CIMMYT'S MAIZE PROGRAM: AN OVERVIEW

CIMMYT

CENTRO INTERNACIONAL DE MEJORAMIENTO DE MAIZ Y TRIGO

INTERNATIONAL MAIZE AND WHEAT IMPROVEMENT CENTER

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International Maize and Wheat Improvement Center
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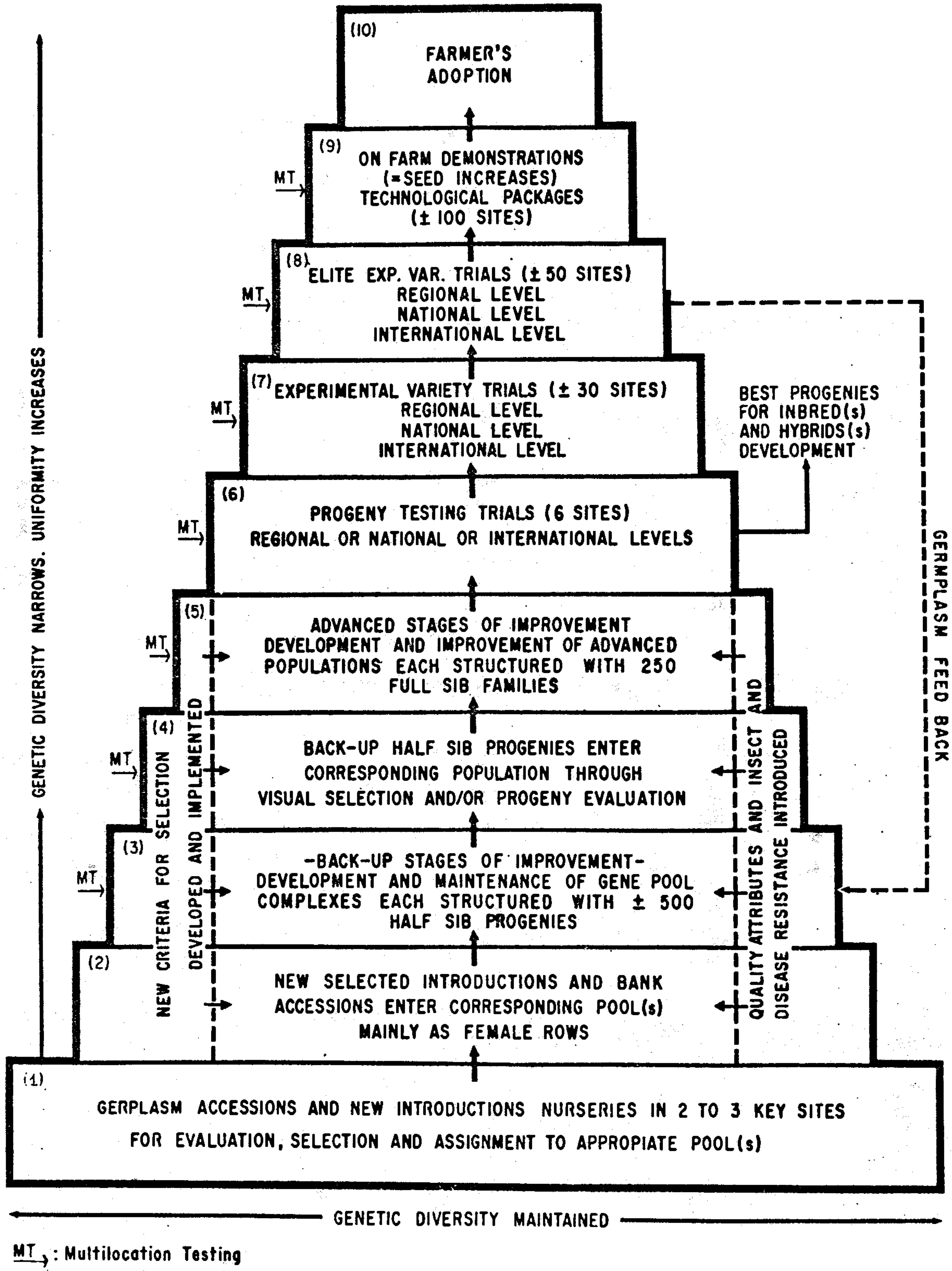


Fig. 1. Stages in Maize germplasm management and improvement

Table 1.
MAIZE GENE POOLS AND CORRESPONDING POPULATIONS IN CIMMYT'S MAIZE IMPROVEMENT SCHEME

NEW GERMPLASM	POOL NO.	POOL NAME	POP. NO.	POPULATION NAME
Introductions and Germplasm Bank	1	Highland early white floury	--	Blanco harinoso precoz
"	2	Highland late white floury	--	---------------------
"	3	Highland early yellow floury	--	Amarillo harinoso precoz
"	4	Highland late yellow floury	--	Chillos x varios
"	5	Highland early white morocho	--	---------------------
"	6	Highland early yellow morocho	--	---------------------
"	7	Highland late white morocho	--	---------------------
"	8	Highland late yellow morocho	--	---------------------
"	9	Highland late white dent	--	---------------------
"	15	Tropical early white flint	30	Blanco cristalino-2
"	16	Tropical early white dent	--	---------------------
"	17	Tropical early yellow flint	31	Amarillo cristalino-2
"	18	Tropical early yellow dent	--	---------------------
"	19	Tropical interm. white flint	23	Blanco cristalino-1
"	20	Tropical interm. white dent	49	Blanco dentado-2
"	21	Tropical interm. yellow flint	26	Mezcla amarilla
"	22	Tropical interm. yellow dent	35	Antigua-República Dominicana
"	23	Tropical late white flint	32	ETO blanco
"	24	Tropical late white dent	21	Tuxpeño
			22	Mezcla tropical blanca
			29	Tuxpeño Caribe
			43	La Posta
"	25	Tropical late yellow flint	27	Amarillo cristalino-1
"	26	Tropical late yellow dent	24	Antigua-Veracruz 181
			28	Amarillo dentado
			36	Cogollero
"	27	Temp.-subtrop. early white flint	--	--------------------
"	28	Temp.-subtrop. early white dent	--	--------------------
"	29	Temp.-subtrop. early yellow flint	46	Templado amarillo cristalino
"	30	Temp.-subtrop. early yellow dent	48	Compuesto de Hungría
"	31	Temp.-subtrop. interm. white flint	34	Blanco subtropical
"	32	Temp.-subtrop. interm. white dent	44	AED-Tuxpeño
			42	ETO-Illinois
			47	Templado blanco dentado
"	33	Temp.-subtrop. interm. yellow flint	33	Amarillo subtropical
"	34	Temp.-subtrop. interm. yellow dent	45	Amarillo del Bajío
--	--	Northern Temperate Range Gene Pool		
--	--	Southern Temperate Range Gene Pool		
--	--	Intermediate Temperate Range Gene Pool		
--	--	CIMMYT-German Gene Pool		
--	--	White flint QPM** Pool	40	White QPM
--	--	White dent QPM Pool	--	---------------
--	--	Yellow flint QPM Pool	39	Yellow QPM
--	--	Yellow dent QPM Pool	--	---------------
--	--	Temperate x Tropical QPM (flint)	41	Templado amarillo QPM
--	--	Temperate x Tropical QPM (dent)	--	---------------
--	--	Temperate White QPM	50	*Templado blanco QPM

* = Proposed advanced population
** Quality protein maize

BACK-UP UNIT AND MAIZE GENE POOLS

CIMMYT's Maize Back-Up Unit evaluates and utilizes superior maize materials (introductions) identified from around the world. A working germplasm bank is maintained and 33 gene pools have been created and are being improved for specific maturities, grain color, and textures. Introductions and bank accessions are systematically evaluated and added to the appropriate gene pools to improve the pools and extend their genetic variability and genetic base. The best performing materials of the gene pools are identified and either transferred to the corresponding Advanced Unit populations for use by cooperators, or used to form new Advanced Unit populations.

The maize bank now holds approximately 14,000 accessions representing over 50 countries from the Americas, Asia and Africa. Over the past 5 years, it has distributed 14,151 materials to nearly 60 countries. Over the same period, 3,040 bank collections and 6,992 introductions from nearly 50 national programs have been evaluated and the promising ones introgressed into appropriate gene pools. Several new gene pools have been formed. The pools have contributed new populations to the Advanced Unit and families to the existing advanced populations. There has been an over-all improvement in the agronomic traits and performance of the pools without apparent reduction in their genetic variability.

The following few pages provide some selected information on the salient aspects of the maize Back-Up Unit. The information is by no means complete.

Pool 1. Highland Early White Floury

This gene pool is based primarily on race Cacahuacintle of Mexico and includes germplasm from the highlands of Colombia, Bolivia, Peru, Ecuador, and Mexico. A small proportion of germplasm also comes from the temperate areas of the USA and Europe. Selection is being practiced for large floury seeds and resistance to ear rots and ear worms.

Pool 2. Highland Late White Floury

Based mainly on races Cuzco Gigante of Peru and Hualtaco of Bolivia, this pool has germplasm from the same countries as Pool 1. In addition, it has a trace of germplasm from Kenya and Cuba. Selection is being practiced for large floury seeds and resistance to ear rots and ear worms.

Pool 3. Highland Early Yellow Floury

This pool is based essentially on the same germplasm as Pool 1 except that yellow floury kernels have been selected. Selection is being practiced for the same traits as in Pool 1.

Pool 4. Highland Late Yellow Floury

Based primarily on race Chillo of Ecuador, this gene pool is being selected for large floury seeds and resistance to ear rot and ear worm. Additional germplasm in this pool is from the highlands of Andean countries, Mexico, Africa, and the USA.

Pool 5. Highland Early White Morocho

This gene pool is based on early white Morocho genotypes of Peru, Bolivia, Colombia, and Ecuador, with some germplasm from Mexico, the USA, and Europe. Selection is being practiced for improved seed type and resistance to ear worms and ear rots.

Pool 6. Highland Early Yellow Morocho

This gene pool is based on early yellow Morocho genotypes of the same Andean countries as Pool 5. In addition, it has germplasm from the highlands of Mexico and Africa, and from the USA, Europe, and Indonesia. Selection is being practiced for the same traits as in Pool 5.

Pool 7. Highland Late White Morocho

This gene pool is a mixture of late white and yellow Morocho types from the highland areas of the Andean countries. In 1982, it was changed to a white pool. Some of its germplasm also comes from the highlands of Mexico and Africa, and from the USA. Selection is being practiced for resistance to ear rots and ear worms and for better seed type.

Pool 8. Highland Late Yellow Morocho

Same as above, except that yellow kernels were selected from previous Pool 7 for the formation of this pool.

Pool 9. Highland Late White Dent

This gene pool was developed by crossing materials well adapted to African highlands. Its germplasm includes materials from highlands in Kenya, collections of races from Colombia, Ecuador, Guatemala, and tropical lowland Tuxpeño from Mexico. It is late and tall. Selection is being practiced for resistance to foliar diseases.

Pool 15. Tropical Early White Flint

This gene pool is based on crosses among a large number of early and late white flint materials from Mexico, the Caribbean area, Central and South America, and Asia. Selection is being practiced for early maturity and better plant type while trying to maintain yield. In addition, the pool is being improved for tolerance to high plant density and stalk rot.

Pool 16. Tropical Early White Dent

White dent materials were used in forming this gene pool from the same geographical areas as Pool 15. Selection is being practiced for early maturity and better plant type while trying to maintain yield. In addition, the pool is being improved for tolerance to high plant density and stalk rot.

Pool 17. Tropical Early Yellow Flint

Same as above except yellow flint materials were used in the formation of this pool.

Pool 18. Tropical Early Yellow Dent

Same as Pool 17 except yellow dent types were used.

Pool 19. Tropical Intermediate White Flint

Nearly 30% of the germplasm of this white flint gene pool is contributed by materials from the Philippines that have downy mildew resistance. It also has materials from Cuba, Mexico, Argentina, Honduras, El Salvador, Colombia, Ecuador, India, and central and southern USA. It is intermediate to late in maturity and has good plant type and yield potential. Selection is being practiced for improved shelling percentage and sugarcane borer resistance *Diatraea saccharalis* (F.).

Pool 20. Tropical Intermediate White Dent

This intermediate white dent gene pool is made mainly of materials from the Philippines, India, and Southeast Asia. A small fraction of germplasm is also from Mexico and various Central American countries. The pool is similar in its plant type and yield to Pool 19 and is being specifically selected for increase ear rot resistance.

Pool 21. Tropical Intermediate Yellow Flint

This gene pool is based on yellow flint materials from Mexico, Cuba, Dominican Republic, Colombia, Argentina, Ecuador, Costa Rica, Uruguay, St. Vincent, Guatemala, Surinam, and India. It is relatively more tolerant to stunt and is intermediate in maturity. Selection is specifically being practiced for improved shelling percentage and sucarcane borer resistance.

Pool 22. Tropical Intermediate Yellow Dent

This gene pool is made up of materials from Mexico, Cuba, Dominican Republic, Antigua, Brazil, Peru, Ecuador, Argentina, Colombia, India, Puerto Rico, and several Central American countries. It has good yield potential and variation for plant type. It is specifically being selected for stalk rot resistance.

Pool 23. Tropical Late White Flint

This gene pool is based on white flint selections from crosses among materials from Mexico, Colombia, the Caribbean area, Guatemala, Panama and other Central American countries, India, Thailand, and the Philippines. It is late in maturity and has relatively short plants and excellent yield. Selection is being practiced for increased stalk rot resistance.

Pool 24. Tropical Late White Dent

This gene pool is based mainly on Tuxpeño germplasm from Mexico. It has some materials from Central America, the Caribbean area, and Zaire. It has a relatively high level of tolerance to ear rots, stalk rots, and has excellent plant type and yield potential. It is white dent in kernel type and late in maturity. It is specifically being selected for increased resistance to fall armyworm (Spodoptera frugiperda [J.E. Smith]).

Pool 25. Tropical Late Yellow Flint

This tropical late yellow flint pool is made up of materials from Mexico, Central America, the Caribbean area, Ecuador, Colombia, and Argentina. It is relatively tall in plant type and has good yield potential. Specific selection is being practiced for ear rot resistance.

Pool 26. Tropical Late Yellow Dent

The late yellow dent gene pool is made up of materials from Central America, Mexico, Asia, Colombia, and the Caribbean area. A small fraction of total germplasm is also from the US Corn Belt. It is relatively more tolerant to stunt, is tall, and has good yield potential. This pool is being selected for increased level of fall armyworm resistance.

Pool 27. Temperate Early White Flint

This sub-tropical early white flint pool is made up of materials from Pakistan. It also has germplasm from the USA, China, Lebanon, and several European countries. It is variable in plant type and other agronomic characters but has good yield potential. Selection is being practiced for tolerance to high density and for resistance to ear and stalk rots and leaf diseases.

Pool 28. Temperate Early White Dent

This gene pool is based on white dent selections from crosses between white flint materials from Pakistan and yellow flint and dent materials from Europe, China, Lebanon, Mexico, Guatemala, and the US Corn Belt. It has undergone only a few cycles of selection and, therefore, is more variable. It is early in maturity and has good yield potential. Selection is being practiced for tolerance to high density, and for resistance to ear and stalk rots and leaf diseases.

Pool 29. Temperate Early Yellow Flint

This early yellow flint gene pool has excellent plant type and yield. It is based on materials from Europe, Lebanon, the US Corn Belt, China, Pakistan, Indonesia, and South America. It is being improved for tolerance to high density and for resistance to ear and stalk rots and leaf diseases.

Pool 30. Temperate Early Yellow Dent

This gene pool is made up of materials from Europe, China, Lebanon, Mexico, South America, and the US Corn Belt. It is early in maturity, and has good plant type and yield. It is being improved for tolerance to high density and for resistance to ear and stalk rots and leaf diseases.

Pool 31. Temperate Intermediate White Flint

This medium maturity pool is based on white flint segregates from crosses among materials from Mexico, the US Corn Belt, Brazil, Uruguay, Argentina, China, Pakistan, Yugoslavia, Lebanon, Guatemala, Venezuela, Peru, Cuba, Antigua, and Dominican Republic. It is relatively uniform in plant height and maturity and has good yield potential. It is being improved for resistance to leaf diseases and ear and stalk rots.

Pool 32. Temperate Intermediate White Dent

This gene pool has the same gene base as Pool 31 but is better in plant type and yield. It has deep white dent kernels. It is being selected for increased resistance to Southwestern corn borer (*Diatraea grandiosella* [Dyar]).

Pool 33. Temperate Intermediate Yellow Flint

Same as Pool 31 except that yellow-orange flint kernels have been selected. This pool is being selected for increased resistance to ear rot, stalk rot and leaf diseases.

Pool 34. Temperate Intermediate Yellow Dent

This intermediate yellow dent gene pool is made up of crosses among Mexican lowland and highland materials, and materials from the US Corn Belt, southern USA, Yugoslavia, Hungary, China, Lebanon, Guatemala, Honduras, Chile, Antigua, Cuba, Dominican Republic, Peru, and Pakistan. It has short plant type, well-placed ears, and good yield potential. Selection is being practiced for resistance to ear rot, stalk rot and leaf diseases.

Gene Pool for the NTR

Based primarily on US germplasm, but also including germplasm from China, Korea, and Lebanon, this gene pool is designed to serve maize growing areas 46-52° N and S of equator. This gene pool would also offer useful germplasm for the winter maize growing areas of lower latitudes. Selection is being practiced for early maturity, ability to grow under cold conditions, and for resistances to leaf diseases and ear and stalk rots.

Gene Pool for the ITR

This gene pool is based on materials from Bulgaria, Spain, Hungary, France, Turkey, Yugoslavia, Pakistan, Poland, and Germany. It is designed to serve the maize growing areas of the intermediate temperate range (40-46° N and S) and also the winter maize growing areas of the tropics and sub-tropics. Selection is practiced for the same traits as in the NTR pool.

Gene Pool for the STR

This gene pool is based on germplasm from tropical (both lowland and highland), sub-tropical, and temperate areas of Mexico, Pakistan, the USA, Africa, Central America and the Caribbean area, and Bolivia. It is designed to serve winter maize maize growing areas of the tropics and sub-tropics and low-latitude temperate areas (34-40° N-S). Selection is being practiced for earliness and resistance to leaf diseases and ear and stalk rots.

CIMMYT-German Maize Exotic Gene Pool

This gene pool is an effort to introduce tropical germplasm into temperate areas. This pool is being handled in cooperation with the University of Hohenheim, Germany. It is based on germplasm from Mexico, Peru, Bolivia Pakistan, China, Hungary, the USA, and Yemen. Selection is being practiced for earliness, standability, ability to grow under cold conditions, and for resistance to leaf diseases.

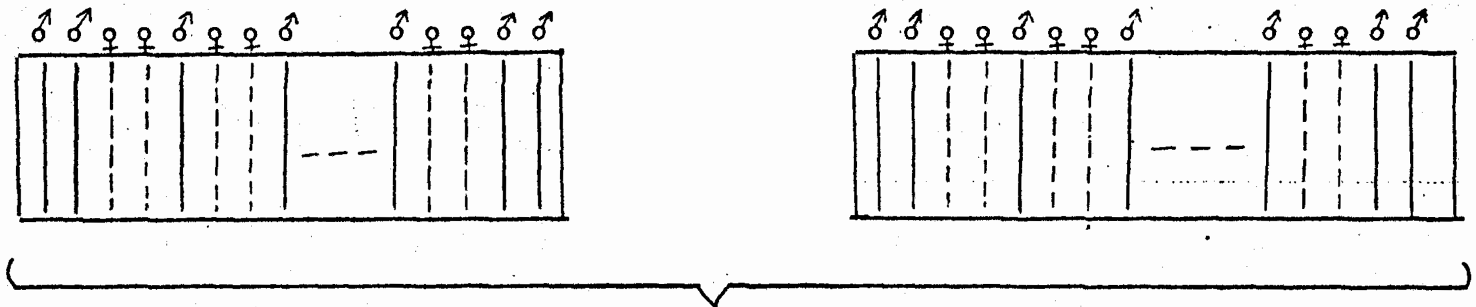
Table 2. CLASSIFICATION OF MAIZE GENE POOLS 1982A

Gene pool		Cycles of selection completed in 81B	No. of materials included	Countries of origin
TROPICAL HIGHLAND				
H.E.W.Fl.	(Pool 1)	--	130	7
H.L.W.Fl.	(Pool 2)	--	81	7
H.E.Y.Fl.	(Pool 3)	--	56	7
H.L.Y.Fl.	(Pool 4)	--	112	7
H.E.W.Mor.	(Pool 5)	--	44	7
H.E.Y.Mor.	(Pool 6)	--	63	10
H.L.W.Mor.	(Pool 7)	--	31	7
H.L.Y.Mor.	(Pool 8)	--	31	4
H.L.W.D.	(Pool 9)	--	10	5
TROPICAL LOWLAND				
T.E.W.F.	(Pool 15)	9	58	40
T.E.W.D.	(Pool 16)	9	56	26
T.E.Y.F.	(Pool 17)	9	66	40
T.E.Y.D.	(Pool 18)	9	49	27
T.I.W.F.	(Pool 19)	13	65	23
T.I.W.D.	(Pool 20)	13	34	13
T.I.Y.F.	(Pool 21)	13	31	25
T.I.Y.D.	(Pool 22)	14	40	23
T.L.W.F.	(Pool 23)	13	57	18
T.L.W.D.	(Pool 24)	13	25	10
T.L.Y.F.	(Pool 25)	12	39	18
T.L.Y.D.	(Pool 26)	12	43	16
TEMPERATE				
Tm.E.W.F.	(Pool 27)	14	121	19
Tm.E.W.D.	(Pool 28)	8	147	17
Tm.E.Y.F.	(Pool 29)	9	128	17
Tm.E.Y.D.	(Pool 30)	9	156	21
Tm.I.W.F.	(Pool 31)	9	46	11
Tm.I.W.D.	(Pool 32)	14	51	7
Tm.I.Y.F.	(Pool 33)	14	95	12
Tm.I.Y.D.	(Pool 34)	14	99	10
SPECIAL				
Gene Pool for the Northern Temperate Region (NTR-Pool)		7	255	6
Gene Pool for the Intermediate Temperate Region (ITR-Pool)		7	399	9
Gene Pool for the Southern Temperate Region (STR-Pool)		7	129	9
CIMMYT-German Maize Exotic Gene Pool		9	27	10

Abbreviations: T. = tropical; Tm. = temperate; H. = highland; E. = early; I. = intermediate; L. = late; W. = white; Y. = yellow; F. = flint; D. = dent; Fl. = floury; Mor. = Morocho

Figure 2. Diagramatic representation of the modified half-sib selection in gene pools in more than one location : *

Location - 1 | Location - 2



Among family selection | Within family selection

On the basis of multi-stage visual observations across locations, select 40% of the families.

In the families selected across locations select 4-5 superior plants at each site at appropriate stage of plant development.

1) At harvest, select superior ears from the selected plants in the selected families at each site -approximately 450 ears in total. Plant them as ♀'s and a balanced mixture of the superior 300 ears and ♂ next season.

2) Select 20-25 ears in total from families greatly superior at only one site. Plant them as ♀ only next season.

3) Additional new introductions to be planted as ♀ only.

*

A. All ♀ rows and undesirable plants in the ♂ rows are detasseled before pollen-shed.

B. Selection for early maturity is practiced by selecting earliest silking plants in the ♀ rows and detasseling all ♂ rows when 70% of the pool has silked, to avoid late pollinations.

C. When selecting for tolerance to high plant populations, the ♂ rows are planted at double the density of the ♀. Weak and lodged plants and plants with poor synchronization of pollen-shed and silking are detasseled before pollen-shed.

D. In improving resistance to fall armyworm and borers, all plants in the ♂ rows and half of each ♀ row are artificially infested at appropriate stage of plant development. More susceptible plants are detasseled in the ♂ rows before pollen-shed. Ears are selected from resistant as well non-infested plants in the ♀ rows. For corn ear worm, fresh silks are infested in the ♀ rows and less damaged ears are selected at harvest.

E. For improving ear and stalk rot, artificial inoculation is done at appropriate stage of plant development in half of each family. At harvest, ears are selected from resistant as well as non-inoculated plants. In addition, 500 agronomically superior plants are inoculated in ♂ rows of all pools and ears from resistant plants are selected.

Table 3. Progress made in some pools for some agronomic characteristics.

Materials	Cycles	Yield kg/ha	Days to 50% silk	Height (cm) Plant	Height (cm) Ear
Tropical Intermediate White Flint (Pool 19)	C_1	3184	74	175	98
	C_8	3888	71	156	85
	5% lsd	211	0.7	10.1	3.0
	% CV	9.3	1.5	9.4	5.1
Tropical Intermediate Yellow Flint (Pool 21)	C_1	3890	73	201	118
	C_8	4429	70	180	105
	5% lsd	230	0.1	5.0	3.7
	% CV	8.6	1.0	4.1	5.2
Tropical Late White Flint (Pool 23)	C_1	4039	76	190	109
	C_8	4764	73	174	96
	5% lsd	283	0.5	4.1	3.3
	% CV	10.1	1.0	3.5	4.9
Temperate Intermediate White Dent (Pool 32)	C_1	5766	75	202	124
	C_9	6147	71	170	101
	5% lsd	364	0.8	1.2	1.6
	% CV	8.3	1.5	0.9	1.9
Temperate Intermediate Yellow Dent (Pool 34)	C_1	4224	70	190	112
	C_9	5700	67	163	95
	5% lsd	316	0.6	5.5	4.4
	% CV	9.8	1.4	4.8	6.5

Table 4. EXAMPLES OF ADAPTATION OF GENE POOLS COMPARED TO CORRESPONDING ADVANCED POPULATIONS

Material	Yield			Days 50% silking			Ear height		
	tons/ha	b	s^2_d	Days	b	s^2_d	cm	b	s^2_d
1. T.I.W.F. (Pool 19) C_9	5.25	1.00	0.09	57	0.96	0.46	106	1.03	10.45
2. Bl. Crist. (Pop. 23) C_4	5.19	1.05	0.05	59	1.00	1.07	111	1.00	32.93
3. T.I.Y.F. (Pool 21) C_9	5.44	0.99	0.04	58	0.96	1.55	115	0.98	3.36
4. Mez. Amar. (Pop. 26) C_3	4.96	0.93	0.04	59	1.00	1.00	110	0.96	9.16
5. T.L.W.F. (Pool 23) C_9	5.42	1.12	0.02	60	0.99	0.62	113	1.00	6.74
6. ETO Blanco (Pop. 32) C_3	5.12	1.07	0.08	61	0.99	0.24	111	1.02	52.78
7. T.L.W.D. (Pool 24) C_9	5.74	1.10	0.13	61	0.97	0.20	116	1.03	0.04
8. Tuxpeño-1 (Pop. 21) C_3	5.87	1.11	0.03	61	1.02	0.04	109	0.78	33.84
9. T.L.Y.F. (Pool 25) C_9	5.23	0.86	0.08	60	1.02	0.83	118	1.03	10.31
10. Am. Crist. (Pop. 27) C_4	5.12	1.02	0.29	62	1.04	0.87	122	1.08	9.04
11. T.L.Y.D. (Pool 26) C_9	5.40	1.09	0.08	60	1.01	0.45	117	0.93	9.84
12. Am. Dentado (Pop. 28) C_3	5.77	1.15	0.28	62	0.99	0.00	132	0.98	50.04
S.E. of one "b"		0.09			0.03			0.10	
% C.V.	8.08			1.82			4.64		
LSD (5%)	0.20			0.52			2.56		

Locations: Tlaltizapan, La Maquina, Poza Rica, Kwadaso, Suwan, Takfa, Sete Lagoas, Kisanga and Ilonga.

