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FINAL REPORT
TO
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

TITLE: A Collaborative Interdisciplinary Research and Training Program Using Winter and Facultative Wheat Germplasm Enhancement as a Model to Simulate the Agricultural Sector in Less Developed Countries
DA-0621-A-00-4044-00

DURATION: 10/5/76 through 12/31/85

AMOUNT AWARDED: 3,645,356

CONTRACTOR: Oregon State University

COOPERATING AGENCIES: International Maize and Wheat Improvement Center and 106 Cooperating Research Programs located in 47 Countries

PROGRAM OBJECTIVES

The goal of this interdisciplinary research and training program was to provide a model represented by an integrated approach for increasing food production while strengthening or building the necessary infrastructures within developing countries. This goal was accomplished through the following specific objectives:

A) Collected, enhanced and distributed wheat germplasm with tolerance or resistance to environmental stresses. Greater genetic variability was created through the systematic hybridization of winter x spring and winter x winter gene pools. Due to differences in vernalization and photoperiod response between winter and spring types, it was possible to drastically change the growth pattern of the wheat plant, thus developing cultivars for specific growing conditions and for various cropping systems including minimum or no tillage, intercropping and multiple cropping. Multiple and durable disease and insect resistance also contributed to greater stability of yield. Thus the systematic probing of the winter and spring gene pools and winter x winter crosses result in higher and more stable yielding cultivars.

B) Trained dedicated young scientists in M.S. and Ph.D. programs in various aspects of cereal improvement. Students identified were expected to assume major responsibility and provide leadership in research, teaching and extension activities in Less Developed Countries (LDCs) and international agriculture programs. Since many of the principles and concepts apply to more than just wheat improvement; such a program had a wider application to all segments of agriculture. This graduate level program complemented the applied research and training activities for young scientists from LDCs conducted at the international centers.

C) Conducted interdisciplinary in-country (LDCs) and regional training and seminar programs involving all aspects of cereal production and marketing. Such programs have been conducted in cooperation with United States Agency for International Development (USAID) missions and International Maize and Wheat Improvement Center (CIMMYT) in Peru, Tunisia and Argentina.

D) Established new and expand existing relationships between LDC agencies and institutions, U.S. universities, United States Department of Agriculture (USDA), USAID missions, CIMMYT, International Center for Agricultural Research in the Dry Areas (ICARDA), Food and Agriculture Organization (FAO) and other regional and international cereal improvement programs.

E) Provided technical assistance and serve as a resource center for information and short term consultants for USAID missions seeking expertise in various aspects of cereal improvement.

ACCOMPLISHMENTS

A. Collection, Enhancement and Distribution of Winter and Facultative Wheat Germplasm

1) Working Germplasm Collection

A collection of 8500 cultivars and advanced experimental selections have been obtained from breeding programs located in the facultative and winter wheat growing areas of the world. With the existing international network established as a part of the winter x spring international improvement program, this collection has been enriched each year with approximately 1000 new entries. A significant factor was that materials have been received from countries which normally do not share their experimental material. This was particularly true for countries in Eastern Europe, some in the Middle East, and the People's Republic of China. Thus such germplasm was made available to wheat breeders on a worldwide basis. A list of introductions from various countries or regions and the major genetic strengths of the material received is presented in Table 1. In addition to introductions from cooperating countries, the winter x spring program at Oregon State University (OSU) receives eight international nurseries from CIMMYT, ICARDA, Wheat Research and Training Center - Turkey, and the University of Nebraska.

The term 'working collection' refers to the fact that all genetic stocks received were evaluated at one or more experimental sites. Information collected was catalogued for such attributes as vernalization and photoperiod response, stand establishment, winter and frost tolerance, disease and insect reactions, maturity, nutritional quality as it relates to end product use and other agronomic properties. Data obtained were summarized and sent to cooperators upon request. Seed stocks of specific lines were made available when requested by researchers with priority given to those in LDCs.

This effort complements and supplements the world collection of wheat now being maintained by the USDA and FAO. It differs from these collections in that the most recently developed cultivars and selections from active research centers were added each year. Such germplasm was evaluated for important agronomic traits and forms the nucleus for parental material for the winter x spring hybridization program. This activity complements a similar role that CIMMYT is now playing in developing a working collection of spring wheats. A significant feature of this exchange of germplasm was that it was free of political factors which had limited access to some materials.

2) Enhanced Wheat Genetic Diversity

There are widespread concerns that yield plateaus have been reached for many of the major food crops including wheat. It has been suggested by some that most of the usable genetic variability has been exhausted. In Table 2, eighteen of the major limiting factors are identified for 39 cooperating developing countries. These are listed in terms of severity for each country. It must be recognized that such a ranking may vary for specific locations within a given country. Also provided are data regarding the average importance across locations and the number of locations where a particular stress is of importance. The systematic hybridization between winter and spring gene pools has provided clear evidence

that new usable genetic variability for many traits, including grain yield, were achieved by this approach. In Table 3, a yield comparison is provided between locally adapted cultivars and materials in the winter x spring wheat screening nurseries developed by OSU and CIMMYT when grown in 39 different countries. What is so significant about the results are that despite the wide range of different environmental and biological stresses found in these countries, the lines resulting from winter x spring crosses were superior to the local checks in every country. The current total production for those countries identified is 159,024,000 metric tons (MT). By adopting the improved selections from the winter x spring program, a potential production of 217,850,000 MT could be possible or a 38% increase in the production of wheat. Based on the current International World Wheat Price ($176 per MT), this would generate an additional 10.3 billion dollars annually.

It must be emphasized that in order to achieve such an increase, a package of cultural practices must also be employed. This includes the necessary inputs of credit, fertilizer, pesticides, farming systems, seed multiplication, transportation and marketing. To accomplish this requires the development and dissemination of appropriate technology and a cadre of trained scientists and extension workers with a strong commitment by the government of the developing countries. These factors were addressed in the other major components of this program.

One important aspect of the systematic crossing of winter x spring cultivars was the opportunity to change the growth pattern of the wheat plant. Differences in vernalization requirements and response to phctoperiod provided an opportunity to develop facultative type wheats. Such cultivars are more compatible with various farming systems like intercropping and multiple cropping which are becoming more important in some LDCs. Also, this type of material was better adapted to areas of high elevation like those found in the Andean Region of South America and the highlands of Pakistan and India. These areas have potential for increased production where neither the spring wheats nor true winter type wheats are adapted.

Other attributes which have been enhanced by combining winter and spring gene pools include 1) more durable-type disease and insect resistance, 2) improved drought tolerance, 3) higher levels of tolerance to acid and alkaline soils, 4) dwarfing genes, 5) increased protein quantity and improved quality, 6) greater spike fertility, and 7) improved quality of numerous end products.

3) Screening Nurseries

Since the beginning, the spring x winter program has distributed fourteen screening nurseries as well as crossing blocks, selected F2 populations and an international yield trial (Table 4). As promising F5 and F6 lines were evaluated and identified at the major testing sites, they were harvested in Oregon and disseminated through the existing network of cooperators. Currently there are 47 countries and 106 programs participating in the winter and facultative screening nurseries (Fig. 1 and Table 5). The existing linkages were established after ten years of experience in terms of identifying programs where such material would be most adapted and used. One positive aspect of this program was that annual evaluations were made as to how the material was being used and the impact it was made in terms of increasing production in a specific LDC. In addition, each cooperator was requested to obtain detailed information regarding the performance

of each entry in the screening nursery in comparison to the local check cultivars.

The screening nursery was sent six months earlier to cooperators in the southern hemisphere so that all data on the current screening nursery were returned in time for inclusion in the annual summary. Such a practice provided a more complete picture of the performance of lines across a wide range of environments.

Testing sites in cooperating countries were divided into three rainfall zones: low (400mm), intermediate (400-650mm), and high (650mm and irrigated sites) in an effort to better summarize data and pinpoint lines which were most suitable to specific areas.

A procedure at OSU was developed so that when cooperators return their data, it was coded and analyzed by the computer. The computer facilitated the handling of information on the more than 200 lines in the screening nursery. A complete catalogue of all data received for each line was printed, enabling the cooperator to view the performance of a particular line across a wide range of environments and growing conditions. Utilizing weighted scores obtained by ranking all the lines for nine agronomic traits, the best 25 lines over all locations reporting were identified for yield potential, earliness, winterhardiness, stripe rust, leaf rust, stem rust, septoria, and powdery mildew. Finally, based on weighted scores from all locations reporting in the low, intermediate, and high rainfall zones, a table was printed of the 25 lines in each rainfall zone which exhibit adaptation for a particular area.

By the first of March, the summarization was completed and printed in book form. It was in the hands of the cooperators prior to the subsequent crossing season so they could make the most effective use of the information. It should be noted that the summary books were available to those other than cooperators who might be interested in specific germplasm. This summary of data for all cooperators was a valuable tool for OSU and CIMMYT breeders in planning their crosses for new hybrid combinations.

The screening nursery also served as an excellent worldwide surveillance nursery for sudden changes in disease and insect complexes. Furthermore, it was a means of identifying new and more durable sources of resistance.

The most promising lines identified by the cooperator were increased and distributed in replicated yield trials especially in LDCs where active breeding programs were not found.

Germplasm disseminated from Oregon State University has had a direct and positive impact on the varietal development programs of many LDCs (Table 6). Several lines have been purified and increased for direct release while many others have been used in hybridization programs and have provided increased genetic variability.

