves the improvement of potential parental strains developed to carry known sources of disease or insect resistance, aluminum tolerance, improved nutritional properties and other desireable attributes.

Initial computer programs of a data base system for the germ plasm bank have been written. Each line is cataloqued according to available data on: origin, strengths, years in the crossing block, number of times used as a parent, progeny remaining, growth habit, tillering capacity, genes for necrosis and Smut resistance, quality, seed class, protein, test

weight, Leaf rust, Stem rust, Stripe rust, Mildew, Septoria, Barley Yellow Dwarf Virus, green bug resistance, Cercosporella, take-all, Cephelasporium, winter survival, lodging, heading, maturity, grain filling period and height. Data will be updated each growing season. The data base has been compiled and cataloging and data update programs have been written.

The system will be expanded to include interactive programs which will allow the researcher to request a list of lines with certain desireable characteristics so that seed requests from cooperating countries can be filled more efficiently. Such programs will enable the wheat breeder to plan crosses more effectively by making use of the wide genetic diversity in the bank. General information concerning the combining ability of each line will accelerate the improvement process because the breeder will not waste time on unproductive parental combinations.

A bank inventory program will also be written to keep track of the seed stock of each entry and to indicate which lines should be grown to replenish stocks or renew viability.

2. Genetic Diversity

It is apparent that the concept of systematically crossing spring x winter wheat is providing increased genetic variability for both the improvement of spring and winter cultivars. Currently 30% of the entries in the spring bread wheat international screening nurseries sent out by CIMMYT have some winter wheat parentage. More specifically, the most promising new varieties being released for the Yaqui Valley of Mexico represent products of the spring x winter program. A similar story is unfolding on the winter side with the superior yielding materials coming from the winter x spring program rather than from winter x winter crosses. This is not only true for yield and yield stability but for many other desireable attributes. One specific example has been the resistance to Septoria tritici which as been transferred into the winter background from the "Bobwhite" and "Buck Buck" spring wheat materials. Also, with the worldwide incidence of Barley Yellow Dwarf Virus it would appear that sources of tolerance are found in a limited number of spring cultivars (Anza, Alondia) and winter types (Yamhill, Ribesel). Since tolerance is not complete, it will be necessary to combine sources which hopefully are additive in order to achieve adequate levels of tolerance. A more detailed presentation on the impact of this increased genetic diversity from spring x winter crosses will be presented in the section of this report dealing with the overall effectiveness of the program.

It should be noted that with the additional genetic variability resulting from crossing spring x winter gene pools, several new areas are being brought into wheat production. One region is the highlands of Peru where several entries in the IWSWSN have appeared especially promising. This aspect of the program will be covered in detail under the in-country training portion of this report.

3. Incorporation of Superior Nutritional Properties

Two years ago breeders from the program made extensive selections of the high protein materials identified by the University of Nebraska and grown at Yuma, Arizona. Emphasis was placed on selecting lines which were not only high in grain protein but agronomically promising. This material has subsequently been evaluated and the superior types incorporated into the winter x spring F1's using three and four way crosses. Based on the findings from the University of Nebraska regarding the lack of genetic variation for lysine, no attempt is being made to select for this quality factor.

Following preliminary visual selection for kernel quality, this past year all of the F4 lines (3720) were screened for protein and hardness using an infrared analyzer. The retention of a higher pecentage of high protein lines will be possible by making such an evaluation as well at the F4 generation.

The concern regarding the possible negative relationship between grain yield and protein was investigated by two graduate students as a part of their M.S. dissertations. From the results obtained any potential negative relationship appears only after yield levels reach six tons per hectare. Since most winter wheat is grown under conditions where such yields are rarely attained, this possible association does not appear to be a problem. Also, several lines were identified which are much more efficient in translocating nitrogen from the vegetation to the grain. Such lines will be used in future crosses.

All entries identified for the IWSWSN are evaluated for protein and hardness using the infrared analyzer. This, coupled with the visual selection for hard and viscous kernels, should assist the breeders in the Less Developed Countries (LDC's) in selecting those lines with improved quality when grown in their nurseries. Complete milling and baking data will be provided on materials now being sent out to the cooperators through the replicated SXW yield trials. Such data will be available for a number of end product uses depending on the needs of the specific LDC.

4. Selection Pressures and Early Generation Segregating Populations

This past year four additional testing sites were added to complement the information and evaluation obtained from the three sites in Oregon. Selections (F5 and F6's) which are being advanced to the Preliminary Yield Trials were sent to Toluca, Mexico along with F3 populations. Here the lines were artificially inoculated with races of leaf and stem rust not present in Oregon, providing an opportunity to select a broader spectrum of resistance In addition, a severe infection of BYDV, Fusarium nuvale and numerous other disease complexes were present. It should be noted that frost injury was also recorded at this site. To evaluate those factors which are limiting in the Middle East, segregating populations were also sent to three locations in Turkey. These included Izmir where all the major diseases of wheat of the region are found,

Ankara, a dryland site on the Anatolian Plateau and Eskisher which is located in the transitional or intermediate rainfall area. Breeders from OSU visited all locations and evaluated the material. Those populations which appeared promising at these sites were then harvested at Pendleton in Oregon. Since in Turkey the material represented advanced generations, it was not necessary to harvest seed since the same populations were grown in Oregon and matured at a later date. The Turkish cooperators did make extensive use of this material for their own programs. In Mexico the materials represented F3 populations therefore, individual plant selections were made in addition to evaluating F3 populations.

By growing these generations over such diverse locations it is possible to identify lines which exhibit both wide and narrow adaptation for the IWSWSN. This is very important when evaluating lines which have high and stable yields and attributes for specific LDCs. However, this coming year only the lines being advanced to the Preliminary Yield Trials (F5 and F6) will be grown at Toluca, Mexico and the three sites in Turkey, in addition to the three locations in Oregon.

At the three sites in Oregon (Hyslop, Moro and Pendleton) a very mild and wet winter and spring was observed this past year. A major epidemic of Septoria tritici occurred at the high rainfall Hyslop site. Also, severe BYDV, Stripe rust, Leaf rust and some root and crown rot diseases provided good information in terms of identifying resistant types. Excellent yields (largely due to late spring rains) were obtained at the dryland site at Moro. In the segregating populations, the major disease was a head infection of Stripe rust. Just prior to harvest, hot temperature and strong winds also gave a measure of shattering resistance. The intermediate rainfall site at Pendleton also benefited from the late spring rains. However, Septoria tritici, Leaf and Stripe rust, Powdery Mildew and Cercosporella foot rot were present at high enough intensities to make selection effective. In Table 1 the number of individual populations grown at each location are presented.

5. Screening Nurseries

The international winter x spring (IWSWSN) was sent to 86 cooperators in 48 countries this past year. There were 70 cooperators who returned the requested information or indicated why the data were not available. This is an excellent 77% response. The nursery was grown at 15 locations in the Southern Hemisphere in 1979 and 71 locations in the Northern Hemisphere during 1979-80 crop season.

a. Yield, Earliness and Winterhardiness

One specific selection, ANZA/4/VIL29/VG8081//INIA S/ 3/55-1744/DRC (94), noted in Table 2, ranked high in yield, earliness, winterhardiness and was also high in resistance to leaf rust and overall performance in all three rainfall zones. The cross ANZA/3/P162/MAR59//HYS (116) was also noted for yield, earliness, stripe rust resistance and overall

Table 1.

Location	Generation	Lines Planted
Toluca, Mexico	F6 (PYT)	575
	F3	3280
Izmir, Turkey	F4	2170
	F5	1910
	F6	830
	F7	240
Ankara, Turkey	F4	2170
	F5	910
Eskishier, Turkey	F5	1000
	F6	830
	F7	240
Corvallis, Oregon	F2 MASA	420
	F2 IP*	1790
	F3 IP	4970
	F4 IP	3720
	F5 IP	3240
	F6 IP	1190
	F7 IP	370
	PYT**	825
	AYT***	450
Moro, Oregon	F4 IP	3720
	F5 IP	3240
	F6 IP	1190
	F7 IP	570
	PYT	825
	AYT	363
Pendleton, Oregon	F2 MASA	420
	F2 IP	1790
	F3	4970
	F4	3720
	F5	3240
	F6	1190
	F7	370
	PYT	825
	AYT	380

*Handled as individual plants within lines.
**Preliminary Yield Trials
*** Advanced Yield Trials