Table 5. UTILIZATION OF GENE POOLS

A. New Advanced Populations contributed by Back-Up Pools

Population formed		From Back-Up Pool	No. Fam.
Templado Am.Crist. 3	(Pop. 46)	Tm. E.Y.F. (Pool 29)	240
Templado Bl. Dent.	(Pop. 47)	Tm. I.W.D. (Pool 32)	276
Amarillo Subtropical	(Pop. 33)	Tm. I.Y.F. (Pool 33)	275

B. Promotion of materials from the Back-Up to the Advanced Unit.

To Population		From Pool		No. Fam.	Proportion of Advanced Population (%)
Tuxpeño-1	(Pop. 21)	T.L.W.D.	(Pool 24)	54	17
Mez. Trop. Bl.	(Pop. 22)	"	(Pool 24)	10	11
Bl. Cristalino-1	(Pop. 23)	T.L.W.F.	(Pool 23)	36	9
Mezcla Amarilla	(Pop. 26)	T.I.Y.F.	(Pool 21)	54	25
Am. Crist.-1	(Pop. 27)	T.L.Y.F.	(Pool 25)	50	20
Am. Dentado	(Pop. 28)	T.L.Y.D.	(Pool 26)	44	10
Bl. Crist. 2	(Pop. 30)	T.E.W.F.	(Pool 15)	77	58
Am. Crist. 2	(Pop. 31)	T.E.Y.F.	(Pool 17)	30	4
Bl. Sub-trop.	(Pop. 34)	Tm.I.W.F.	(Pool 31)	65	9
Cogollero	(Pop. 36)	T.I.Y.D.	(Pool 22)	52	19
"	(Pop. 36)	T.L.Y.D.	(Pool 26)	27	20
La Posta	(Pop. 43)	T.L.W.D.	(Pool 24)	10	6
Comp. Hungary	(Pop. 48)	Tm.E.Y.D.	(Pool 30)	169	43

ADVANCED UNIT AND MAIZE POPULATIONS

The Advanced Unit is responsible for the improvement and refinement of normal maize populations. Presently the unit is handling 24 populations. The full-sib family selection scheme is used with Advanced Unit materials and is described in Figure 4. These populations have been improved for yield, plant height, maturity, diseases, and other traits ranging from none to four cycles through international testing. These materials as such or selections from them are of immediate and direct use to most national programs.

The following pages describe the Advanced Unit Populations and illustrate the introgression of new germplasm into these populations. Tables indicate numbers of varieties tested, materials released by national programs, and examples of outstanding experimental varieties.

Population 21 - Tuxpeño-1

Components: Tuxpeño race collections Veracruz 48, Veracruz 143, Veracruz 174, Michoacan 137, Michoacan 166, V-520C, Colima group 1-Mix. 1 and 16 families from tropical late white dent pool (Pool 24).

Description: Adapted to tropical lowlands, white dent grain, late maturity, excellent standability and relatively short plant type. Fairly tolerant to most foliar diseases. Good performance in most tropical lowlands. Specifically being improved since 1977 for resistance to fall armyworm.

Countries where progeny tests have been conducted:

1974: Egypt (Gemeiza), India (Pantnagar), Guatemala (Cuyuta), Mexico (Cotaxtla, Poza Rica).
1975: Costa Rica (Guanacaste), Mexico (Poza Rica), Tanzania (Ilonga).
1977: El Salvador (San Andres), Guatemala (La Maquina), Honduras (Guaymas), Mexico (Poza Rica), Tanzania (Ilonga), Zaire (Gandajika).
1979: Costa Rica (Los Diamantes), Mexico (Cotaxtla, Poza Rica), Venezuela (Maracay).
1981: Brazil, Ghana, Honduras, Mexico, Rep. South Africa, Zimbabwe. (NOTE: Trials in progress).

Population 22 - Mezcla Tropical Blanco

Components: Tuxpeño, ETO blanco, Antigua group 2 white selection (Mix. 1-Colima group 1) ETO, Pfister hybrids, Compuesto Centro-Americano, Lineas de El Salvador, V-520C, Nicarillo selección blanca and 13 families from tropical late white dent pool (Pool 24).

Description: Lowland, tropical with white dent semident, late maturity. Very broad genetic base with tested good performance in the tropical regions of Mexico, Central America, Northern part of South America, East and West Africa, and India. Since 1980 was based in Thailand's National Program to improve its downy mildew resistance.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), Guatemala (La Maquina), Mexico (Poza Rica).
1975: Colombia (Palmira), Honduras (Guaymas), Mexico (Poza Rica), Venezuela (Maracay).
1976: El Salvador (San Andres), India (Delhi, Dholi), Ivory Coast (Ferke), Mexico (Poza Rica), Philippines (Los Baños).
1978: Bolivia (Chuquisaca), Mexico (Cotaxtla, Poza Rica), Tanzania (Ilonga).
1980: Guatemala (La Maquina), Honduras (Guaymas), Ivory Coast (Ferke), Mexico (Poza Rica), Nicaragua (Santa Rosa).

Population 23 - Blanco Cristalino 1

Components: White segregates from Mezcla Amarilla, Antigua x tipos cubanos, Antigua x Cupurico, Población cristalina x Tuxpeño, Cuba 20, Granada 9D, CWF, Nicaragua Syn II, Harinoso de Ocho and 7 families from tropical late white flint pool (Pool 23).

Description: Lowland tropical with white semi-flint grain. Late to intermediate maturity, relatively short plant height. Has less foliage than many tropical materials. Suitable for the lowland tropics of Mexico, Central America, Northern-South America, West Africa and South-East Asia. Emphasis on sugar cane borer resistance.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), El Salvador (San Andres), Mexico (Poza Rica), Nicaragua (Managua), Philippines (Los Baños).
1975: Egypt (Gemeiza), Guatemala (Cuyuta), Mexico (Poza Rica), Pakistan (Pirsabak).
1976: Colombia (Cali), Ghana (Nyankpala), Mexico (Cotaxtla, Poza Rica).
1978: Colombia (Cali), Costa Rica (Los Diamantes), El Salvador (San Andres), Mexico (Poza Rica), Nicaragua (Santa Rosa).
1980: Ivory Coast (Ferke), Mexico (Poza Rica), Pakistan (Pirsabak), Venezuela (Maracay).

Population 24 - Antigua-Veracruz 181

Components: Tuxpeño race collection Veracruz 181 and Antigua Group 2 (Antigua 1D to 8D included).

Description: Lowland, tropical with yellow semi-dent grain. Intermediate plant height and maturity. Good performance in lowland tropics of South America, Central America, Mexico, South East Africa and Asia. Emphasis on improving resistance to fall armyworm.

Countries where progeny tests have been conducted:

1974: Ecuador (Pichilingue), Mexico (Poza Rica), Pakistan (Patnagar), Thailand (Suwan).
1975: Guatemala (Cuyuta), Mexico (Poza Rica, Obregon), Panama (Tocumen).
1976: India (Dholi), Mexico (Poza Rica, Nayarit), Nicaragua (Santa Rosa), Pakistan (Yousafwala).
1978: Brazil (Sete Lagoas), Costa Rica (Guanacaste), Ecuador (Pichilingue), Mexico (Poza Rica), Thailand (Suwan).
1980: Mexico (Poza Rica), Panama (Chiriqui).

Population 26 - Mezcla Amarilla

Components: Tuxpeño, Cuban flints, Antigua, ETO amarillo, some Corn Belt x Tuxpeño crosses, and 22 families from tropical intermediate yellow flint pool (Pool 21).

Description: For the lowland tropics, yellow semi-flint grain, intermediate maturity, and relatively short plants. Composed basically of Caribbean germplasm. Good performance in the tropical lowlands of South America and parts of Asia. Emphasis on earliness and ear rot resistance.

Countries where progeny tests have been conducted:

1974: India (Delhi), Mexico (Poza Rica), Nicaragua (Managua), Panama (Tocumen), Philippines (Los Baños).
1975: India (Ludhiana), Ivory Coast (Ferke), Mexico (Poza Rica).
1977: Bolivia (Chuquisaca), Brazil (Sete Lagoas, Petrolina), Ecuador (Pichilingue), Mexico (Poza Rica), Thailand (Suwan).
1979: Bolivia (Saavedra), Mexico (Poza Rica), Pakistan (Islamabad), Panama (Tocumen), Peru (Piura).
1981: Costa Rica, Ethiopia, India, Mexico, Peru, Thailand (Trials in progress).

Population 27 - Amarillo Cristalino 1

Components: Tuxpeño, Cuban flints, ETO amarillo and 15 families from tropical late yellow flint pool (Pool 25).

Description: Lowland tropical with yellow flint grain. Intermediate plant size and medium to late maturity. Is being improved for borer resistance. Good performance in the following regions: Lowland tropics of South America, Caribbean area, India and South East Asia.

Countries where progeny tests have been conducted:

1974: Guatemala (Cuyuta), India (Delhi), Mexico (Poza Rica, Obregon), Pakistan (Yousafwala), Panama (Tocumen).
1975: Ecuador (Pichilingue), Mexico (Poza Rica), Nicaragua (Managua), Panama (Tocumen), Thailand (Suwan).
1976: Colombia (Palmira), El Salvador (San Andres), Mexico (Poza Rica, Obregon) Peru (Satipo).
1978: Costa Rica (Guanacaste), Ecuador (Pichilingue), Guatemala (La Maquina), Mexico (Poza Rica), Peru (Satipo).
1980: Honduras (Guaymas), Mexico (Poza Rica), Panama (Tocumen), Thailand (Suwan).

Population 28 - Amarillo Dentado

Components: Tuxpeño, Caribbean, Brazilian germplasm, ETO amarillo and 9 families from tropical late yellow dent pool (Pool 26).

Description: Adapted to the lowland tropics, late maturity, relatively tall plants and yellow dent grain. High yields and tested good performance in the tropical lowland of Mexico, Central America, South America and parts of Asia. It has undergone four cycles of improvement through IPTTs, with special attention to plant height reduction; since 1980-81 it has been subjected to selection for downy mildew resistance.

Countries where progeny tests have been conducted:

1974: Mexico (Poza Rica), Pakistan (Yousafwala), Panama (Tocumen).
1975: Costa Rica (Guanacaste), El Salvador (San Andres), India (Ludhiana), Mexico (Poza Rica), Peru (San Ramon), Thailand (Suwan).
1977: Bolivia (Chuquisaca), Brazil (Sete Lagoas), Mexico (Poza Rica), Nicaragua (La Calera), Panama (Tocumen).
1979: Costa Rica (Guanacaste), Ecuador (Pichilingue), Guatemala (La Maquina), Ivory Coast (Ferke), Mexico (Poza Rica).
1981: Brazil, Ivory Coast, Indonesia, Panama, Peru, Thailand (Trials in progress).

Population 29 - Tuxpeño - Caribe

Components: Tuxpeño, Cuban flints, ETO.

Description: For lowland tropics, white dent grain and late maturity. High yield potential demonstrated in Mexico, Central America, Egypt and parts of Africa and Asia. Emphasis on reduced plant height.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), Ecuador (Pichilingue), Guatemala (Cuyuta), Mexico (Cotaxtla, Poza Rica).
1975: Honduras (Guaymas), Ivory Coast (Ferke), Mexico (Poza Rica), Tanzania (Ilonga).
1977: Costa Rica (Guanacaste), Mexico (Poza Rica), Tanzania (Ilonga), Zaire (Kisanga).
1979: Egypt (Sids), Guatemala (Cuyuta), Honduras (El Paraiso), Mexico (Cotaxtla, Poza Rica).
1981: Colombia, Costa Rica, Ivory Coast, Mexico, Nicaragua, Venezuela (Trials in progress).

Population 30 - Blanco Cristalino-2

Components: Thirty six families from "Selección compuesto precoz" C_8 (derived from the early fraction of all late tropical CIMMYT's populations) crosses of tropical by temperate materials and 49 families from tropical early white flint pool C_6 (Pool 15), were finally selected to constitute this population.

Description: Adapted to tropical and subtropical areas, early maturity and relatively short plants. To maximize yield potential recommended plant density should be about 60,000 pts/ha. Emphasis on earliness and ear rot resistance.

Countries where progeny tests have been conducted:

1979: Guatemala (Jutiapa), El Salvador (Santa Cruz Porrillo), Mexico (Poza Rica), Pakistan (Pirsabak), Tanzania (Ilonga).
1981: Colombia, Honduras, India, Ivory Coast, Mexico (Trials in progress).

Population 31 - Amarillo Cristalino-2

Components: Ninety six families from "Compuesto selección precoz" C_8 (derived from the early fraction of all late tropical CIMMYT's populations), crosses of tropical by temperate materials and four families from tropical early yellow flint pool C_6 (Pool 17), were finally selected to constitute this population.

Description: Adapted to tropical and subtropical areas, yellow flint to semi-flint grain, early maturity and relatively short plants. To maximize yield potential recommended plant density should be about 60,000 pts/ha. Based in Thailand's national program since 1980 to improve its downy mildew resistance.

Countries where progeny tests have been conducted:

1979: Brazil (Sete Lagoas), Ecuador (Pichilingue), Mexico (Poza Rica), Panama (Tocumen), Peru (Satipo).
1981: India, Ivory Coast, Pakistan, Peru, Thailand (Trials in progress).

Population 32 - ETO Blanco

Components: Developed in Colombia from 11 ears finally selected from advanced crosses of Colombia 1 (Blanco Comun, Blanco de Urrao) and Venezuela 1 (Cuban yellow flints) with recombined germplasm from Argentina, Brazil, Cuba, Mexico, Puerto Rico, United States of America and Venezuela. The white segregates originated ETO Blanco (or Diacol V-351). ETO variety has been distributed in Colombia since 1951.

Description: Suitable for subtropical areas. Intermediate maturity. White hard flint grain type. Short plant type. Successfully grown in Andean Region below 1500 m., parts of West Africa, Egypt, India, South East Asia. Emphasis on ear rot resistance.

Countries where progeny tests have been conducted:

1975: Costa Rica (Alajuela), Mexico (Poza Rica, Obregon), Pakistan (Pirsabak), Venezuela (Maracay).
1976: El Salvador (San Andres), Guatemala (Cuyuta), India (Pantnagar), Mexico (Poza Rica), Philippines (Los Baños).
1978: Egypt (Sakha), Mexico (Poza Rica), Venezuela (Maracay), Zaire (Gandajika).
1980: Costa Rica (Alajuela), Mexico (Cotaxtla, Poza Rica).

Population 33 - Amarillo Subtropical

Components: This population was derived from Pool 33 (temperate intermediate yellow flint); 275 half-sib families were selected from the eighth cycle of recurrent selection. Yellow segregates from crosses of germplasm from Mexico, USA Corn Belt, Brazil, Uruguay, Argentina, China, Pakistan, Yugoslavia, Lebanon, Guatemala, Venezuela, Peru, Cuba, Antigua and Dominican Republic are included.

Description: This new, genetically broad based population is an intermediate subtropical-temperate yellow flint, with medium to short plant height. Emphasis on ear rot resistance.

Countries where progeny tests have been conducted:

1980: Guatemala (San Jeronimo), India (Pantnagar), Mexico (Tlaltizapan), Pakistan (Yousafwala).

Population 34 - Blanco Subtropical

Components: Palung Valley white, Synthetic 66, Pando, ETO blanco, Dwarf 1 tall, Población cristalina, Tuxpeño Crema I, Dwarf 1 short, PD(MS)6, Amarillo Peru, Sintetico de 10 lineas.

Description: Subtropical broad genetic base including germplasm from Cuban Flints, ETO, Tuxpeño, Corn Belt Dent, India and Nepal. Late maturity, semi-dent grain and relatively tall plants. High yield potential demonstrated in Pakistan, parts of India, South Brazil and subtropical regions of Mexico. Has undergone four cycles of selection through the IPTT system, with emphasis on reduced plant height.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), Mexico (Obregon), Mexico (Tlaltizapan), Nepal (Rampur), Pakistan (Pirsabak).
1975: Egypt (Sids), Mexico (Obregon), Mexico (Tlaltizapan), Tanzania (Ukiriguru).
1977: Egypt (Sids), India (Pantnagar), Mexico (Obregon), Mexico (Tlaltizapan), Pakistan (Pirsabak), Tanzania (Hjombe).
1979: Brazil (Sete Lagoas), Zaire (Kaniama). Mexico (Tlaltizapan).
1981: Egypt, Ethiopia, Guatemala, India, Mexico, Tanzania (Trials in progress).

Population 35 - Antigua - Republica Dominicana

Components: Republica Dominicana groups 2, 3, 7, 8, 9 and 15 crossed with Antigua Group 2 (Antigua collections 1D to 8D).

Description: Suitable for lowland tropical areas. Intermediate in maturity, with yellow dent grain type. Short plant type with tolerance to stunt. Is being improved for better stalk quality and standability. Performs well in the following regions: Mexico, Central America, Caribe and lowland tropical regions of South America, West Africa, parts of South Africa, Pakistan, India and South East Africa.

Countries where progeny tests have been conducted:

1975: Colombia (Turipana), Ecuador (Pichilingue), El Salvador (San Andres), India (Delhi), Mexico (Poza Rica), Thailand (Suwan).
1976: Guatemala (La Maquina), India (Ludhiana), Ivory Coast (Ferke), Mexico (Poza Rica), Panama (Tocumen).
1978: Brazil (Bahia), Ecuador (Pichilingue), El Salvador (Santa Cruz Porrillo), Haiti (Levy), Mexico (Poza Rica), Panama (Tocumen).
1980: Mexico (Poza Rica), Pakistan (Islamabad), Thailand (Suwan).

Population 36 - Cogollero

Components: Derived from The Caribbean Composite involving 165 accessions from all the Caribbean Islands. About 50 families from IDRN P^pulation, twenty families from pool 22 and 26 families from pool 26.

Description: Lowland tropical and subtropical, yellow semi-dent grain, intermediate to late maturity, and tall plants. A broad genetic base derived from Caribbean Composite. New germplasm added from Pool 22 (Tropical Intermediate Yellow Dent) and Pool 26 (Tropical Late Yellow Dent). Good performance in Central America, lowland South America and parts of Africa. Has been subjected to four cycles of improvement through IPTTs; reduction of plant height is given emphasis.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), Mexico (Poza Rica), Thailand (Suwan).
1975: Ecuador (Pichilingue), Guatemala (Cuyuta), Mexico (Poza Rica), Panama (Tocumen), India (Chindwara).
1977: Bolivia (Chuquisaca), Brazil (Petrolina), Mexico (Poza Rica), Mexico (Tlaltizapan), Thailand (Suwan).
1979: Mexico (Obregon), Mexico (Poza Rica), Peru (Piura).
1981: Brazil, Mexico, Panama, Philippines, Peru, Dominican Republic (Trials in progress).

Population 42 - ETO - Illinois

Components: See population 32. Seven USA Corn Belt resistant inbred lines to common rust (*Puccinia sorghi*) and 18 USA Corn Belt lines resistant to turcicum leaf blight (*Helminthosporium turcicum*) used as differentials in world wide evaluations.

Description: Advanced generation of short plant selected ETO with Illinois stocks. Is segregating for resistance (major genes) to *P. sorghi* and *H. turcicum*. Subtropical to cooler areas. Emphasis on reduced plant height and uniformity for white grain.

Countries where progeny tests have been conducted.

1974: Egypt (Gemeiza), Mexico (Obregon), Pakistan (Pirsabak), Turkey (Adapazari).
1975: Egypt (Sids), Mexico (Obregon), Mexico (Tlaltizapan), Tanzania (Ukiriguru), Turkey (Adapazari).
1976: Colombia (Cali), Mexico (Tlaltizapan), Nepal (Khumaltar), Pakistan (Pirsabak)
1978: Bolivia (Chuquisaca), Brazil (Sao Paulo), Egypt (Sakha), Mexico (Tlaltizapan), Zaire (Kisanga).

Population 43 - La Posta

Components: Tuxpeño Synthetic composed of 16 inbred lines.

Description: Adapted to tropical lowlands, white dent grains. Based on Tuxpeño germplasm. Tall and late with a high yield potential which has been verified in lowlands of South America, Central America, Mexico, humid tropics of West and Central Africa and parts of East Africa. Emphasis on streak resistance and reduced plant height, being conducted at IITA, Nigeria.

Countries where progeny tests have been conducted:

1974: Colombia (Palmira), Egypt (Sids), Mexico (Obregon, Poza Rica, Tlaltizapan).
1975: Mexico (Cotaxtla, Obregon, Poza Rica), Venezuela (Maracay).
1976: Ghana (Nyankpala), Honduras (Omonita), Ivory Coast (Ferke), Mexico (Obregon, Poza Rica), Philippines (Los Baños).
1978: Ghana (Ejura), Guatemala (La Maquina), Mexico (Poza Rica).
1980: Costa Rica (Los Diamantes), El Salvador (San Andres), Mexico (Cotaxtla).

Population 44 - AED - Tuxpeño

Components: American early and Tuxpeño (see population 21).

Description: Advanced generation of American Early (from Egypt) with short plant Tuxpeño material. Fairly tall, late white dent. Capable of very high yields under favorable conditions. Emphasis on reduced plant height.

Countries where progeny tests have been conducted:

1974: Egypt (Sids), Mexico (Poza Rica, Tlaltizapan).
1975: Egypt (Gemmeiza), Mexico (Obregon, Tlaltizapan), Tanzania (Ukiriguru).
1976: Egypt (Gemmeiza, Sids), India (Dholi), Mexico (Tlaltizapan), Pakistan (Yousafwala).
1978: Egypt (Gemmeiza, Sids), Mexico (Cotaxtla, Tlaltizapan), Zaire (Kisanga).

Population 45 - Amarillo Bajio

Components: Inbred lines from Purdue University, US 13, Pfister hybrids 347, 381, 383, 409, 418, Hixanth., CBC Nebraska, Iowa stiff stalk synthetic, Tuxpeño, Cuban flints, Puerto Rico composite, collections from Dominican Republic.

Description: Subtropical-temperate, intermediate maturity, yellow dent. Broad germplasm base, derived from crosses among lowland tropical maize types from Mexico and the Caribbean Islands and Corn Belt dents from USA. Emphasis on reduced plant height.

Countries where progeny tests have been conducted:

1978: Bolivia (Chuquisaca), Mexico (Tlaltizapan), Pakistan (Yousafwala).
1980: Mexico (Obregon, Tlaltizapan), Turkey (Antalya).

Population 46 - Templado amarillo cristalino

Components: Two hundred and forty half sib families from the fourth cycle of selection of Pool 29 were used to constitute this population (see Pool 29).

Description: New population, has wide genetic base, early maturity, yellow flint grain, and adapted to subtropical-temperate areas. Full sib selection was initiated and continued for four cycles to improve uniformity for plant type, maturity and other characters. In order to maximize yield potential of this early short plant type population, the plant density should be about 60,000 pts/ha. Emphasis on stalk rot resistance.

Countries where progeny tests have been conducted:

1980: Mexico (Obregon, Tlaltizapan).
1981: Brazil, Ethiopia, India, Mexico, Pakistan, Peru (Trials in progress).

Population 47 - Templado blanco dentado-2

Components: Two hundred and seventy six half sib families from the eighth cycle of selection of Pool 32 were used to constitute this population (see Pool 32).

Description: The germplasm base is temperate and subtropical white intermediate dents. Short plant type with high yield potential. Emphasis on Southwestern corn borer resistance.

Countries where progeny tests have been conducted:

1980: Egypt (Gemmeiza), Ethiopia (Awassa), Mexico (Tlaltizapan), Pakistan (Swat).

Population 48 - Compuesto de Hungria

Components: Central USA Corn Belt materials, Southern European materials and 54 half sib families from Pool 30.

Description: Yellow dent grain with early maturity. Good yield potential in temperate regions. Emphasis on resistance to leaf diseases and ear rot.

Countries where progeny tests have been conducted:

1974: Mexico (Obregon), Pakistan (Pirsabak), Turkey (Adapazari, Samsun).
1975: India (Delhi), Iran (Karaj), Mexico (Tlaltizapan), Turkey (Samsun).
1977: India (Dolhi), Mexico (Obregon).
1979: Chile (Quilampu), Mexico (Tlaltizapan), Turkey (Adapazari).

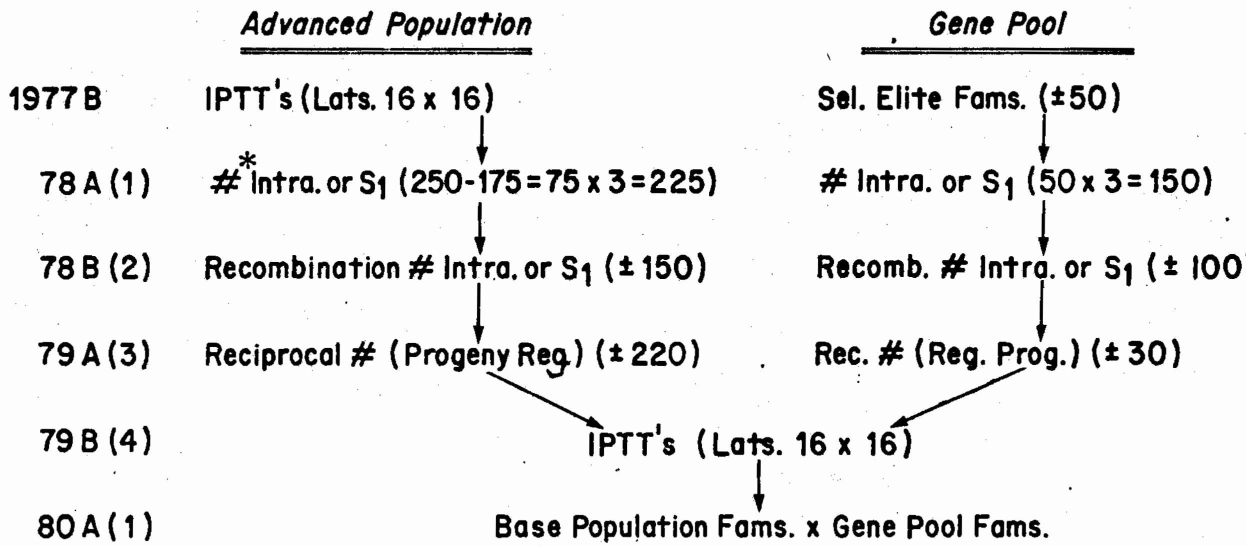
Population 49 - Blanco dentado-2

Components: Originated from initial selection of 240 full sib families from Tuxpeño Crema-1 Cycle 17 (see Population 21).