B) Graduate Training

If a solution is to be found to population-food supply problems, it will be only after there is a sufficient number of highly motivated young scientists with the training to make the necessary contribution. It will not be possible for any country or organization to provide enough support to the developing countries to

solve the food problem. The goal should be the strengthening of the national programs which can only be achieved if there is enough expertise in a given country to get the job done. The need for strong training programs at the M.S. and Ph.D. levels to complement the training received at the various centers such as CIMMYT must receive top priority, for this is the groundwork upon which to build strong national programs that can meet existing and future requirements for food. The graduate training program addressed itself to this need.

An integral part of this program was a graduate training segment where young scientists received appropriate training leading to M.S. and Ph.D. degrees. The program was developed to provide an educational base for those young people who would be expected to assume leadership roles in their national programs. To date, 92 students (45 M.S. and 47 Ph.D.) have participated in the program representing 21 different countries (Table 7).

A student who joined the program was assigned responsibility on the research project. As a result, students became familiar with the practical aspects of the research program through actual participation. They were expected to take a leadership role and discuss phases of the program with visiting scientists and with farmers during field days. The importance of the team approach to research was stressed and the student had the opportunity to participate as a team member. As the individual progressed through the graduate program, the research effort turned toward the M.S. and Ph.D. thesis problem which often, by its very nature, was more specific than the work on the cereal research program. Thesis problems selected were in keeping with the student's interest and research experience and the needs of their respective countries. A program had been developed where, under certain circumstances, students completed their academic work at OSU and conducted their thesis research at one of the international centers. This allowed for more appropriate research opportunity since the student could use as their experimental material rice, corn, sorghum, or crop species other than wheat or barley.

The scientific approach, integrity in reporting data and dedication were stressed. It was equally important that the students learn to disseminate information; therefore, they were exposed to extension philosophies and techniques. Furthermore, they came to realize that there is dignity in getting one's hands dirty as they worked beside faculty members in the field.

A positive result was the establishment of lasting relationships between the former students and the faculty and staff. Contacts were maintained through a newsletter and, in some instances, faculty members were able to visit various countries and assist in developing programs either as a part of the germplasm enhancement or in-country and regional seminars and workshops. Such visits not only reinforced the young scientists' confidence in themselves, but frequently road blocks could be removed by visiting with government officials either in the particular country or while the officials were touring the United States.

C) In-Country and Regional Workshops and Seminars

In-depth reviews in the form of seminars, workshops and discussion groups involving a core of people representing different disciplines from OSU, CIMMYT, and USAID Missions were conducted in Peru, Tunisia, and Argentina in 1981, 1982, and 1983 respectively. The participants interacted on a country and regional

basis with scientists from developing countries involved in the Ministry of Agriculture, research and extension agencies or institutes and universities. Programs were structured so that formal discussions were held as well as field tours to experimental sites. Topics varied from various aspects of research to farming systems, marketing and the most effective means of transferring appropriate technology to the subsistence farmers. The format provided a network to encourage interactions between people representing different agencies or organizations within the developing countries.

Results of the workshops were published in two languages: the language of the host country and English. In addition to the information presented, recommendations, priorities and target dates were established with regard to researchable problems.

One major objective of such a program was to bring together those within different agencies of developing countries and thus hopefully establish a more coordinated effort in reducing existing constraints to increased food production.

D) Establish New and Expand Existing Relationships

In addition to those cooperators in the 47 countries, a request by six academia and universities in the People's Republic of China to participate in this program was received. This includes a willingness to exchange germplasm, an opportunity which is rarely extended even today by the People's Republic of China to other programs based here in the U.S. or other countries.

Linkages, in addition to germplasm exchange, were also established with several institutes in developing and developed countries as follows:

1) The Government of Tunisia Accelerated Cereal Project - Tunis, Tunisia.

2) The Turkey Wheat Research and Training Center - Ankara, Turkey.

3) The Wheat Research Program at the University of Jordan - Amman, Jordan.

4) IDGC - The Algerian Institute for Development of Cereal Production and Companion Crops - Algiers, Algeria.

5) The Agricultural Research Council for the Government of Pakistan - Islamabad, Pakistan.

6) The Ministry of Agriculture and Irrigation - Kabul, Afghanistan.

7) The All-India Wheat Coordinated Program - New Dehli, India.

8) Wheat and Barley Research Institute - Suweon, Korea.

9) Institute de Investig. Agropec - Casilla, Santiago, Chile.

10) Programa de Cereales, Universidad Nacional Agraria - Lima, Peru.

11) Organization of the National Agricultural Research Institute - Quito, Ecuador.

12) Chinese Academy of Agricultural Science - Beijing, PRC.

13) Jiangsu Academy of Agricultural Science - Nanjing, PRC.

14) Shandong Agricultural College - Taian, Shandong, PRC.

15) Zhejiang Agricultural University - Hangzhou, Zhejiang, PRC.

16) National Agricultural Program (INIA) - Mexico.

17) National Agricultural Program - Argentina.

18) Jose Buck S.A. - Argentina.

19) International Center for Agricultural Research in the Dry Areas (ICARDA) - Syria.

The screening nursery, in-country workshops, and graduate training programs all provided an opportunity to establish meaningful linkages with other individuals and country programs. This strengthened the sharing of germplasm and information with the end result being to strengthen the total worldwide effort to keep pace with an increasingly hungry world.

E) Technical Assistance

The program has served as a resource center for specialists in various aspects of research (breeding, genetics, plant pathology, entomology, soils, farming systems, seed multiplication, agricultural engineering, transportation, and marketing and extension) for USAID missions. In addition, OSU served as an information retrieval center to respond to specific questions or requests by USAID missions involving various agricultural problems.

F) Summary of Accomplishments

1. Established that the systematic crossing of winter and spring gene pools of wheat significantly increased genetic variability for many traits including more durable disease resistance, grain yield and stability of yield.

2. Developed, for the first time, an international network for sharing germplasm, advanced lines and information regarding winter and facultative wheats which included countries in Eastern Europe and the People's Republic of China. This collecting, enhancing and distributing of genetic materials also offset the negative aspects of varietal protection laws being developed by many countries including the U.S.

3. The international winter x spring screening nursery grown, in every major winter or facultative wheat growing region in the world, clearly identified new sources of genetic resistance to the major disease complexes. As a surveillance nursery it has enabled breeders to anticipate changes in the physiological races of major diseases of wheat.

4. When reviewing the current positions held by the 98 scientists who have received their M.S. or Ph.D. in this program, one must be impressed with

their accomplishments. Twenty U.S. Students who were also a part of this program received a much greater appreciation of international agriculture.

5. This program was the first to identify the major biotic and abiotic stresses influencing winter and facultative wheat on a world-wide basis.

6. Nineteen wheat breeding programs in the U.S. greatly benefited from this program as they received annual enhanced germplasm.

7. Graduate student thesis research has resulted in numerous publications in such journals as Theoretical and Applied Genetics, Crop Science, Plant Disease Reporter, etc. Significant findings have included: 1) the successful regeneration of barley and wheat plans from callus tissue; 2) development of a seedling technique to identify and incorporate aluminum tolerance into several crop species; 3) development of new breeding approaches which are more efficient for breeders in LDCs; 4) native resistance to various pathogens and the identification and development of cultural practices for upland rice production systems for savanna soils of Columbia; 5) evaluation of quantitatively inherited traits such as grain yield and its components, particularly as they are influenced by possible genotype x environment interactions; 6) the influence of vernalization, photoperiod response and temperature on plant growth and development with special emphasis on rate and duration of grain fill.

8. Dwarfing genes Rh+8, Rh+9, Rh+10 are now available to breeders in the U.S. where were obtains from Yugoslavian material. This complements the Rh+1 and Rh+2 genes found in most U.S. semi-dwarf wheats.

9. Materials from the People's Republic of China have provided excellent sources of scab resistance, Fusarium spp., earliness and spike fertility.

10. Genetic lines from Argentina are serving as excellent sources of resistance to Xanthomonas translusiens, an increasingly serious bacterial disease in the U.S. Such materials have also shown excellent resistance to Septoria spp.

11. Enhanced protein levels derived from triticum dicoccoides into hexaploid wheats by scientists in Israel are now being incorporated into winter x spring material and disseminated to U.S. wheat breeders through germplasm developed by the OSU international program.

12. Sources of Yellow Dwarf Virus resistance have been identified in material received from several Eastern Block countries. Using facilitated recurrent selection, populations combining several sources of such resistance to BYDV are being developed and will be disseminated to U.S. breeders.

13. Excellent sources of resistance to Cercosporella foot rot have been received from programs in England and France. Of significance is that the private sector is also participating in sharing of such germplasm.

14. The country of Turkey has continued to contribute sources of resistance to the various races of common and dwarf bunt.

15. Tolerance to aluminum toxicity used in the winter x spring program traces to Brazil.

Table 1. Wheat Germplasm received at Oregon State University From Cooperators in Different Countries and Regions During Six Years, 1980-85.

Region	No. of Intros.	Major Genetic Strengths
Africa	108	SR,LR,SEPT,DRT
Australia	240	EAR,YLD,LR,QU
China	330	EAR,DWF,BYDV
East. Europe	480	PM,DR,LR,FUS,YLD,WH,DWF
West. Europe	816	CER,YR,SEPT,PM,LR,DWF,WH,YLD
Korea/Japan	180	EAR,DWF,WH
Mexico	2160	YLD,LR,DR,PM,DWF,SEPT
Middle East	1068	LR,DR,LTFR,DRT,PM
South America	612	YR,LR,SR,SEPT,PM,YLD,BYDV
U.S./Canada	504	QU,WH,YLD,SEPT,YR,SR
TOTAL	6500	

YLD = Yield
EAR = Earliness
DWF = Dwarf
CER = Cercosporella
FUS = Fusarium
DRT = Drought tolerance
SEPT = Septoria
BYDV = Barley Yellow Dwarf

LTFR = Late frost
YR = Yellow rust
WH = Winterhardiness
LR = Leaf rust
SR = Stem rust
PM = Powdery mildew
QU = Quality

Table 2. Wheat Statistics in 39 Developing Countries with Estimated Potential of Improved Lines Resulting from Wheat Crosses Grown in the Screening Nursery when Compared to Highest Yielding Local Checks.