TABLE 2. CULTIVARS OCCURRING THREE OR MORE TIMES IN THE SUMMARY TABLES 4 THROUGH 14

ENTRY NO.	PEDIGREE	CHARACTERS[1/]								ZONES		
		YIELD	DAYS TO FLOWER	WINTERHARDINESS	STRIPE RUST	LEAF RUST	STEM RUST	SEPTORIA SP.	P. MILDEW	LOW MOISTURE	INTER. MOISTURE	HIGH MOISTURE
2	Bezostaja	X		X							X	X
4	Roussalka		X							X	X	X
10	ROM F34-70//BB/GLL			X						X	X	
33	II58-57//YMH/2*P101		X				X			X	X	
45	55-1744/7C//SU/RDL	X			X		X					
48	MNL/3/BMAN/7C//CDL		X								X	X
56	ANZA/SDY		X	X						X	X	
63	OR342//WRR/MN5412/3/CID/MAX		X			X	X			X	X	X
64	67-237-69-30/YMH,F_1//F_1,KVZ/YMH				X	X		X				
72	JCAM/EMU S				X		X					X
86	ERA/YMH	X									X	X
89	SPD/YR	X		X		X	X					X
94	ANZA/4/VIL29/VG8881//INIA S/3/55-1744/DRC[1/]	X	X	X		X				X	X	X
116	ANZA/3/P162/NAR59//HYS	X	X		X					X		X
117	BMAN/RAF//PA		X			X				X		X
125	II58-57/ODZI	X		X	X							
127	BEZ//TOB/8156	X		X				X			X	X
128	APF		X				X			X	X	
131	ANZA/4/VIL29/VG8881//INIA S/3/55-1744/DRC[1/]		X			X				X	X	
168	NAI/STC//MIC		X							X	X	
179	FN//T/TH/3/3*CLLF/4/ANZA								X	X	X	
197	CD*3/3/MD/MCM//EX				X				X	X		
215	VORO		X							X		X
216	ROM F9-70//CNO/GLL		X							X		X
222	SN64/T/PP//NAI/3/CRIM/4/DJ*2/GB[1/]		X							X		X
223	SN64/T/PP//NAI/3/CRIM/4/DJ*2/GB[1/]		X							X		X

[1/] Sib lines.

performance in the low and high rainfall zones. Fifteen of the 25 entries listed in Table 2 were early in flowering and also well adapted in two or three rainfall zones. Many cooperators have expressed interest in earlier maturing cultivars; therefore, earliness is continually emphasized in the crossing and selection programs. Sib lines of the cross BEZ//TOB/8156 (127) have performed well since they were first introduced into the Third IWSWSN in 1975. This specific sib line ranked high in the Seventh IWSWSN for yield, winterhardiness, resistance to Septoria sp. and performance in the intermediate and high moisture zones. Cross II 58-57/ODZI (125) has also expressed high yield and good winterhardiness for the past two years.

b. Resistance to Stripe, Leaf and Stem Rust

Natural infections of Stripe rust are common in the high rainfall zones having prolonged spring moisture and cooler temperatures. Several of these locations, such as Santiago, Chile; Cambridge, England and Izmir, Turkey are influenced by large bodies of water and consistently provide excellent information regarding reaction patterns of the entries. Two sib lines from the cross, II 58-57/ODZI, displayed good general resistance to Stripe rust across locations.

Leaf rust is distributed widely throughout the winter wheat regions of the world; however, its development is more pronounced in regions having intermediate to high temperatures during late spring and summer. Eight sib lines of the cross CD*3/3/MD/MCM//EX exhibited good resistance to Leaf Rust across all locations. Two sib lines from the cross ANZA/4/VIL29/VG8881//INIA S/3/55-1744/DRC earlier noted for outstanding overall performance, expressed good resistance to Leaf rust as well. The cross AU/ERA, also represented by two sib lines, displayed good yield potential and resistance to Leaf Rust.

Losses to winter wheat production from attack of Stem Rust have been particularly high in warmer climates. The broad race spectrum of this disease makes it extremely difficult to develop cultivars with adequate resistance over many locations. Heavy infections are normally observed at Izmir, Turkey; Tessaloniki, Greece; and Bethlehem, South Africa; however, the most severe attack of stem rust on the Seventh IWSWSN was observed at Santiago, Chile. Although susceptible reactions were observed at a specific location, there were sib lines of two crosses 55-1744/7C//SU/RDL and INIA//HBGN/CD which expressed good general resistance to Stem Rust over the locations. Several entries occurred in the top 25 selections for resistance to two of the rust species.

c. Resistance to Septoria and Powdery Mildew

Races and biotypes of leaf blotch and powdery mildew are quite variable between locations. Nine sib lines of cross CD*3/3/MD//MCM/EX, earlier reported resistant to leaf rust, were also resistant to leaf blotch and powdery mildew. Three additional lines of this cross were also resistant to powdery mildew. The general disease resistance expressed by the sib

lines of this cross have been commendable in both the Sixth and Seventh IWSWSN. Three sib lines of cross T-7589/PLN expressed good tolerance to Septoria over all locations. Good resistance was also expressed for Powdery Mildew by three sib lines of cross CLLF/PCH//P101/VOGAF.

d. Adaptation to Different Rainfall Zones. Several entries exhibited superior performance over all three rainfall zones, expressing general adaptation over a diverse collection of environments. Two of these crosses, ANZA/4/VIL29/VG8881//INI S/3/55-1744/DRC and OR 342//WRR/MN5412/3/CID/MAX were previously reported superior for other traits (Table 2). Cross II 58-57//PCH/ VG9052 and the check variety ROUSSALKA also occurred in the top 25 entries within the three rainfall zones. All four of the cultivars mentioned above were early maturing which lends support to the thesis that earliness is an important characteristic in a major portion of the winter wheat area of the world.

6. Cultivar X Management Interaction

Greater importance must be placed on developing cultivars in keeping with specific management practices. Germ plasm developed in the winter x spring hybridization program must meet the needs of many different systems. These vary from the summer fallow system where only one crop is produced every two years on a given field in limited rainfall areas (450 mm or less) to the multiple cropping practice observed in such countries as South Korea. Therefore, factors associated with stand establishment, winterhardiness, frost tolerance, flowering and maturity dates, competition with weeds and tolerance to herbicides and a whole complex of different disease and insect problems must be considered. Some factors can be identified in early segregating populations such as maturity date; however, many desired traits can only be evaluated when the material is grown under a specific cultural practice. This is especially true for wheat production under low rainfall conditions; particularly, when minimum or no tillage cultural practices are employed for wind and water erosion control. To better assess what some of the limiting factors to plant growth and development will be under such cultural practices, a three hectare experimental site has been established on the Sherman Branch Experiment Station located at Moro, Oregon. The cultural practices to be imposed include (1) minimum tillage, (2) stubble mulching and (3) conventional use of the mold plow. Such factors including different planting dates and a wide array of different genotypes will be used to determine (1) what are the limiting factors influencing plant development, (2) are there genetic differences among genotypes and (3) which selection techniques are most effective. This work will be carried out in cooperation with researchers working on dryland cultural practices. It should also be noted such research will also enable the graduate students associated with the program to broaden their educational experience by becoming knowledgeable in both the breeding and production aspects.

B. GRADUATE TRAINING

A list of former graduate students who have completed the requirements for either the M.S. or the Ph.D. degree this past year is provided in Table 3. Also identified is the title of their research dissertation. Table 4 contains a list of current students, their native country, degree sought, fellowship support and proposed thesis topic.

Several students including Drs. Brajcich, Ortiz and Valencia did part or all of their thesis research in their own country of Mexico. This work was done at Ciudad Obregon at CIANO in cooperation with INIA (National Agricultural Organization of the Government of Mexico) and CIMMYT. Dr. Cuevas, after completing his course work at OSU, did his thesis research at IRRI in the Philippines then returned to the campus to finish writing and subsequently defended his thesis research in the final oral. Currently Dario Leal after completing his course work will be returning to Columbia and working with Dr. Peter Jennings at CIAT. His Ph.D. research will involve a problem in upland rice production. These thesis problems as well as those conducted in Oregon emphasize the concept of developing meaningful research to provide an educational experience that will be most appropriate to the student's future professional needs.

A total of 64 students, from many different countries have participated in this program. Without question in terms of the long term goals this graduate training activity is the most productive aspect of the program. To date, with the exception of one former student, the foreign students have have returned home and are currently working in either the position they were trained for or in some related segment of agriculture. Several of the U.S. students are now located at international centers or in other related foreign service. A paper is now being developed which will present an indepth review of this phase of the program whereby each of the careers and contributions of the former students will be highlighted. It is truly an outstanding story in terms of their contributions and the importance of the training of gifted and dedicated young people. We all share a great deal of pride in their accomplishments.

C. IN-COUNTRY TRAINING AND SEMINAR PROGRAM

Starting on March 20, 1981, a team of scientists from Oregon State University and one scientists from the University of Nebraska spent 11 days interacting with the various agencies involved in increasing cereal production in Peru. They represented various disciplines including wheat and barley breeding, weed control, extension, agronomy, economics, plant pathology and agricultural uses of computer science. The workshop was sponsored jointly by the National Agricultural University of Peru and USAID-SU with the central objective of organizing and coordinating research to facilitate the improvement of cereal production in Peru.