Description: White dent grain, intermediate maturity and adapted to the lowland tropical-subtropical areas. Through cycles of selection plant height has been considerably reduced and the population made earlier compared to the genetically related population Tuxpeño 1 (Pop. 21). To maximize yield potential recommended plant density should be about 60,000 pts/ha.

Countries where progeny tests have been conducted:

1980: Mexico (Obregon, Poza Rica).
1981: Mexico (Poza Rica), Nigeria, Zaire (Ikenne), Zimbabwe.



* Within family sibs

Fig. 3. Introgresion of elite gene pool Families into an advanced population

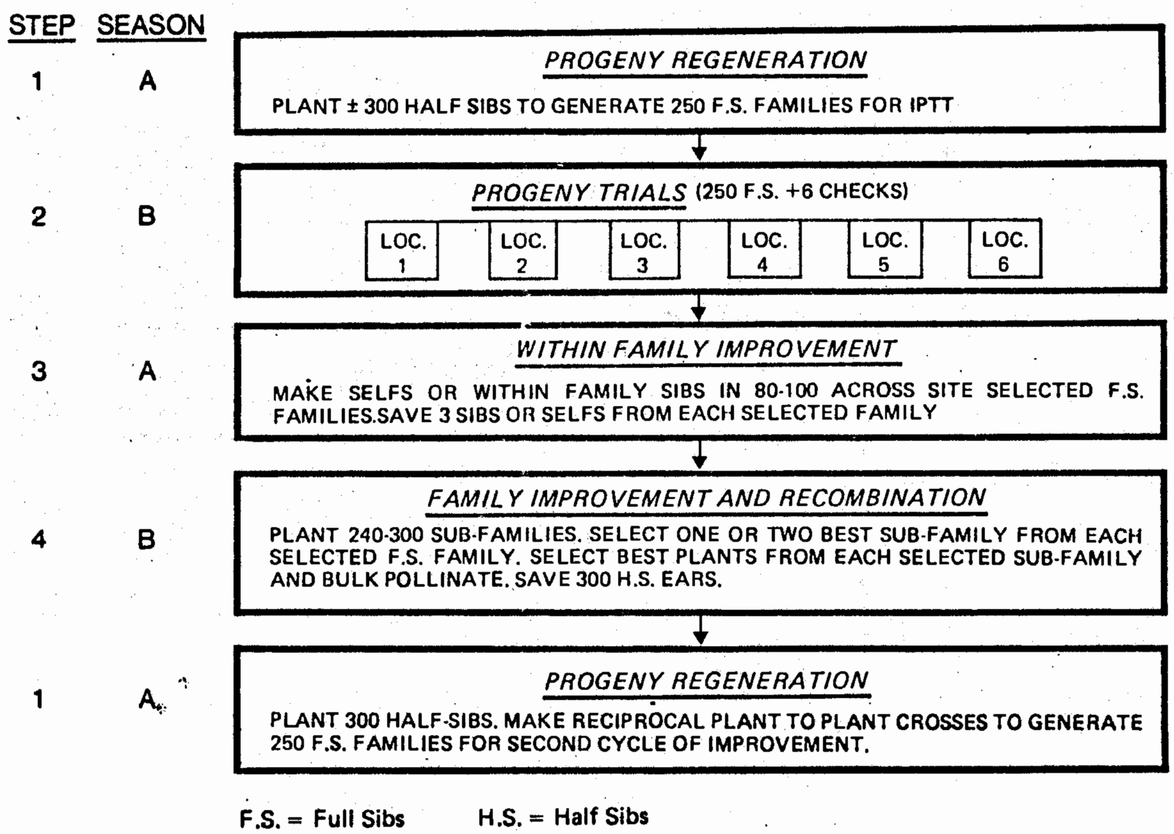


Fig. 4. Population Improvement Scheme Breeding Sequence

Table 6. Addition of new germplasm to Advanced Unit Populations

Population Number	Population Name	Source of New Germplasm	Number of families Promoted	No. F.S. Families Included in Subseq. IPTT	No. families merged with population based on good performance. Number	%
21	Tuxpeño	Base Pop.	328. h.s.	190	79	82
		Pool 24	54 h.s.	30	16	17
		TSR Sel.	84 f.s.	30	1	1
22	Mezcla Trop. Blanca	Base Pop.	100 f.s.	233	107	89
		Pool 24	10 h.s.	17	13	11
23	Blanco Cristalino 1	Base Pop.	285 h.s.	230	74	91
		Pool 23	55 h.s.	20	7	9
26	Mezcla Amarilla	Base Pop.	272 h.s.	190	47	55
		Pool 21	54 h.s.	35	22	25
		TSR	48 f.s.	25	17	20
27	Amarillo Crist.	Base Pop.	66 f.s.	190	61	79
		Pool 25	50 h.s.	30	15	20
		TSR	46 f.s.	30	1	1
28	Amar. Dentado	Base Pop.	358 h.s.	184	70	76
		Pool 26	44 h.s.	36	9	10
		TSR	128 f.s.	30	13	14
29	Tuxpeño-Caribe	Base Pop.	299 h.s.	200	74	88
		TSR	56 f.s.	50	10	12
30	Blanco Cristalino-2	Sel. Precoz (Lote 81)	173 f.s.	100	36	42
		Pool 15	77 h.s.	150	49	58
31	Amar. Cristalino-2	Sel. Precoz (Lote 81)	220 f.s.	235	96	96
		Pool 17	30 h.s.	15	4	4
32	Eto Blanco	Base Pop.	186 h.s.	215	107	79
		TSR	101 f.s.	35	28	21
34	Blanco Subtropical	Base Pop.	285 h.s.	220	96	91
		Pool 31	65 h.s.	30	10	9
36	Cogollero	Base Pop.	272 h.s.	150	65	61
		Pool 22	52 h.s.	50	20	19
		Pool 26	27 h.s.	50	21	20
39	Yellow QPM	Base Pop.	250 h.s.	246	116	100
		TSR	47 f.s.	4	0	-
41	Templado Amarillo	Base Pop.	255 f.s.	222	86	88
		Lote 191	50 h.s.	28	12	12
43	La Posta	Base Pop.	100 f.s.	238	108	94
		Pool 24	10 h.s.	12	7	6
48	Comp. Hungría	Base Pop.	76 f.s.	132	70	57
		Pool 30	169 h.s.	118	54	43

T.S.R. - Tar, spot (*Phylaccora maidis*) resistant selections, from the conversion at the base population by crossing to tar spot donor sources.

Table 7. EXPERIMENTAL VARIETIES GENERATED FROM FULL-SIB FAMILY TESTING TRIALS CONDUCTED DURING 1974B TO 1981B

Gpo. no.	Pop. no.	No. E.V. generated	No. ELV identified	No. of particip. countries	No. of cycles of FS sel.	Population name	Envir-matur. color-texture
2	21	27	5	10	C-4	Tuxpeño-1	TLWD
1	22	33	13	11	C-4	Mezcla Tropical Blanco	TLWSD
1	23	29	6	13	C-4	Blanco Cristalino-1	TIWF
1	24	30	7	12	C-4	Antigua - Veracruz 181	TLYD
2	26	27	8	12	C-4	Mezcla Amarilla	TIYF
1	27	33	6	13	C-4	Amarillo Cristalino-1	TLYF
2	28	33	17	14	C-4	Amarillo Dentado	TLYD
2	29	26	11	13	C-4	Tuxpeño Caribe	TLWD
2	30	9	2	6	C-1	Blanco Cristalino-2	TEWF
2	31	7	2	5	C-1	Amarillo Cristalino-2	TEYF
1	32	25	3	10	C-3	ETO Blanco	TLWF
1	33	28	7	14	C-0	Amarillo Subtropical	Tm-subIY[redacted]
2	34	23	8	10	C-4	Blanco Subtropical	Tm-subI[redacted]F
1	35	26	6	13	C-3	Antigua-Rep. Dom.	TIYD
2	36	20	6	11	C-4	Cogollero	TLYD
1	39	30	8	11	C-1	Yellow QMP	TIYF
2	40	22	8	11	C-4	White QMP	TIWF
2	41	15	1	8	C-2	Templado Amarillo QMP	Tm-subIY[redacted]
1	42	27	15	10	C-3	ETO-Illinois	Tm-subIWD
1	43	27	8	12	C-4	La Posta	TLWD
1	44	28	6	6	C-3	AED - Tuxpeño	Tm-subL[redacted]D
1	45	10	2	4	C-1	Amarillo Bajío	Tm-subI[redacted]D
2	46	2	0	1	C-1	Templado Cristalino Amarillo	Tm-subE[redacted]YF
1	47	7	0	4	C-1	Templado Blanco Dentado	Tm-subIWD
2	48	21	1	5	C-4	Compuesto Hungary	TmIYD
2	49	1	0	1	C-1	Blanco Dentado-2	TIWD
	TOTAL:	566	156	240			

T = Tropical
Tm-sub = Temperate-subtropical
L = Late
I = Intermediate
E = Early

W = White
Y = Yellow
D = Dent
F = Flint
SD = Semi-dent
SF = Semi-flint

Table 8. Gains following 2 to 3 cycles of selection in 13 populations

No.	Population Name	Cycles of Improvement	Total percent gain	% gain per cycle
21	Tuxpeño - 1	2	4.4	2.20
22	Mezcla Tropical Blanco	3	4.3	1.44
23	Blanco Cristalino - 1	3	6.6*	2.20
24	Ant. x Ver. - 181	3	10.6**	3.50
25	(Mix. Col. Gpo. 1) x Eto	2	4.8	2.40
26	Mezcla Amarilla	2	6.2	3.10
27	Amarillo Cristalino	3	13.6**	4.50
28	Amarillo Dentado	2	5.9	2.90
29	Tuxpeño Caribe	2	5.4	2.70
32	ETO Blanco	2	1.5	0.75
35	Ant. x Rep. Dom.	2	8.1*	4.05
36	Cogollero	2	19.7**	9.80
43	La Posta	3	15.7**	5.20
X			7.9**	3.44

* and ** significant at the 0.50 and 0.01 level of probability, respectively

Table 9. PCCMCA uniform yield maize trial 1980[1/]

Entry No.	Variety	Yield kg/ha	Percent over check	Days to flower	Plant height cm
30	B-666	5703	111	58	269
14	Poza Rica 7843*	5544	108	57	250
17	Poza Rica 7822*	5381	105	56	231
5	ICTA T-101	5364	104	56	236
32	7904	5350	104	57	238
16	La Maquina 7843*	5344	104	58	252
31	7901	5322	104	58	252
1	ICTA HB-33	5309	103	56	229
20	CENTA H-9	5230	102	56	254
36	CENTA H-5	5136	100	57	254
4	La Maquina*	4652	90	58	242

1/ Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios.
Open-pollinated variety.

Table 10. MATERIALS RELEASED BY NATIONAL PROGRAMS

COUNTRY	SOURCE POP.	POPULATION NAME	MATERIAL	NAL. PROGRAM NAME
Colombia	43	La Posta	La Posta	PATIA-1
	31	Braquiticos	Braquiticos	MB-220
Ecuador	24	Antigua-Veracruz 181	Santa Rosa 7624	INIAP-527
	28	Amarillo Dentado	San Andres 7528	INIAP-526
	--	Pool 1	Compuesto Cacahuacintle	INIAP-101
Perú	30	Pool 1	Highland early white fl.	Cajamarca 101
Venezuela	25	Mix.1 (Colima Gpo.1) ETO	Across 7425	FOREMAIZ-2
Costa Rica	21	Tuxpeño-1	Tuxpeño-1	TICO V-1
	26	Mezcla Amarilla	Mezcla Amarilla	TICO V-2 (Am.)
	"	" "	" "	TICO V-5 (Bca.)
				TICO V-5 x Tux.P.B.C.18
El Salvador	21	Tuxpeño-1	Tuxpeño-1	H-8 (♀)
	21	"	ICTA B3	CENTA M3-B
	43	La Posta	La Posta	CENTA M1-B
Guatemala	21	Tuxpeño-1	Tuxpeño-1	ICTA B-1
	"	"	"	ICTA B-3
	22	Mezcla Trop. Bca.	La Maquina 7422	La Maquina
	31	Amarillo Cristalino-2	Amarillo Cristalino-2	ICTA A-4 (Am.)
	30	Blanco Cristalino-2	Blanco Cristalino-2	ICTA B-5 (Bca.)
	21 x 32	Tuxpeño-1 x ETO Bco.	Tuxpeño-1 x ETO Bco.	ICTA T-101
	28	Amarillo Dentado	La Maquina 7928	ICTA A-6
	22	Mezcla Trop. Bca. (♀) HB-67	Family 100 of Pop. 22	HB67
	29	Tuxpeño Caribe	Family 5 of Pop. 29	

(con't)

COUNTRY	SOURCE POP.	POPULATION NAME	MATERIAL	NAL. PROGRAM NAME
Guatemala (con't)				
	29	Tuxpeño Caribe	Family of Pop.	
	23	Blanco Cristalino	" " "	
	43	La Posta	" " "	HB-33
	22	Mezcla Trop. Bca.	Family of Pop.	
	21	Tuxpeño-1		HB-11 (♀)
	22	Mezcla Trop. Bca.	Family of Pop.	H-10 (♂)
	23	Blanco Cristalino-1 (♂) x	Family of Pop.	
		ICTA B-1 x ETO Bco. (♀)		HB-19
	27	ICTA A-2 x Am. crist.-1 (♀)	Family of Pop.	
	28	Amarillo Dentado (♂)	Family of Pop.	HA-28
	--	Pool 21 x Ant.-Ver. 181 (♀)	Pool 21	
	26	Mezcla Amarilla (♂)	Mezcla Amarilla	HA-44
	43	La Posta	La Maquina 7843	
Dominican	36	Cogollero	Across 7736	CESDA 36
Republic	27	Amarillo Cristalino -1	La Maquina 7827	CESDA 27
Honduras	--	---------	Tuxpeño (several)	Sintético Tuxpeño Hondureño
	21	Tuxpeño-1	Tuxpeño-1	Hondureño Planta baja
	"	"	"	Honduras B-104
	43	La Posta	Tlaltizapan 7443	Guayape B-102
	22	Mezcla Trop. Bca.	La Maquina 7422	Guaymas B-101
	28	Amarillo Dentado	Tocumen 7428	Guaymas A-501
	30	Blanco Cristalino-2	Blanco Cristalino-2	Honduras B-103 (Bca.)
	31	Amarillo Cristalino-2	Amarillo Cristalino-2	Honduras A-502 (Am.)

(con't)

COUNTRY	SOURCE POP.	POPULATION NAME	MATERIAL	NAL. PROGRAM NAME
Nicaragua	21	Tuxpeño-1	Tuxpeño-1	NB-1
	22	Mezcla Trop. Bca.	La Maquina 7422	NB-3
Haiti	28	Amarillo Dentado	Tocumen 7428	
	27	Amarillo Cristalino	Poza Rica 7427	Carolina
Panama	28	Amarillo Dentado	Tocumen 7428	Tocumen 7428
México	21	Tuxpeño-1	Tuxpeño-1	V-524
	29	Tuxpeño-Caribe	Tuxpeño-caribe	V-454
	22	Mezcla Trop. Bca.	Mezcla Trop. Bca.	V-455
	--	Trop. Interm. white flint	Pool 19	V-425
	49	Blanco dentado-2	Blanco dentado-2	V-424
	43	La Posta	La Posta	VS-525
Ivory Coast	29	Tuxpeño-Caribe	Poza Rica 7529	Poza Rica 7529
	22	Mezcla Trop. Bca.	La Maquina 7422	La Maquina 7422
	21	Tuxpeño-1	Tuxpeño-1	Tuxpeño-1
Lesotho	--	Highland early yellow flint	Pool 4	Pool 4
Tanzania	21	Tuxpeño-1	Tuxpeño-1	Tuxpeño
Zaire	21	Tuxpeño-1	Tuxpeño-1	Salongo II
	21 x 25		Tuxpeño 1 (Mix 1-Col. Gpo. 1) ETO x Shaba Safi	PNM I
	21 x 32	Tuxpeño 1 x ETO Bco.	Tuxpeño-1 x ETO	Kasai I
	21 x 32	Tuxpeño 1 x ETO Bco.	(Tuxpeño-1 x ETO) Shaba Safi	Shaba I
China	21	Tuxpeño-1	Tuxpeño-1	Mexican white-94

(con't)

COUNTRY	SOURCE POP.	POPULATION	MATERIAL	NAL. PROGRAM NAME
China (Cont.)				
	--	Tuxpeño-1	Tuxpeño P.B. (C_{15})	Mexican white-1
Burma	27	Amarillo Crist.-1	Satipo (1) 7627	Golden Yellow
India	21	Tuxpeño-1	Tuxpeño-1	Pathari Makka (♀)
	44	AED-Tuxpeño	Sids 7444	Lakshami
Nepal	34	Blanco Subtropical	Rampur 7434	Janaki

Table 11. MATERIALS UNDER CONSIDERATION FOR RELEASE BY NATIONAL PROGRAMS

COUNTRY	SOURCE POP.	POPULATION NAME	MATERIAL	NAL. PROGRAM NAME
Bolivia	28	Amarillo Dentado	Poza Rica 7528	
	"	" "	Ludhiana 7528	
Ecuador	26	Mezcla Amarilla	Ferke 7526	
Perú				PMV Selva 1
				PMV Selva 2
				PMV Selva 3
Venezuela	23	Blanco Cristalino-1	ICA 7423	------------
	23		Across 7523	------------
	25	Mix.1(Colima Gpo.1)ETO	Poza Rica 7525	------------
	28	Amarillo Dentado	Obregon 7328	------------
Costa Rica	28	Amarillo Dentado	Tocumen 7428	
Honduras	29	Tuxpeño-Caribe	Pichilingue 7429	
Panama	27	Amarillo Cristalino-1	Tocumen 7527	
	35	Antigua-Rep. Dom.	Tocumen 7635	
	36	Cogollero	Across 7536	
Haiti	27	Amarillo Cristalino-1	La Maquina 7827	
Egypt	44	AED-Tuxpeño	Sids 7444	
Ghana	43	La Posta	Poza Rica 7843	
	43	La Posta	Ejura (1) 7843	
Mozambique	43	La Posta	Obregon 7643	
	34	Blanco Subtropical	Obregon 7734	
	28	Amarillo Dentado	Across 7728	
Swaziland	43	La Posta	Across 7443	
Tanzania	30	Blanco Cristalino-2	Blanco Cristalino-2	

(con't)

COUNTRY	SOURCE POP.	POPULATION	MATERIAL	NAL. PROGRAM NAME
Upper Volta	--	Trop. early white dent	Pool 16	
Kenya	--	Trop. early white dent	Pool 16	
Burma	28	Amarillo Dentado	La Calera (1) 7728	
	22	Mezcla Trop. Bl.	Tl 7322	
	36	Cogollero	Petrolina 7736	
Pakistan	30	Blanco Cristalino-2	Pirsaback (1) 7930	
	45	Amarillo Bajio	Yousafwala (1) 7845	
Yemen AR	28	Amarillo Dentado	Sete Lagoas 7728	

Table 12A. PERFORMANCE OF ELITE VARIETY, POZA RICA 7822 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE Y*	D.S.*	P.h.*	CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK Y (%)*	D.S.*	P.h*	C.V. %
EVT 12	1979	Mexico	Cotaxtla	6.2	55	273	Cot-18SMI	108	-2	-41	6.8
EVT 12	1979	Mexico	La Huerta	3.7	62	217	T-47**	114	-2	-18	21.7
EVT 12	1979	Mexico	Poza Rica	5.3	67	270	H-507**	136	-6	-65	8.9
EVT 12	1979	Mexico	Nayarit	2.7	53	232	V-524	112	0	+29	9.7
ELVT 18A	1980	Mexico	Obregon (1)	7.1	60	236	H-419**	114	+2	-12	7.9
ELVT 18A	1980	Mexico	Obregon (2)	5.6	80	243	H-419**	106	+1	-33	12.9
ELVT 18A	1980	Mexico	Poza Rica	4.2	61	243	H-510**	123	-5	-50	12.1
PCCMCA	1980	Mexico	La Huerta	5.0	52	245	Centa H-5**	91	-3	-25	24.3
PCCMCA	1980	Mexico	Mextipac	7.8	78	283	Centa H-5**	89	-1	-24	9.2
EVT 12	1979	El Salvador	San Andres	4.6	54	251	H-9**	89	0	-32	13.4
EVT 12	1979	El Salvador	Sta. Cruz P.	5.1	48	254	H-10**	97	+1	-13	14.6
ELVT 18A	1980	El Salvador	San Andres	4.5	58	249	H-9**	108	+1	+ 6	13.5
ELVT 18A	1980	El Salvador	Sta. Cruz P.	4.2	57	213	H-9**	86	+3	-23	19.5
ELVT 18A	1980	El Salvador	San Miguel	4.2	52	227	H-9**	105	0	-13	19.0
PCCMCA	1980	El Salvador	San Andres	4.5	59	273	H-5**	100	0	-26	20.5
PCCMCA	1980	El Salvador	Sta. Cruz P.	5.8	57	233	H-5**	96	0	-20	19.3
EVT 12	1979	Guatemala	Cuyuta	4.8	55	224	Loc. Var.	104	+1	+11	9.6
EVT 12	1979	Guatemala	La Maquina	5.5	53	212	ICTA B-1	95	+1	+24	8.0
ELVT 18A	1980	Guatemala	Cuyuta	6.0	51	228	Comp. 2	109	+2	+13	10.7
ELVT 18A	1980	Guatemala	La Maquina	5.6	57	194	ICTA A-10	88	-1	+21	10.5
PCCMCA	1980	Guatemala	La Maquina	4.6	56	213	ICTA B-1	123	0	+ 9	10.2
PCCMCA	1980	Guatemala	Cuyuta	4.9	54	248	H-5**	116	-1	-19	12.1
EVT 12	1979	Dom. Rep.	S. Cristobal	3.8	58	240	Frances.Mej.	101	+3	-34	17.1
PCCMCA	1980	Dom. Rep.	S. Cristobal	5.2	57	262	H-5**	127	0	-48	6.9
PCCMCA	1980	Dom. Rep.	Quininga	3.7	57	250	H-5**	102	+1	-10	16.2
EVT 12	1979	Ghana	Nyankpala	3.3	60	257	Comp. W	135	-1	-36	24.7
ELVT 18A	1980	Ghana	Ejura	4.3	58	220	Comp. 4	131	-2	-41	21.3
EVT 12	1979	Nigeria	Ibadan	2.3	59	156	TZPB	101	-2	-26	26.0
ELVT 18A	1980	Nigeria	Ibadan	3.5	60	186	TZPB	108	-3	-11	19.4

* Y = yield in tons/ha; D.S. = days to silking; P.h. = plant height in cm   ** Hybrids

Table 12B. PERFORMANCE OF ELITE VARIETY, SAN ANDRES (1) 7823 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 12	1980	Colombia	Turipana	1.8	56	---	ICA H-154**	173	-5	---	20
ELVT 18A	1980	Colombia	Turipana	2.3	49	242	ICA V-105	164	-1	-15	24
EVT 12	1979	El Salvador	San Andres	4.6	54	251	Centa H-9**	96	-2	-33	13
ELVT 18A	1980	El Salvador	San Andres	4.7	58	246	Centa HE-15**	96	-2	- 5	14
EVT 12	1979	El Salvador	Sta. Cruz P.	5.2	48	254	Centa H-10**	85	0	-10	15
ELVT 18A	1980	El Salvador	Sta. Cruz P.	4.2	57	213	Centa H-9**	91	0	-42	20
ELVT 18A	1980	El Salvador	San Miguel	5.6	52	237	HE-15**	74	-1	-29	19
EVT 12	1979	Ivory Coast	Ferke	7.4	60	270	IRAT-81**	88	-6	-31	11
ELVT 18A	1980	Ivory Coast	Ferke	7.4	61	266	IRAT-81**	94	-5	-37	9
ELVT 18A	1980	Ivory Coast	Bouake	3.4	65	255	IRAT-81**	114	-5	-11	17
EVT 12	1979	Bangladesh	Jamalpur	4.6	--	185	Sadaf	109	--	-43	13
ELVT 18A	1980	Bangladesh	Jamalpur	5.8	93	165	Sadaf	104	-6	-26	16

* Y = yield tons/ha; D.S. = days to silking; P.h. - plant height in cm ** Hybrids

Table 12C. PERFORMANCE OF ELITE VARIETY, ACROSS 7726 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE Y*	D.S.*	P.h.*	CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK Y (%)*	D.S.*	P.h*	C.V. %
EVT 13	1979	Honduras	Guaymas	3.0	54	216	HA 504**	115	-5	0	16.3
EVT 14A	1980	Honduras	S. Pedro Sula	6.0	55	241	Local Var.	96	-5	-25	13.8
ELVT 18B	1980	Honduras	S. Pedro Sula	4.6	55	205	Local Var.	91	-3	-21	16.8
ELVT 18B	1980	Honduras	Omonita	4.4	56	225	Hondureño PB	113	-5	+3	18.0
ELVT 18B	1980	Honduras	Comayagua	5.0	60	222	Hondureño PB	111	-12	-18	18.7
ELVT 18B	1980	Ethiopia	Bako	4.1	82	271	OP 512	114	-3	-84	12.8
EVT 14A	1980	Ethiopia	Nazareth	3.9	64	218	Shaye	130	+3	-20	27.0
EVT 13	1979	Sierra Leone	Njala	2.8	59	206	Local Var.	120	-3	-47	19.2
EVT 14A	1980	Sierra Leone	Rokupr	1.8	56	145	Local Var.	115	-1	+32	25.3
EVT 13	1979	Sudan	Halima	2.1	61	205	Katumani	152	+2	-22	22.3
ELVT 18B	1980	Sudan	Halima	5.0	60	171	Halima II	93	+1	-21	13.5
EVT 13	1979	Bangladesh	Ishurdi	4.2	82	201	Sadaf	115	0	-11	12.3
EVT 14A	1980	Bangladesh	Jamalpur	6.1	87	163	Sadaf	88	-1	-22	12.5
ELVT 18B	1980	Bangladesh	Raibari	7.3	96	228	Sadaf	118	-1	-30	7.6
EVT 14A	1980	Pakistan	Yousafwala	4.9	56	203	Sultan	106	+5	+10	13.6
EVT 14A	1980	Pakistan	Islamabad	3.1	55	178	Syn. 551	126	+2	- 2	19.2