Country	Area Harvested in 1000ha Winter	Spring	Total	Production in 1000MT Current	Potential	Yield (kg/ha) Local Ck	Improved	% Difference	Potential $ Increase (in $100,000s)
AFRICA									
Algeria	1571	435	2006	1330	1745	3588	4707	131	730
Egypt	0	585	585	1850	2880	3924	6109	156	1813
Ethiopia	78	445	523	491	689	4154	5828	140	348
Kenya	23	94	117	158	603	1611	6149	382	783
Libya	54	215	269	127	371	2161	6317	292	430
Niger/Nigeria	0	5	5	9	10	4400	4847	110	2
Rhodesia	0	35	35	90	115	7088	9076	128	44
South Africa	1471	319	1790	2090	3780	2830	5118	181	2974
Sudan	45	255	300	264	314	2133	2533	119	87
Tanzania/Uganda	0	64	64	81	127	2221	3495	157	82
Tunisia	298	589	887	837	1286	2937	4511	154	789
ASIA									
Afghanistan	1029	1438	2467	2788	3482	6206	7751	125	1222
Bangladesh	30	120	150	218	232	5667	6037	107	25
China	25344	6336	31680	53838	66056	4781	5866	123	21504
India	5814	16045	21859	32911	39259	4096	4886	119	11172
Nepal	260	61	321	385	505	4215	5529	131	211
Pakistan	2797	4041	6838	10698	20195	3190	6022	189	16715
South Korea	63	9	72	149	217	2988	4351	146	120
Turkey	7424	1856	9280	17054	29803	3807	6653	175	22438
MIDDLE EAST									
Iran	3077	2256	5333	5667	7777	6928	9507	137	3713
Iraq	593	890	1483	1297	1742	3278	4402	134	783
Jordan	71	51	122	70	124	1583	2794	177	94
Lebanon	7	16	23	34	46	2978	4052	136	22
Saudia Arabia	0	140	140	205	270	2889	3811	132	115
Syria	417	965	1382	1877	3113	3059	5073	166	2175
Yeman	31	46	77	88	172	2219	4331	195	147

(cont'd)

Table 2. Wheat Statistics in 39 Developing Countries with Estimated Potential of Improved Lines Resulting from Wheat Crosses Grown in the Screening Nursery when Compared to Highest Yielding Local Checks

Country	Area Harvested in 1000ha Winter	Spring	Total	Production in 1000MT Current	Potential	Yield (kg/ha) Local Ck	Improved	% Difference	Potential $ Increase (in $100,000s)
SOUTH AMERICA									
Argentina	5023	2153	7175	11200	14456	4090	5279	129	5730
Bolivia	35	49	84	70	96	3581	4907	137	46
Brazil	1502	2031	3533	3200	4771	1102	1643	149	2765
Chile	420	278	698	850	1218	4670	6692	143	648
Colombia	15	35	50	60	125	2897	6029	208	114
Ecuador	15	39	54	66	93	3844	5402	141	47
Guatemala	9	26	35	48	61	3856	4881	127	22
Mexico	100	697	797	3354	3787	5455	6160	113	763
Peru	45	95	140	148	192	3316	4313	130	78
Uraguay	380	158	538	505	604	1087	1300	120	174
EUROPE									
Greece	38	25	63	61	84	3591	4942	138	40
Portugal	280	287	567	680	834	3395	4162	123	270
Spain	1386	1386	2772	4176	6617	1962	3109	158	4297
TOTALS	59745	44569	104314	159024	217850				103534

Table 3. Abiotic and Biotic Stresses on Wheat Production in Developing Countries by Order of Importance.

REGION/COUNTRY	A*	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
AFRICA																		
Algeria	5	2	4	1					8	7	3	6						
Egypt			4	9	2		6		5	3	1			7		8		
Ethiopia		3	5	7			8			4	2	1					6	
Kenya		6	1		4				2	3	5							
Libya		5	2	1	4		3		6	7		8						
Niger/Nigeria			1			5			2	3	4			6		8	7	
Rhodesia		1	2			3			4	5								
South Africa	1	3		2					4	5		6			8	7		
Sudan			1		5				2	3					6		4	
Tanzania/Uganda			2	7					1		3					5	6	
Tunisia	4	3	1	8		5				6	2		7					
ASIA																		
Afghanistan		2		1			7		3	5	4			6				
Bangledesh				6	3	5			2	1				7				4
China	2	6	5	4	8	7				1	4							4
India		4	5	3	8					8	1	2						7
Nepal	5	1	3		7	4				2	6		8					
Pakistan	8	4			3				7	1	2		6	5				
South Korea	1	2		4		4			7				6					5
Turkey	1	6		2					5	3	4	7				8	9	
MIDDLE EAST																		
Iran	1	2	4	3					5	8	6				7			
Iraq	5	2		1					4	3		7	6	8				
Jordan		2	5	1					7	3	4		6	8				
Lebanon		6		1					4	3	2			5				
Saudi Arabia		5	2	1			7		3	4								
Syria		7	4	1	6				5	2			8	3				
Yemen		2		1		6			3	4	5			7				
SOUTH AMERICA																		
Argentina	3	1		5			6	2	4		7			9	8			
Bolivia	1	2						5	4	6				3				
Brazil		2		6		7	1	5	3		9	8		4				
Chile	5	1						3	7	4	6			2	8			
Colombia	5	1	7					3	4	2				6				
Ecuador																		
Guatemala			4		5				7	1	2			6	3			
Mexico		5	4	8					3	1	2			6	7			
Peru	2	1	4	3				8	7	5				6				
Uruguay		6		7	9		8	3	4	5	1						2	
EUROPE																		
Greece	3	1	4	2		9		5	7	6		8						
Portugal	6	5					1		7	2		8			3	4		
Spain		1			7		8	6	3	2	5	4			9			
AVERAGE IMPORTANCE	3	3	3	3	5	6	7	5	4	4	3	5	7	6	6	7	6	4
NUMBER OF LOCATIONS	17	32	22	25	11	12	6	5	30	36	27	14	11	10	11	11	6	5

*Identification Code for Environmental Stresses on following page

IDENTIFICATION CODE FOR ABIOTIC AND BIOTIC STRESSES

I. Abiotic

A. Winterkill
B. Cold Stress/Frost Damage
C. Heat Stress/Hot Winds
D. Drought/Moisture Stress
E. Saline Soils/Poor Drainage
F. Sprouting/Reduced Quality
G. Shattering
H. Aluminium Toxicity

II. Biotic

I. Stem Rust
J. Leaf Rust
K. Stripe Rust
L. Septoria
M. Powdery Mildew
N. Smuts
O. Barley Yellow Dwarf Virus
P. Root Rots/Fusarium
Q. Root Rots/Cercosporella
R. Head Scab/Alternaria

Table 4. Total Numbers of Cooperators and Countries Receiving Germplasm from the Winter x Spring Wheat Program at Oregon State University from 1973 to the Present.

Crop Season	IWSWSN No. of Cooperators	IWSWSN No. of Countries	F2 No. of Cooperators	F2 No. of Countries	IWSWYT No. of Cooperators	IWSWYT No. of Countries	Crossing Block No. of Cooperators	Crossing Block No. of Countries
1973-74	38	24					3	1
1974-75	52	30					3	1
1975-76	63	33					4	2
1976-77	69	40					7	3
1977-78	80	46					9	4
1978-79	97	48					11	5
1979-80	96	49	24	18			14	6
1980-81	102	50	24	18			15	6
1981-82	104	54	25	19	15	12	18	7
1982-83	107	47	25	19	15	12	19	8
1983-84	109	47	25	19	15	12	26	9
1984-85	111	47	25	19	18	14	24	9
1985-86	106	47	26	22	18	14	25	10

Table 5. Location of Scientists and Their Agencies Cooperating with the 13th International Winter X Spring Wheat Screening Nursery -- 1985