Currently with a population of 17 million, Peru consumes approximately 930,000 metric tons of wheat and 260,000 metric tons of barley annually. With only 1.7 percent of the land under cultivation, production is limited to 130,000 metric tons and 160,000 metric tons of wheat and

TABLE 3 STUDENTS WHO HAVE GRADUATED SINCE OCTOBER, 1979

NAME	COUNTRY	SUPPORT	DEGREE	THESIS TITLE	CURRENT POSITION
W.L. Alexander	U.S.A.	Grad. Asst.	Ph.D.	A study of methods of parental evaluation using testers to predict subsequent progeny performance in winter wheat.	Post-doctorate Corn Breeding North Dakota St. Univ.
D.W. Altman	U.S.A.	Grad. Asst.	Ph.D.	Effect of late foliar applications of urea on protein, hardness and yield of winter wheat cultivars (Triticum aestivum L.)	Ph.D. student University of Minnesota
Pedro Brajcich	Mexico	Rockefeller	Ph.D.	Nature of inheritance, genotype-environment interaction and association of selected agronomic characters in crosses of winter x spring wheats (Triticum aestivum L. em Thell).	Post-doctorate Spring Wheat Program CIMMYT, Mexico
			M.S.	Estimates of heterosis for five agronomic traits in selected winter x spring and winter x winter wheat crosses.	
Mary Boulger	U.S.A.	OSU Exp. Sta.	M.S.	Influence of phosphorus and lime application on root growth and grain yield of two winter wheat cultivars (Triticum aestivum L em Thell).	Barley Breeder Oregon State Univ.
Federico Cuevas-Perez	Dominican Republic	Rockefeller	Ph.D.	Inheritance and associations of six agronomic traits and stem base carbohydrate concentration on ratooning ability in rice (Oryza sativa, L.).	Rice & Wheat Breeder Institute of Agriculture Dominican Republic
Ali Ekse	Turkey	Rockefeller	M.S.	Chemically inducted male sterility and natural out-crossing in selected wheat cultivars (Triticum aestivum, L. em Thell).	Durum Wheat Breeder Agriculture Research Institute Izmir, Turkey

NAME	COUNTRY	SUPPORT	DEGREE	THESIS TITLE	CURRENT POSITION
Luz Gomez-Pando	Peru	CIMMYT	M.S.	Influence of different nitrogen and moisture levels on the expression of grain yield and protein content in selected wheat (Triticum aestivum L. em Thell) and barley (Hordeum vulgare L. em Lam.) cultivars.	Barley Breeder Universidad Nacional Agraria Lima, Peru
James Mareck	U.S.A.	Grad. Asst.	Ph.D.	Methods of evaluation, effects of intermating and results of one cycle of S1 family recurrent selection in barley.	Internship with /CR/SAT pigeonpia program INDIA
Hwag Kee Min	Korea	I.I.E.	M.S.	Association between length of grain filling period and grain yield in two wheat populations (Triticum aestivum L. em Thell).	Wheat Breeder Seoul, South Korea
Stephen Oakley	U.S.A.	Grad. Asst.	M.S.	Estimates of heterosis in winter x winter, winter x spring and spring x spring crosses of barley (Hordeum vulgare L.)	Ph.D. Student Altheimer Laboratory Fayetteville, Arkansas
Guillermo Ortiz	Mexico	Rockefeller	Ph.D.	A comparison of four methods of selection for the improvement of grain yield in winter x spring wheat crosses (Triticum aestivum L. em Thell)	Post-doctorate Triticale program CIMMYT, Mexico
Vichien Petpisit	Thailand	Rockefeller	Ph.D.	Progeny tests for predicting grain yield and selected agronomic traits in single, three-way and double crosses in wheat.	Rice Breeder Kuan Gut Rice Experiment Phatthalung, Thailand
Rollin Sears	U.S.A.	OSU Exp. Sta.	Ph.D.	Identification, inheritance and association of different dwarfing sources and gibberellic acid insensitivity in barley.	Assistant Professor Kansas State University Manhattan, Kansas

NAME	COUNTRY	SUPPORT	DEGREE	THESIS TITLE	CURRENT POSITION
Antonio Valencia-V	Mexico	Mexican Gov't.	Ph.D.	Competitive effect for grain yield of four cultivars in pure and mixed populations in wheat.	Wheat Breeder CIANO Cd Obregon, Mexico
Amor Yahyaoui	Tunisia	Grad. Asst.	M.S.	Effects of three herbicides on yields of five cultivars of winter wheat (*Triticum aestivum* L. em Thell).	Breeder Elkef, Tunisia

Table 4.

Current Graduate Students on Cereal Project (as of June, 1981)

Name	Native Country	Degree Sought	Support*	Thesis Topic
Nadjib Benacef	Algeria	M.S.	CIMMYT	Effect of Row Spacing, Date and Rate of Seeding on Yield of Five Winter Wheat Cultivars
Jerry Boinnet	Kenya	M.S.	KENYA GOV'T	Outcrossing in wheat
Byung Han Choi	Korea	M.S.	USAID	Vernalization and Photoperiod Responses as Related to Earliness in Winter Wheat
Leonardo Corral	Ecuador	Ph.D.	OAS	Combining Ability Effects in Single, Three and Four-Way Crosses in Winter Wheat
John Frederickson	USA	Ph.D.	USAID	Recurrent Selection for Heading Date in Winter Wheat
Necati Hazar	Turkey	M.S.	R.F.	Early Generation Evaluation of Quality Characteristics in Wheat
Patrick Hayes	USA	M.S.	OSU	Evaluation of Breeding Systems in Handling Segregating Populations in Wheat.
Mesut Kanbertay	Turkey	M.S.	R.F.	The Inheritance of Common Bunt Resistance
Dario Leal	Columbia	Ph.D.		Problems in upland rice production
Michael Marcianik	USA	M.S.	USAID	Relationship between Protein and Yield in Cultural Practices in Hard Red Winter Wheat.
Jesus Martinez	Mexico	Ph.D.	Mex. Govt.	Quality Characteristics of Winter X Spring Wheat Crosses
Colleen Mork	USA	M.S.	USAID	Effect of Stripe Rust on the Yield of Wheat
Jaime Tola	Ecuador	Ph.D.	R.F.	The Inheritance of Barley Yellow Dwarf Resistance in Winter Wheat

*R.F.: Rockefeller Foundation
OAS: Organization of American States
CIMMYT: International Maize and Wheat Improvement Center
USAID: United States Agency for International Development
OSU: Oregon State University

barley, respectively. Therefore, Peru has become a consistent and an increasingly cereal deficit country, importing over 900,000 metric tons of cereals annually.

At present most of the 125,000 hectares of cereal production in Peru is concentrated in the intermediate hill and highland zones. There are more than four million hectares of grassland on the high plateau that could be converted to cereal production if adequate cultivars could be identified. Spring wheat will not survive in the major plateau area. The winter cultivars must have adequate winterhardiness, a proper developmental cycle to avoid spring and summer frosts, resistance to hail and an ability to mature in fluctuating temperature conditions. Several barley cultivars have shown promise in earlier screening traits. More recently, wheat cultivars from international cooperators and specifically from the OSU winter x spring program have performed well at several locations on the plateau. A young, gifted Peruvian scientist, Miss Luz Gomez-Pando, recently completed her M.S. degree in plant breeding at OSU and upon her request, a large volume of wheat and barley germ plasm has been sent to Peru. It is from this genetic material that many new promising cultivars are emerging for use in the highlands.

The symposium was attended by scientists from throughout Peru including several universities and the national research organization (INIPA). CIMMYT scientists from the Andean region were also present and participated by presenting papers and chairing sessions of the program. The meetings provided a rare opportunity to national researchers to come together and develop a coordinated approach to cereal research thereby eliminating some of the duplication of effort that was becoming counter-productive. New researchable areas were identified particularly those which would lead to the expansion of cereal production in the high plateaus of the Andean region.

The major objectives of the in-country cereal workshop were:

1. To inform national scientists, administrators and the visiting scientists of past and present research being conducted nationally in Peru and internationally by cooperating agencies with special emphasis on the role the winter x spring program might play in improving the cereal production in the highlands of Peru.

2. To observe the research activities and to mutually propose area for further cereal research and production in the Andean Plateau region of Peru.

3. To discuss present emphasis of cereal research in Peru and identify future goals and requirements for staff and equipment.

Strong support for a coordinated cereal program conducted by the national scientists and the establishment of closer linkages between the spring x winter program at OSU and the Peruvian cereal activities was surfaced. The need for identifying prospective students for future graduate training to lead in-country research activities was also stressed. Unlike other international conferences, this workshop focused strictly on the research programs and needs of Peru. Thus the presentations and subsequent discussions addressed a much narrower spectrum and provided a more in-depth review of factors limiting increased cereal production.

Details of daily activities.