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height ** Hybrids

Table 12D. PERFORMANCE OF ELITE VARIETY, ACROSS 7728 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 13	1979	Panama	Tocumen (1)	3.9	58	220	UNP-1	138	- 1	+ 4	10.7
EVT 13	1979	Panama	Tocumen (2)	3.7	58	228	UNP-1	115	- 2	-13	8.4
EVT 13	1979	Panama	Rio Hato	3.8	53	213	UNP-2	133	- 1	- 8	16.9
EVT 13	1979	Panama	Guarare	4.4	54	273	Tocumen 7428	112	0	-59	11.7
ELVT 18A	1980	Panama	Alanje	5.4	52	224	Tocumen 7428	107	- 1	-10	21.9
ELVT 18A	1980	Panama	Progreso	4.0	53	300	Tocumen 7428	128	- 3	-69	14.0
ELVT 18A	1980	Panama	Guarare	4.0	58	241	P-X-3068**	91	+ 2	-12	10.3
PCCMCA	1980	Panama	Tocumen	5.4	57	213	Centa H-5**	101	- 1	- 8	10.6
PCCMCA	1980	Panama	Chiriqui	4.6	53	260	Centa H-5**	107	- 1	- 6	14.9
EVT 13	1979	Brazil	Jardinopolis	6.1	66	243	AG 301**	96	- 2	+18	11.7
EVT 13	1979	Brazil	Sete Lagoas	7.8	62	285	AG 301**	101	0	-12	8.9
ELVT 18A	1980	Brazil	Sete Lagoas	6.5	71	176	AG 305B**	133	- 4	+97	11.9
ELVT 18A	1980	Brazil	Guaira	5.2	65	223	CMS 05	113	+ 1	+ 1	7.7
EVT 13	1980	Brazil	Guaira	4.4	67	210	CMS 05	126	0	+11	9.6
EVT 13	1980	Brazil	Sete Lagoas	6.5	81	225	AG 301**	87	- 1	-19	18.2
EVT 13	1979	Ecuador	Pichilingue	6.2	56	268	Pichil. 504	108	- 1	-20	9.7
ELVT 18A	1980	Ecuador	Pichilingue	5.7	56	280	Pichil. 504	108	0	-25	8.8
EVT 13	1980	Ecuador	Pichilingue	6.2	56	275	Pichil. 504	98	+ 1	-12	10.5
EVT 13	1979	Mozambique	Umbeluzi	3.0	--	---	SR 52**	98	---	---	13.3
EVT 13	1980	Mozambique	Umbeluzi	3.1	53	---	SR 52**	240	0	---	20.5
EVT 13	1980	Mozambique	Nampula	2.9	55	---	SR 52**	98	- 3	---	19.1
ELVT 18A	1980	Mozambique	Umbeluzi	2.1	53	---	SR 52**	139	+ 3	---	20.6
ELVT 18A	1980	Mozambique	Mutuali	3.9	58	---	SR 52**	97	- 6	---	23.1
EVT 13	1979	Ivory Coast	Ferke	6.3	60	284	IRAT-81**	116	- 5	- 9	9.5
ELVT 18A	1980	Ivory Coast	Ferke	7.4	61	266	IRAT-81**	83	- 5	-18	8.7
ELVT 18A	1980	Ivory Coast	Bouaké	3.4	65	255	IRAT-81**	117	- 3	-20	17.4
EVT 13	1979	Sudan	Halima	2.1	61	205	Katumani	125	+ 5	- 2	22.3
ELVT 18A	1980	Sudan	Halima	4.0	66	204	Halima II	122	- 2	- 1	19.0
EVT 13	1979	Yemen A.R.	Taiz	3.5	59	158	Local Var.	139	+13	+13	12.5
ELVT 18A	1980	Yemen A.R.	Taiz	3.5	64	166	Khumaltar	132	+ 4	+ 4	10.3
ELVT 18A	1980	Yemen A.R.	Surduo	4.9	53	286	Local Var.	115	- 1	-58	9.2
ELVT 18A	1980	Yemen A.R.	Ibb	2.1	93	205	Misri	94	+ 2	-17	19.4
EVT 13	1979	Sri Lanka	Mahailluppallama	4.1	59	201	Bhadra 1	130	+ 1	+ 7	15.1
EVT 13	1979	Sri Lanka	Mahailluppallama (2)	2.8	60	170	Bhadra 1	154	+ 1	+33	17.3

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height ** Hybrids

Table 12E. PERFORMANCE OF ELITE VARIETY, ACROSS 7729 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 12	1979	Bangladesh	Jamalpur	4.6	91	185	SADAF	133	+7	- 7	13.1
ELVT 18A	1980	Bangladesh	Jamalpur	5.8	93	165	SADAF	100	-4	-12	15.8
EVT 12	1979	Colombia	Turipana	1.8	56	- -	ICAH-154**	188	-2	- -	19.8
ELVT 18A	1980	Colombia	Turipana	2.3	49	242	ICAH-107**	145	0	-14	23.8
EVT 12	1979	Honduras	Chirinas	6.3	57	239	Hondureño PB	95	0	+10	10.9
EVT 12	1979	Honduras	Las Acacias	5.8	55	206	Hondureño PB	117	0	+19	11.3
ELVT 18A	1980	Honduras	Omonita	4.4	56	273	Sint. Tuxpeño	111	-3	-43	20.1
ELVT 18A	1980	Honduras	Catacamas	6.5	61	326	Sint. Tuxpeño	111	-3	-70	10.0
ELVT 18A	1980	India	Pantnagar	11.6	58	- -	Ganga - 2	113	+2	- -	8.6
ELVT 18A	1980	India	Dholi	1.8	70	- -	Ganga - 2	101	+1	- -	33.4
ELVT 18A	1980	Argentina	Yatasto	3.0	--	266	Cargill T-228**	120	--	-12	17.1
ELVT 18A	1980	Brazil	Guaira	5.2	65	223	CMS 05**	119	+2	- 8	7.7
ELVT 18A	1980	Brasil	Sete Lagoas	6.0	67	239	CMS 05**	120	0	+ 5	11.9
ELVT 18A	1980	Surinam	Tijgerkreek	3.9	62	220	CS 3	150	-6	-36	21.3
ELVT 18A	1980	Thailand	Suwan	6.9	53	203	Suwan 1	81	+3	-21	12.1
ELVT 18A	1980	Thailand	Suwan (2)	6.9	55	200	Suwan	100	-2	+11	8.4
ELVT 18A	1980	Thailand	Takfa	6.5	56	198	Suwan	105	0	-13	10.7
EVT 12	1979	Yemen A.R.	Taiz	2.4	62	116	- - -	155	+14	- 4	17.5
ELVT 18A	1980	Yemen A.R.	Taiz	3.5	64	166	Khumaltar	153	+3	- 3	10.3
ELVT 18A	1980	Yemen A.R.	Surdud	4.9	53	286	Khumaltar	100	-1	-55	9.2
ELVT 18A	1980	Yemen A.R.	Jbb	2.1	93	205	Misrí	104	+3	-27	19.4

* Y = yield; D.S. = days to silking; P.h. = plant height in cm   **Hybrid

Table 12F. PERFORMANCE OF ELITE VARIETY, PIRSABAK (1) 7930 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 14B	1980	Mexico	Obregon (2)	4.5	78	228	H-419**	103	- 7	-64	9.9
EVT 14B	1980	Mexico	Obregon (1)	6.8	63	233	H-419**	90	-10	-28	9.1
EVT 14B	1980	Mexico	Cotaxtla	4.5	56	211	Local Var.	103	- 9	- 9	9.4
EVT 14B	1980	Guatemala	Cuyuta	4.4	48	235	B-5	106	- 3	-12	12.4
EVT 14B	1980	Guatemala	La Maquina	4.5	51	206	B-5	105	- 4	- 5	11.2
EVT 14B	1980	Ethiopia	Bako	3.8	80	257	OP-512	111	- 9	-79	13.1
EVT 14B	1980	Mozambique	Umbeluzi	2.2	47	---	Kalahari	127	- 2	---	15.8
EVT 14B	1980	Mali	Sotuba	2.8	60	253	Tiemante	121	-11	-63	19.2
EVT 14B	1980	Senegal	Sefa	2.4	50	176	Local Var.	92	- 8	-22	17.2
EVT 14B	1980	Nigeria	Ikenne	3.6	55	208	TZVT	117	- 7	-17	17.5
EVT 14B	1980	Ivory Coast	Ferke	4.8	56	264	CJB	119	- 5	-64	13.3
EVT 14B	1980	Pakistan	Yousafwala	6.1	55	220	Comp. 11	102	- 3	+ 4	9.6
EVT 14B	1980	Pakistan	Pirsabak	4.8	56	175	Sarhad (W)	95	0	- 4	11.4
EVT 14B	1980	Pakistan	Islamabad	4.0	60	178	Sarhad (W)	88	- 3	- 4	18.6

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height in cm ** Hybrid

Table 12G. PERFORMANCE OF ELITE VARIETY, TOCUMEN (1) 7835 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 13	1979	Colombia	Turipana	2.7	53	---	ICA H-107**	123	-4	---	17.3
ELVT 18B	1980	Colombia	Turipana	2.4	53	236	ICA V-105	115	-4	-37	27.0
EVT 13	1979	Sudan	Halima	2.1	61	205	Katumani	146	-1	-12	22.3
ELVT 18B	1980	Sudan	Halima	5.0	60	171	Halima II	88	-3	-44	13.5
EVT 13	1979	Yemen A.R.	Taiz	3.5	59	158	Local Var.	120	+3	-17	12.5
ELVT 18B	1980	Yemen A.R.	Taiz	3.3	61	176	Khumaltar	112	-1	-13	14.2
EVT 13	1979	Nigeria	Ibadan	1.9	55	125	TZB	108	-5	-24	24.2
ELVT 18B	1980	Nigeria	Ibadan	3.4	55	179	TZB	108	-5	-26	13.0
EVT 13	1979	Senegal	Sefa	3.6	50	164	AC1 x B1**	101	0	-20	20.2
ELVT 18B	1980	Senegal	Sefa	3.7	54	178	AC1 x B1**	102	-3	-17	22.5

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height in cm   ** Hybrid

Table 12H. PERFORMANCE OF ELITE VARIETY, LA MAQUINA 7843 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
PCCMCA	1980	Costa Rica	Diamantes	7.1	53	294	H-5**	113	0	+ 1	13.8
PCCMCA	1980	Costa Rica	Guanacaste	6.5	53	245	H-5**	103	+1	+ 2	12.1
EVT 12	1979	Guatemala	La Maquina	5.5	53	212	ICTA B-1	110	+1	+47	8.0
EVT 12	1979	Guatemala	Cuyuta	4.8	55	224	Comp. 2	102	+2	+25	9.6
PCCMCA	1980	Guatemala	Cuyuta	4.9	54	248	Centa H-5**	111	0	- 2	12.1
PCCMCA	1980	Guatemala	La Maquina	4.6	56	213	ICTA B-1	131	+1	+46	10.2
EVT 12	1979	Honduras	Chirinas	6.3	57	239	Hond.P.B.	107	+3	+45	10.9
EVT 12	1979	Honduras	Las Acacias	5.8	55	206	Hond.P.B.	134	+1	+46	11.3
EVT 12	1979	Mexico	Cotaxtla	6.2	55	273	Cot.28SMT	106	0	-14	6.8
EVT 12	1979	Mexico	Poza Rica	5.3	67	270	H-507**	131	-3	-33	8.9
EVT 12	1979	Mexico	Nayarit	2.7	53	232	V-524	117	+2	+72	9.7
EVT 12	1979	Mexico	La Huerta	3.7	62	217	T-47**	114	-1	- 1	21.7
PCCMCA	1980	Mexico	La Huerta	5.0	52	245	H-5**	95	+4	- 5	24.3
EVT 12	1979	Bolivia	Gran Saavedra	3.9	64	223	Tuxpeño	141	-1	-15	16.9
EVT 12	1979	Colombia	Turipana	1.8	56	---	ICA H-154**	160	-2	---	19.8
EVT 12	1979	Ivory Coast	Ferke	7.4	60	270	IRAT-81**	104	-2	+12	10.6
EVT 12	1979	Ghana	Nyankpala	3.3	60	257	Comp. W	129	0	-11	24.7
EVT 12	1979	Sierra Leone	Njala	3.3	59	204	Local Var.	130	-1	- 9	14.5
EVT 12	1979	Bangladesh	Jamalpur	4.6	91	185	Sadaf	125	+8	+27	13.1
EVT 12	1979	Saudi Arabia	Hofuf	5.4	64	211	Local Var.	109	+5	+ 6	15.1
EVT 12	1979	Yemen A.R.	Taiz	3.4	75	108	Local Var.	112	+2	+12	17.5

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height in cm ** Hybrid

Table 12I. PERFORMANCE OF ELITE VARIETY, POZA RICA 7843 IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

TRIAL	YEAR	COUNTRY	LOCATION	CHECK PERFORMANCE			CHECK NAME	ELITE VAR. PERFORMANCE COMPARED TO CHECK			C.V. %
				Y*	D.S.*	P.h.*		Y (%)*	D.S.*	P.h*	
EVT 12	1979	Bolivia	Gran Saavedra	3.9	64	223	Tuxpeño	149	0	-14	16.9
EVT 12	1979	Colombia	Turipana	1.8	56	---	ICA H-154**	174	-1	---	19.8
PCCMCA	1980	Costa Rica	Guanacaste	6.5	53	245	CENTA H5**	94	+1	-14	12.1
PCCMCA	1980	Costa Rica	Los Diamantes	7.1	53	294	CENTA H5**	107	+2	- 1	13.6
EVT 12	1979	El Salvador	San Andres	4.6	54	251	CENTA H9**	93	+3	-13	13.4
PCCMCA	1980	El Salvador	San Andres	4.5	59	273	CENTA H5**	100	+2	- 6	20.5
EVT 12	1979	El Salvador	Sta. Cruz P.	5.2	48	254	CENTA H10**	91	+2	+15	14.6
PCCMCA	1980	El Salvador	Sta. Cruz P.	5.8	57	233	CENTA H5**	96	-1	- 5	19.3
EVT 12	1979	Guatemala	Cuyuta	4.8	55	224	Comp. 2	116	+2	+24	9.6
PCCMCA	1980	Guatemala	Cuyuta	4.9	54	248	CENTA H5**	125	0	+ 1	12.1
EVT 12	1979	Guatemala	La Maquina	5.5	53	212	ICTA B-1	106	+2	+47	8.0
PCCMCA	1980	Guatemala	La Maquina	4.5	56	213	ICTA B-1	121	0	+30	10.2
EVT 12	1979	Honduras	Chirinas	6.3	57	239	Hondur. PB	108	0	+35	10.9
EVT 12	1979	Honduras	Las Acacias	5.8	55	206	Hondur. PB	133	+1	-32	11.3
EVT 12	1979	Mexico	Cotaxtla	6.2	55	273	Cot-28MT	107	-1	-24	6.8
EVT 12	1979	Mexico	La Huerta	3.7	62	217	T-47**	94	-2	+14	21.7
PCCMCA	1980	Mexico	La Huerta	5.0	52	245	CENTA H5**	115	+1	- 5	24.3
PCCMCA	1980	Mexico	Nextipac	7.8	78	283	CENTA H5**	95	+3	- 4	9.2
EVT 12	1979	Mexico	Nayarit	2.7	53	232	V524	110	0	58	9.7
EVT 12	1979	Mexico	Poza Rica	5.3	67	270	H-507**	125	-5	-34	8.9
PCCMCA	1980	Panama	Tocumen	5.4	57	213	CENTA H5**	109	+1	- 4	10.6
PCCMCA	1980	Panama	Chiriqui	4.6	53	260	CENTA H5**	119	0	+11	14.9
PCCMCA	1980	Panama	Rio Hato	5.1	56	240	CENTA H5**	106	+1	- 2	16.7
PCCMCA	1980	Rep. Dom.	Quininga	3.7	57	250	CENTA H5**	109	+2	- 1	16.2
PCCMCA	1980	Rep. Dom.	San Cristobal	5.2	57	262	CENTA H5**	103	+1	- 9	6.9
EVT 12	1979	Saudi Arabia	Hofuf	5.4	64	211	- - - - -	114	+5	-11	15.1
EVT 12	1979	Sierra Leone	Njala	3.3	59	204	- - - - -	122	0	-10	14.5
EVT 12	1979	Ivory Coast	Ferke	7.4	60	270	IRAT 81**	97	-2	+ 1	10.6
EVT 12	1979	Ghana	Nyankpala	3.3	60	257	Comp. W	157	0	- 5	24.7
EVT 12	1979	Tanzania	Ilonga	3.6	66	248	Ilonga Comp.	110	-6	-50	18.5

* Y yield tons/ha; D.S. = days to silking; P.h. = plant height in cm. ** Hybrid

Table 12J. PERFORMANCE OF EXPERIMENTAL VARIETY, GUANACASTE 7940 IN EVT 15A AT SELECTED LOCATIONS IN 1980

COUNTRY	LOCATION	CHECK PERFORMANCE			EXP. VAR. PERFORMANCE COMPARED TO BEST CHECK			C.V. %
		Y*	D.S.*	P.h.*	Y (%)*	D.S.*	P.h.*	
Bolivia	Iboperenda	7.7	63	230	96	-3	+ 5	11.4
Brazil	Sete Lagoas	6.9	64	246	107	0	- 1	13.1
Brazil	Guaira	4.6	71	273	128	-6	-55	10.1
Ecuador	Pichilingue	5.6	57	265	103	-1	-16	11.2
Venezuela	Durigua	3.1	50	167	122	0	+ 7	10.6
Panama	Tocumen	4.2	57	179	92	0	-18	18.1
Panama	Chiriqui	4.8	52	239	111	-1	-21	9.9
Panama	Rio Hato	5.3	56	235	91	-2	-10	10.7
Mexico	Poza Rica	5.7	56	216	98	-3	-16	7.4
Mexico	Obregon	7.1	65	263	94	-8	-44	7.4
Ghana	Kwadaso	3.7	61	206	104	-6	+ 1	16.4
Mali	Sotuba	3.9	60	264	127	-5	-44	13.6
Mozambique	Nampula	3.8	48	-	94	-1	-	14.0
Mozambique	Umbeluzi	2.3	51	-	132	0	-	18.6
Bangladesh	Jessore	6.3	88	204	108	-1	-12	9.7
Burma	Yezin	4.1	44	174	123	+3	+10	13.8
India	Varanasi	4.2	109	237	103	0	+11	11.8
Nepal	Rampur	8.0	56	204	107	+1	- 7	21.7
Philippines	Karaan	2.6	59	169	137	-1	+ 4	14.2

* Y = yield tons/ha; D.S. = days to silking; P.h. = plant height in cm ** Hybrid

Table 13. PERFORMANCE OF TEMPERATE-SUBTROPICAL ELITE VARIETIES IN INTERNATIONAL TESTS OVER LOCATIONS AND YEARS

Variety	Trial	Year	Country	Location	Check Performance			Check Name	Elite Variety Performance Compared to Check			
					Y*	D.S.*	P.h*		Y(%)*	D.S.*	P.h.*	C.V.(%)
Across 7734	EVT 16	1979	Mexico	Tlaltizapan	5.1	64	236	H-412**	136	- 1	-10	12.1
Across 7734	ELVT 20	1980	Mexico	Tlaltizapan	9.3	64	234	H-419**	107	- 3	-23	8.0
Across 7734	ELVT 20	1980	Mexico	Obregon (1)	6.8	63	248	H-419**	100	- 9	-29	5.2
Across 7734	ELVT 20	1980	Mexico	Obregon (2)	6.0	79	245	H-412**	97	- 2	-41	11.5
Tlaltizapan 7734	EVT 16	1978	Argentina	Pergamino	5.0	75	208	- - -	102	+ 7	+ 5	10.2
Tlaltizapan 7734	ELVT 20	1980	Argentina	Pergamino	7.0	70	250	Contigran**	102	+ 6	+21	7.6
Tlaltizapan 7734	ELVT 20	1980	Argentina	Yatasto	3.3	--	263	C.T. 228**	111	---	- 3	23.3
Sids (1) 7734	EVT 16	1978	Chile	La Platina	10.2	77	258	INIA-9**	117	+ 8	+20	8.6
Sids (1) 7734	ELVT 20	1979	Chile	Antumapu	7.0	86	155	T-88**	136	+13	+80	10.3
Tlaltizapan 7734	ELVT 20	1980	Turkey	Antalya	6.3	48	206	PX-616**	113	+ 7	+33	13.3
Tlaltizapan 7734	ELVT 20	1980	Turkey	Adapazari	7.3	77	253	PX-616**	131	+21	+32	16.7
Tlaltizapan 7734	ELVT 20	1980	Turkey	Adana	5.1	--	---	PX-616**	99	---	---	25.0
Across 7842	EVT 16	1980	Mexico	Tlaltizapan	8.5	66	235	H-419**	106	- 4	-17	7.5
Across 7842	EVT 16	1980	Mexico	Obregon	7.8	60	264	H-419**	91	- 2	-30	8.1
Tlaltizapan 7842	EVT 16	1979	Jordan	Deir Alla	3.0	52	216	- - -	117	+ 3	-10	26.6
Tlaltizapan 7842	ELVT 20	1980	Jordan	Deir Alla	3.3	52	213	- - -	118	+ 6	- 8	20.5
Tlaltizapan 7842	EVT 16	1979	Saudi Arabia	Hofuf	5.3	53	181	Tainan	132	+ 6	+17	19.8
Tlaltizapan 7842	ELVT 20	1980	Saudi Arabia	Hofuf	3.1	71	155	Tainan-5	130	+ 5	+10	21.8
Tlaltizapan 7842	ELVT 20	1980	Ethiopia	Awassa	1.6	80	---	A512	213	- 2	---	25.6
Tlaltizapan 7842	ELVT 20	1980	Ethiopia	Bako	6.2	78	277	A512	94	- 5	-70	12.6
Across 7842	EVT 16	1980	Mozambique	Lioma	3.3	54	---	SR52**	132	- 7	---	14.3
Across 7842	EVT 16	1980	Mozambique	Mutuali	5.5	55	---	- - -	95	- 7	---	18.4
Sao Paulo 7842	EVT 16	1980	Pakistan	Yousafwala	5.6	56	221	Comp. II	109	+ 2	-10	12.5
Sao Paulo 7842	EVT 16	1980	Pakistan	Pirsabak	5.1	56	186	Sarhad (Y)	132	+ 2	- 2	9.8
Across 7844	EVT 16	1980	Pakistan	Yousafwala	5.6	56	221	Comp. II	113	+ 4	- 7	12.5
Across 7844	EVT 16	1980	Pakistan	Pirsabak	5.1	56	186	Sarhad (Y)	130	+ 4	+17	9.8
Across 7844	EVT 16	1980	Mozambique	Lioma	3.3	54	---	SR52**	130	- 4	---	14.3
Across 7844	EVT 16	1980	Mozambique	Mutuali	5.5	55	---	SR52**	110	- 6	---	18.4
Cotaxtla 7844	EVT 16	1980	Malawi	Chitedze	10.2	68	247	CX-H45**	93	- 1	-13	8.7
Cotaxtla 7844	EVT 16	1980	Swaziland	Mongcongo	5.3	--	221	SR52**	105	---	-36	19.1
Tlaltizapan 7845	EVT 16	1979	Brazil	Chapeco	4.5	75	212	Agroceres 64**	89	-10	-28	25.8
Tlaltizapan 7845	ELVT 20	1980	Brazil	Chapeco	7.3	71	201	Saue 345**	83	- 4	-14	8.8
Tlaltizapan 7845	EVT 16	1979	Saudi Arabia	Hofuf	5.3	53	181	Tainan	132	+ 6	+17	19.8
Tlaltizapan 7845	ELVT 20	1980	Saudi Arabia	Hofuf	3.1	71	155	Tainan-5	130	+ 5	+10	21.8
Tlaltizapan 7845	EVT 16	1979	Pakistan	Pirsabak	6.4	59	179	Sarhad (ω)	104	+ 2	0	14.0
Tlaltizapan 7845	ELVT 20	1980	Pakistan	Islamabad	2.9	56	170	Syn. 551	115	0	-14	22.9

* Y = yield tons/ha; D.S. = days to silking P.h. = plant height in cm ** Hybrid

QUALITY PROTEIN MAIZE

In developing quality protein maize (QPM) materials at CIMMYT, the opaque-2 gene has been used. Although CIMMYT initiated its QPM program in the late 1960's, it was not until early 1970's that the efforts on this project were intensified. This work remains an integral and parallel part of the total program.

Begining in 1974, a program was started to convert most of the advanced unit populations and the gene pools to quality protein maize. In developing QPM, the genetic modifiers were exploited to improve kernel phenotype and its stability over environments without sacrificing protein quality. By 1980, QPM versions of most of the materials were obtained. Now efforts are underway to systematically merge and improve them for general adaptation and stability of kernel modification through international testing.

CIMMYT now has a range of QPM materials including 4 advanced populations to fit many agroclimatic conditions and food preferences.

The following pages review the early problems of QPM research and CIMMYT's breeding strategy. In addition, information is provided on the performance of these materials relative to the best normal entries being used in the national programs.

PRESENT STATUS OF BREEDING HIGH-QUALITY PROTEIN MAIZE

The discovery of new mutant genes that bring about drastic alterations in plant or kernel characteristics of economic importance to achieve certain well-defined goals in maize breeding has always fascinated maize breeders. Whenever such new genes are discovered, they have sparked enthusiasm and led to a world-wide effort in introducing the desired traits to the most promising maize genotypes through a simple straight-forward backcrossing program. Normally the introduction of any such genes takes several years before the beneficial effects of such genes are actually realized. This time span, however, is likely to be extended in case these genes bring along with them some undesirable side-effects as has been the case with high-quality protein maize mutants. Depending upon the complexity of the problems that come along, the incorporation and exploitation of such genes require genetic manipulation quite different from what may appear to be a simple breeding process.

Breeding for protein quality of maize endosperm through the use of high-quality mutant genes (opaque-2, floury-2 and opaque-7) has been underway for the past fifteen years. Though several genes are known and have boosted the levels of lysine and tryptophan to almost double, only opaque-2 gene has been tried extensively to convert normal maize genotypes to opaque-2. It seems important at this point to review some of the developments and the progress that has taken place in the past several years. Historically the year 1964 generated considerable optimism and interest among maize breeders all around the world to develop quality protein maize (QPM) materials by upgrading the quality of protein in the endosperm. From the year of discovery of the biochemical effects of opaque-2 gene up until 1970, the major emphasis in maize breeding programs has been in obtaining opaque-2 versions of normal maize genotypes through the calssical backcross approach. Several opaque-2 varieties and hybrids were developed during the first 6-7 years of this intensive research effort. Some of these materials appeared on commercial production scene in the early 70's in different countries but these materials suffered major setbacks due to the lack of competitive performance with their normal counterparts. The interest started declining gradually and by mid-70's, the excitement was overshadowed by disappointment and frustation. Many breeding programs abandoned work on QPM while others drastically reduced this research activity to a minimal level. CIMMYT has continued research work on QPM with the same pace over the years and the progress made so far is reported in this paper.