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
AFGHANISTAN	DARUL AMAN RES. STA.	1	A.AYAR,S.SADAT, M.E.ZEERAK		3	1825	34°27'N	69°08'E					
AFGHANISTAN	KUNDUZ AGR. RES. STA.	2	A.ABDUL AHAD		3	450	36°32'N	68°53'E					
ALGERIA	SETIF-IDGC	3	IDGC STAFF		1	1085	34°33'N	64°21'E	RECEIVED TOO LATE FOR COMPUTER SUMMARY				
ARGENTINA	INTA-EERA BALCARCE	4	R. BEDOGNI, J.H. BARIFFI, H. DELMAGRO	558	2	130	37°45'S	58°18'W	27/06/83	18/01/84	18N 46P	*	CARGILL TRIGAL
ARGENTINA	INTA-EERA BORDENAVE	5	S. GARBINI	98	1	212	37°50'S	63°01'W	23/06/83			*	CHASICO INTA
ARGENTINA	INTA-EERA-MARCOS JUAREZ	6	J.NISI,R.CHURIN, J.SALINES,M.GALICH, C. BAINOTTI	228	1	112	32°42'S	62°07'W	17/06/83	18/12/83		*	LAS ROSAS INTA
ARGENTINA	CRIADERO BUCK-LA DULCE	7	JOSE BUCK S.A.	365	1	72	38°20'S	57°00'W	11/06/82	15/01/84	18N 46P	*	BUCK NANDU
AUSTRALIA	ROSEWORTHY AGRIC. COLLEGE	8	G. HOLLAMBY		1		30°10'S	140°05'E	NURSERY DELAYED ONE SEASON BY QUARANTINE				
AUSTRALIA	SIDNEY - CASTLE HILL	9	R. MCINTOSH,D.MILNE, J.CUSICK		1	121	33°44'S	151°10'E	01/05/83	01/12/83		*	HARRIER
BELGIUM	GEMBLOUX	10	J. VANDAM	604	3	160	50°34'N	04°40'E	22/10/83	20/08/84	40N 70P 105K	*	ZEMON
BRAZIL	CAMPINAS	11	C.CAMARGO		3	600	23°22'S	47°52'W					
BRAZIL	CNPT-PASSO FUNDO	12	L. DEL DUCA	1289	3	684	28°15'S	52°24'W	06/05/83	30/11/83	50N 56P 40K	*	JACUI
BRAZIL	PELOTAS	13	M. ROCHA		2	30	31°95'S	52°50'W					
BULGARIA	TOLBUHIN	14	N. STAVREVA		1	236	43°40'N	28°10'E	LOST NURSERIES TO WINTERKILLING				
CANADA	LACOMBE AND OLDS	15	D.SALMON, J.HELM		1	923	52°50'N	113°00'W					
CANADA	ELORA RESEARCH STATION-ONTARIO	16	L.HUNT, P.MEHTA		3	380	43°39'N	80°25'W					
CANADA	UNIVESITE LAVAL.ST. FOY	17	C. ST. PIERRE, A. COMEAU	550	2	150	46°52'N	71°13'W	01/09/83	25/07/84	75N 125P 125K	*	LENNOX

Table 5 (continued)

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
CHILE	QUILAMAPU-CHILLAN	18	L. AGUAYO	835	3	217	36°31'S	71°55'W	26/05/83	14/01/84	130N 65P	*	QU14-75
CHILE	QUILAMAPU-YUNGAY	19	L. AGUAYO		2	530	37°09'S	72°02'W	08/06/83	11/01/84	120N 65P	*	QU 8-81
CHILE	CARILLANCA-TEMUCO	20	C. HEWSTONE, J. ACEVEDO	772	3	200	38°41'S	72°25'W	23/05/83	01/02/84	128N 142P	*	TALAFEN
CHINA	SICHUAN, CHENGDU	21	WHEAT BREEDING STAFF	227	1	250	30°70'N	104°08'E	26/10/83	26/05/84	173N 125P	*	CHUAN MAI 19
CHINA	NANJING JIANGSU	22	CAO YANG		2	9	32°03'N	118°47'E	28/10/83	15/06/84		*	NANJING WHEAT
CHINA	BEIJING	23	HENG LI WANG	100	3	54	39°59'N	116°17'E	24/09/83	15/06/84	247N 70P 46K	*	NONG DA 139
CHINA	SHI-JIA-ZHUANG	24	LI JIN-MING		3	80	38°03'N	114°28'E	04/10/83	02/06/84	35P	*	JIMAI 3
CHINA	SHANDONG AG. UNIV.	25	Q. Q. LI, W. N. LIU, A. F. LI	356	3	129	36°10'N	117°09'E	05/10/83	20/06/84	274N 232P 113K	*	JI-NAN 13
CHINA	SHAANXI-WUGONG	26	N. KUN	438	2	455	34°21'N	108°10'E	04/10/83	17/06/84	30P	*	XIAO YAN 6
CHINA	HENAN PROV. ACADEMY OF AG. SCI.	27	Z. DE FANG	230	1	81	34°49'N	113°40'E	12/10/83	06/06/84	252N 68P 45K	*	7023
COLOMBIA	BOGOTA	28	M. ZAPATA		1	2640	40°04'N	74°12'E	NURSERY NOT SOWN DURING THIS SEASON				
CZECHOSLAVAKIA	BUCANY	29	M. KOVAR	389	2	145	48°35'N	17°40'E	01/10/83	04/09/84	146N 27P 49K	*	VIGINTA
CZECHOSLAVAKIA	PRAHA-RUZYNE	30	P. BARTOS	417	2	350	50°00'N	14°30'E	06/10/83	04/09/84	GREEN MANURE	*	MICHIGAN AMBER
DENMARK	PJBJERGFONDEN-ODDER	31	E. BOLLERUP		3	20	55°98'N	10°05'E	25/09/83	06/08/84	160N	*	KRAKA
ECUADOR	SANTA CATALINA	32	INIAP-CIMMYT	884	3	3050	00°22'S	78°[illegible]	11/01/83	19/07/83	100N 180P	*	INIAP-ALTAR
ENGLAND	CAMBRIDGE	33	J.BINGHAM,J.BLACKMAN	416	2	20	52°10'N	00°06'E	08/10/83	15/08/84	120N	*	MARIS HUNTSMAN
FINLAND	PLANT BREEDING INSTITUTE	34	R. MANNER		1	92	60°49'N	23°29'E	26/08/83		135N 35P 65K	*	VAKKA
FRANCE	CLERMONT FERRAND	35	J. KOENIG, M.ROUSSET	350	2	329	45°47'N	03°10'E	25/10/83	14/08/84	100N	*	FIDEL
FRANCE	CACBA-LESCAR	36	CACBA STAFF		2	130	51°04'N	03°10'E			200N 180P 150K	*	ADAM

Table 5 (continued)

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
FRANCE	MON-EN-PEVELE	37	M.MOMONT, P.POULLARD	571	2	30	50°34'N	00°43'E	12/10/83	30/08/84	60N 60P 60K	*	FIDEL
FRANCE	CNRA-VERSAILLE	38	P.AURIAU	439	3	118	48°48'N	02°04'W	08/11/83	01/08/84	67N 125P 125K	*	PERNEL
WEST GERMANY	HAMBURG	39	J. LANGE	761	3	20	54°01'N	10°43'E	02/10/83	15/08/84	200N 120P 120K	*	CARIBO
WEST GERMANY	RASTATT	40	GOERTZ,GREIMER		2	150	48°50'N	08°25'E					
GREECE	THESSALONIKI- CEREAL INST.	41	S. STRATILAKIS, D. GOGAS	214	1	10	40°38'N	22°57'E	29/12/83	26/06/84	100N 40P	*	DIO,VERGINO,GOR
HUNGARY	MARTONVASAR	42	L.BALLA		2	150	47°21'N	18°49'E	LOST NURSERY FROM WINTERKILL				
HUNGARY	SZEGED - CER.RES. INST.	43	Z. BARABAS	411	2	90	47°21'N	20°03'E	20/10/83	23/07/84	100N 100P 100K		
INDIA	KASHIMIR	44	A.AUSTIN		2	2800	34°20'N	75°00'E					
INDIA	NAINITAL	45	A.AUSTIN		2	1000	28°05'N	83°10'E					
IRAN	KARAJ-CENTRAL RES. STA.	46	N. BANISADAR	285	3	1300	50°35'N	58°50'E	04/11/83	06/07/84	120N 60P	*	AZADI
IRAQ	BARKA JO, SULAIMANYA	47	A.ALAKA,A.SMHAMA		3	700	36°05'N	46°05'E					
JAPAN	HOKKAIDO	48	S. OZEKI	406	2	196	43°47'N	143°42'E	20/09/83	08/08/84	60N 108P 72K	*	HOROSHIRIKOMUGI
JORDAN	RAMTHA	49	M.DUWAYRI		2	980	32°01'N	35°53'E					
JORDAN	SHOBAK	50	N.KATKHUDA		1	1300	32°35'N	31°30'E					
KOREA	WHEAT AND BARLEY INST.-ORD	51	C. S. PARK	333	1	37	36°19'N	126°59'E	10/10/83	22/06/84	120N 90P 70K	*	GEURUMIL
LEBANON	TEL-AMARA	52	A.ALAMEDDINE		3	950	33°55'N	35°38'E	NOT POSSIBLE TO COLLECT DATA ON NURSERY THIS YEAR				
LIBYA	ZAHRA EXP. STA.	53	K.DAHNOUS		1	50	32°40'N	12°50'E					
MEXICO	CIUDAD OBREGON	54	S.RAJARAM,CIMMYT BREAD WHEAT STAFF		3	40	27°30'N	109°50'W					
MEXICO	TOLUCA-CIMMYT	55	S. RAJARAM, CIMMYT WHEAT STAFF		3	2640	19°16'N	99°51'W	11/11/83	10/07/84	100N 80P	*	NR72-837

Table 5 (continued)