The Monday session, March 23, was inaugurated by the Peruvian Minister of Agriculture, Mr. Erickson, and he requested a copy of the conclusions and recommendations following the final session. The President of the National University of Peru also welcomed the participants. The response on behalf of Oregon State University and CIMMYT was made by W. E. Kronstad. There were 13 scientific presentations by the Peruvian scientists discussing topics of cereal breeding, major cereal diseases, production, quality, commercialization and industrization of winter and spring wheat and barley in Peru. Papers regarding cooperative programs with USAID, West Germany and CIDA, Canada were also presented. Time was allowed for questions following each presentation. The program was well organized and very informative for all international and national participants.

The Tuesday session, March 24, was devoted to presentation of information from nine scientists representing OSU, the University of Nebraska, CIMMYT and the O.I.E.A. (atomic energy commission cooperative program on induced mutations). There were six scientists from OSU discussing current research in winter wheat improvement, winter x spring wheat development and dissemination, winter and spring barley improvement, weed control, computerization and programming of a breeding program and cereal extension. One scientist from the University of Nebraska discussed the development and of germ plasm containing high protein. Two CIMMYT staff from Latin America presented recent research findings for cereal diseases and agronomic practices within the Andean and southern cone regions of the continent. A brief presentation of cooperative research on induced mutations was made by a representative of the O.I.E.A., Norway. The information for all topics was well-received and stimulated an abundance of questions by the 70+ Peruvian participants.

The final morning session, March 30, was initiated with brief presentations of general views by representatives of UNA, INIPA, CIMMYT and OSU. Lengthy discussions then proceeded for seven major subject areas followed by a final meeting with a limited number of people representing the four above mentioned agencies to draft conclusions and recommendations. A brief summary of some basic thoughts for each of the seven subject areas follows:

A. Cereal Improvement

1. Peruvian universities must teach more practical application of research rather than only theoretical science.

2. Cereal research must be better coordinated between the national universities and the national research institutes.

3. Appropriate incentives are needed for scientists.

4. A seed multiplication structure must be developed.

5. An annual cereal research coordination meeting would be helpful.

B. Cereal Production

1. Lack of mechanization is a major hinderance to land preparation and timely harvest. Stationary threshers are needed. Equipment cooperatives could be developed with machinery for rent.

2. Credit for farmers to increase inputs is a major limiting factor in some areas.

3. There is a lack of appropriate technology to extend.

4. Lack of adequate price for wheat is a problem in the coastal area.

5. Transportation, in terms of availability and cost from the highlands to the major flour mills on the coast needs to be evaluated.

C. Training In Cereals

1. Centralization of universities is an important consideration to training.

2. Active participation between universities and regional experiment stations would provide local training, reducing travel and per diem.

3. Designated funding is needed for training.

4. Many young scientists have received short-term training at CIMMYT and future training should be concentrated in the region.

5. More young Peruvian scientists need to receive advanced graduate level training to fill leadership roles and strengthen existing programs. Also, more incentives need to attract students into agriculture.

D. Extension Service

1. Funding is a major constraint to effective extension.

2. Extension at present is very weak to almost non-existent.

3. There is lack of coordination between extension and both research and university teaching.

E. Marketing of Cereals

1. Farmers cannot move their wheat production due to a lack of a marketing system.

2. Lack of incentives for development of a marketing system is due to non-commitment of the government.

3. The government needs to develop a price structure for cereals.

F. National Coordination

1. Research results should be exchanged between agencies.

2. INIPA should cooperate with the 17 universities throughout Peru that develop theses for students.

3. There was a suggestion for both public and private agencies to develop guidelines to coordinate future research, education and extension activities.

4. It was proposed that a concrete objective be established and then a committee could develop guidelines for discussion with all cereal participants.

G. International Coordination

1. Strong recommendations were made for continuing provision of germ plasm by OSU and CIMMYT for winter and spring cereals, respectively.

2. Training of young scientists is essential in graduate programs at Oregon State University, University of Nebraska and others emphasizing applied research.

3. Better coordination is needed between the Peruvian research agencies and various international groups. Likewise, the international groups themselves should work closer together in a more unified effort.

H. Crop Substitutes and Commercialization for Wheat

1. A major objective must be to reduce the amount of importation of wheat.

2. Substitutes such as sweet potatoes, potatoes, chenopodium, etc., may not be available on a constant basis.

3. Most of the suggested substitutes, with the exception of barley, are higher in price than wheat and prices must be cheaper to encourage their use.

4. Nutritional quality is an important consideration for grain substitutes.

The OSU participants and the Peruvian organizers feel the in-country cereal workshop was very successful. Time was provided in the sessions, while travelling on tours and during unscheduled hours to interact with local and international scientists. This meeting brought together the cereal breeders, production agronomists, pathologists, economists, extension specialists, quality specialists, commercial and industrial representatives from different agencies throughout the country. The need for coordination of cereal activities within the country and provision of government support as incentives and credit were emphasized continually. Conclusions and recommendations of the workshop were presented to the Peruvian Minister of Agriculture for consideration.

A detailed report and summary document is being compiled and will be presented to USAID, Washington, DC and the Ministry of Agriculture of Peru in the near future.

III. Evaluation of Effectiveness of Program and Publications

Useful germ plasm is being distributed effectively to the developing and developed countries throughout the world where winter wheat is produced. Screening nurseries, yield trials, crossing blocks, segregating populations and specified cultivars serve as the vehicles. Lists for distribution of each nursery are included in Appendix Table 2 and 4. Continuing communication through correspondence, data returned for the IWSWSN and personal visits with the cooperators indicate that the winter x spring germ plasm is being utilized extensively. The cooperators are selecting cultivars from the germ plasm that are resistant to their pathological and/or environmental stresses for hybridization with their adapted varieties or as direct release as new cultivars. A summary of the number of cultivars selected by the cooperators from the Seventh IWSWSN is presented in Appendix Table 8. The number of cultivars selected by each cooperator varies greatly, however, this data provides some general measure of the extensive utilization of the winter x spring germ plasm. Because of the genetic diversity in the spring x winter wheat program, the previously mentioned cultivars have been selected by cooperators to meet the specific needs within their individual environments. There is a potential production area of more than 18 million hectares for the selected cultivars of winter wheat within the countries listed in Appendix Table 8, excluding the U.S.A.

The following specific examples also demonstrate the utilization of the winter x spring germ plasm being distributed by OSU. Observations for Central and South America were made during a visit by Dr. Cholick last December (1980).

ARGENTINA, Cordoba

Marco Juarez, INTA

This is primarily a spring wheat production area. Entries selected from the Seventh IWSWSN are being utilized in their crossing program for disease resistance (particularly Septoria tritici and Leaf Rust), plant type (greater head fertility) and increasing the reproductive cycle (heading to maturity): These include NS732/PCI, MA 38/WRM, B MAN/RAF PA, CD*3/3/MD/MCD/EX.

Buenos Aires

Bordenave, E.E.A., INTA

This dryland area of Southern Argentina represents 2.5 million hectares and is similar to winter wheat production acres found Eastern Oregon. Cultivars selected from the screening nurseries are used both in crossing and as possible varietal releases. In this past season's yield trials, a selection (ANZA/SDY) selected from a previous IWSWSN produced a grain yield of 2937 kg/ha compared to 1596 kg/ha for the leading commerical variety. Another promising selection from the IWSWSN, B MAN/RAF PA,

exceeding the predominant commercial variety by 15 percent. The breeder at this location has indicated that these selections appear to be a very promising candidate for varietal release.

BRAZIL, Sao Paulo

Campinas, Instituto Agronomico

Segregating populations have been utilized extensively at this location. Selection from winter x spring segregating populations which have been subjected to acid soil conditions has proved useful in increasing yield and yield stability in experimental lines. The wheat breeder of this station received his Ph.D. degree from Oregon State University as a part of the Winter x Spring graduate program. His Ph.D. thesis included an evaluation of different dwarfing sources when crossed to Brazilian Al tolerant, tall plant types to determine if semi-dwarf Al tolerant plants could be developed. The results of this study were very positive with both the technique and materials being used. Some of the winter parents producing good hybrid combinations when crossed with spring parents are: KAVKAZ, AMIGO, OR 93-44/KVZ, OR F1 158/FDL, LOM 24, F 49-70, NAD//TMP/CI 12406, OASIS, SAGE and WEIQUE RED MACE.

CHILE

Santiago, Temuco and Chillan Experiment Stations

In the northern parts of Chile (Santiago), the cultivars are being selected primarily for their crossing program with emphasis on resistance to Leaf and Stem rust. Several winter x spring selections being used as parents in crosses are: BEZ/NAD//KTZ, AU/SN64//MD*2/VG8316, 55-1744/PI//237-30/KVZ, CLEO/ PCHU//7C/3/ATL66/AU, YY/OR 93/4/FL/3/PI/QN/4-11//BEZ/P101 and PEREGRINE. The central (Chillan) and southern (Temuco) areas have selected cultivars from the IWSWSN for both crossing and as potential varieties. At both locations the highest yielding cultivars presently being evaluated for varietal release were derived from winter x spring crosses. These crosses are ASPEN, ASP/CNO//PJ, BEZ//TOB/8156, BHR/CZHO/P101/ANZA, WRM//KAL/BB and CD*3/MD/MCM/EX.