In 1970 CIMMYT initiated an intensive and large-scale research effort to breed for superior maize genotypes combining high-quality protein characteristics. In the beginning both opaque-2 and floury-2 genes were used, the latter however was dropped after it had been tried for some generations. To start with major emphasis was placed on converting normal maize genotypes from tropical, subtropical-temperate and highland areas to opaque-2 with soft and chalky endosperm. This type of activity was carried out in full swing for about five years and by this time two to three backcrosses had been achieved in several materials. The converted materials were tested nationally and internationally in replicated yield tests. Some of these materials performed reasonably well in different countries but in general suffered from several problems which varied in degree and magnitude in different areas around the world. The key problems which acted as the major obstacles in the promotion of these materials were: 1) Reduced grain yield of the order of 10-15%; 2) Unacceptable kernel appearance due to dull, soft and chalky endosperm; 3) Greater vulnerability to ear rot organisms; 4) More damage by weevils during storage; and 5) slower drying following physiological maturity of the grain. Problems confronting opaques have been known for a long time but unfortunately very little was done up until the early 70's to alleviate such problems. It was almost a decade after the work had begun that these problems were widely recognised and drew attention of the maize breeders.

Exploring new ideas and approaches

By early 1970's, enough information and experience had been accumulated on QPM both on research and production fronts. The breeders in many national programs and at CIMMYT found themselves in a state of dilemma. This unfortunate situation brought a turning point in the breeding effort to take a new hard look at the experience gathered in the past and to consider relevant future courses of action in developing acceptable types of quality protein maize genotypes. New thinking and several new ideas started emerging. New breeding approaches were initiated at research institutions having an interest in this kind of work. Of the approaches that seemed to have some promise, recurrent selection for high-lysine without involving quality protein mutants, increased germ size through selection and exploiting double mutant combinations of su_2o_2 and fl_2o_2 were tried at CIMMYT but unfortunately for various drawbacks, these approaches could not be used for further breeding work. The only approach which appeared encouraging and which could remedy several of the problems encountered in opaques involved the accumulation and exploitation of genetic modifiers of the opaque-2 locus. This has proven to be the most efficient, effective and viable breeding strategy.

Switch-Over in Breeding Strategy

Once the right breeding procedure was worked out, a complete switch-over to the new breeding strategy was quickly implemented. This strategy has been named as "Selection of genetic modifiers of the opaque-2 locus". This change in new strategy coincided with the reorganisation of maize germplasm management and improvement in the maize program in the year 1974. At this point, the genetic engineering of QPM types became a parallel and integral improvement effort of the total maize program. The new strategy involved the use of two genetic systems. A simple system involving the opaque-2 gene to improve the protein quality; and a more complex polygenically controlled system to remedy the undesirable side-effects of the opaque-2 system. The second system has been superimposed on the former to change the undesirable phenotypic effects of the opaque-2 gene in the desired direction.

Building-up Donor Stocks

The new strategy necessitated the development of donor stocks carrying the opaque-2 gene with modified phenotype. This was a challenging and indeed a difficult and tedious task. A careful search and selection process was initiated to look for variations for this trait in materials already converted to opaque-2 with soft phenotype. Though variation did exist, it required pyramiding several favorable genes to produce an altered phenotype almost indistinguishable from the normal maize. The selection process was started independently in several genetic backgrounds. Modified ears were selected and handled separately for some generations. During the selection of modified phenotype, a new problem unknown previously was identified. This posed a new challenge and slowed down the progress in the initial stages. In the selection process involving change of endosperm phenotype from soft to vitreous, an adverse effect was noticed in several genotypes on the quality of protein. Several exceptions, however, were observed in which the decline in protein quality was either slight or of no practical concern. The decline in protein quality emphasized the need that selection for accumulated changes in kernel modification and maintenance of protein quality had to be considered simultaneously in the selection process. Though variations for this trait had been observed as early as 1970, it took almost 3 years before suitable donor stocks carrying the opaque 2 gene with modified kernel characteristics could be developed.

Two basic approaches were adopted in the development of donor stocks. In the first approach, the modified ears were sorted out independently from several different genetic backgrounds and were handled separately for several generations either by selfing or by sibbing. This effort resulted in the production of QPM lines or families with different levels of inbreeding. At this point the white and yellow hard endosperm opaque-2 (H.E.o_2) lines and families were composited separately to give rise to two materials named as White H.E.o_2 and Yellow H.E.o_2 respectively. The second approach was used specifically only in those materials which had a fairly high frequency of modified phenotype opaque-2 ears. In these materials intra-population selection for genetic modifiers had to be practised for several generations to develop reasonbly acceptable H.E.o_2 materials. Two materials namely Composite K H.E.o_2 and Ver. 181-Ant. gro.2 x Venezuela-1o_2 were developed through this approach.

The materials resulting from the aforementioned approaches laid the foundation for further breeding and development of quality protein maize genotypes. It may, however, be pointed out that the development of donor stocks with desired modified phenotypes was a slow and disappointing process. Nevertheless, it was a timely genetic breakthrough. It set a new era of hope and optimism and led to a more intensified research effort towards the development of QPM that will have good productivity and market acceptability both from producer and consumer points of view.

Philosophy and research objectives in developing QPM

CIMMYT recognises that QPM materials must perform competitively with normal genotypes to generate the same calories with quality protein as a bonus. To accomplish the aforementioned objectives CIMMYT breeders have followed a conservative approach in at least accepting the initial boost in lysine content to be of sufficient magnitude. This was needed not to place any more major emphasis on further enhancing the level of lysine. Rather effort was made to maintain the protein quality at a level of 9-10% in the whole grain. This has greatly helped in placing major emphasis on breeding agronomically superior high yielding genotypes with major focus on remedying problems encountered in QPM materials.

Genetic Considerations in the manipulation of modifiers

The genetic modifiers are complex in their inheritance and are controlled by polygenic system. Genetically favorable modifiers can be accumulated through recurrent selection; however, it is important that during the process of accumulation the protein quality should be maintained. Also it is both important and desirable that the final product should have uniform and stable kernel appearance for market acceptance. It is, therefore necessary that as one is increasing the gene frequency of modifiers, one should start looking for stability of hard endosperm phenotypes at some point in the selection process.

Genetic modifiers and their role in overcoming problems confronting opaque-2 maize

Most of the problems encountered in opaques can be overcome through careful and systematic selection for hard endosperm opaques. However, it is important that a program of this nature should have facilities for rapid and reliable analyses of a large number of samples. Exploitation and accumulation of genetic modifiers can help change the soft chalky appearance of opaques to shiny, vitreous and translucent endosperm. The altered phenotype can tremendously increase the acceptability of QPM materials at least in areas where farmers prefer flint or dent maize. The modified phenotype will also help reduce the incidence of ear rots and the damage due to stored grain pests. The genetic modifiers may also increase the kernel weight and density in opaques. Through systematic effort it is possible to capitalize on this variation to narrow down the yield gap existing between opaques and normals.

Also, during the process of accumulation of genetic modifiers, several direct and indirect field criteria need to be used to improve the performance of QPM materials. Selection against dull modifiers and ears with open kernel rows has resulted in shiny, translucent kernels with better kernel weight in QPM materials. Popping or splitting tendency in QPM kernels is frequently encountered. Elimination of individual ears or sometimes even the whole family showing this character has helped to reduce the incidence of ear rots. Also, early harvesting of QPM materials enables selection of faster drying genotypes. This has helped to improve the rate of drying of opaque-2 kernels following physiological maturity of the grain.

Germplasm development and improvement

Since 1974, the development of QPM germplasm has continued to meet the germplasm needs for short-term and long-term objectives. The donor stocks developed earlier were used heavily in this developmental effort. The existing QPM germplasm in CIMMYT's maize program has been developed by the following two breeding approaches:

(i) Conversion process

The conversion process was initiated as early as 1974 and has continued to date. The conversion process includes materials from both the advanced and back-up stages of the program. These materials are tropical and subtropical-temperate in adaptation and belong to different maturity, color and texture groups. The conversion process involves a breeding procedure which is a combination of backcross and recurrent selection program. The scheme combines several advantages including 1) use of the improved version of recurrent parent in backcross program, 2) ease of handling materials in homozygous opaque-2 background, 3) fairly flexible in terms of time for making the ensuing backcross, 4) continuous improvement of stable modifiers and other characters, and 5) materials undergoing improvement can be used at any stage of the Conversion process.

In developing QPM materials during the conversion process, emphasis has been placed on all the important characters that will ultimately improve the performance of QPM materials with respect to yield, kernel appearance, stability of kernel modification, reduced ear rot incidence and ability to lose moisture quickly. The progress is evident from the fact that most of the converted materials have started looking like normals in kernel phenotype and have lower rating for kernel modification score on a rating scale of 1 to 5 (1-completely modified; 5-completely soft). Though kernel modification has reached an acceptable level, there is room for further improvement in these materials. In several materials that have undergone through this conversion process, phenotype of endosperm has improved. Plant height and ear height are as good as normals and in some cases even better than the normals. Ear rot incidence has reduced though some materials continue to show somewhat higher incidence. The QPM versions in some cases have become earlier than their normal counterparts as indicated by moisture content of the grain.

Through the use of conversion process, a wide array of QPM germplasm has been developed over the past six years. Merging process involving genetically similar materials has been initiated and will continue over the next few years to reduce the germplasm to a manageable level for more intensive research effort in the future.

Some of the QPM materials resulting from the conversion program have been tested world-wide. Their performance will be discussed in the following section of this report.

ii) Development and improvement of QPM gene pools

A total of four tropical and three subtropical-temperate QPM gene pools are being maintained and improved continuously by half-sib breeding procedure. These pools are broad-based in genetic constitution and have been formed specifically to accumulate modifiers from as many different genetic backgrounds as possible in an effort to remedy several undesirable attributes affecting QPM materials. In addition these QPM gene pools serve several important functions including 1) Excellent donor stocks to convert normal maize genotypes to QPM, 2) Extraction and introgression of superior fraction into appropriate advanced unit QPM populations for continuous improvement; 3) Source materials for improvement process in national programs; and 4) to provide new populations in CIMMYT's international maize delivery system.

These QPM gene pools are receiving major emphasis in accumulating more and more favourable alleles for altering and improving the kernel phenotype at every possible stage in the selection process without sacrificing protein quality. In addition several direct and indirect selection criteria have been used for improving resistance to ear rot incidence, foliar diseases, faster drying following physiological maturity, yield and other important agronomic characters.

Some QPM gene pools have undergone as many as 13 cycles of selection. Evaluation of different cycles in such pools has shown a linear trend in imporvement for several attributes in successive cycles of selection. The latest cycles are shorter in plant and ear height, earlier in maturity, lesser in ear rot incidence, and substantially improved in kernel modification of the grain. Within-ear variation for kernel modification has been reduced but needs additional cycles of selection for further improvement. The yield imporvement has been observed in some but not in others. The protein quality has either remained unchanged or has registered a slight decrease. Elite fractions have already been extracted from some gene pools.

Improvement and delivery of QPM populations in the advanced unit

Three quality protein maize populations namely population 39 (Yellow QPM), Population 40 (White QPM) and population 41 (Templado amarillo QPM) form part of the advanced unit. These populations are undergoing continuous improvement for agronomic and quality protein related traits. One cycle of selection is completed every other year. The intervening period between two cycles of selection is used for improving the traits considered most deficient in any given population using within family selection. Site specific and across location data are used in improving the population and for extracting the experimental varieties. The experimental varieties so developed are included in experimental variety trials for test performance in several countries. Some of the experimental varieties from these populations have given good performance. The results have been discussed in the following sections of this report.

Development and improvement of highland QPM materials

In the highland program the conversion of 4 floury and 3 non-floury gene pools is underway. Conversions of old pools were merged to develop equivalent QPM versions of the new 7 pools. In QPM versions of the four floury pools, the major emphasis has been placed on developing materials with large soft floury kernels with reduced ear rot incidence. At least two of the four pools have attained an acceptable kernel size. In three non-floury QPM versions, the major thrust has been placed on accumulation of modifiers to develop normal looking QPM materials. In developing these materials the breeding approach resembles that of tropical and temperate QPM materials. These materials have improved considerably in kernel modification and agronomic performance yet additional cycles of selection are needed to further improve upon their performance in kernel modification and stability.

Distribution and performance of QPM materials

QPM materials resulting from different breeding approaches have been made available to several country programs in the form of bulk samples and also through a network of international progeny and experimental variety trials. During the year 1980, 63 sets of EVT 15-A, 31 sets of EVT 15B and 57 sets of ELVT-19 were sent to countries of South America, Central America, Caribbean islands, Mexico, Africa and Asia. The results of previous years and the preliminary results of 1980 indicate the following:

The QPM materials in many countries appear to be shorter and earlier than the normal check entries included in the trials. In 50-60% of the countries reporting the data, the QPM materials have given yield performance similar to the best normal check entries included in the trials. The entries which have given good performance, in general, are Tuxpeño-1 QPM, Late White Dent QPM, White QPM, La Posta QPM, Yellow QPM, Blanco Cristalino QPM, Temp. x Tropical QPM, Temperate White QPM and Amarillo Bajio x Maices Argentina QPM.

Experimental varieties derived from some of the populations have also given very good performance. From population 40, Across 7740, Obregon 7740, Guanacaste 7940 and Ferke 7940 have been the best performers across several locations. In population 41, Across 7741 and Chuquisaca 7741 have performed very well.

Future research needs and outlook of QPM materials

For the last 2-3 years, a beginning has been made to explore new and innovating ideas to meet future research needs and challenges. Several new approaches including identification of simply inherited modifiers; efficient and effective methods of isolating and accumulating genetic modifiers for improved kernel weight and yield, introduction of dominant gametophytic factor to provide genetic isolation of opaques from normals, artificial ear rot inocculation for increased ear rot resistance, and some exploratory research on increased oil-content of the maize grain will receive some emphasis in the future.

A wide array of QPM germplasm has been developed over the past 8 years. Merging of genetically similar QPM materials has already been initiated and will continue over the next cycle to reduce the germplasm to a manageable level. Additional QPM populations will be added to the advanced unit. The appropriate QPM gene pools will be formed to support the on going improvement process in the advanced unit QPM populations.

As the problems encountering QPM materials have been solved to a great extent, the future outlook of QPM has considerably improved. The genetic breakthrough in developing acceptable type of QPM is hoped to spark a new challenge and excitement in this area over the next few years.

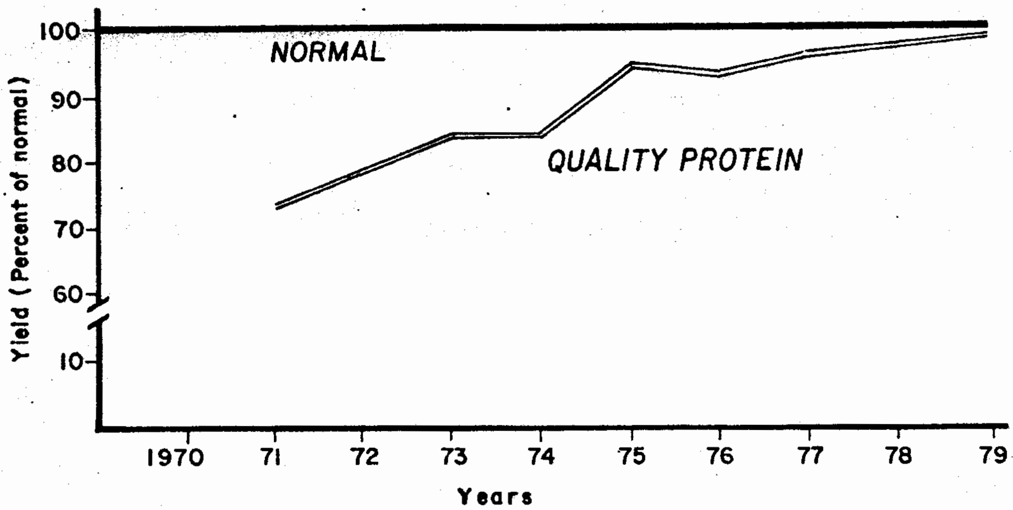


Fig. 5. Grain yield of superior quality protein maize expressed as a percentage of normal maize check in different years across all test locations

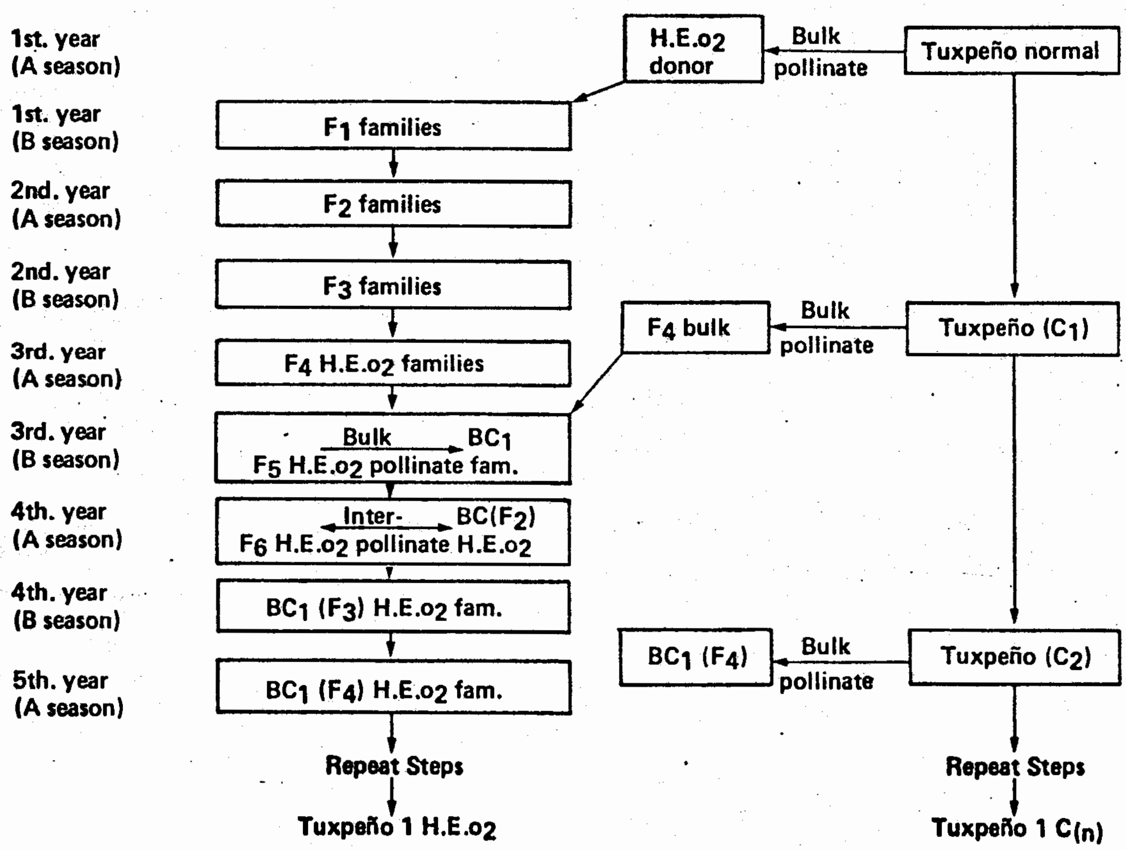


Fig. 6. Backcrossing-cum-recurrent selection scheme for obtaining quality protein maize versions of normal populations undergoing improvement

Table 14.

Comparison of grain yield in normals and QPM versions in the same genetic background.

Material	% of Normal (Across years and locations data)*
Tuxpeño-1	99.3
Blanco Cristalino	86.8
Mex. 1 - Col. gpo. 1 x Eto	93.3
Mezcla Amarilla	97.0
Tuxpeño Caribe	92.2
Ant. x Rep. Dom.	95.2
Pool 23	91.4

* = 2 years and 3 locations

Table 15.

Comparison between normals and QPM versions for various agronomic characters. (Data across 10 populations).

Character	Normal	QPM
50% Silking (Days)	62	61
Plant height (cm)	216	217
Ear height (cm)	118	117
Ear rots (%)	1.9	2.7
Moisture (%)	29.3	29.3

Table 16. Endosperm Hardness Ratings of different cycles of Selection in Six QPM Back-Up pools*.

QPM Pool	CYCLES			
	C_0	C_4	C_8	C_{11}
White QPM Back-Up pool (Flint)	4.9	3.0	2.5	1.3
White QPM Back-Up pool (Dent)	4.7	3.1	2.3	1.8
Yellow QPM Back-Up (Flint)	4.1	3.3	2.3	1.8
Yellow QPM Back-Up pool (Dent)	4.0	3.2	2.3	2.0
Temp. x Trop. QPM (Yellow Flint)	4.2	3.1	2.3	1.5**
Temp. x Trop. QPM (Yellow Dent)	4.4	3.1	2.3	2.0**

* = Average of 2 locations data

** = C_{12}

Endosperm Hardness Rated on a Scale of 1-5

1=Completely vitreous

5=Completely soft.

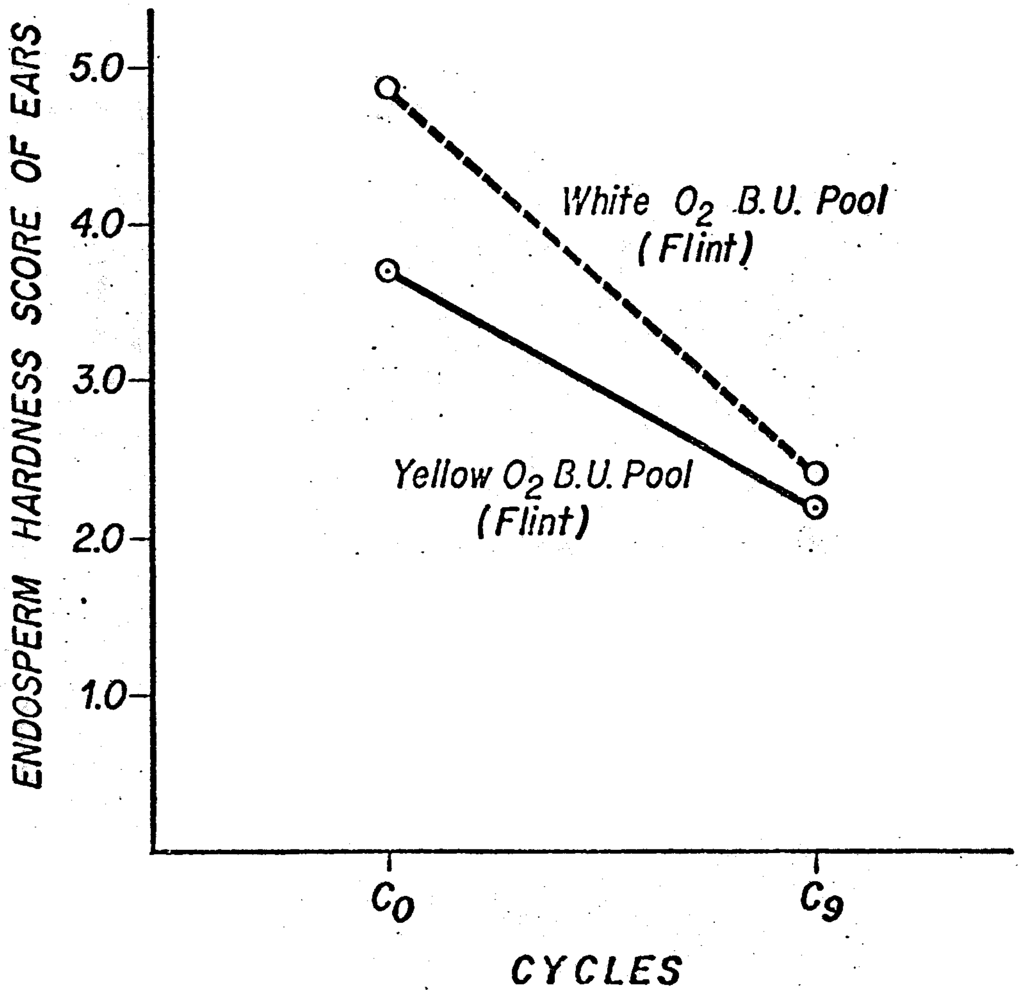


Figure 7. Endosperm Hardness Score of Cycles of Selection in Two Quality Protein Maize Pools

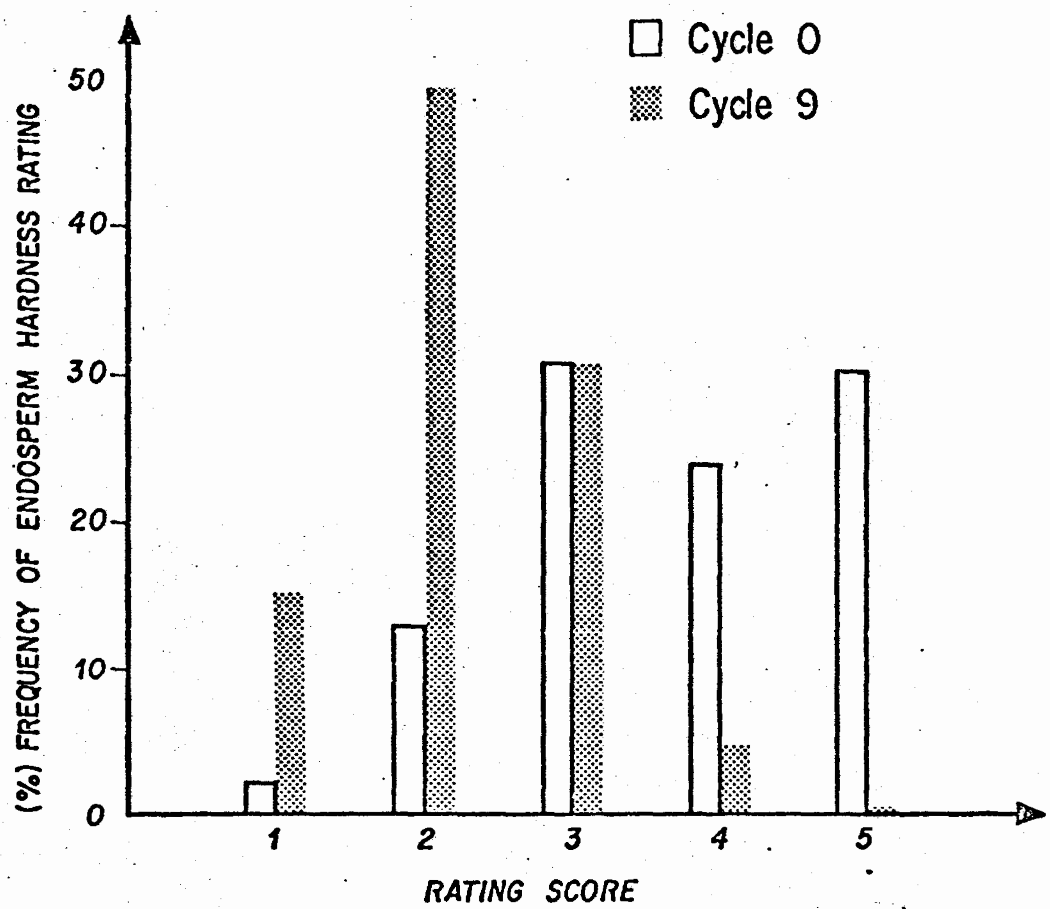


Figure 8. Frequency Distribution of Endosperm Hardness of Opaque-2 Kernels Classified from Cycles 0 and 9 of White Opaque-2 Back-up Pool (Flint).