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
MEXICO	CAMPO-BAJIO-CIAB-INIA	56	J.L.MAYA, R.BARCENAS		3	1765	20°32'N	100°49'W					
MOROCCO	ANNOCEUR	57	M. ZLIBENE		1	1345	34°30'N	04°40'W					
NEPAL	CROP RESEARCH DIVISION	58	CEREAL RES. TEAM		3	2000	27°48'N	85°15'E					
NEW ZEALAND	CROP SES. DIV.-CANTERBURY	59	D.WRIGHT		2	11	43°38'S	172°30'E					
PAKISTAN	PIRSABAK,NOWSHERA	60	CEREAL RES. TEAM		3	905	34°00'N	72°00'E					
PAKISTAN	SARIAB-QUETTA	61	WHEAT BOTANIST	63	1	1708	29°00'N	68°00'E	24/12/83	09/07/84	120N 60P	*	ZARGHOON 79
PERU	JUNIN - EL MANTARO	62	J. CALDERON, J. MANDUJANO	238	1	3325	12°04'S	75°12'W	04/05/83	17/03/84	50N 50P 20K	*	UNC2, UNC3
PERU	PUNO	63	M.ROMERO-LOLI		1	1800	15°90'S	70°05'W	NURSERY SEED LOST IN CUSTOMS				
POLAND	POLANOWICE-PLT.BDG.STA.	64	T. RUEBENBAUER	365	2	280	50°02'N	20°02'E	07/10/83	17/09/84	40N 100P 140K	*	GRANA
POLAND	LASKI-PLT.BDG.STA.	65	J. BIATOSKORSKI	479	2	100	51°45'N	21°15'E	23/09/83	20/08/84	100N 139P 95K	*	GRANA
PORTUGAL	ELVAS	66	F. BAGULHO	610	3	208	38°54'N	07°09'W	19/10/83	15/07/84	140N 63P 50K	*	MARIUS, EDCH
ROMANIA	I.C.C.P.T. FUNDULEA	67	WHEAT BREEDING TEAM	509	2	67	44°27'N	26°32'E	15/10/83	20/07/84	120N 80P	*	FUNDULEA 29
SOUTH AFRICA	SMALL GRAIN CNT.-BETHLEHEM	68	I. B. J. SMIT	400	1	1631	28°10'S	28°18'E	19/05/83	21/12/83	60N 64P 30K	*	BETTA
SPAIN	EL ENCIN - MADRID	69	M. BRANAS	279	1	673	40°31'N	3°19'W	02/12/83	30/07/84	110N 120P 40K	*	PIRON
SPAIN	LA ORDEN	70	J.MONTERO DE ESPINOSA		1	200	38°49'N	06°39'W					
SWITZERLAND	ZURICH	71	F. WEILENMANN, H. WINZELER,P.FRIED	640	3	445	47°29'N	09°32'E	12/10/83	14/08/84	120N 90P 180K	*	ZENITH
SYRIA	TEL HADYA, ALLEPO	72	G. ORTIZ FERRARA	260	1	282	36°05'N	36°55'E	16/12/83	15/06/84	60N 40P	*	SHAM 2
THAILAND	SUMAN FARM	73	N. RATANADILOK	52	1	300	14°40'N	102°00'E	10/11/83	01/03/84	120N 94P	*	INIA66
TUNISIA	KEF	74	A.DAALOUL		1	300	36°50'N	08°85'E					

Table 5 (continued)

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
TURKEY	ANKARA	75	K.YAKAR, M.KIZILIAN		1	1055	39°41'N	32°39'E					
TURKEY	ADAPAZARI	76	M.ARICAN		3	33	40°44'N	20°22'E					
TURKEY	DIYARBAKIR	77	A.AYDIN,A.ERTUG FIRAT, M.OZTURK		2	660	37°55'N	40°12'E					
TURKEY	EDIRNE	78	N. HAZAR, Y. CELIKER, B. KIRAL	539	2	41	41°40'N	26°43'E	24/10/83	20/07/84	95N 92P	*	KIRKPINAR 79
TURKEY	ERZURUM	79	A.KIRAL		2	1870	39°40'N	41°46'E					
TURKEY	ESKISEHIR	80	B.SUZEN		2	789	36°45'N	30°45'E					
TURKEY	IZMIR	81	M.KANBERTAY, P.SOLEN		3	20	38°35'N	27°05'E					
U.S.A.	FAYETTEVILLE, AR	82	R. BACON		3	427	36°00'N	94°00'W	09/11/83	05/07/84	101N	*	CALDWELL
U.S.A.	FT. COLLINS, CO	83	J.S.QUICK		1	1610	40°35'N	105°10'W	SELECTIONS ADVANCED TO DRYLAND				
U.S.A.	EXPERIMENT, GA	84	J.JOHNSON		3	875	34°00'N	85°50'W					
U.S.A.	FORT HAYES, KS	85	J. MARTIN	480	2	600	39°00 N	99°30 W	15/10/83	10/07/84	33N	*	TAM105
U.S.A.	MANHATTAN, KS	86	R. SEARS, T. COX	1050	3	335	39°20'N	96°44'W	20/10/83	14/07/84	90N 35P	*	NEWTON
U.S.A.	LEXINGTON, KY	87	D.A. VAN SANFORD		3	1000	38°05'N	84°30'W					
U.S.A.	BATON ROUGE, LA	88	L.ANZALONE		2	6	30°32'N	91°09'W					
U.S.A.	EAST LANSING, MI	89	E.EVERSON		3	270	42°42'N	84°28'W	DATA COLLECTION NOT POSSIBLE THIS SEASON				
U.S.A.	BOZEMAN, MT	90	A.TAYLOR		2	1368	45°60'N	111°00'W	DATA RECEIVED TOO LATE TO SUMMARIZE BY COMPUTER				
U.S.A.	LINCOLN, NE	91	V. JOHNSON, C.PETERSON, S.KUHR		2	360	40°51'N	96°38'W	15/09/83	15/07/84		*	BRULE
U.S.A.	WOOSTER, OH	92	H. LAFEVER		2	310	40°47'N	81°56'W	08/11/83			*	TITAN
U.S.A.	STILLWATER, OK	93	E. L. SMITH	522	3	270	36°06'N	97°04'W	14/11/83	10/07/84	64N 62P	*	PAYNE

Table 5 (continued)

COUNTRY	STATION	CODE	COOPERATOR(S)	SEASONAL RAINFALL MM	ZONE	ELEV M	LATITUDE	LONGITUDE	PLANTED	HARVESTED	APPLIED	DATA	LOCAL VARIETY
U.S.A.	HERMISTON, OR	94	M.KOLDING		1	624	45°70'N	119°40'W	NOT SEEDED THIS CROP SEASON				
U.S.A.	CORVALLIS. OR	95	W. MCCUISTION, W.KRONSTAD, D.EATON	1125	3	68	45°30'N	123°30'W	15/10/83	04/08/84	180N 40P		* STEPHENS
U.S.A.	MORO, OR	96	W. MCCUISTION, W.KRONSTAD, D.EATON	326	1	187	45°29'N	120°43'W	20/09/83	25/07/84	60N		* STEPHENS
U.S.A.	PENDLETON	97	W. MCCUISTION, W. KRONSTAD, D.EATON	564	2	454	45°30'N	118°26'W	09/10/83	18/07/84	90N		* STEPHENS
U.S.A.	FARGO, SD	98	J.GELLNER		1	491	44°18'N	96°22'W	PLANNED SPRING PLANTING BUT NOT POSSIBLE				
U.S.A.	PULLMAN, WA	99	C.KONZAK		3	833	46°42'N	117°08'W	NURSERY WASN'T SPRING PLANTED AS USUALLY DONE				
U.S.A.	PULLMAN, WA	100	C.PETERSON		2	777	46°42'N	117°08'W					
U.S.S.R.	KRASNODAR	101	Y. PUCHKOV	457	2	37	45°00'N	38°55'E	04/10/83	05/07/84	90N 60P 45K		*
U.S.S.R.	MOSKOVSKAYA	102	V.GULYAYEV		2	500	55°38'N	36°48'E					
U.S.S.R.	ODESSA	103	L. SECHNJAK	318	1	42	46°40'N	31°20'E	10/10/83	30/07/84	150N 60P 60K		* ODESSKAJA 51
YEMEN ARAB REP.	DHAMAR REG.AG.RES.INST.	104	N.CHANDHRI, M. AAGIL, H. AMER		1	2360	14°32'N	44°24'E	21/12/83	27/06/84	120N 26P		* SONALIKA
YUGOSLAVIA	NOVI SAD	105	S.BOROJEVIC	340	2	84	45°03'N	19°08'E	10/11/83	23/07/84	150N 100P 60K		* ZITNICA
YUGOSLAVIA	SKOPJE	106	I.ANGELOV		2	250	42°02'N	21°22'E					
YUGOSLAVIA	ZAGREB	107	Z.MARTINIC		2	116	45°51'N	15°56'E					
U.S.A.	FT. COLLINS, CO NAPB	108	R. BRUNS		3	1530	40°00'N	105°00'W	01/03/83	12/08/84	120N		* HAWK
ARGENTINA	BAHIA BLANCA	109	R. MIRANDA										

Table 6. How Materials from the Winter x Spring Wheat Improvement Program are being used by Various Cooperators

COUNTRY	AREA OF WHEAT PRODUCTION (1000HA) WINTER	SPRING	TOTAL	CULTIVAR	SEL.NO.	STATUS OF ADVANCEMENT
Afghanistan	1,920	480	2,400	FN//T/TH/3/3*CLLF/4/ANZA	30/80	Advanced yield trials Several cultivars suggeste for release for higher altitudes. Multiplication of these cultivars are in progress on a newly established seed farm. Yields of these cultivars have be 200 to 400% higher than th check variety.
				SN/BEZ	36/80	
				INIA66R//HBGN/CD	92/80	
				LFN/VOGAF	209/80	
				RCT/564/3/SU92/CI13645//NAI	56/81	
				SW073159/5/AU/4/YMH/P101/3/ OM/PI178383//RBS	111/81	
				YMH/JAR//KVZ	146/81	
				RPB70066034	155/81	
				68-74/HYS,F3//237-12	216/81	
Algeria	1,610	690	2,300	ANZA/3/PI62/NAR59/HYS	10/79	Possible varietal release These cultivars have prope maturity cycle for high altitude, low moisture and drought stress.
				BMAN/RAF//PA	117/80	
				ALBA/GNS//FN/SN	234/80	
				APF	128/80	
Argentina	4,500	2,675	7,175	MRS/ZZ1	84/80	Advanced yield trials These cultivars have been very promising in comparative varietal trials and are being used as parents in the crossing program.
				BMAN/RAF//PA	117/80	
				AN//SN/SS2	129/80	
				JI/3/PJ/NAR//HN7/CD/4/JAR//GNS/ LP	11/81	
				69-153/YMH,F3//237-24	43/81	
				ANZA/SDY	35/78	
				BEZ/ERA	194/78	
				MRS/3/YMH//RBS/NCO/4/SW072031	141/81	
Belgium	203	-	203	SN64/TZPP//NAI/3/CRIM/4/DJ*2/GB	223/80	Advanced yield trials Good expression of winter-hardiness and Septoria resistance.
				69-153/YMH,F3//237-24	103/81	
				KC/BEZ/3/II50-18/P101//II50-18/ VGDW	139/81	
				SPN/3/EXR//HYS/7C	250/81	