TURKEY

The following observations were made as a result of Dr. McCuistion's visit to Turkey to evaluate segregating populations this past July.

Scientists working in the Turkish National Wheat Improvement programs located throughout Turkey have selected numerous cultivars from the winter x spring germ plasm. These selections are at all phases of evaluation in the national programs and are being incorporated into the present commercial varieties through their crossing programs. Turkish wheat breeders have identified and named six new varieties from germ plasm distributed by OSU. Two varieties, KIRKPINAR 79 and ATAGUN, are

being grown on the Anatolian Plateau in central Turkey. The remaining four varieties, TRAKYA, EDIRNE, TASKAN and ENEZ are best suited to the transitional zones of northern and western Turkey. Selections for resistance to leaf rust and winterhardiness from the Seventh IWSWSN at Edirne were ANZA/SDY, OR 342//WRR/MN 5412/3/CID/MAX, ANZA/4/VIL29/VG8881//INIA/3/55-1744/DRC, INIA//SMD/HN4 and INIA//HBGD/CD.

ALGERIA

Setif

The long vegetative and short reproductive cycle exhibited by some of the winter x spring selections make them well adapted to the high plateau area. Three selections from the Fifth IWSWSN, ANZA/3/P162/NAR59/HYS, P101/ANZA and BEZ/ERA, are presently at the seed multiplication phase of varietal release at this location. Four selections form the Seventh IWSWSN that exceeded the best commercial variety by more than 15 percent were B MAN/RAF PA, AN//CLLF/SDY and two sisters of P101/ANZA.

JORDAN

Amman

One selection, LOH1/DIRK/4/SU92/CI13645/3/BC/ CI13232//INIA, from the Sixth IWSWSN is presently being increased as a potential new variety for this area. This selection has demonstrated excellent resistance to drought stress and is also being used in the crossing program. Additional selections from the Seventh IWSWSN presently in yield trials that exceeded the local variety by more than 41 percent were AN//CLLF/BEZ, 58-182/DRC//SPN, SPN/MCD//CAMA and three sister lines of CLLF/PCHU//P101/VOGAF.

HUNGARY

Szeged and Martonvasar

Several cultivars selected from the IWSWSN are being evaluated in advanced yield trials. One selection, BEZ//TOB/8156, has demonstrated sufficient promise to be named 'GK Apollo' and is presently under seed multiplication for varietal release. Two outstanding selections from the Seventh IWSWSN grown at Martonvasar and yielding 143 percent more than the commercial check variety were KVZ/T/TH*6/KF//LEE*6/KF and INIA//SMB/HN4.

YUGOSLAVIA

Novisad, Skopje and Zagreb

All three programs have selection from IWSWSN in yield trial evaluations as well as utilizing the material in their hybridization programs. The program at Zagreb has two cultivars, NOR67/3/CD/P101// DRC/4/YMH and

SN64/SS2, under seed multiplication for possible varietal release. Two selections from the Seventh IWSWSN were identified for resistance to Powdery Mildew, TJB 854-1 and HK/38MA//LOH1/DIRK. Another selection, TT/OPAL//NAI/HYS, also resistant to Powdery Mildew, yielded 18 percent higher than the local variety.

U.S.A.

Oregon

Three hard red winter wheat selections from previous IWSWSN's are presently being evaluated and increased for possible release in the Pacific Northwest region. These selections, BEZ//TOB/8156, PEX/TOB and ANZA/SDY, have demonstrated high, stable yielding ability, disease resistance and good bread making quality. Four entries from the Seventh IWSWSN that were resistant to Stripe and Leaf rust at Corvallis and exceeded the commercial variety, Stephens, by at least 16 percent were F34-70//BB/GLL, SN/HN4//RE/ 3/EDCH/MEX, SN64/TZPP/NAI/3/CRIM/4/DJ*2/GB and PMF/LFN. AT the intermediate rainfall site of Pendleton, three selections exceeding the commercial variety by 28 to 36 percent were INIA//HBGN/DRC, F5 TJB916/4L and VG8881/HN4. There were two selections, II 58-57/ODZI and CNO//SN/Y50/3/TT/SN// CHR/4/CLEO/GNS that expressed a 30 percent higher yielding ability than the commercial variety, Stephens, at the Sherman Branch Experiment Station, the dryland site in central Oregon.

Louisiana

Of the 19 entries selected from the Seventh IWSWSN, four selections combined high yielding ability (more than 12% of Arthur 70) and resistance to leaf rust. These pedigrees were ALPINE FIR, P101/KTZ/3/KUPA//CNO/GLL, CD*3/3/MD/MCM//EX and B MAN/RAF PA.

Georgia

Eighteen entries from the Seventh IWSWSN exceeded the yield of the commerical variety, Holly, under heavy infestations of Powdery Mildew and Leaf rust. The pedigrees of four lines that exceeded this check variety from 40 to 205 percent were JCAM/BEZ//SDY, HYS/T-3055// YMH*2/RBS/3/SN/SS2//RBS, SPD/YR and 55-1744/7C// PDGA/3/YMH/TOB//BEZ.

Oklahoma

Two entries from the Seventh IWSWSN, ANZA/SDY and ANZA/4/VIL29/VG8881//INIA/3/55-1744/DRC, were selected for high yield (exceeded PAYNE by 29%), early maturity and good seed type under the local conditions of the Great Plains.

Two areas in the 1978 Project Review were identified as requiring greater emphasis in germ plasm development phase of the program. These areas were earlier maturity and disease resistance, specifically Stem and Leaf

rust resistance. The need for additional emphasis remains; however, noteworthy progress has been achieved.

Progress in improving earliness is evidenced by the increase in the number of early lines included in the screening nurseries. There were 22, 64, 56 and 104 lines which flowered at least one week earlier than the local check variety, Stephens, at Corvallis in the Sixth, Seventh, Eighth and Ninth IWSWSN, respectively. Improvement in earliness has been greatly enhanced by the recent introduction of excellent early maturing germ plasm from the People's Republic of China. As the need for multiple or double cropping systems increases, coupled with the drought escaping cultivars desired for the dryland areas, the demand for new, high yielding, earlier maturing wheat cultivars is becoming greater; therefore, this area will continue to receive emphasis.

Sources of resistance to Leaf and Stem rust from both the winter and spring wheats are being incorporated into the germ plasm. New cultivars are continuously being identified in the IWSWSN that have excellent resistance to Leaf and Stem rust. These cultivars are then combined and incorporated into the germ plasm through the crossing program. To insure that resistance to these diseases is incorporated, selected segregating populations are now being grown at Toluca, Mexico and Izmir and Ankara, Turkey, This procedure will not only assist in providing new and more durable sources of disease resistance but provide greater adaptability and the resulting stability of yield.

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Journal articles:

1. Camargo, C. E. O., W. E. Kronstad and R. J. Metzger. 1980. Parent-progeny regression estimates and associations of height level with aluminum toxicity and grain yield in wheat. Crop Sci. 20:355-358.

2. Camargo, C. E. O., W. E. Kronstad, R. J. Metzger. 1980. Heritability estimates and associations of different height levels with aluminum toxicity and grain yield in wheat. Manuscript in progress.

3. Cuevas, F. E., W. R. Coffman and W. E. Kronstad. 1980. Stem (base) carbohydrate concentration and ratooning ability in rice (Oryza sativa, L.). Manuscript in progress.

4. Keim, D. L. and W. E. Kronstad. 1979. Drought resistance and dryland adaptation in winter wheat. Crop Sci. 19:574-576.

5. Keim, D. L. and W. E. Kronstad. 1981. Drought response of winter wheat cultivars grown under field stress conditions. Crop Sci. 21:11-15.

6. Roberts, D. D., W. E. Kronstad and A. Haunold. 1980. Genetic variability and association of maturity, yield and quality characteristics of female hops (Humulus lupulus L.). Crop Sci. 20:523-527.

7. Sears, R. G., W. E. Kronstad and R. J. Metzger. 1980. Inheritance of dwarf and semidwarf plant height in barley. Accepted for publication. Crop Science.

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Oregon State University Cereal Team. 1980.
Results of the Seventh International Winter X Spring Wheat Screening Nursery. OSU-CIMMYT-USAID.

Presentations and proceedings:

Kronstad, W. E. 1981. The Turkish Experience in Increasing Food Production in Arid and Semiarid Lands. In Advances in Food Producing Systems for Arid and Semi-Arid Lands. Academic Press, Inc.

Appleby, 1981. Weed Control in Small Grains. Presented at the Symposia for the Improvement of Cereals in Peru, Lima, Peru. March 23-30, 1981. To be published in proceedings.