Table 17. Comparison of best QPM Experimental Varieties to the best Normal Check in EVT 15 (1978-1979)

Country	Location	Best EV	Year	Yield (t/ha)	Yield as % of best check	Days to silking compared to best check
Costa Rica	Alajuela	TL 7740	1978	5.6	112	-3
Panama	Tocumen	Ilonga 7740	1979	4.4	105	-1
"	Rio Hato	Across 7740	"	3.8	105	0
Haiti	Levy	Laguna 7740	"	3.0	110	-1
"	"	PR 7839	"	3.0	107	-2
Bolivia	Abapo-Izozog	TL 7740	1978	4.9	125	+1
"	" "	Tocumen 7639	"	4.9	106	-1
"	Chuquisaca	Gemeiza (1) 7741	"	4.9	106	-4
"	"	Tocumen 7639	"	2.1	162	+2
Brazil	Sao Paulo	Ilonga 7740	1979	5.5	107	-1
"	"	Across 7740	"	5.5	103	+1
Peru	Satipo	Across 7740	"	4.4	105	-3
Egypt	Sids	PR 7738	1978	4.6	104	-3
Senegal	Sefa	OB 7738	1978	3.4	127	+2
"	"	TL 7740	"	3.4	123	+6
"	"	TL 7741	"	3.4	110	+2
Sierra Leone	Rokupr	Ilonga 7740	1979	2.0	134	+4
" "	"	Suwan 7738	"	2.0	130	0
" "	"	PR 7839	"	2.0	116	+4
Zaire	Gandajika	OB 7740	1978	7.5	101	-3
Burma	Yazin	Tocumen 7639	"	3.4	127	-4
"	"	Khumaltar 7741	"	3.4	121	-5
"	"	OB 7740	"	3.4	112	-2
Pakistan	Pirsabak	Tocumen 7739	1978	3.6	120	+2
"	"	OB 7740	"	3.6	119	+3
"	"	TL (E) 7741	"	3.6	111	+2
Philippines	Karaan	Satipo (2) 7639	"	1.9	161	+1
"	"	TL 7740	"	1.9	144	+1

(con't)

Performance of best QPM Experimental Varieties in comparison to the best check performance of EVT-15 (1978-1979).

Country	Location	Best EV	Year	Yield (t/ha)	Yield as % of best check	Days to silking compared to best check
Philippines	Karaan	OB 7738	1978	1.9	122	-2
"	"	TL (E) 7741	"	1.9	110	-2
Nepal	Rampur	Laguna 7740	1979	6.2	120	+1
"	"	PR 7839	"	6.2	105	0

Table 18. RESULTS OF EVT 15 A-1980

Country	Site	Best Normal Check	Yield Tons/ha	Best EV's	Yield % of best Check	Dif. in DS* from best Check
Brazil	Sete Lagoas	CMS-95	6.9	Ferke 7940 (1)	113	-1
				Guanacaste 7940	107	0
				Ferke 7940	105	-1
	Guaira	ESALQ-VD$_{2}$-o_2	4.6	Poza Rica 7940	139	-6
				Across 7740	130	-6
				Guanacaste 7940	128	-8
Panama	Rio Hato	Tocumen 7428	5.3	Ferke 7940	93	-1
				Guanacaste 7940	91	-2
Venezuela	Durigua	Local	3.1	Across 7740	127	0
				Poza Rica 7940	127	0
				Ferke 7940	123	0
				Guanacaste 7940	122	0
Ecuador	Pichilingue	Pichilingue 504	5.6	Poza Rica 7940	107	-3
				Ferke 7940	106	-1
				Guanacaste 7940	103	-2
Mali	Sotura	IRAT-85	3.9	Guanacaste 7940	127	-5
				Poza Rica 7938	127	-7
				San Jeronimo 7738	119	-6
Ivory Coast	Ferkessedougou	IRAT-81	5.8	Ferke 7940	92	-6
				Poza Rica 7940	91	-6
				Guanacaste 7940	87	-6
Ghana	Kwadaso	Opaque-2 Comp.	3.7	Poza Rica 7940	111	-5
				Across 7740	110	-4
Mexico	Obregon	H-510	7.1	Ferke 7940	96	-7
				Guanacaste 7940	94	-8
				Across 7740	94	-5
Senegal	Nioro	HVD-1	1.5	Ferke 7940 (1)	100	-2
	Sefa	HVB-1	2.5	Guanacaste 7940	85	+1
Mozambique	Umbeluzi	PR. 7740 o_2	2.3	Ferke 7940 (1)	138	0
				Guanacaste 7940	132	0
Malawi	Bunmbwe	Local	7.5	La Posta QPM	78	-3
				Guanacaste 7940	78	-3
Sierra Leone	Rokupr	Local	1.2	San Jeronimo 7738	114	-2
				La Posta QPM	107	-2
				Across 7740	97	-1
Bangladesh	Jessore	J_1	9.2	Guanacaste 7940	108	-1
				La Posta QPM	103	-2
				Ferke 7940	103	+1
Zaire	Kaniama	Kasai-1	6.9	Obregon 7940	101	0
				Ferke 7940	97	+2
				Poza Rica 7940	95	+1
Saudi Arabia	Gassim	Local	4.4	Guanacaste 7940	76	+7
Nepal	Rampur	White Flint H.E.o_2	8.0	Poza Rica 7940	110	+2
				Guanacaste 7940	107	+1

* DS - Days to 50% silking

Table 19. RESULTS OF EVT 15A-1980 (EAR ROT DATA)

Country	Site	Best Normal Name	% Ear Rot	Best QPM Name	% Ear Rot
Brazil	Sete Lagoas	CMS-05	3.6	Ferke 7940	7.6
				Guanacaste 7940	1.6
	Guaira	AG-305 B	1.5	Poza Rica 7940	3.3
Panama	Rio Hato	Tocumen 7428	2.2	Ferke 7940	7.6
Venezuela	Durigua	Local	4.4	Across 7740	14.0
		Local	22.0	Poza Rica 7940	11.4
Ecuador	Pichilingue	Pichilingue 504	2.6	Poza Rica 7940	5.1
		INIAP 526	5.5	Ferke 7940	8.4
Ivory Coast	Ferkessedougou	IRAT-81	1.0	Ferke 7940	0.0
Ghana	Kwadaso	Comp. W	1.1	Poza Rica 7940	3.4
				Across 7740	2.9
Mexico	Obregon	H-510	0.6	Ferke 7940	0.6
Senegal	Nioro	HVD-1	0.9	Ferke 7940	5.0
				Yellow o_2 B.U. Pool	2.7
Mozambique	Umbeluzi	SR-52	3.2	Ferke 7940	1.2
				Guanacaste 7940	2.0
Malawi	Bunmbwe	Local	2.6	La Posta QPM	8.3
				Guanacaste	9.7
Zaire	Kaniama	Kasai-1	2.1	Obregon 7940	5.5
		Solong-2	5.9	Ferke 7940	8.1
Nepal	Rampur	Rampur Comp.	2.4	Poza Rica 7940	2.2

Table 20. RESULTS OF ELVT - 19 - 1979

Country	Location	Best Check (Normal)	Tons/ha	Best EV's	Yield % best check
Mexico	Poza Rica	V 524	4.4	Tuxpeño QPM	100
	Cotaxtla	SM-Cot. 20*	5.4	Tlaltizapan 7740	104
				Tuxpeño-1 QPM	92
	Nayarit	H 507	2.3	Tuxpeño QPM	130
				Obregon 7740	111
Panama	Tocumen	UNP-2	3.4	Tuxpeño QPM	106
				Satipo (2) 7639	103
				Obregon 7740	102
	Rio Hato	UNP-1	4.1	Obregon 7740	103
Bolivia	Chuquisaca	Comp. 101	4.5	Ferke (1) 7539	146
				La Maquina 7540	121
Surinam	Tigerkreek	Pichilingue 7429	5.6	Poza Rica (E) 7537	108
Ecuador	Pichilingue	INIAP-526	6.0	Tlaltizpan 7740	86
Peru	Satipo (1)	PMC-747	3.7	Tuxpeño QPM	133
				Tlaltizapan 7740	120
				Satipo (2) 7639	116
Ivory Coast	Bouake	IRAT-81	5.7	Obregon 7740	89
				Poza Rica (E) 7737	92
	Ferke	IRAT-81	6.2	Obregon 7740	93
Malawi	Ngabu	R-201	2.2	Poza Rica (E) 7737	139
Zaire	Kisanga	Kasai-1	7.1	Tlaltizapan 7740	101
	Nicoro	AC_1 x B_1	4.7	Obregon 7740	81
	Sefa	BDS 111	3.6	Obregon 7740	99
				Satipo (2) 7639	97
Pakistan	Pirsabak	Sarhad-y	3.9	Suwan 7539	110
				Obregon 7740	106
Thailand	Suwan	Suwan-1	6.8	Poza Rica (E) 7737	84
Burma	Yezin	TKS-1	1.1	Tlaltizapan (E) 7741	173
				Obregon 7740	160
Somalia	Afgai	Local Var.	5.0	Tuxpeño-1 QPM	96
Nepal	Rampur	Local Var.	7.7	Poza Rica (E) 7737	94
Saudi Arabia	Hofuf	Local Var.	5.9	Tuxpeño-1 QPM	97
Jamaica	Bodles	X-304 A	5.1	Cotaxtla (2) 7537	70

Table 21. RESULTS OF ELVT 19- 1980

Country	Site	Best Normal Check	Yield Tons/ha	Best EV's	Yield% of best Check	Dif.DS* from best Check
Costa Rica	Alajuela	B-666	6.7	Blanco Crist. QPM	97	-9
				Ilonga 7740	95	-4
				White QPM	94	-8
Venezuela	Acariagua	H. Obregon	2.9	Across 7740	136	-2
				Tuxpeño Caribe QPM	135	-3
				Ilonga 7740	120	-3
Ecuador	Pichilingue	INIAP-526	6.3	Across 7740	98	-3
				White QPM	97	-4
				Ilonga 7740	96	-3
Bolivia	Santa Cruz	Suwan-1	7.7	Across 7740	100	+2
				Mez. Trop. Bl. QPM	100	+2
				Tuxp. Caribe QPM	98	+2
				Laguna 7740	98	+3
				White QPM	97	+1
Mexico	Los Mochis	NL H5	6.0	Ilonga 7740	100	+1
				White QPM	99	+5
				Across 7740	97	+3
Mexico	La Huerta	Local Var.	3.7	Across 7740	133	-6
				White QPM	123	-2
				Mez. Trop. Bl. QPM	115	-7
Ivory Coast	Ferkessedougou	IRAT-81	6.1	Mez. Trop. Bl. QPM	78	-4
	Bouake	Poza Rica 7429	4.6	La Posta QPM	114	-3
				Late White Dent QPM	97	-1
				Across 7740	96	-2
Egypt	Sakha	Comp. 5	8.7	La Posta QPM	88	+1
				White QPM	85	-1
Mexico	Obregon	H 452	8.2	Across 7740	87	-4
				Laguna 7740	82	-5
				White QPM	77	-7
Swaziland	Malkerns	SR-52	6.3	White QPM	69	0
				Across 7740	68	0
Mozambique	Lioma	SR-52	8.0	Mez.Trop. Bl. QPM	77	-3
				White QPM	75	-4
Malawi	Ngabu	PNR-95	3.9	Across 7740	106	+2
				White QPM	94	0
Senegal	Sefa	Local	2.5	Across 7738	79	-2
	Nioro	Local	1.8	Across 7738	88	-1
				Bl. Cristalino QPM	86	-3
				Across 7740	86	+1

DS - Days to 50% silking

Table 22. Comparison of best QPM Materials to the best Normal Check in in OMPT 11, OMPT 11A and OMPT 11B (1978-2979)

Country	Location	Best QPM material	Year	Yield t/ha	Yield as % of best check	Days to silk as compared to best check
Panama	Rio Hato	Late white dent HEo_2	1978	4.2	100	-1
"	Guarape	White HEo_2	"	2.9	109	-4
El Salvador	San Andres	Tuxpeño Caribe HEo_2	"	3.3	117	-5
Costa Rica	Guanacaste	Late white dent HEo_2	"	1.5	102	-1
Dom. Rep.	San Cristobal	Ant.xVer. 181 HEo_2	"	3.1	110	+2
Nigeria	Ibadan	Eto blanco HEo_2	"	6.2	104	-3
Jamaica	Grove Place	White B.U. Pool HEo_2	"	3.0	117	-
Pakistan	Yousafwala	Mez. Trop. Bl. HEo_2	"	3.8	149	0
Nepal	Rampur	White HEo_2	"	4.1	114	+1
Bolivia	Sta. Cruz	La Posta HEo_2	"	5.3	105	-2
Brazil	Sete Lagoas	La Posta HEo_2	"	5.1	107	-6
Panama	Tocumen	White flint HEo_2	1979*	4.5	104	-3
Guatemala	San Jeronimo	Late white dent HEo_2	"	7.6	113	-3
Costa Rica	Alajuela	White HEo_2 B.U. Pool	"	2.9	103	-6
Ibadan	Nigeria	" " "	"	3.4	112	-1
Pakistan	Yousafwala	Mez. Amarilla HEo_2	"	4.0	146	+1
Nepal	Rampur	White o_2 B.U. Pool	"	6.2	113	-2
Mexico	Obregon	Chuquisaca 7741	1979**	3.6	101	-4
Pakistan	Swat	" "	"	4.5	161	+3
"	Pirsabak	Gemeiza 7741	"	3.5	156	+8
Brazil	Londrina	Chuquisaca 7741	"	5.1	104	-7
Nepal	Rampur	Across 7741	"	6.4	110	0
Ecuador	Pichilingue	Chuquisaca 7741	"	1.9	150	-6
Argentina	Leales	Temp. White HE.o_2	"	5.7	108	-7

1979* = OMPT = 11A

1979** = OMPT = 11B

Table 23. Results of OMPT-11B - 1979 (Yield data across 9 locations)

Material	Grain Yield Kg/ha	Rank
Chuquisaca 7741	4890	1
Temperate White QPM	4606	2
Across 7741	4604	3
Am. Bajio x Maices Arg. QPM	4559	4
Temperate x tropical QPM (Flint)	4537	5
Temperate x tropical QPM (Dent)	4471	6
Gemeiza 7741	4446	7
Amarillo Bajio QPM	4371	8
Am. Bajio x Mezcla tropical QPM	4353	9
Amarillo subtropical QPM	4349	10
Pool 34 QPM	4292	11

Table 24. Comparison between best Normal and best QPM in different countries

Country	Location	% of Normal
Mexico	Obregon	101
Mexico	Tlaltizapan	87
Pakistan	Swat	161
Pakistan	Pirsabak	156
Brazil	Londrina	104
Nepal	Rampur	110
Ecuador	Pichilingue	150
Argentina	Leales	108

Table 25. CIMMYT's QPM Gene Pools

1. Tropical White Flint QPM Pool: White H.E.o_2 composite, QPM versions of Tuxpeño-1, Mezcla tropical blanca, Blanco Cristalino, Tuxpeño-Caribe, Eto, La Posta, Pool 19, Pool 20, Pool 23, Pool 24, Mix. 1-Col. gpo. 1 x Eto, Lineas El Salvador, Tropical Late White dent.

2. Tropical White Dent QPM Pool: White H.E.o_2 composite, QPM versions of Tuxpeño-1, Mezcla tropical blanca, Blanco Cristalino, Tuxpeño-Caribe, Eto, La Posta, Pool 19, Pool 20, Pool 23, Pool 24, Mix. 1-Col. gpo. 1 x Eto, Lineas El Salvador, Tropical Late White Dent.

3. Tropical Yellow Flint QPM Pool: Yellow H.E.o_2 composite, PD(MS)6 QPM, Composite K QPM, Ver. 181-Ant.gpo. 2 x Ver. 1 opaco-2, CIMMYT QPM, QPM versions of Thai composite# 1, Amarillo cristalino, Amarillo dentado, Mezcla amarilla, Ant. x Ver. 181, Pool 21, Pool 22, Pool 25, Pool 26, Selección precoz, Ant. x Rep. Dominicana, Serie Crist., Yellow flint H.E.o_2, Tropical yellow flint dent, and yellow QPM segregates from pool 23.

4. Tropical Yellow Dent QPM Pool: Yellow H.E.o_2 composite, PD (MS)6 QPM, Composite K QPM, Ver. 181-Ant. gpo. 2 x Ver. 1 opaco-2, CIMMYT QPM, QPM versions of Thai composite # 1, Amarillo cristalino, Amarillo dentado Mezcla amarilla, Ant. x Ver. 181, Pool 21, Pool 22, Pool 25, Pool 26, Selección precoz, Ant. x Rep. Dominicana, Serie Crist., Yellow flint H.E.o_2, tropical yellow flint dent, and yellow QPM segregates from pool 23.

5. Temperate x Tropical QPM (Flint): PD (MS)6 QPM, CIMMYT QPM, Mat. o_2 composite, composite K QPM, Composite opaco-2 Argentina, QPM versions of Eto x Illinois, Tuxpeño x Lin. ILL., Amarillo Bajio, Mezcla amarilla x Lin. Ill., Amarillo Bajio x Varios templados, Kansas Synthetic, Hung. 660, Corn Belt composite, T_1, T_2, T_3, Yugoslavian materials, Pool 34 and Yellow QPM segregates from pool 32.

6. Temperate x Tropical QPM (Dent): PD(MS)6 QPM, CIMMYT QPM, Mat. o_2 composite, Composite K QPM, Compuesto opaco-2 Argentina, QPM versions of Eto x Illinois, Tuxpeño x Lin. Ill., Amarillo bajío, Mezcla amarilla x Lin. Ill., Amarillo bajio x Varios templados, Kansas synthetic, Hung. 660,

(con't)

Corn Belt composite, T_1, T_2, T_3, Yugoslavian materials, pool 34 and Yellow QPM segregates from pool 32.

7. Temperate White QPM: White QPM segregates from Amarillo subtropical, Eto x Illinois, Amarillo bajío, Amarillo Bajio x Maices Argentina, Amarillo Bajio x Mezcla tropical blanca, Amarillo Bajio x P.D.M.G., Amarillo Pakistan, Blanco Pakistan, Mezcla Amarilla P.B. x Lin. Ill., Pool 27, Pool 31, Pool 32 and White segregates from Temperate x tropical QPM and Pool 34.

Table 26. Population 39 - Yellow QPM

Components: Composite K QPM, Ver. 181, Ant. gpo. 2 x Ver. 1 QPM, QPM, Yellow QPM, Kisan QPM, Puerto Rico Gpo. 1 QPM, Comp. L (MC) QPM, PD(MS)6 QPM, Tuxpeño 1 QPM, Eto blanco QPM, Tuxp. -Ant. gpo. 2 QPM, Tuxp.-Cubano, White flint QPM Pool, Yellow flint QPM pool, Yellow QPM segregates from Mezcla tropical blanca, Blanco Cristalino, Ant. x Ver. 181, Mix. 1-Col. gpo. 1 x Eto, Amarillo cristalino, Amarillo dentado, Tuxpeño Caribe and La Posta.

Description: Suitable for lowland tropical and subtropical areas. Intermediate in maturity and plant height. A broad genetic base population with protein content of 9.4% in the whole grain. It has 0.8% tryptophane and 4.7% lysine in protein in the whole grain. It has good yield potential and is tolerant to common foliar diseases.

Countries where progeny tests have been conducted:

1977 Mexico (Obregon), Mexico (Poza Rica), Mexico (Tlaltizapan)

1978 Mexico (Poza Rica), Mexico (INIA), Bolivia (Chiquisaca), Peru (Satipo), Ivory Coast, Philippines.

1980 Mexico (Poza Rica), Guatemala (San Jeronimo), Panama (Tocumen), Ivory Coast (Ferkessedougou), Ecuador. Honduras.

Population 40 - White QPM

Components: QPM versions of Tuxpeño-1, Mezcla tropical blanca, Blanco cristalino, Tuxpeño Caribe, Mix. 1-Col. gpo. 1 x Eto, La Posta, Eto blanco, Pool 19, Pool 20, Pool 23, Pool 24, Late white dent, and white H.E.o_2 composite.

Description: Lowland tropical and subtropical in adaptation, white semi-flint grain, intermediate in maturity and plant height. A broad genetic base population with a protein content of 9.5% in the whole grain. It has 0.98% tryptophane and 3.8% lysine in protein in the whole grain. Has given good performance in West Africa, Mexican lowlands and parts of Central America.

Countries where progeny tests have been conducted

1977 Mexico (Obregon), Mexico (Poza Rica), Mexico (Tlaltizapan), Ivory Coast (Costa de Marfil), Tanzania (Ilonga), Philippines (Laguna).

1979 Mexico (Poza Rica), Mexico (Obregon), Costa Rica (Guanacaste), Ivory Coast (Ferkessedougou), Honduras Nicaragua

1981 Mexico (Poza Rica), Guatemala, Honduras, Nigeria, Ghana, Philippines.

Population 41 - Templado Amarillo QPM

Components: PD(MS) QPM, CIMMYT QPM, Mat. Composite QPM, Composite K QPM, Comp. Argentina Opaco-2, QPM versions of Eto x Illinois, Tuxpeño x Illinois, Amarillo Bajio, Kansas synthetic, Corn Belt composite, Hungarian 660, Mezcla Amarilla x Lin. Ill., Amarillo Bajio x Varios templados, Pool 32, Pool 34, and Yugoslavian materials.

Description: It has 30-40% temperate germplasm and 60-70% tropical germplasm. Good yield potential, medium plant height and late to intermediate in maturity. Carries excellent modifiers of opaque-2 locus for kernel modification, and has almost double normal levels of lysine and tryptophane in protein in the whole grain. Suitable for subtropical-temperate regions of Nepal, India, Pakistan, Central America, Mexico and South America.

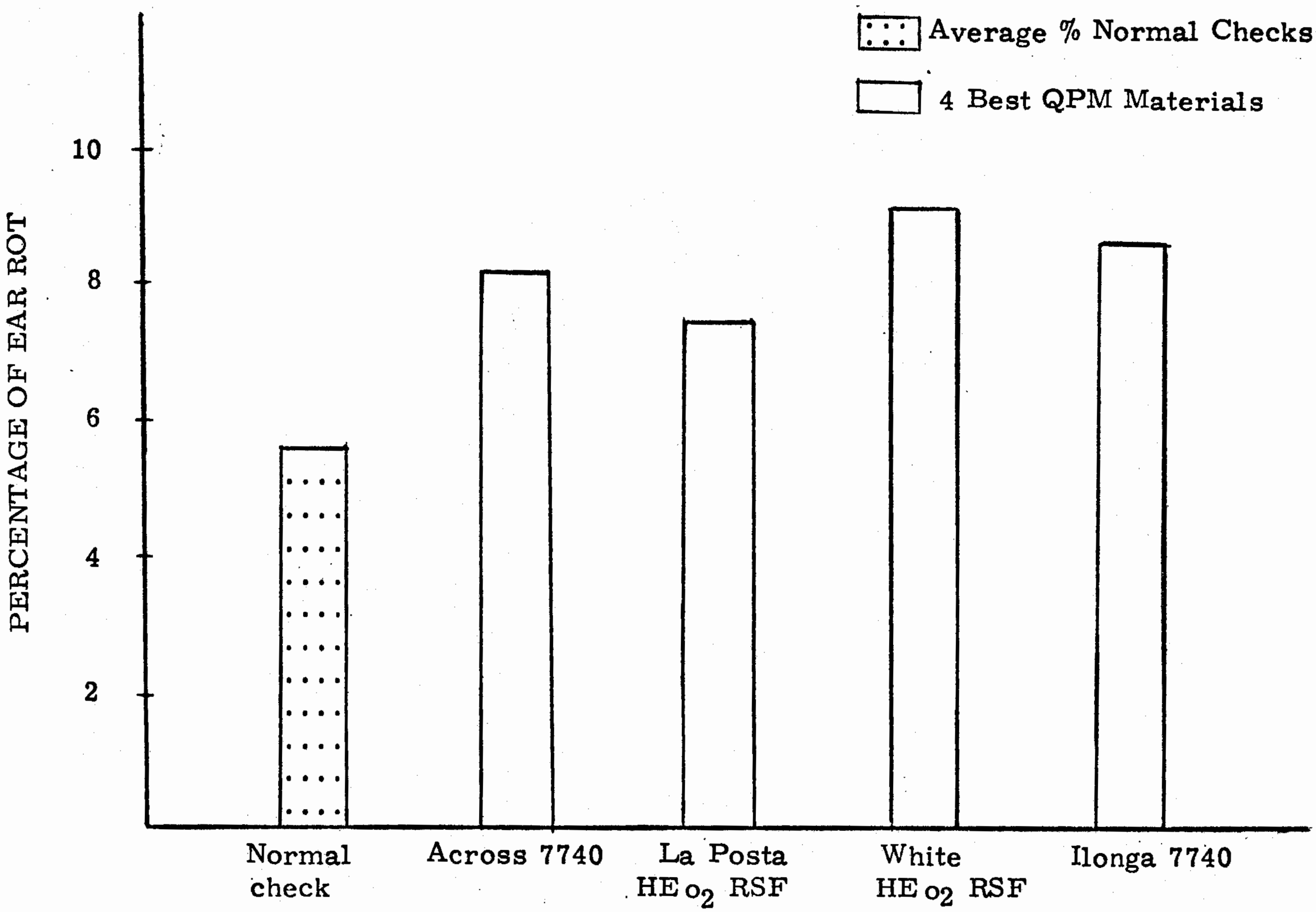
Countries where progeny tests have been conducted

1977 Mexico (Tlaltizapan), Egypt (Gemiza), Nepal (Khumaltar), India, (Pantnagar), Bolivia (Chuquisaca), Colombia.

1979 Mexico (Tlatizapan), Mexico (Obregon), Brazil (Piracicaba), Chile (La Platina), Guatemala (San Jeronimo), Thailand (Suwan).

1981 Bolivia, Mexico (Tlaltizapan), India, Pakistan, Turkey.

Figure 9. AVERAGE EAR ROT (%) OF NORMAL CHECKS AND FOUR BEST QPM MATERIALS IN ELVT 19 OVER 22 LOCATIONS, 1980



INTERNATIONAL TESTING TRIALS

CIMMYT's maize program is designed to (1) serve national programs that are at different levels of development, and (2) to combine into one mechanism a system for continuous improvement of maize germplasm as well as a delivery system to and from national programs. A key feature in this system is the partnership role that national program scientists play in the improvement of maize populations and the development of superior experimental varieties.

The purpose of the international testing program is to identify improved materials for the areas where they are meant to serve.