Table 6 (cont'd)

COUNTRY	AREA OF WHEAT PRODUCTION (1000HA) WINTER	SPRING	TOTAL	CULTIVAR	SEL.NO.	STATUS OF ADVANCEMENT
Brazil	1,800	1,733	3,533	YKT406/N057	107/81	Advanced yield trials
				FDL133-67/4/CC/INIA/3/TOB/CFN //BB	SWM77-8228	Multiplication for release
				BGS/SORT//PVN	6/81	Advanced yield trials
				BEZ2B/3/CC/INIA//CAL	41/81	Several SXW cultivars exceed
				KVZ/GV	52/81	local varieties by 50% when
				S148/PCI	176/81	grown on acid-free soils
Chile	318	380	698	SPD/YR	89/90	Advanced yield trials
				55-1744/PI//237-30/KVZ	87/81	Excellent resistance for
				69-153/YMH,F3//237-24	103/81	stripe and leaf rust combine
				PEX/TOB	143/81	with yield potential.
				YMH/P101//KKK/3/55-1744/7C//HYS	232/81	
				BMAN/RAF//PA	117/80	
				ANZA/4/VIL29/VG8881//INIAS/3/ 55-1744/DRC	131/80	
Czechoslovakia	1,270	-	1,270	AN//SN/SS2	129/80	Advanced yield trials
				PMF/LFN	217/80	" " "
				ND/CI13438//CJ,F1/CTFN*3/JN	73/81	Yield trials
				55-1744/7C//SU/RDL	113/81	" "
				FGO/M2	153/81	" "
				HYS/NOR	238/81	" "
Greece	2,044	511	2,555	ROMF34-70//BB/GLL	10/80	Advanced yield trials
				INIA//HBGN/DRC	17/80	" " "
				SN64/TZPP//NAI/3/CRIM/4/DJ*2/GB	223/80	" " "
				CBC148//CNO/INIA//LFN/3/KLPE/RAF	24/81	Yield trials
				GOV/PCI	71/81	" "
				SMB/PCH//KAL/BB	108/81	" "
				CNO/PJ//YMH/3/LBR/SPN	192/81	
Hungary	3,877		3,877	BEZ//TOB/8156	25/79	New variety: GK APOLLO
Japan	89		89	P101/KTZ,F1/3/F1,KUPA//CNO/GLL	73/80	Advanced yield trials
				BEZ//TOB/8156	127/80	" " "

Table 6 (cont'd)

COUNTRY	AREA OF WHEAT PRODUCTION (1000HA) WINTER	SPRING	TOTAL	CULTIVAR	SEL.NO.	STATUS OF ADVANCEMENT
Korea	28	9	37	ROMF9-70//CNO/GLL	216/80	Advanced Yield Trials
				YMH/HYS	245/80	
				69-153/YMH,F3//237-24	43/81	
				YKT406/NO57	107/81	
Lebanon	10	15	25	BHR//CNO/GLL	21/81	Very promising - Yield Trial
Mexico	80	717	797	69-153/YMH,F3//237-24	43/81	Advanced Yield Trials
				JI/HYS/3/CNO/PJ//YMH	136/81	" " "
Pakistan	2,444	3,667	6,111	5148/BLO	27/81	Yield trials
				BEZ2B/3/CC/INIA//CAL	41/81	" "
				PJ/HN4//TI	65/81	" "
				SU92/CI13645//AMD	121/81	
Jordan	55	82	137	55-1744/7C//PDGA/3/YMH/TOB//BEZ	106/80	
				CLLF/PCH//P101/VOGAF	156/80	
Poland	3,133	-	3,133	GOV/PCI	72/81	Very promising - Yield Trial
South Africa	1,100	360	1,460	7C/SPD//SW073324	81/81	Yield trials
				SN/KUZ/4/MRS/3/ND/2*P101//CAMA	84/81	" "
				7C/CNO//CAL/3/HYS/4/MRS	135/81	" "
Spain	1,055	452	1,507	ASP/3/7C//TOB/NAPO	29/81	Yield trials
				HYS/NO//LVII,F1/3/F1,KVZ/HYS	44/81	" "
				CI26-13/CLLF//C59287/3/P101	57/81	" "
				CBC148//CNO/INIA//LFN/3/KLPE/RAF	207/81	" "
Tunisia	476	713	1,189	CBC148//CNO/INIA//LFN/3/KLPE/RAF	23/81	Yield Trials - excellent cultiva
				CLLF/BEZ//SU92/CI13645/3/NAI/4/EMU	32/81	in low rainfall environment.

Table 6 (cont'd)

COUNTRY	AREA OF WHEAT PRODUCTION (1000HA) WINTER	SPRING	TOTAL	CULTIVAR	SEL. NO.	STATUS OF ADVANCEMENT
China	20,460	10,540	31,000	KVZ/4/ARTTYPE*5/3/AA//TF/BULG88	118/81	Yield trials
				ERA/YMH	152/81	High yield potential and
				PATO/237-30//ROM F12-71	197/81	early maturity.
				61-1228/AU,F1/3/F1,HYS//DJ*2/ VG8316	218/81	
Turkey	6,880	1,720	8,600	HYS S/7C		New variety: KIRKPINAR 79
				HYS S/7C (sister)		New variety: TRAKYA
				CD/P101//DRC/HYS		New variety: EDIRNE
				YMH/HYS		New variety: TASKAN
				BHR/CZHO		New variety: ENEZ
				ND/P101*2		New variety: ATAGUN
France	3,851	428	4,279	6720//BB/NOR/3/70-1228/YMH		Possible varietal release
				SPN//MCD/CAMA		Possible varietal release
Yugoslavia	3,469	-	3,469	NOR67/3/CD/P101//DRC/4/YMH	427/75	Multiplication for release
				SN64/SS2	367/75	Multiplication for release
				YMH/TOB	384/75	Advanced Yield Trial
GRAND TOTALS	60,672	25,172	85,844			

Table 7. Current and Former Graduate Students

Current Students

Name	Country	Degree	Support	Thesis Topic
Baltazar, B.	Mexico	M.S.	CIMMYT-35	The Relationship between Plant Height and Septoria Tritici Infection in Three Isogenic Crosses
Camacho, M.	Mexico	M.S. & Ph.D.	AID	Yield Loss Assessment in Non-protected Winter Wheat Varieties
Cao, W.	PRC	Ph.D.	Nanjing. Ag. Univ.	Physiology and Genetic Aspects for Maturity and Grain Yield in Spring Barley
Chen, C.	PRC	Ph.D.	Chinese Govt.	Identification and Inheritance of Factors Influencing the Rate and Duration of Grain Filling in Selected Wheat Cultivars
Costa, J.	Argentina	M.S.	AID	Morphological and Developmental Characteristics of Winter Wheat in Relation to Yield and Protein Content
Das, M.	Bangladesh	M.S.	CIMMYT	Genetic Mechanism of Slow Rusting in Spring Wheat
Encinas, A.	Mexico	M.S.	AID	Assessment of Durum Wheat Quality and Relationship with Banding Patterns
Habernicht-Holmer, J.	USA	M.S.	OSU	Screening of Hard-Red Winter Wheats for Environmental Effects on N Assimilation, N Allocation and Grain Protein
Khan, N.	Pakistan	Ph.D.	FAO-AID-MISSION	Precision of Three Different Experimental Designs in Genotypic Evaluation and Selection
Lewis, H.	USA	M.S.	Lafarge Coppee	Evaluation of Chemical Hybridization (Male Gametocide) Agents on Selected Winter Wheat Cultivars
Masood, S.	Pakistan	Ph.D.	FAO	Combining Ability over Successive Generations in Diallel Crosses of Bread Wheat
Medina, L.	Columbia	M.S.	Self	Possible Associations between Kernel Number and Weight in Winter Wheat
Mou, Beiquan	PRC	M.S. & Ph.D.	Chinese Govt.	Duration and Rate of the Grain Filling Period and Subsequent Grain Yield in Crosses between Facultative and Winter Wheat Cultivars

Name	Country	Degree	Support	Thesis Topic
Pedretti, R.	Paraguay	Ph.D.	LASPAU/AID	Inheritance of Dwarfism in Selected Winter Wheat Cultivars and Agronomic Performance of Resulting Progeny
Rahman, M.	Bangladesh	M.S.	FAO	Possible Associations of Protein Banding Patterns to End Product Use in Isogenic Winter Wheat Lines
Re, J.	Argentina	M.S.	AID	Selection Procedures for Septoria Tritici Resistant Wheat
Vanavichit, A.	Thailand	Ph.D.	CIMMYT-35	Genetic Study of Grass Dwarfism as a Source of Heat Tolerance in Wheat
Verges, R.	Uruguay	M.S.	Uruguay Govt.	Yield Comparison between Parents, F1's and Composite Populations across Diverse Environments