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Presentations and proceedings (continued):

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McCuistion, W. L. 1981. Development and Use of Winter X Spring Wheat Germ Plasm. Presented at the Symposia for Cereal Improvement in Peru, Lima, Peru. March 23-30, 1981. To be published in proceedings.

Scott, N. H. 1981. The Computer - An Agronomist's Assistant. Presented at the Symposia for Cereal Improvement in Peru, Lima, Peru. March 23-30, 1981. To be published in proceedings.

IV. APPENDIX TABLES

APPENDIX TABLE 1.

Germ Plasm Bank

To make crosses directed toward specific objectives, it is necessary to accumulate and maintain a working genetic pool made up of superior winter wheat cultivars which cover a wide range of adaptability. OSU's contact with a network of institutions and agencies continues to provide a wealth of superior varieties and advanced lines through exchange of wheat genetic material. The following list includes the number of introductions and major genetic strengths from the countries sending seed to OSU during 1979 and 1980:

WHEAT GERM PLASM RECEIVED AT OSU FROM COOPERATING COUNTRIES - 1979-1980

Country	No. of Introductions	Major Genetic Strengths
Algeria	140	Septoria resistance, drought tolerance
Greece	25	Stem rust and powdery mildew resistance
Jordan	12	Drought tolerance, late frost
Syria	318 + 250 barley	Stem rust resistance, high yield potential, spring barley
Turkey, Diyarbakir	33	Yield potential, late frost
Turkey, Ankara	50	High plateau environment, winterhardiness
Turkey, Eskisehir	56	Stem rust resistance, Cercosporella tolerance
Turkey, Izmir	27	Stem, leaf, stripe rust and Septoria resistance
Turkey, Edirne	44	Stripe rust, powdery mildew, Cercosporella and bunt resistance
Yugoslavia, Novi Sad	40	Dwarfing genes, leaf rust resistance, earliness
Yugoslavia, Zagreb	32	Stem rust resistance, yield potential

Country	No. of Introductions	Major Genetic Strengths
Bulgaria	17	Powdery mildew, leaf rust, Fusarium resistance, yield potential
Romania	9	Powdery mildew, stem, leaf and stripe rust resistance
Hungary, Szeged	65	Powdery mildew, leaf rust, Fusarium resistance
Hungary, Martonvasar	18	Dwarfing genes, winterhardiness, powdery mildew, stem rust resistance
Poland, Laski	15	Winterhardiness, dwarfness, powdery mildew, stem rust resistance
Switzerland	73	Septoria nodorum, stem and leaf rust resistance
Germany	10	Leaf and stem rust resistance
France, Clermont Ferrand	30	Cercosporella root rot, winter-hardiness
France, Versaille	46	Yield potential, stripe rust resistance
France, Pau Cedex	378	Stripe and leaf rust, powdery mildew Cercosporella resistance
France, Froissy	10	Yellow, leaf rust, powdery mildew, Cercosporella resistance
France, Claeys-Luck	22	Cercosporella, stripe rust, powdery mildew resistance
France, Semonville, Cidex	72	Powdery mildew, stripe rust, Septoria resistance
France, Le Rheu	43	Cercosporella, stripe rust, powdery mildew resistance
England, Cambridge	18	Dwarfness, yield potential, stripe rust resistance
England, Rothwell	6	Yield potential, stripe rust and Cercosporella resistance
Russia, via USDA, Md.	128	Winterhardiness

Appendix Table 1. (continued)

Country	No. of Introductions	Major Genetic Strengths
China	122	Earliness, dwarfness, winterhardiness
Sweden	12	Winterhardiness
South Africa	61	Stem rust resistance
Argentina	34	Stem, leaf rust resistance, yield potential
Ecuador	153	Stripe and leaf rust, powdery mildew resistance
Mexico, CIANO	140	Stem and leaf rust, powdery mildew resistance
Mexico, CIMMYT	354	Winter crossing block of diverse germ plasm
India	3	Barley yellow dwarf resistance
Spain	35	Stem and leaf rust, Septoria resistance
Korea	11	Earliness, dwarfness
Chile	12	Stripe, leaf, stem rust resistance
Portugal	5	Septoria, powdery mildew resistance
Kenya	51	Stem and leaf rust resistance
Iran	31	Leaf and stem rust, Septoria resistance
Ethiopia	3	Stem rust, powdery mildew resistance
Total Introductions	2764 + 250 barley	

Appendix Table 1. (continued)

BARLEY GERM PLASM RECEIVED AT OSU FROM COOPERATING COUNTRIES - 1979-1980

Country	No. of Introductions	Major Genetic Strengths
Greece	10	Mildew, helminthosporium resistance
Turkey	100	Snow mold resistance, disease resistance
France	9	Agronomic type, yield, mildew resistance
England	20	Short straw, mildew resistance
Mexico	250	Observation nursery - earliness, short straw
Netherlands	6	Agronomic type
Denmark	5	High lysine, yield
Sweden	5	High lysine
Japan	7	Short straw
Poland	2	Mildew and leaf rust resistance
Czechoslovakia	6	Mildew and leaf rust resistance
Romania	1	Mildew and leaf rust resistance
China	50	Earliness
Finland	5	Mildew, quality
Germany	2	Yield potential
Jordan	2	Drought tolerance
Syria	250	ICARDA observation nursery - disease resistance, leaf rust resistance

Quality Laboratory

An experiment was conducted to determine if a consistent and acceptable protein level could be obtained for hard red winter cultivars using different forms and methods of applications of nitrogen fertilizer.

Foliar applications of urea significantly increased grain protein over the control and standard topdressing treatments for most of the cultivars tested. At the Hyslop location (high rainfall) grain protein percentage increased

for all nitrogen treatments with values of 11.5, 12.2, and 13.6 respectively for one of the genetically high potential protein lines. For the Kaseberg location (dryland), topdressing and the combination of topdressing plus one foliar application of urea increased the grain protein percentage to 9.3 and 10.4, respectively.

In a second study, two levels of nitrogen fertilizer were applied to five winter wheat cultivars selected for their grain yield or potential high grain protein. The experimental sites were the Kaseberg Farm (dryland) and the East Farm (high rainfall) located just east of Corvallis. The objectives of this investigation were: (1) to determine the relationship between the nitrogen percentage in the plant tissue at various stages of growth and subsequent grain protein, and (2) to evaluate the possible association between grain yield and grain protein as influenced by different cultivars, fertilizer and moisture levels.

The most significant finding in both of these studies was that higher protein levels could consistently be achieved at the higher rainfall locations. Such information will be helpful in terms of the selection and evaluation of new hard red winter varieties for Oregon.

Currently the quality laboratory is screening remnant grain samples of early generation populations (F3 and F4) which are now growing at the three major testing sites (Hyslop, Moro, and Pendleton). This, coupled with evaluating the quality pattern of frequently used parents, will result in greater overall efficiency in the breeding program.

Appendix Table 2. Additional Germplasm Sent to Various Locations in 1980

Distribution of F2 Bulk Populations

Cooperator	Country
Dr. J.J.M. Noulard	Belgium
Dr. Kosta Gatzov	Bulgaria
Mr. P. Auriau	France
Dr. Malik & Mr. Mir	India
Dr. C. Camargo	Brazil
Dr. V. Almanza	Colombia
Mr. M.A. Noory	Afghanistan
Dr. Pakendorf	South Africa
Mrs. Ho	Canada
Mr. John Bingham	England
Dir. Jean Roussineau	France
Dr. Aristeo Acosta-UAAAN	Mexico
Dr. R.K. Rai	The Netherlands
Dr. G. Halloran	Australia
Dr. Chang Hwan Cho	Korea
Dr. A. Vallencia-CIANO	Mexico
Dr. Martinic	Yugoslavia
Mr. J. Acevedo	Chile
Dir., I.D.G.C.	Algeria
Director ESGC	Tunisia
Dr. Fossati	Switzerland
Dir., Wheat Res. Center	Turkey
Dir., Food & Ag. Div.	Nepal
Dr. B. Valer	Romania
Mr. S. Sunderwirth	France

Spring X Winter Yield Trials

Cooperator	Country
Dir., E.E.A. Inta	Argentina
Dr. I. Ramirez	Chile
Mr. T.C. Nel	South Africa
Mr. P. Auriau	France
Dr. Chang Hwan Cho	Korea
Dr. S. Rajaram	Mexico
Dr. J. Brykszynski	Poland
Dr. N. Saulescu	Romania
Dir., Wheat Research Center	Turkey
Dr. Z. Martinic	Yugoslavia
Dr. E. Smith	Oklahoma, USA