These stages include:

(1) International Progeny Testing Trials (IPTT)

The data and/or progeny selection requests from these trials are used for the development of superior experimental varieties (EVs) from selected progenies. Due to the limited quantity of seed of each progeny, six sets of IPTTs from each Advanced Unit population are planted at 6 different countries.

(2) International Experimental Variety Trials (EV) and Quality Protein Maize Trials (QPMT)

The experimental varieties are next put into EVTs and QPMTs. The grouping of varieties into different trials depends upon the requirements for different agroclimatic zones, maturity, grain color and texture. The quality protein maize materials are assembled separately into QPMTs.

Since seed quantity is not a limiting factor with the EVs and QPMs, these trials go to many countries on the basis of requests received.

International Elite Variety Trials (ELVTs)

The data from EVTs and QPMTs are next used for an across-location analysis. Those EVs and QPMs showing wide adaptation, good and stable performance for yield and other desirable attributes are selected and put into different ELVTs, again keeping in view the requirements for agroclimatic zones, and maturity.

The details of trials sent and cooperating countries are given in the following tables.

INTERNATIONAL PROGENY TESTING TRIALS (IPTT, 1982)
(ENSAYOS INTERNACIONALES DE PROGENIES (IPTT), 1982)

Trial No. (Ensayo No.)		22	23	24	27	32	33	35	43	44	45	47	48	Total
Country (País)														
	South America													
1.	Bolivia	-	-	-	-	-	1	-	-	-	1	-	-	2
2.	Brazil	-	-	1	1	-	1	1	-	-	1	1	1	7
3.	Chile	-	-	-	-	-	-	-	-	-	-	-	1	1
4.	Colombia	-	1	-	-	-	-	-	-	-	-	-	-	1
5.	Ecuador	-	-	1	1	-	-	-	-	-	-	-	-	2
6.	Peru	-	-	1	-	-	-	1	-	-	-	-	-	2
7.	Venezuela	1	-	-	-	1	-	-	-	-	-	-	-	2
	Central America													
8.	Costa Rica	1	-	-	1	-	-	-	-	-	-	-	-	2
9.	El Salvador	-	1	-	1	-	-	-	-	-	-	-	-	2
10.	Guatemala	-	1	-	-	1	-	-	-	-	-	1	-	3
11.	Honduras	-	1	-	-	-	-	-	1	-	-	-	-	2
12.	Nicaragua	-	-	1	-	1	-	-	1	-	-	-	-	3
13.	Panama	-	-	-	-	-	-	1	-	-	-	-	-	1
14.	Rep. Dominicana	-	-	-	-	-	-	-	-	-	-	-	-	0
15.	México	-	1	1	1	1	1	1	-	1	1	1	1	10
	Africa													
16.	Egypt	-	-	-	-	1	-	-	-	1	1	-	-	3
17.	Cameroun	-	-	-	-	-	-	-	1	-	-	-	-	1
18.	Ghana	-	-	-	-	-	-	-	-	-	-	-	-	0
19.	Ivory Coast	-	-	-	-	-	-	1	1	-	-	-	-	2
20.	Kenya	-	-	-	-	-	-	-	-	1	-	-	-	1
21.	Malawi	-	-	-	-	-	-	-	-	1	-	-	-	1
22.	Nigeria	-	1	-	-	-	-	-	1	-	-	-	-	2
23.	Rep. of South Africa	-	-	-	-	-	1	-	-	-	-	1	-	2
24.	Tanzania	-	-	-	-	-	-	-	-	-	-	-	-	0
25.	Zaire	-	-	-	-	-	-	-	-	-	-	-	-	0
26.	Zimbabwe	1	-	-	-	-	-	-	-	1	-	-	-	2
	Asia													
27.	India	1	-	-	1	1	-	-	-	1	1	1	1	7
28.	Indonesia	-	-	-	-	-	-	1	-	-	-	-	-	1
29.	Nepal	-	-	-	-	-	1	-	-	-	-	1	-	2
30.	Pakistan	-	-	-	-	-	-	-	-	-	1	-	1	2
31.	Philippines	1	-	-	-	-	-	-	1	-	-	-	-	2
32.	Thailand	1	-	1	-	-	-	-	-	-	-	-	-	2
33.	Turkey	-		-	-	-	1	-	-	-	-	-	1	2
	Total	6	6	6	6	6	6	6	6	6	6	6	6	72

QPMT 11 B: QUALITY PROTEIN MAIZE TRIAL, 1982.
(ENSAYO DE CALIDAD DE PROTEINA DE MAIZ, 1982)
TRIAL WITH SUBTROPICAL -TEMPERATE QPM MATERIALS.
(ENSAYOS CON MATERIALES SUBTROPICALES -TEMPLADOS QPM)

Exp. Design: RBD
(Diseño Exp.: RBD)

Trial No. (Ensayo No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición)			
					1	2	3	4
1.	Piracicaba 7941	Brazil	Templado Amarillo QPM	TL 81A-1079	5	17	31	35
2.	La Platina 7941	Chile	" " "	TL 81A-1080	6	21	24	42
3.	Across 7941	Across Locations (A traves de Locs.)	" " "	TL 81A-1081	3	16	30	37
4.	ETO x Illinois QPM (RSF)	Mexico	- - - - - - - - - - - -	TL 81B-1828	7	13	28	43
5.	Pool 31 QPM (RSF)	Mexico	- - - - - - - - - - - -	TL 81B-1829	10	12	26	34
6.	Pool 34 QPM (RSF)	Mexico	- - - - - - - - - - - -	TL 81B-1827	8	20	29	36
7.	Across 7741 RE	Across Locations (A traves de Locs.)	Templado Amarillo QPM	TL 81B-1565	1	14	23	40
8.	Across 7845 NRE	Across Locations (A traves de Locs.)	Amarillo del Bajio	TL 81B-1527	11	18	32	38
9.	Local Check (QPM)	- - - - - - - -	- - - - - - - -	- - - - - - - -	9	19	27	41
10.	Local Check (Normal)	- - - - - - - -	- - - - - - - -	- - - - - - - -	4	22	33	39
11.	Local Check (Normal)	- - - - - - - -	- - - - - - - -	- - - - - - - -	2	15	25	44

QPM= Quality Protein Maize
(Maíz de Alta Calidad de Proteina)
N= Normal
RE= Reference Entry
(Entrada de Referencia)

EVT 12: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
LATE TROPICAL NORMAL WHITE VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL, 1982)
(VARIEDADES NORMALES BLANCOS TARDIOS TROPICALES)

Expt. Desing: RBD
(Diseño Expt.: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Los Diamantes (1) 7921	Costa Rica	Tuxpeño 1	TL 81A-1082	15	26	58	69
2.	Across 7921	Across Locations (A traves de Locs.)	"	TL 81A-1084	3	22	55	73
3.	Chuquisaca (1) 7822	Bolivia	Mez. Trop. Blanca	TL 81A-1077	4	29	43	79
4.	Poza Rica 8022	Mexico	" " "	TL 81B-1520	20	25	59	77
5.	La Maquina 8022	Guatemala	" " "	TL 81B-1521	14	40	47	72
6.	Sta. Rosa 8022	Nicaragua	" " "	TL 81B-1549	9	36	48	67
7.	Guaymas (1) 8022	Honduras	" " "	TL 81B-1550	6	23	62	66
8.	Ferke (1) 8022	Ivory Coast	" " "	TL 81B-1551	11	35	51	75
9.	Across 8022	Across Locations (A traves de Locs.)	" " "	TL 81B-1592	13	37	49	71
10.	Across 7925	Across Locations (A traves de Locs.)	(Mix. IX Col. Gpo. 1)ETO	TL 81A-1085	16	24	53	70
11.	El Paraiso 7929	Honduras	Tuxpeño Caribe	TL 81B-1589	10	31	63	84
12.	Across 7929	Across Locations (A traves de Locs.)	" "	TL 81A-1088	7	39	57	80
13.	San Andres 8043	El Salvador	La Posta	TL 81B-1557	19	33	44	83
14.	Los Diamantes (1) 8043	Costa Rica	" "	TL 81B-1558	17	41	60	65
15.	Cotaxtla 8043	Mexico	" "	PR 81B-526	18	42	61	82
16.	Across 8043	Across Locations (A traves de Locs.)	" "	PR 81B-527	21	28	56	64
17.	Across 7622 RE	Across Locations (A traves de Locs.)	Mez. Trop. Blanca	TL 79A-1071	2	27	45	68
18.	Across 7729 RE	Across Locations (A traves de Locs.)	Tuxpeño Caribe	TL 81A-1100 I	5	34	46	81
19.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	8	30	52	78
20.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	1	32	54	76
21.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	12	38	50	74

RE: Reference Entry (Entrada de Referencia)

EVT 13: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
LATE TROPICAL YELLOW NORMAL VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL, 1982)
(VARIEDADES NORMALES AMARILLOS TARDIOS TROPICALES)

Exp. Design: RBD
(Diseño Exp.: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Poza Rica 8024	Mexico	Ant. X Ver. 181	TL 81B-1555	6	28	43	67
2.	Chiriqui (1) 8024	Panama	" " " "	TL 81B-1561	3	25	36	68
3.	Chiriqui (2) 8024	Panama	" " " "	TL 81B-1562	1	33	47	61
4.	Satipo (1) 7827	Peru	Amar. Cristalino - 1	TL 81A-1083	11	22	45	59
5.	Guaymas 8027	Honduras	" " "	TL 81B-1552	17	20	38	66
6.	Poza Rica 8027	Mexico	" " "	TL 81B-1553	14	30	37	57
7.	Tocumen 8027	Panama	" " "	TL 81B-1554	7	24	35	55
8.	Suwan 8027	Thailand	" " "	TL 81B-1593	16	31	41	65
9.	Pichilingue 7928	Ecuador	Amar. Dentado	TL 81A-1086	8	18	50	58
10.	Across 7928	Across Locations (A traves de Locs)	" "	TL 81A-1087	10	26	46	56
11.	Piura (1) 7936	Peru	Cogollero	TL 81A-1089	4	29	39	64
12.	Across 7936	Across Locations (A traves de Locs)	"	TL 81A-1090	15	19	49	62
13.	Across 7728 RE	Across Locations (A traves de Locs)	Amar. Dentado	PR 81B-511	2	23	40	60
14.	Across 7627 RE	Across Locations (A traves de Locs)	Amar. Cristalino - 1	TL 79A-1089	5	21	44	52
15.	Local Check	- - - - -	- - - - -	- - - - -	12	32	42	54
16.	Local Check	- - - - -	- - - - -	- - - - -	9	27	51	63
17.	Local Check	- - - - -	- - - - -	- - - - -	13	34	48	53

RE: Reference Entry (Entrada de Referencia)

EVT 14A: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
INTERMEDIATE TROPICAL NORMAL YELLOW VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL, 1982)
(VARIEDADES NORMALES AMARILLAS INTERMEDIAS TROPICALES)

Exp. Design: RBD
(Diseño Exp.: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Piura (1) 7926	Peru	Mez. Amarilla	TL 81A-1074	16	23	48	68
2.	Islamabad (1) 7926	Pakistan	" "	TL 81A-1071	4	25	41	55
3.	Saavedra 7926	Bolivia	" "	TL 81A-1075	1	31	40	52
4.	Across 7926	Across Locations (A traves de Locs.)	" "	TL 81A-1078	3	32	39	65
5.	Sete Lagoas 7931	Brazil	Amarillo Cristalino - 2	TL 81A-1067	8	34	43	63
6.	Pichilingue 7931	Ecuador	" " "	TL 81A-1072	11	18	49	56
7.	Satipo (1) 7931	Peru	" " "	TL 81A-1070	5	24	38	61
8.	Satipo (2) 7931	Peru	" " "	TL 81A-1061	15	26	51	54
9.	Across 7931	Across Locations (A traves de Locs.)	" " "	TL 81A-1073	14	29	44	59
10.	Islamabad 8035	Pakistan	Ant. x Rep. Dominicana	TL 81B-1547	13	19	50	62
11.	Poza Rica 8035	Mexico	" " "	TL 81B-1548	17	20	35	64
12.	Suwan 8035	Thailand	" " "	TL 81B-1582	2	30	47	57
13.	Across 7726 RE	Across Locations (A traves de Locs.)	Mez. Amarilla	TL 81A-1100 U	9	28	42	67
14.	Across 7635 RE	Across Locations (A traves de Locs.)	Ant. x Rep. Dominicana	PR 78A-21 A	12	21	45	66
15.	Local Check	- - -	- - -	- - -	7	22	37	53
16.	Local Check	- - -	- - -	- - -	10	27	46	58
17.	Local Check	- - -	- - -	- - -	6	33	36	60

RE: Reference Entry (Entrada de Referencia)

EVT 14 B: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
INTERMEDIATE TROPICAL NORMAL WHITE VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL, 1982)
(VARIEDADES NORMALES BLANCOS INTERMEDIOS TROPICALES)

Exp. Design: RBD
(Diseño Exp.: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Poza Rica 8023	Mexico	Blanco Cristalino - 1	TL 81B-1563	10	25	46	64
2.	Ferke (1) 8023	Ivory Coast	" " "	TL 81B-1564	15	20	42	61
3.	Pirsabak 8023	Pakistan	" " "	TL 81B-1586	14	27	45	52
4.	Maracay 8023	Venezuela	" " "	TL 81B-1587	11	29	41	66
5.	Across 8023	Across Locations (A traves de Locs.)	" " "	TL 81B-1590	9	31	50	63
6.	Ilonga (1) 7930	Tanzania	Blanco Cristalino - 2	TL 81A-1064	8	19	43	67
7.	Kisanga 7930	Zaire	" " "	TL 81A-1065	6	23	40	58
8.	Across 7930	Across Locations (A traves de Locs.)	" " "	TL 81A-1066	13	21	37	56
9.	Poza Rica 8032	Mexico	ETO Blanco	TL 81B-1556	1	30	36	59
10.	Alajuela 8032	Costa Rica	" "	TL 81B-1560	12	32	48	57
11.	Cotaxtla 8032	Mexico	" "	TL 81B-1591	2	26	44	53
12.	Mexico 8049	Mexico	Blanco Dentado - 2	TL 81B-1532	7	18	35	62
13.	Pirsabak (1) 7930 RE	Pakistan	Blanco Cristalino - 2	PR 81B-512	5	22	39	65
14.	Los Diamantes 7823 RE	Costa Rica	Blanco Cristalino - 1	TL 80A-1018	4	24	51	68
15.	Local Check	- - - - -	- - - - -	- - - - -	17	28	47	55
16.	Local Check	- - - - -	- - - - -	- - - - -	16	33	38	60
17.	Local Check	- - - - -	- - - - -	- - - - -	3	34	49	54

RE = Reference Entry (Entrada de Referencia)

EVT 15A:

INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
TROPICAL QPM EXPERIMENTAL VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL 1982)
(VARIEDADES EXPERIMENTALES QPM TROPICALES)

Exp. Design: RBD
(Diseño Exp.: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Jardinopolis 7938	Brazil	PD (MS) 6 QPM	TL 81A-1062	10	25	36	47
2.	Chuquisaca (1) 7839	Bolivia	Yellow QPM	TL 81A-1063	5	23	45	50
3.	Satipo (1) 7839	Peru	" "	TL 81A-1069	15	28	40	54
4.	Satipo (2) 7839	Peru	" "	TL 81A-1091	11	29	33	58
5.	Tocumen 80 9	Panama	" "	TL 81B-1544	12	24	39	53
6.	San Jeronimo 8039	Guatemala	" "	TL 81B-1546	4	26	43	48
7.	Ferke (1) 8039	Ivory Coast	" "	TL 81B-1545	14	30	38	49
8.	Poza Rica 8039	Mexico	" "	TL 81B-1543	7	27	42	46
9.	Across 8039	Across Locations (A traves de Locs.)	" "	TL 81B-1584	1	16	31	56
10.	Across 7940	Across Locations (A traves de Locs.)	White QPM	TL 81A-1063	6	18	34	57
11.	Across 7740 RE	Across Locations (A traves de Locs.)	" "	PR 81B-535	3	21	41	51
12.	Across 7726 NRE	Across Locations (A traves de Locs.)	Mezcla Amarilla	TL 81A-1100 U	13	17	44	60
13.	Local Check (QPM)	- - - - - -	- - - - - -	- - - - - -	9	22	32	59
14.	Local Check (Normal)	- - - - - -	- - - - - -	- - - - - -	2	20	35	52
15.	Local Check (Normal)	- - - - - -	- - - - - -	- - - - - -	8	19	37	55

QPM = Quality Protein Maize
(Maíz de Alta Calidad de Proteina)
N = Normal
RE = Reference Entry
(Entrada de Referencia)

EVT 16 A: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
SUBTROPICAL-TEMPERATE NORMAL, YELLOW VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL, 1982)
(VARIEDADES AMARILLA, NORMALES SUBTROPICALES-TEMPLADOS)

Experimental Disegn: RBD
(Diseño Experimental: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Chuquisaca (1) 7833	Bolivia	Amarillo Subtropical (Old)	TL 81A-1076	7	26	70	84
2.	San Jeronimo 8033	Guatemala	" " (New)	TL 81B-1569	1	29	65	76
3.	Pantnagar (1) 8033	India	" " "	TL 81B-1570	24	42	51	77
4.	Tlaltizapan 8033	Mexico	" " "	TL 81B-1571	10	40	52	96
5.	Yousafwala 8033	Pakistan	" " "	TL 81B-1572	21	30	61	86
6.	Chuquisaca (1) 7845	Bolivia	Amarillo del Bajio	TL 80B-1591	8	43	53	81
7.	Chuquisaca 7845	Bolivia	" "	TL 80B-1563	23	38	59	94
8.	Obregon 8045	Mexico	" "	TL 81B-1528	18	34	66	91
9.	Tlaltizapan 8045	Mexico	" "	TL 81B-1529	2	32	55	83
10.	Antalya (1) 8045	Turkey	" "	TL 81B-1530	14	39	71	88
11.	Antalya 8045	Turkey	" "	TL 81B-1531	19	28	50	85
12.	Across 8045	Across Locations (A traves de Locs.)	" "	TL 81B-1574	13	48	63	89
13.	Obregon 8046	Mexico	Temp. Amar. Cristalino	TL 81B-1537	22	35	69	87
14.	Tlaltizapan 8046	Mexico	" " "	TL 81B-1538	20	44	54	80
15.	Quilamapu 7948	Chile	Comp. Hungary	TL 81B-1533	3	45	64	79
16.	Adapazari 7948	Turkey	" "	TL 81B-1534	11	33	68	95
17.	Adapazari (1) 7948	Turkey	" "	TL 81B-1535	6	41	56	93
18.	Tlaltizapan 7948	Mexico	" "	TL 80B-1596	15	31	72	82
19.	Across 7948	Across Locations (A traves de Locs.)	" "	TL 81B-1536	5	25	62	73
20.	Across 7748 RE	Across Locations (A traves de Locs.)	" "	TL 79A-1092	17	47	60	75
21.	Across 7845 RE	Across Locations (A traves de Locs.)	Amarillo del Bajio	TL 81B-1527	9	37	57	90
22.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	16	27	49	92
23.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	4	46	67	78
24.	Local Check	- - - - - - - -	- - - - - - - -	- - - - - - - -	12	36	58	74

RE: Reference Entry (Entrada de Referencia)

EVT 16 B: INTERNATIONAL EXPERIMENTAL VARIETY TRIAL, 1982
SUBTROPICAL -TEMPERATE NORMAL WHITE VARIETIES
(ENSAYO INTERNACIONAL DE VARIEDAD EXPERIMENTAL 1982)
(VARIEDADES BLANCAS NORMALES SUBTROPICALES-TEMPLADOS)

Experimental Design: RBD
Diseño Experimental: RBD)

Entry No. (Entrada No.)	Variety Name (Nombre Variedad)	Country (País)	Parent AU Population (Pob. Parentales AU)	Origin (Origen)	Replication (Repetición) 1	2	3	4
1.	Tlaltizapan 7934	Mexico	Blanco Subtropical	TL 80B-1580	3	20	34	49
2.	Sete Lagoas 7934	Brazil	" "	TL 81A-1093	13	25	46	54
3.	Kaniar.a 7934	Zaire	" "	TL 81A-1092	2	19	43	62
4.	Across 7934	Across Locations (A traves de Locs.)	" "	TL 81A-1094	12	27	41	51
5.	Awassa (1) 8047	Ethiopia	Temp. Blanco Dentado - 2	TL 81B-1539	15	18	38	50
6.	Swat (1) 8047	Pakistan	" " " "	TL 81B-1573	14	29	47	56
7.	Swat 8047	Pakistan	" " " "	TL 81B-1540	1	28	48	61
8.	Gemeiza 8047	Egypt	" " " "	TL 81B-1542	8	17	36	57
9.	Gemeiza (1) 8047	Egypt	" " " "	TL 81B-1526	6	22	45	58
10.	Tlaltizapan 8047	Mexico	" " " "	TL 81B-1525	10	24	39	63
11.	Across 8047	Across Locations (A traves de Locs.)	" " " "	TL 81B-1541	7	32	44	52
12.	Across 7734 RE	Across Locations (A traves de Locs.)	Blanco Subtropical	TL 81A-1100 K	9	21	42	55
13.	Across 7844 RE	Across Locations (A traves de Locs.)	AED x Tuxpeño	TL 81B-1519	11	23	37	59
14.	Local Check	- - - -	- - - -	- - - -	4	30	40	64
15.	Local Check	- - - -	- - - -	- - - -	5	31	35	60
16.	Local Check	- - - -	- - - -	- - - -	16	26	33	53

RE: Reference Entry (Entrada de Referencia)

INTERNATIONAL QUALITY PROTEIN MAIZE TRIALS (QPMT) AND ELITE VARIETY TRIALS (ELVT), 1981
(ENSAYOS INTERNACIONALES DE CALIDAD DE PROTEINA DE MAIZ (QPMT) Y ENSAYOS VARIEDADES ELITE (ELVT), 1981)

Trial (Ensayo) No. Country (País)	QPMT 11 A	QPMT 11 B	ELVT 18 A	ELVT 18 B	ELVT 20	TOT
South America						
1. Argentina	-	1	1	1	1	4
2. Bolivia	4	2	1	1	1	9
3. Brazil	2	5	10	9	8	34
4. Chile	-	-	-	-	-	0
5. Colombia	-	-	-	-	-	0
6. Ecuador	1	1	2	2	1	7
7. Guyana Francaise	-	-	-	-	-	0
8. Paraguay	1	1	1	1	1	5
9. Peru	4	-	5	5	-	14
10. Surinam	-	-	-	-	-	0
11. Uruguay	-	-	-	-	2	2
12. Venezuela	2	-	5	6	-	13
Central America						
13. Belize	1	-	1	1	-	3
14. Costa Rica	1	-	2	2	1	6
15. El Salvador	-	-	2	2	-	4
16. Guatemala	2	1	2	2	1	8
17. Honduras	2	-	4	3	-	9
18. Nicaragua	2	-	3	3	-	8
19. Panama	6	4	8	8	-	26
Caribbean						
20. Bahamas	-	-	-	1	-	1
21. Barbados	-	-	1	1	-	2
22. Grenade	1	-	-	-	-	1
23. Haiti	-	-	-	-	-	0
24. Jamaica	1	-	1	1	-	3
25. Puerto Rico	-	-	-	-	-	0
26. Rep. Dominicana	5	-	3	3	-	11
27. St. Kitts	-	-	-	-	-	0
28. St. Vincent	-	-	-	-	-	0
29. Trinidad	1	-	1	1	-	3
30. Mexico	9	1	9	12	1	32
Africa						
31. Algeria	-	-	-	-	-	0
32. Angola	-	1	-	-	1	2
33. Benin	1	-	2	2	-	5
34. Bostwana	-	-	-	2	-	2
35. Burundi	-	-	-	-	-	0
36. Cameroun	1	2	1	2	2	8
37. Comores	1	1	-	-	-	2
38. Congo	-	-	1	1	-	2
39. Egypt	-	3	-	-	3	6
40. Ethiopia	1	1	2	2	1	7
41. Gambia	-	1	1	-	-	2
42. Ghana	2	-	2	2	-	6
43. Guinea - Bissau	1	-	1	1	1	4
44. Haute Volta	3	2	1	3	2	11
45. Ivory Coast	2	-	2	1	-	5
46. Kenya	1	1	2	2	1	7
47. Lesotho	-	-	-	-	-	0
48. Libya	-	-	-	-	-	0
49. Malawi	2	2	3	2	3	12
50. Mali	-	1	1	1	1	4

NOTE: 1982 final distribution of EVT and QMPT available Oct. 1982

Trial (Ensayo) No. / Country (País)	QPMT 11 A	QPMT 11 B	ELVT 18 A	ELVT 18 B	ELVT 20	TOTAL
51. Mauritania	1	-	-	1	-	2
52. Morocco	-	1	-	-	2	3
53. Mozambique	2	1	2	2	1	8
54. Niger	-	-	-	1	-	1
55. Nigeria	1	1	3	2	2	9
56. Rep. Centrafricaine	-	-	1	1	-	2
57. Rep. de Guinee	-	-	1	1	-	2
58. Rep. South Africa	2	2	2	2	2	10
59. Reunion	1	1	2	2	2	8
60. Rwanda	-	-	-	-	-	0
61. Senegal	2	-	2	2	-	6
62. Somalia	2	-	1	1	-	4
63. Sierra Leone	7	-	7	7	-	21
64. Sudan	1	-	1	4	-	6
65. Swaziland	-	-	1	4	2	7
66. Tchad	-	-	-	-	-	0
67. Tanzania	1	-	1	1	1	4
68. Togo	-	-	2	2	-	4
69. Transkei	-	1	-	-	1	2
70. Tunisia	-	-	-	-	-	0
71. Uganda	1	1	1	1	1	5
72. Zaire	1	-	1	1	1	4
73. Zambia	1	-	1	1	1	4
74. Zimbabwe	1	1	1	1	1	5
Asia						
75. Afganistan	-	-	-	-	-	0
76. Bangladesh	1	-	1	1	1	4
77. Burma	-	-	2	2	2	6
78. India	1	1	1	2	1	6
79. Indonesia	-	-	-	1	-	1
80. Iraq	-	-	-	2	2	4
81. Jordan	-	-	-	-	-	0
82. Malaysia	1	-	1	1	-	3
83. Nepal	-	1	-	2	2	5
84. Pakistan	-	2	-	3	4	9
85. Philippines	2	-	1	3	1	7
86. Saudi Arabia	2	1	-	2	1	6
87. South Korea	-	1	-	-	1	2
88. Sri Lanka	2	-	2	2	-	6
89. Syria	-	-	-	-	-	0
90. Thailand	2	1	2	2	2	9
91. Turkey	-	4	-	-	4	8
92. Yemen A. R.	2	-	4	3	1	10
93. Vietnam	2	1	2	2	1	8
Others						
94. Greece	-	-	-	-	2	2
95. Tahiti	-	-	-	1	-	1
96. U. S. A.	-	-	2	2	2	6
97. Yugoslavia	1	1	1	1	1	5
Total	100	53	130	155	77	515

Request of seeds of EVs 1981

For seed increase purposes.