Former Students

Name	Country	Degree	Support	Present Position
Abi-Antune, M.	Lebanon	Ph.D.	R.F.	Teaching and Research American University Beirut, Lebanon
Alcala, M.	Mexico	Ph.D.	R.F.	Head, International Nurseries CIMMYT, Mexico
Alexander, W.L.	USA	Ph.D.	OSU	USDA Wheat Geneticist Montana State University
Altman, D.	USA	M.S.	USAID-GRANT	USDA Cotton Geneticist, Texas A&M University
Bayraktar, A.	Turkey	Ph.D.	R.F.	Instructor, Wheat Research Roseworthy College Australia
Benacef, N.	Algeria	M.S.	CIMMYT	Research Position Ministry of Agriculture Algeria
Boinnet, J.	Kenya	M.S.	Kenya Govt.	Seed Muliplication Director Kenya
Brajcich, P.	Mexico	M.S.		
		Ph.D.	R.F.	Head, Durum Program CIMMYT, Mexico
Camargo, C.	Brazil	Ph.D.	USAID-MISSION	Wheat Breeder and Research Coordinator University of Campinas Brazil
Charoenwatana, T.	Thailand	Ph.D.	Self	Rector, Khon Kaen University, Thailand
Chemli, M.	Tunisia	M.S.	USAID-MISSION	Extension Service Ministry of Agriculture Tunisia
Choi, B. H.	Korea	M.S.	USAID-GRANT/OSU	Project Leader, New Crop Breeding Research Suwon, Korea
		Ph.D.	OSU/USAID Grant	
Conway, M.	USA	M.S.	Self	Corn Breeder Private Seed Co.
Corral, L.	Ecuador	Ph.D.	OAS,USAID	Head of Agronomy Dept. School of Agriculture "El Zamorano" Honduras

Name	Country	Degree	Support	Present Position
Cuevas, F.	Dom. Rep.	Ph.D.	R.F.	Rice Coordinator of the Caribbean Area (CIAT) Cali, Columbia
Daaloul, A.	Tunisia	M.S.	USAID-MISSION	Chairman Agronomy Department INAT (National Institute) Tunisia
Duratan, N.	Turkey	M.S.	R.F.	Weed Control Specialist and Agronomist Ankara, Turkey
Dutlu, C.	Turkey	M.S.	R.F.	Plant Pathology Director Agriculture Research Izmir, Turkey
Ekse, A. O.	Turkey	M.S.	R.F.	Wheat Breeder Izmir, Turkey
Firat, E.	Turkey	M.S.	R.F.	Station Director and Wheat Breeder Diyarbakir, Turkey
Frederickson, L.J.	USA	Ph.D.	USAID-GRANT	Plant Breeder, Cargill Research Co., St. Peter, MN
Ganapathy, M.	India	Ph.D.	Self	Plant Breeder India
Goldstein, C.	USA	M.S.	USAID-GRANT	Research Assistant, Biotechnology, Del Monte Corp., California
Gomez-Pando, L.	Peru	M.S.	CIMMYT	Cereal Breeder UNA (National Univ.) Lima, Peru
Guler, M.	Turkey	M.S.	USAID-MISSION	Agronomist, CIMMYT Bangladesh
Harrabi, M.	Tunisia	M.S.	R.F.	Teaching and Research INRAT Tunis, Tunisia
Hayes, P.	USA	M.S.	OSU	Continuing Graduate Studies, University of Minnesota
Hazar, N.	Turkey	M.S.	R.F.	Wheat Breeder Edirne, Turkey
Helm, J.	USA	Ph.D.	OSU	Director, Agricultural Cereal Research Program, Alberta, Canada
Ihrke, C.	USA	Ph.D.	NASA	Chairman, Biological

Name	Country	Degree	Support	Present Position
				Science Division University of Wisconsin Green Bay, WI, USA
Indelen, E.	Turkey	M.S.	R.F.	Director, Research Sta. and Sunflower Breeder Edirne, Turkey
Jones, D.	USA	Ph.D.	Self	Assistant Professor Biology Department Centralia Jr. College Centralia, WA, USA
Kanbertay, M.	Turkey	M.S.	R.F.	Plant Breeder Ankara, Turkey
Keim, D.	USA	Ph.D.	OSU	Plant Breeder Private seed co. Lubbock, Texas USA
Leal, D.	Colombia	Ph.D.	ICA	Project Leader, Upland Rice Research, Colombia
Lopez, A.	Mexico	Ph.D.	R.F.	Research and Breeding University Santio Mexico
Lorenzo, A.	Argentina	Ph.D.	Jose Buck Company	
Lovato, C.	Brazil	Ph.D.	Brazil Govt.	Sweet Corn Breeder U.F.S.M., Brazil
Maatougui, M.	Algeria	M.S.		
Marciniak, M.	USA	M.S.	USAID-GRANT	Teacher and Consultant of Agriculture Sciences, Danhiko College, Zimbabwe
Mareck, J.	USA	Ph.D.	OSU	Corn Breeder, IITA, Nigeria
Martinez, C.	Colombia	Ph.D.	R.F.	Rice Breeder CIAT, Colombia
Maya, J.L.	Mexico	Ph.D.	R.F.	Director, Wheat Research INIA, Mexico
Min, H.K.	Korea	M.S.	IIE-AID-MISSION	Rice Breeder Wheat Research Center South Korea
Mork, C.	USA	M.S.	OSU	Research Assistant Plant Pathology Dept. Montana State Univ.
Oakley, S.	USA	M.S.	OSU	Altheimer Laboratory Lafayette, Ark. USA

Name	Country	Degree	Support	Present Position
Ortiz, G.	Mexico	Ph.D.	R.F.	Wheat Breeder CIMMYT Aleppo, Syria
Pehlivanturk, A.	Turkey	M.S.	R.F.	Assistant Director of Agriculture Ankara, Turkey
Peterson, C.	USA	Ph.D.	ARS	ARS-USDA Winter Wheat Breeder, Washington State Univ. Pullman, WA, USA
Petpisit, V.	Thailand	Ph.D.	R.F.	Director and Coordinator of Rice Research Southern Thailand
Roberts, D.	USA	Ph.D.	ARS	Plant Breeder Private Seed Co.
Rose, C.	USA	M.S.	self	Grass Seed Breeder, Turf Seed, Inc., Hubbard, Oregon, USA
Saini, S. K.	India	Ph.D.	Self	Professor, Ohio, USA
Salmeron, J.	Mexico	Ph.D.	Mexican Govt.	Oat Breeder, INIA, Chihuahua, Mexico
Samphantharak, K.	Thailand	Ph.D.	OSU	Sorghum Breeder Kasetsart University Bangkok, Thailand
Schumaker, K.	USA	M.S.	OSU	Pursuing Ph.D. degree University of Maryland USA
Sears, R.	USA	Ph.D.	OSU	Wheat Breeder Kansas State University Manhattan, KS, USA
Solen, P.	Turkey	Ph.D.	R.F.	Director & Coordinator Spring Cereal Research Izmir, Turkey
Stein, I.	USA	M.S.	USAID-OSU	Pursuing Ph.D. in Wheat Breeding and Genetics, Kansas State University
Tola, J.	Ecuador	Ph.D.	R.F.	Director, Santa Catalina Res. Sta., Quito, Ecuador
Vahabian, M.	Iran	Ph.D.	Ford-CIMMYT	Under-Secretary of Agriculture Iran
Valencia, J.A.	Mexico	Ph.D.	Mexican Govt.	Director of CIANO

Name	Country	Degree	Support	Present Position
				National Research Institute Mexico
Verhoeven (Boulger), M.	USA	M.S.	OSU	Barley Breeder Oregon State University Corvallis, OR, USA
Yahyaoui, A.	Tunisia	M.S.	USAID-GRANT	Plant Pathologist Tunis, Tunisia
Yakar, K.	Turkey	M.S.	R.F.	Project Leader National Wheat Research Project Ankara, Turkey

Figure 1. Cooperators in the Winter X Spring Wheat Improvement Program. (numbers correspond to location numbers in Table 4)