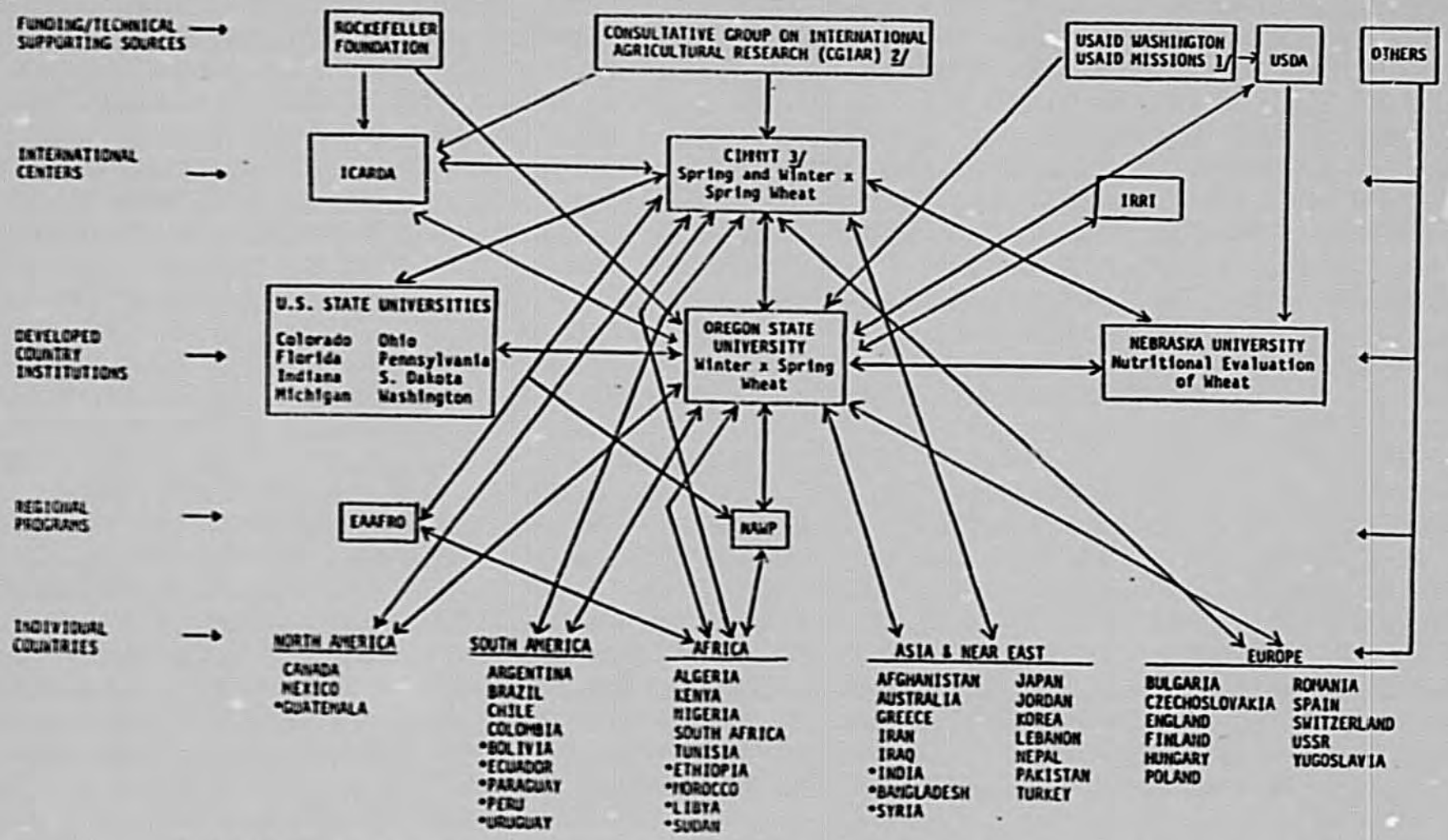
Additional International Seed Shipments

Cooperator	Country
Dr. Schmuetz	West Germany
Dr. Fang	China
Dr. Sheng	China
Dr. Z. Eyal	Israel
Mr. K. Yakar	Turkey
Mr. M. Trottet	France
Dr. J. Josset	France
Dr. O. Laudoyer	France
Dr. M. Romero-Loli	Peru
Dr. A. Salazar	Spain
Mr. Thiebaut	France
Mr. Pinochet	Spain
Mr. A. Fossati	Switzerland
Dr. Comeau	Canada
Mr. P. Portman	Australia
Mr. G. Hollamby	Australia
Mr. Leturgue	France
Dr. S. Sunderwirth	France
Mr. H. Wang	China
Dr. Bedogni	Argentina
Dr. A. Hunt	Canada
Mr. C. Van Deventer	South Africa
Dr. I. Ramirez	Chile
Miss L. Gomez	Peru
Mr. H. Min	Korea
Mr. A. Campana	Bolivia
Director-ACSAD	Syria
Dr. D. Atsmon	Israel
Dr. H. Winseler	Switzerland
Mr. E. Indelen	Turkey
Mr. Y. Amor	Tunisia
Dr. S. Rajaram	Mexico
Dr. G. Ortiz	Mexico
Mr. A. Ekse	Turkey
Dr. M. Noory	Afghanistan

Appendix Table 2 (cont'd.)

OSU Winter Wheat Crossing Block

Cooperator	Purpose of Evaluation
Ankara, Turkey	Adaptation to anatolian plateau
Izmir, Turkey	Screening for resistance to three rusts
Toluca, Mexico	Stem rust resistance & new F1 hybrids
Cd. Obregon, Mexico	Leaf rust resistance & new F1 hybrids
Nebraska & Kansas USA	Winterhardiness
Pendleton, Oregon	Cercosporella root rot resistance
Hermiston, Oregon	Barley yellow dwarf resistance
Corvallis, Oregon	Stripe rust & Septoria resistance and new F1 hybrids



1/ AID IS SHOWN APART IN ORDER TO INDICATE FUNDING LINKAGES TO U.S. RESEARCH INSTITUTIONS. AID ALSO CONTRIBUTES THROUGH BILATERAL ARRANGEMENTS TO INDIVIDUAL COUNTRY PROGRAMS. OTHER DONOR MEMBERS OF CGIAR HAVE CORRESPONDING ADDITIONAL FUNDING LINKAGES.

2/ THE DONOR MEMBERS SUPPORTING CIMMYT ARE CGIAR, FORD FOUNDATION, ROCKEFELLER FOUNDATION, GERMANY, UNDP AND IBRD. OTHER CGIAR DONORS INCLUDE BELGIUM, DENMARK, FRANCE, JAPAN, KELLOGG FOUNDATION, NETHERLANDS, NORWAY, SWEDEN, SWITZERLAND, UNITED KINGDOM. ALL CGIAR MEMBERS ARE POTENTIAL FINANCERS OF OPERATING LINKAGES WITHIN THE NETWORK.

3/ THE LINKS BETWEEN CIMMYT AND THE INDIVIDUAL COUNTRIES TAKE THE FORM OF INFORMATION AND MATERIALS EXCHANGE, THE CONDUCT OF SEMINARS AND WORKSHOPS, COOPERATIVE RESEARCH PROJECTS, ADVISORY SERVICES AND TRAINING.

* FUTURE COOPERATORS

APPENDIX TABLE 4.

List of Cooperators of International Screening Nursery
1981
9th IWSWSN
(Northern Hemisphere)

AFGHANISTAN
Mr. M.A. Noory
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Ministry of Agriculture and Irrigation
Kabul, AFGHANISTAN

Port of Entry: Kabul

Mr. M.A. Noory
President of Agriculture Research
Ministry of Agriculture and Irrigation
Kaubl, AFGHANISTAN

Attn: Widukhan-Herat, AFGHANISTAN

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Estacion de Amelioration de
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Port of Entry: Brussels

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Institute for Wheat and Sunflower
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Port of Entry: Sofia

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Port of Entry: Edmonton

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Guelph, Ontario, CANADA

Port of Entry: Toronto

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Chinese Academy of Agricultural and
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Attn: Director Fang

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Port of Entry: Beijing

CHINA
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Henan Prov. Academy of Agricultural Science
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CZECHOSLAVAKIA
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CZECHOSLAVAKIA

Port of Entry: Bratislava

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Port of Entry: London

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Port of Entry: Helsinki

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Port of Entry: Paris

Mr. Michel Momont
Ets a Momont Hennette
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Port of Entry: Paris

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HUNGARY
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AND
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Karaj Plant Breeding Center
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Port of Entry: Amman

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Bhairahwa, NEPAL

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9th IWSWSN
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OREGON LOCATIONS

Winter

Hyslop
Moro
Rugg
Hermiston (2 sets)
Flora
Squaw Butte

Spring-Planted

Hyslop
Klamath Falls

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9th IWSWSN
(Southern Hemisphere)

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& Industrial Research
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NEW ZEALAND

Port of Entry: Unknown

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Port of Entry: Lima

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c/o Plant Intro. Officer
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Pretoria, 0001 SOUTH AFRICA

Appendix Table 5. Visitors to the Cereal Project

June 1980 - July 1981

Visitor	Country	Position
Four visiting farmers	France	Touring U.S. research and farming
Dr. George Varughese	Portugal-CIMMYT	Regional coordinator-Med. region
Mr. Oliver Laudoyer	Lan Pau, France	Wheat breeder
Mr. Joseph Bookmeyer	U.S.A.	Training officer-Rockefeller Foundation
Dr. F.R. Sanderson	New Zealand	Plant Pathologist
Mr. Ahmed Senhaji	Rabat, Morocco	Cereal Scientist
Dr. Marino Romero-Loli	Lima, Peru	Director UNA, Wheat breeder
Dr. Santiago Fuentes	CIMMYT-Mexico	Plant Pathologist
Dr. Frank Zillinsky	" "	Triticale breeder
Dr. S. Rajaram	" "	Wheat breeder
Dr. Norman Borlaug	" "	Former Director-Wheat
Dr. Dan Atsmon	Israel	Visiting Scientist-1 year
Dr. Robert Jackson	USAID-Wash.D.C. U.S.A.	Coordinator-International program
Dr. Wirth Fitzgerald	" "	Middle East desk
Dr. Lee Briggle	USDA-SEA,Wash.D.C.	Cereal program coordinator
Dr. Morris Peterson	U. of Davis, U.S.A.	Dept. of Range Management
Dr. R.G. Anderson	CIMMYT-Mexico	Director-CIMMYT Wheat Program
Dr. Jean Pierre Josset	France	Wheat breeder-Cargill
Dr. Byrd Curtis	Colorado-U.S.A.	Wheat breeder & Dir., Cargill
Dr. Bill Roberts	" "	Wheat breeder
Dr. I. Atkins	Texas-U.S.A.	Wheat breeder
Dr. Mike Prescott	CIMMYT-Turkey	Coordinator & Plant Pathologist
Mr. Maxime Trottet	Rennes, France	Plant Pathology & Breeding
Mr. Ali Dighmi	Tunis, Tunisia	Short-term trainee
Mr. Heng Li Wang	Peking, China	Long-term visiting scientist- 1 year
Dr. Molski	Warsaw, Poland	Botanical Gardens taxonomist
Dr. Zoltan Kertesz	Szeged, Hungary	Wheat breeder
Dr. Hans Winzeler	Zurich, Switzerland	Long-term visiting scientist- 9 months
Mr. Halid Lachdari	Algeria	Short-term trainee
Mr. Mohamed Sadji	Algeria	" " "
Mr. M. Achour	Tunisia	" " "
Mr. N.P. Rajbhandari	Nepal	" " "
Mr. N.K. Saha	Bangledesh	" " "
Dr. Richie Cowan	IRRI-Indonesia	Administration
Mr. Ernie Hubbard	IPRI-Cal. U.S.A.	Plant Physiologist
Mr. Li Huan Jun	People's Rep. of China	Cereal scientist
Mr. Huang Yong Ning	People's Rep. of China	" "
Dr. Abderrazak Daaloul	Tunis, Tunisia	Wheat breeder
Mr. M. Hafsia	" "	Director Res. & Educ.-MOA
Mr. M. Lazram	" "	Director INRAT
Mr. Jeffrey Lee	USAID, Wash.D.C.	North African bureau

Appendix Table 5 (continued)

Visitor	Country	Position
Mr. John Flinginger	USAID, Tunisia	Food & Agric. Officer
Dr. Bud Rumberg	U.S.A.	Crop Research Council
Dr. Wade Dewey	U.S.A.-Utah St. Univ.	Wheat breeder
Dr. R.W. Howell	Univ. of Ill.-U.S.A.	
Dr. H.C Potts	Univ. of Miss.-U.S.A.	Seed technology
Dr. Ken Morrison	Wash. St. Univ.-U.S.A.	Cereal Extension
Dr. Neal Jensen	Arizona-U.S.A.	Wheat breeder
Dr. George Sprague	Univ. of Ill.-U.S.A.	Corn breeder
Dr. A. Bronnimann	Zurich, Switzerland	Dir.-Res. Inst. Zurich
Mr. Carlos Fauroatti	Argentina	Wheat breeder
Mr. Lezardo Gonzales	"	" "
Mr. John Brown	Australia	Plant Pathologist
Dr. A. Alameddine	Beirut, Lebanon	Wheat breeder
Mr. G. Brouillaud	La Pau, France	Computer scientist
Dr. Warren Pope	Idaho-U.S.A.	Wheat breeder
Dr. Allan Taylor	Montana-U.S.A.	" "
Dr. Edward Smith	Oklahoma-U.S.A.	" "
Dr. Bo Kristiansson	Svalof, Sweden	" "
Dr. John Gibler	IPRI-Calif.U.S.A.	" "

Appendix Table 6. List of Scientific Names of Diseases and Pedigrees of Lines Mentioned

Common Name	Scientific Name
Stripe rust	Puccinia striiformis
Leaf rust	Puccinia recondita
Stem rust	Puccinia graminis tritici
Septoria spp.	Septoria tritici, Septoria nodorum
Common bunt	Tilletia caries, Tilletia foetida, Tilletia controversa
Take-all	Gaeumannomyces graminis
Foot rot	Cercosporella herpotrichoides
BYDV	Barley yellow dwarf virus
Powdery mildew	Erysiphe graminis
Snow mold	Fusarium nivale
Loose smut	Testilago nuda tritici
Scab	Fusarium spp.
Helminthosporium-Leaf blight	Helminthosporium sativum
Alternaria-Leaf blight	Alternaria triticina
Black chaff	Xanthomonas translucens

Appendix Table 7. List of Abbreviations of Lines Mentioned.

Abbreviations	Cultivar Name
ASP	Aspen
AU	Aurora
BB	Blue Boy
BEZ	Bezostaja
BHR	Benhur
BMAN	Buck Manantial
CD	Cappelle Desprez
CDL	Cardinal
CHR	Chris
CI	Cereal Investigation No.
CLLF	Collafen
CNO	Ciano
COM	Cometa Klein
CRIM	Crim
DJ	Dijon
EDCH	Etoile de Choisy
EMU	Emu's'
EX	Exchange
FDL	Fundulea
FN	Frontana
GB	Gabo
GLL	Gallo
GNS	Gainc;
HBGN	Hesbignon
HK	Heines Kolbein
KN IV	Heine IV
HYS	Hyslop
JCAM	Joss Cambier
KAL	Kalyansona
KVZ	Kavkaz
LFN	Lilifen
LOH	Lohnauer
LV	Lourin
MA38	Michigan Amber
MCM	McMurachy
MD	Marne Desprez
MIC	Maricopa
MN	Monad
MNL	Manella
NAI	Nainari
NAR59	Narino 59
NOR67	Norteno
OR342	Complex Cross
PA	Prima
PCH	Pichon
PCHU	Poncheau
P162	Pitic 62

Abbreviations	Cultivar Name
PJ	Penjamo 62
PMF	Pumafen
P101	Pullman selection 101
QN	Qicanah
RAF	Rafaela
RBS	Riebesel
RDL	Roedel
ROM	Romany 66
SDY	Sturdy
SN64	Sonora 64
SPD	Splendeur
SPN	Stephens
SS2	Stiff straw 2
STC	Santa Catalina
SU92	Suweon
TMP	Triumph
T	Timstein
TH	Thatcher
TOB	Tobari 66
TT	Tom Thumb
TZPP	Tezanos Pintos Precoz
VIL29	Vilmorin 29
VG	Vogel Selection
VOGAF	Complex Pedigree
YMH	Yamhill
YR	Yecora (BB2)
YY	Yayla

Appendix Table 8. The Number of Cultivars Selected by Cooperators from the 7th IWSWSN for Either Crossing or Evaluation as Potential New Varieties

Country	Station	Number of Lines Selected From 7th IWSWSN
Argentina	Bordenave	12
Belgium	Gembloux-EAGC	86
Canada	Quebec-Laval	39
Chile	Quilamapu-Chillan	17
Chile	Laplatina-Santiago	5
Czechoslavakia	Bucany	5
France	CNRA-Versailles	7
France	Marenual	50
West Germany	Klinken-Hamburg	21
Greece	Plant Breeding Institute	9
Japan	Hokkaido	12
Jordan	Shoubak	17
Mexico	Toluca-CIMMYT	22
New Zealand	Crop Research Division	18
Poland	Laski	13
South Africa	Bethlehem	17
Switzerland	Zurich	23
Switzerland	SFRA-Nyon	16
Tunisia	Kef	41
Turkey	Diyarbakir	17
Turkey	Edirne	9
Turkey	Adapazari	17

Appendix Table 8. (continued)

Country	Station	Number of Lines Selected From 7th IWSWSN
USA	Louisiana	19
USA	Kansas	16
USA	Montana	60
USA	Oklahoma	22
USA	Oregon-Corvallis	44
USA	Oregon-Pendleton	33
USA	Oregon-Moro	25
USA	South Dakota	9
USA	Washington-Pullman Spring	45
USSR	Krasnodar	22
Yugoslavia	Novi Sad	13