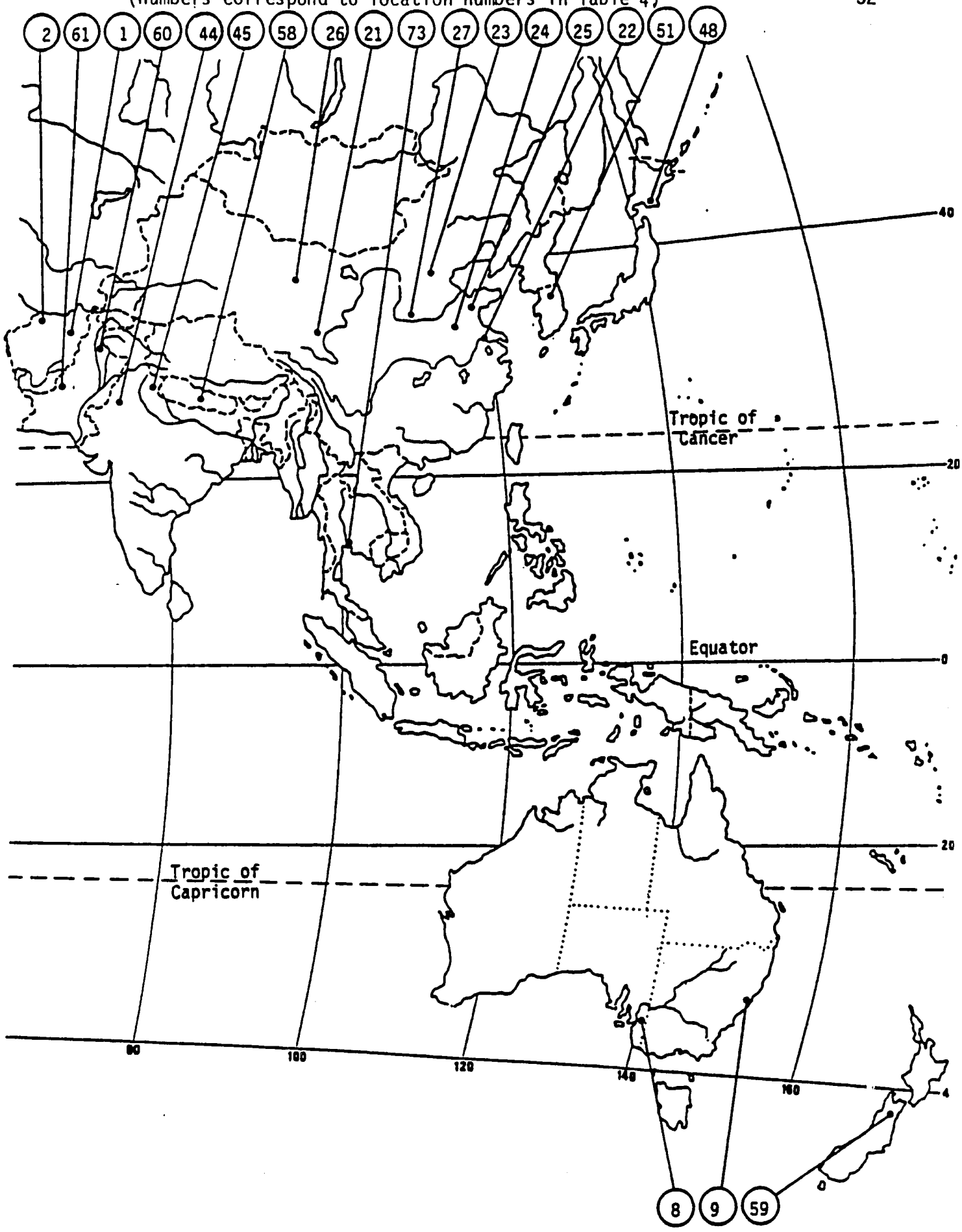
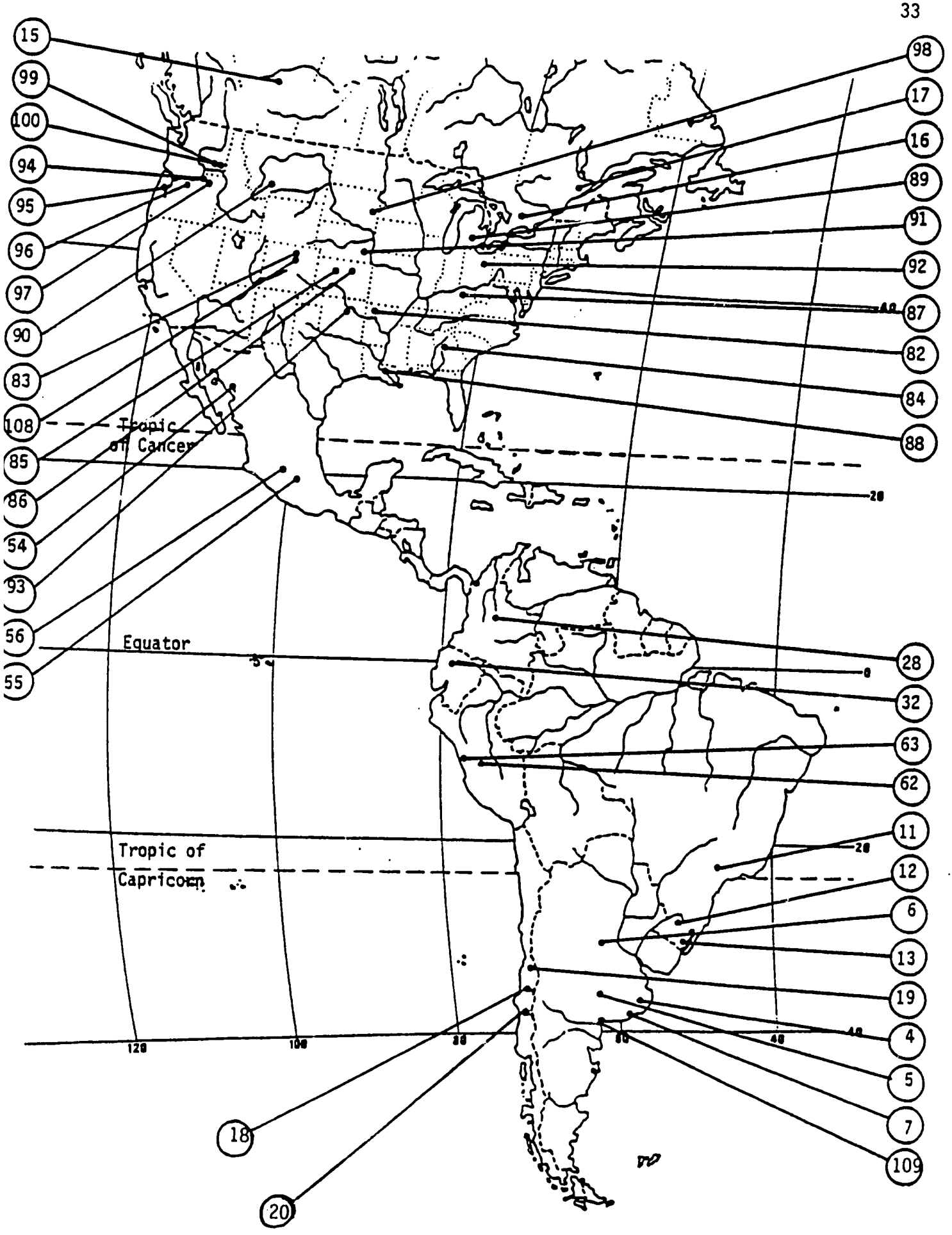


Figure 1



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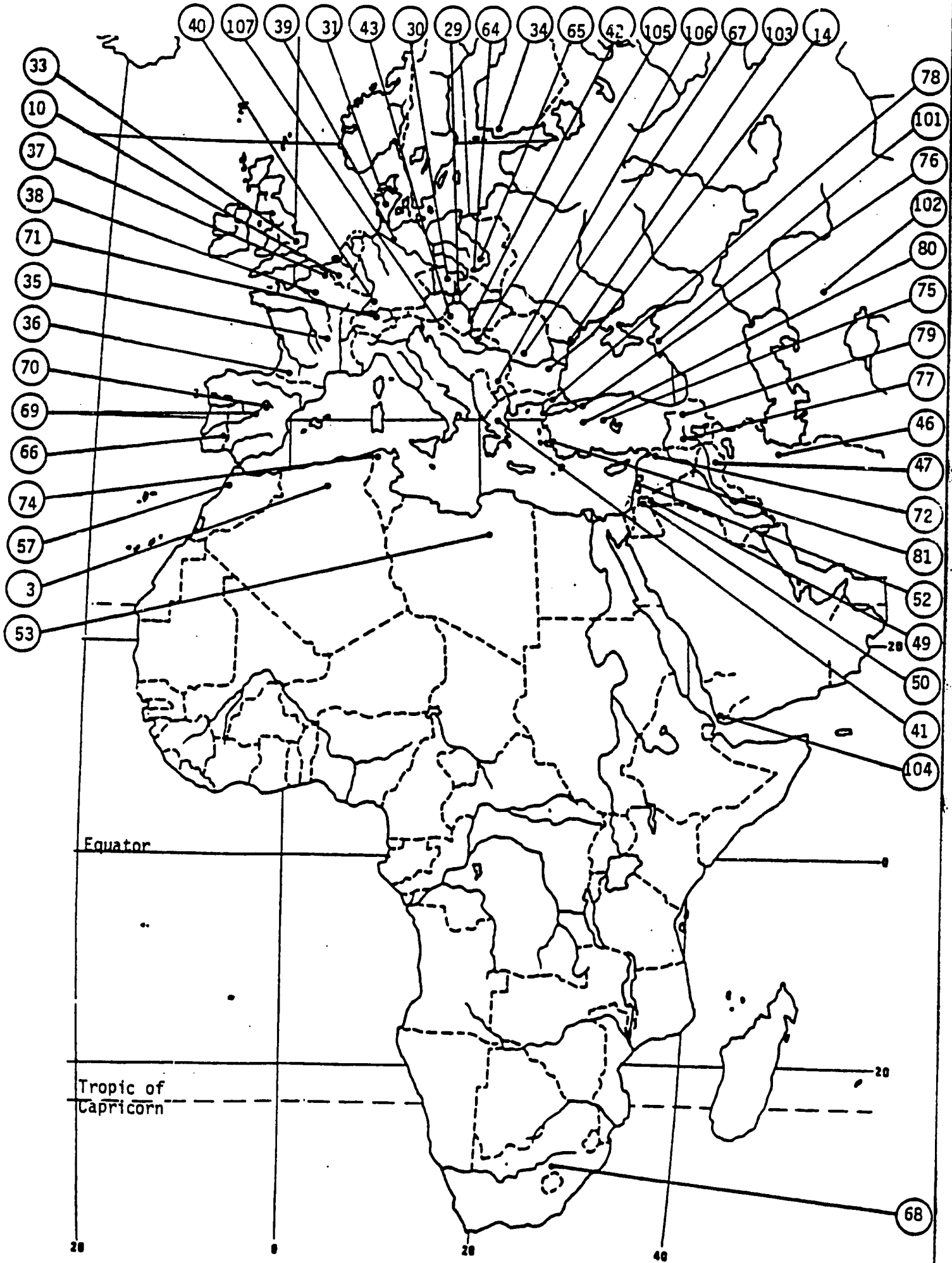

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