	Country	No.: EVs requested	Total Kg.
(1)	Bangladesh	15	142
(2)	Barbados	2	4
(3)	Belize	3	6
(4)	Burma	2	20
(5)	Cameroun	7	20
(6)	Costa Rica	3	28
(7)	China (mainland)	2	—
(8)	Ecuador	8	8
(9)	Ethiopia	15	31
(10)	Guadeloupe	1	5
(11)	Gambia	1	1
(12)	Ghana	2	4
(13)	Guatemala	18	44
(14)	Haiti	16	81
(15)	Haute Volta	13	52
(16)	Honduras	9	38
(17)	Indonesia	5	5
(18)	Ivory Coast	7	14
(19)	Jamaica	1	4
(20)	Liberia	6	12
(21)	Malawi	19	57
(22)	Mali	28	24.500
(23)	Mexico	21	269
(24)	Mozambique	3	25
(25)	Nepal	2	3
(26)	Nigeria	8	20

(Con't)

	Country	No.: EVs requested	Total Kgs.
(27)	Panama	2	20
(28)	Pakistan	10	32
(29)	Philippines	18	36
(30)	Peru	2	4
(31)	Rep. Dominicana	3	9
(32)	Samoa	5	10
(33)	Saudi Arabia	12	12
(34)	Senegal	18	60
(35)	Sierra Leone	8	23
(36)	Swaziland	10	18
(37)	Togo	12	65
(38)	Uganda	3	3
(39)	U.S.A. (Douglass W. King Co.)	7	14
(40)	Venezuela	4	16
		325	1239.5

Varieties - Seeds requested for increase

San Andres 7721
Maracay 7921

Ferke (1) 7622
Poza Rica 7822
Across 7522
Cotaxtla 7822

San Andres (1) 7623

Petrolina 7726
Tocumen (1) 7926
Across 7726
Poza Rica 7726
Pichilingue 7726

La Maquina 7827

Sete Lagoas 7728
Poza Rica 7728
Across 7728
La Maquina 7928

Pirsabak (1) 7930
Sta. Cruz Porr. 7930
Jutiapa (1) 7930
Poza Rica 7930

Across 7931
Poza Rica 7931

San Andres (1) 7632

Across 7734
Tlaltizapan 7734
Sids (1) 7734

Pichilingue 7835
Across 7835
Tocumen (1) 7835
Across 7635

Tlaltizapan 7736

Across 7740
Ilonga 7740
Poza Rica 7740

Across 7842
Tlaltizapan 7842
San Paulo 7842

La Maquina 7843
Poza Rica 7843
Poza Rica 7643

Tlaltizapan 7644
Tlaltizapan 7844
Across 7844
Cotaxtla 7844

Tlaltizapan 7845

DISEASE AND INSECT RESISTANCE WORK

CIMMYT continues to develop and improve maize varieties resistant to attack by diseases and by insects. Populations grown in Mexico are artificially inoculated with stalk and ear-rotting organisms. At appropriate intervals after inoculation, each family is scored for disease damage and progenies with the least damage are retained for future recombinations.

For insect resistance, populations are infested in Mexico with larvae of fall armyworms, earworms, and southwestern corn borer or sugarcane borer. These are some of the most important maize pests in the western hemisphere, which are also related to species causing serious damage on other continents. At different growth stages after infestation, visual ratings for insect damage are made for each family. Progenies showing the least damage are retained for recombination and use in future improvement cycles.

Over the past six years, CIMMYT has developed successful techniques for efficient mass rearing and infestation. These techniques show promise of being adaptable to other pest species, crop species, and screening/breeding initiatives in other parts of the world.

These techniques include establishment of the insect colony and basic requirements for efficient mass rearing. CIMMYT's rearing facility is presently capable of producing four species twice per year for field infestation at appropriate plant-growth stages over two-month-long periods.

COLLABORATIVE RESEARCH FOR DISEASE RESISTANCE

In 1974, three collaborative breeding projects were organized between CIMMYT and six national maize programs to develop germplasm resistant to three major diseases of maize in tropical areas. These diseases are downy mildew, caused by a fungus found mainly in Southeast Asia, but now spreading to Africa and Latin America; maize streak virus, disseminated by a leafhopper throughout tropical Africa; and corn stunt, a disease also spread by a leafhopper mainly in tropical Latin America. In this research, CIMMYT and its collaborators followed a "shuttle breeding" strategy using three genetically broad-based populations. Alternate cycles of selection were carried out in disease-prone areas in collaborating countries to identify sources of resistance, and in Mexico to improve the agronomic characters of the resistant selections.

By 1980, good progress had been made in developing material with resistance to downy mildew and to corn stunt. CIMMYT's activities in these disease research projects are now carried out in regional programs located in the affected areas. The work on downy mildew resistance, including the preparation and distribution of international nurseries, is centered in Thailand, with full involvement of Thai and Asian region scientists. The international breeding program for streak virus resistance is carried out in Nigeria, with full involvement of IITA and West African scientists. After four cycles of selection and recombination for DMR and stunt, special trials using families of these populations were sent to collaborating countries.

Progeny trials for stunt evaluation were planted in Guatemala, El Salvador, Nicaragua, Panama, Dominican Republic, and Mexico. Trials for downy mildew were planted in Honduras, Venezuela, Nepal, Thailand, Philippines, and Mexico. Evidence shows that yield has increased through cycles in less incidence of disease. Other agronomic characters like plant and ear height have been reduced, as well as days to flower (Table 29).

After data from the yield trials were received in Mexico, experimental varieties (EVT) were developed, advanced to F2, and assembled in stunt-or downy mildew resistant EVTs.

The stunt-resistant EVTs were sent to several countries in early 1981. A downy mildew-EVT will be sent for evaluation in early 1982. Tables 30 and 31 describe the stunt or downy mildew-resistant varieties developed from the three base populations.

Table 27. PROGRESS IN IMPROVING RESISTANCE TO DOWNY MILDEW AND STUNT DISEASES COLLABORATIVE RESEARCH

Population	Cycle of selection	% disease	Yield (Kg/ha)	Plant ht. (cm)	Days to 50% silk
A. Downy mildew: (Thailand)					
1. Tropical Interm. White Flint	C_0	41.4	3836	185	68
	C_4	0	4404	160	66
2. Tropical Yellow Flint-Dent	C_0	67.4	2684	199	68
	C_4	2.6	4490	183	66
B. Stunt disease: (El Salvador)					
1. Tropical Interm. White Flint	C_0	30.6	3337	206	49
	C_4	21.8	4120	200	49

Table 28. Stunt-resistant experimental varieties developed from three base populations.

Variety	Base population*	Country
Tlaltizapán 8073	TLWD-STR	Mexico
Tlaltizapán 8076	TIWF-STR	Mexico
Santa Rosa 8073	TLWD-STR	Nicaragua
Santa Rosa 8076	TIWF-STR	Nicaragua
Santa Rosa 8079	TYFD-STR	Nicaragua
Cuyuta 8073	TLWD-STR	Guatemala
Cuyuta 8076	TIWF-STR	Guatemala
Rio Hato 8079	TYFD-STR	Panama
Porrillo 8073	TLWD-STR	El Salvador
Porrillo 8076	TIWF-STR	El Salvador
San Cristóbal 8079	TYFD-STR	Dominican Rep.
Across 8073	TLWD-STR	Guatemala, Nicaragua, El Salvador, Mexico
Across 8076	TIWF-STR	" " "
Across 8079	TYFD-STR	" " "

* TLWD-STR = Tropical Late White Dent - Stunt Resistant.
TIWF-STR = Tropical Intermediate White Flint - Stunt Resistant.
TYFD-STR = Tropical Yellow Flint Dent - Stunt Resistant.

Table 29. Downy mildew-resistant experimental varieties developed from three base populations.

Variety	Base population *	Country
Danli 8072	TLWD-DMR	Honduras
Rampur 8075	TIWF-DMR	Nepal
Rampur 8078	TYFD-DMR	Nepal
Los Baños 8072	TLWD-DMR	Philippines
Los Baños 8075	TIWF-DMR	Philippines
Los Baños 8078	TYFD-DMR	Philippines
Suwan 8072	TLWD-DMR	Thailand
Suwan 8075	TIWF-DMR	Thailand
Suwan 8078	TYFD-DMR	Thailand
Across 8072	TLWD-DMR	Nepal, Philippines, Thailand
Across 8075	TIWF-DMR	" "
Across 8078	TYFD-DMR	" "

* TLWD-DMR = Tropical Late White Dent - Downy Mildew Resistant.
TIWF-DMR = Tropical Intermediate White Flint - Downy Mildew Resistant
TYFD-DMR = Tropical Yellow Flint Dent - Downy Mildew Resistant.

SPECIAL PROJECTS

Within CIMMYT's maize improvement program, some special research activities are carried out to test new ideas and techniques. In these projects, researchers usually confine their study to one or a few populations and the conclusions reached may ultimately influence the improvement priorities and/or methodologies used within central program activities. In 1980, special studies were underway dealing with field efficiency in tropical maize, drought tolerance, early maturity, and wider adaptation. In these research projects, evaluations covering a number of years of work were carried out during 1981 to determine whether the projects needed to be continued further, given the results already obtained.

Three aspects of maize production in the tropics have been examined and the findings summarized in the following tables.

1. Improved grain yield and yield efficiency-
   Three morphological traits--plant height, leaf area and tassel size--have been reduced in tropical maize and their effects on yield efficiency are examined.

2. Selection for drought resistance in tropical maize-
   Techniques which aid in identifying genotypes with relatively better performance under drought conditions are examined. Evidence for the improvement in drought resistance in one tropical population through recurrent selections is given.

3. Grain yield and early maturity-
   Progress from selection for earliness and its effect on grain yield is shown.

WIDE CROSSES

Crosses between maize and two alien genera, sorghum and Tripsacum, are being pursued to determine the feasibility of using potentially useful genes from these genera for maize improvement. In general, the aim is to make maize a more environmentally stable crop with better insect and disease resistance (from Tripsacum) and more drought and water-logging tolerance (from sorghum).

Our work in previous years has shown that maize x Tripsacum crosses give two types of hybrids: classical and non-classical. Classical hybrids retain the expected gametic number of chromosomes from both parents. In appearance they resemble Tripsacum more than maize, and like Tripsacum, are perennial. Non-classical hybrids possess 20 maize chromosomes and various numbers of Tripsacum chromosomes in different root tip cells. These hybrids are more maize-like in appearance and are annual.

In maize x sorghum crosses only non-classical hybrids had been retrieved.

Very little is understood about the mechanism for the production of such hybrids. In 1980-81 harvest and examination techniques were modified to try to determine the possible mechanisms involved. A cytologist joined the staff in early 1981 to help unravel the identity of these hybrids.

Table 30. Plant height, lodging, optimum planting density and the grain yield of various cycles of selection for reduced plant height in Tuxpeño Crema I when grown at their optimum density and at 50,000 plants/ha. (Data are the means of two years testing at three locations; Poza Rica, Obregon and Tlaltizapan, Mexico).

Cycle of Selection	Plant height (cm)	Grain yield (t/ha)		Lodging (%)	Optimum Density (plants/m^2)
		Optimum Density	50,000 plants/ha		
0	282	3.17	3.13	49	4.6
6	218	4.29	4.24	9	5.4
9	210	4.48	4.31	10	5.6
12	202	4.93	4.71	6	5.6
15	179	5.40	5.03	5	6.5
$LSD_{P.05}$	7	0.32	0.36	12	1.2
+ 17	156	4.86	4.57	--	6.6
20	143	5.44	4.70	--	8.8

+ Adjusted data from Poza Rica and Tlaltizapan, 1981A.

Table 31. Plant Height, Leaf Area Index, Harvest Index, the total dry matter (above ground), and grain yield of various cycles of selection for reduced plant height in Tuxpeño Crema I when grown at or near their optimum density. (Data are means for two years testing at two locations; Poza Rica and Tlaltizapan, Mexico).

Cycle of Selection	Plant Height (cm)	Grain Yield (t/ha)	Leaf Area Index	Total dry matter (t/ha)	Harvest Index
0	273	4.05	4.67	14.94	0.30
6	211	5.54	4.49	14.75	0.38
9	203	5.67	4.41	15.32	0.39
12	196	6.18	4.49	15.37	0.41
15	173	6.73	4.26	15.12	0.46
LSD P.05	10	0.41	0.45	1.84	0.05
+ 17	156	6.23	3.70	13.1	0.47
20	143	6.79	3.92	13.6	0.49

+ Adjusted data from Poza Rica and Tlaltizapan, 1981A.

Table 32. Grain Yield and Optimum Density for various cycles of Selection for Reduced Plant Height when Grown under Farmer Conditions (five locations) with different Management Levels.

Cycle	Grain Yield (t/ha) at: Recommended management	Poor weed control	Low Nitrogen level	Density for Recommended management (Plant/m^2)
0	3.34	2.23	2.47	4.2
6	4.16	2.80	3.00	4.5
12	4.34	2.67	2.87	5.1
15	5.02	3.27	3.30	5.8
18	4.46	2.97	2.76	5.8
*Change per cycle (%)	2.94	2.44	1.75	2.50

* for cycle 0 to 15.

Table 33. Mean effect of various selections in Tuxpeño-1(Pop. 21), Eto blanco (Pop.32) and Antigua-Republica Dominicana (Pop.35) on grain yield, optimum density, leaf area index (LAI) total dry matter and harvest index. (Each data is the mean of approx. 48 observations).

Selection	Cycle	Grain yield (kg/ha) at: 50,000 (plants/ha)	80,000 (plants/ha)	Optimum density	Plants/m^2 (at optimum density)	LAI	Total dry matter (kg/ha)	Harvest index
Reduced leaf	0	4644	4731	4924	7.25	2.93	11584	36.0
	6	4747	5040	5266	7.85	2.45	10628	42.3
	*Change (%)	0.36	1.09	1.15	1.38	-2.70	-1.55	2.92
Reduced tassel	0	4644	4731	4924	7.25	2.93	11584	36.0
	6	5094	5061	5467	8.30	2.89	11330	40.6
	*Change (%)	1.62	1.16	1.83	2.41	-0.23	-0.36	2.13
Reduced leaf and tassel	0	4503	4587	4753	6.96	3.17	11793	35.7
	6	4792	5159	5271	7.96	2.82	11614	41.6
	*Change (%)	1.07	2.08	1.80	2.40	-1.85	-0.26	2.77
Multilocation yield test	0	4503	4587	4753	6.96	3.17	11793	35.7
	3	4648	4517	4769	6.83	3.32	11671	36.0
	*Change (%)	1.06	-0.01	0.07	-0.01	1.57	-0.18	0.28

*Change measured as percent/cycle from Cycle 0.

Table 34. Effect of selection for various characters in Tuxpeño on grain yield under irrigation and stress conditions (Tlaltizapan, 1981).

Character	Cycle	Grain yield (kg/ha)		Yield change/cycle (% of original)	
		Irrigation	Stress	Irrigation	Stress
Reduced height	6	5276	1129	1.02	1.10
	12	5358	1203	1.29	6.30
	15	5893	1718*	1.34	3.25
	18	6129	1570		
Reduced tassel	++0	5608	1213	1.67	6.31
	6	6172	1673*		
Reduced leaf	++0	5608	1213	2.10	4.09
	5	6196	1468*		
Drought resistance	++0	5859	1224	1.82	9.46
	3	6179	1572	2.57	11.50
	+EV	6311	1647*		
International progeny test (IPT 21) (C_3)	0	5608	1213	5.03	2.80
	3	6458	1315		
LSD P.05		899	433		
CV%		11.7	23.8		

\+ Experimental variety (EV) (4% selection pressure)

* Significance by preplanned F test with the original cycle.

++ Best estimates.

Table 35. Grain Yield, Grain Yield per Day, Optimum Density, and Maturity Indices for Materials being Developed for Early Maturity, and when Grown in Summer at Three Locations in Mexico.

Selection for:	Cycle	Grain Yield at: Optimum Density	Grain Yield at: 50,000 plants/ha	Grain Yield/Day ($g/m^2/day$)	Optimum Density ($Plants/m^2$)	Maturity: Days to Flower	Maturity: Physiological maturity +
Earliness in Pop. Compuesto Sel. Precoz	0	5635	5367	5.46	6.5	56.8	103.1
	4	5476	5004	5.37	7.7	54.1	102.0
	8	5427	5195	5.42	7.5	52.6	100.1
Change per cycle (%)		-0.46	-0.41	-0.09	1.86	-0.93*	-0.36
Yield in Pop. Compuesto Sel. Precoz ++	0	4330	3521	4.50	8.5	52.0	96.2
	1	4830	4454	4.91	8.1	52.8	98.3
Change per cycle (%)		11.5	26.5	9.1	-4.7	1.5	2.2
LSD P.05		414	402	0.40	1.2	0.8	2.9
CV %		9.0	9.6	10.0	18.2	1.4	8.7

\+ From two locations (Poza Rica and Tlaltizapan).

* Is equivalent to a reduction of 0.5 days per cycle.

++ 4.0% selection pressure.

Table 36. Grain Yield per Day, Optimum Density and Maturity Indices for Materials being Developed for Early Maturity and when Grown in Winter at Two Locations.

Selection for:	Cycle	Grain Yield (kg/ha) at: Optimum density	Grain Yield (kg/ha) at: 50,000 plants/ha	Grain yield per day ($g/m^2/day$)	Optimum density ($plants/m^2$)	Maturity: Flowering (days)	Maturity: Phisiological maturity +
Earliness in Pop.	0	5574	5173	3.98	7.8	87.5	140.2
Compuesto Sel. Precoz	4	5763	5080	4.16	8.8	79.7	138.5
	8	5708	5066	4.28	9.1	77.2	133.4
Change per cycle (%)		0.30	-0.26	0.94	2.05	-1.48*	-0.60
+ Yield in Pop.	0	4847	3789	3.83	10.8	72.0	126.6
Componentes Precoces	1	4918	4109	3.85	8.0	75.2	127.6
Change per cycle (%)		1.5	8.4	0.6	-26.0	4.5	0.8
LSD P.05		414	402	0.40	1.2	0.8	2.9
CV %		9.0	9.6	10.0	18.2	1.4	8.7

* Equivalent to a reduction of 1.3 days per cycle.

\+ Data for Tlaltizapan only, adjusted for comparison with other data.

MAIZE TRAINING

In-service training at CIMMYT offers a wide range of training opportunities to scientists working in maize improvement and production in the developing world. During 1980 and 1981, 120 in-service trainees from 38 countries participated in the program. Each trainee specialized in one of the program's four areas: maize improvement, maize production research, experiment station operations, and maize quality laboratory techniques.

CIMMYT's in-service training program is in its eleventh year of existence. Emphasis is on on-farm research in maize production. Trainees spend long hours of field work associated with on-farm experiments and surveys, where they are introduced to the integrated research strategies necessary in a dynamic maize production program.

In addition to the in-service training courses (five-and-a-half months long), CIMMYT works with graduate students in cooperative programs with universities; students may spend 12-18 months in Mexico either completing their thesis research or developing their research project. Postdoctoral fellows spend two years in the maize program and visiting and associate scientists may receive up to one-year fellowships.

Work in maize improvement is carried out at CIMMYT's experiment stations in Mexico (El Batán, Toluca, Tlaltizapan, and Poza Rica). Emphasis is given to the field research skills needed to design and manage a maize improvement program. This practical training is interspersed with participation in the agronomy experiments conducted by production trainees on farmers' fields and with classwork related to the breeding methodologies used by CIMMYT scientists.

In order to follow up with former trainees and increase the number of trained production agronomists in the world, CIMMYT's maize training agronomists have given support to a number of regional and national training programs during 1980 and 1981. Three visits were made to Ecuador in 1980 to participate in an intermittent training course in the province of Manabí. Single visits were made to Nicaragua and Pakistan for in-country training courses, and to Kenya for a regional training course on on-farm research with participants from 12 African countries. CIMMYT's regional scientists or CIMMYT scientists assigned to work with national programs were involved in all these training activities, as were some CIMMYT training alumnae.

Maize In-Service Trainees, 1980-1981.

COUNTRY	Improvement	Production Research	Experiment Station Operations	Quality Laboratory Techniques
Bangladesh	2	2		
Belize		1		
Botswana		1		
Burma	1			
Cape Verde Islands		1		
Colombia	2	2		
Dominican Republic		2		
Ecuador		1		1
Egypt	1	1		
Ethiopia	2	1		
Ghana	5	9	1	
Guatemala				1
Haiti		2		
Honduras		1		
Hungary	1			
India		1		
Indonesia	1	2		
Japan		2		
Kenya	1	1		
Malawi	1	2		
Malaysia		2		
Mexico		9		
Mozambique		3		
Nepal		2		
Nicaragua		2		
Pakistan	2	6	3	2
Panama		2		
Peru	1	3		
Philippines		2		
Swaziland		1		
Tanzania		2		
Thailand	1	8	3	
Transkei		1		
Turkey	4			1
Venezuela	1			
Vietnam	2			
Zaire		3		
Zambia	1	1		
Totals	29	79	7	5
Grand Total		120		

NUMBER OF MAIZE IN-SERVICE TRAINEES REGION AND COUNTRY 1971-1981

CENTRAL AMERICA AND CARIBBEAN

Belize (6)

1974 - 2
1975 - 1
1976 - 2
1980 - 1

Costa Rica (10)

1973 - 1
1976 - 2
1977 - 1
1978 - 2
1979 - 4

Dominican Rep. (13)

1971 - 1
1972 - 2
1974 - 1
1976 - 2
1977 - 3
1979 - 2
1980 - 1
1981 - 1

El Salvador (22)

1971 - 1
1972 - 5
1973 - 3
1974 - 1
1975 - 2
1976 - 8
1978 - 1
1979 - 1

Dominica (1)

1977 - 1

Grenada (1)

1976 - 1

Guatemala (15)

1972 - 4
1973 - 3
1975 - 2
1976 - 5
1979 - 1

Guyana (1)

1972 - 1

Haiti (13)

1972 - 3
1976 - 2
1977 - 2
1978 - 2
1979 - 2
1980 - 2

Honduras (25)

1971 - 1
1972 - 1
1973 - 5
1974 - 2
1975 - 5
1976 - 4
1977 - 5
1979 - 1
1980 - 1

CENTRAL AMERICA AND CARIBBEAN (cont.)

Mexico (32)

1973 - 2
1974 - 2
1975 - 3
1976 - 3
1977 - 4
1978 - 1
1979 - 7
1980 - 6
1981 - 4

Nicaragua (18)

1971 - 1
1972 - 1
1973 - 1
1975 - 1
1976 - 4
1978 - 3
1979 - 5
1980 - 1
1981 - 1

Panama (12)

1972 - 1
1973 - 2
1977 - 1
1978 - 3
1979 - 3
1981 - 2

SOUTH AMERICA

Argentina (11)

1971 - 3
1973 - 8

Bolivia (10)

1973 - 2
1974 - 2
1975 - 1
1976 - 2
1978 - 1
1979 - 2

Brazil (3)

1973 - 2
1974 - 1

Colombia (13)

1972 - 3
1974 - 2
1977 - 1
1978 - 2
1979 - 1
1980 - 2
1981 - 2

Chile (2)

1972 - 1
1973 - 1

SOUTH AMERICA (cont.)

Ecuador (19)

1971 - 1
1972 - 1
1973 - 1
1974 - 3
1975 - 3
1976 - 2
1977 - 3
1978 - 2
1979 - 2
1980 - 1

Venezuela (8)

1971 - 3
1974 - 1
1977 - 1
1978 - 1
1979 - 1
1980 - 1

Peru (21)

1973 - 2
1974 - 1
1976 - 2
1977 - 3
1978 - 4
1979 - 5
1980 - 2
1981 - 2

SOUTH AND EAST ASIA

Afghanistan (6)

1978 - 4
1979 - 2

Bangladesh (9)

1978 - 2
1979 - 3
1980 - 2
1981 - 2

Burma (1)

1981 - 1

India (9)

1971 - 1
1974 - 1
1978 - 5
1979 - 1
1980 - 1

Indonesia (6)

1978 - 3
1980 - 3

SOUTH AND EAST ASIA (cont.)

Japan (8)

1971 - 3
1977 - 1
1978 - 1
1979 - 1
1980 - 1
1981 - 1

Korea (2)

1976 - 1
1978 - 1

Malaysia (3)

1979 - 1
1980 - 2

Nepal (20)

1971 - 2
1973 - 1
1974 - 2
1975 - 4
1977 - 4
1978 - 5
1980 - 2

Pakistan (35)

1971 - 1
1972 - 2
1973 - 1
1974 - 4
1975 - 5
1976 - 3
1977 - 3
1978 - 2
1979 - 2
1980 - 4
1981 - 8

Philippines (20)

1971 - 4
1972 - 3
1974 - 1
1975 - 6
1977 - 2
1978 - 1
1979 - 1
1980 - 2

Thailand (28)

1972 - 1
1973 - 2
1976 - 3
1977 - 4
1979 - 7
1980 - 5
1981 - 6

Vietnam (2)

1981 - 2

NORTH AFRICA AND MIDEAST

Algeria (1)

1973 - 1

Egypt (17)

1971 - 1
1973 - 2
1974 - 3
1975 - 2
1976 - 2
1977 - 2
1978 - 2
1979 - 1
1980 - 2

Syria (1)

1978 - 1

Tunisia (3)

1971 - 1
1977 - 2

Turkey (13)

1973 - 2
1974 - 1
1978 - 3
1979 - 2
1980 - 3
1981 - 2

Yemen Arab Rep. (3)

1975 - 1
1976 - 1
1977 - 1

TROPICAL AFRICA

Botswana (2)

1978 - 1
1980 - 1

Cabo Verde (1)

1981 - 1

Cameroon (1)

1973 - 1

Ethiopia (6)

1974 - 1
1976 - 1
1977 - 1
1980 - 1
1981 - 2

Ghana (22)

1974 - 3
1975 - 3
1979 - 2
1980 - 6
1981 - 8

TROPICAL AFRICA (cont.)

Ivory Coast (4)

1971 - 1
1974 - 1
1975 - 2

Kenya (5)

1975 - 2
1976 - 1
1980 - 2

Malawi (4)

1976 - 1
1980 - 1
1981 - 2

Mozambique (3)

1981 - 3

Nigeria (12)

1972 - 3
1973 - 1
1974 - 4
1975 - 4

Rwanda (1)

1978 - 1

Senegal (1)

1977 - 1

Swaziland (1)

1980 - 1

Tanzania (52)

1972 - 5
1973 - 6
1974 - 4
1975 - 4
1976 - 6
1977 - 12
1978 - 9
1979 - 4
1980 - 2

Transkei Rep. (1)

1980 - 1

Uganda (1)

1973 - 1

Zaire (31)

1972 - 6
1973 - 4
1974 - 4
1975 - 5
1976 - 1
1978 - 2
1979 - 6
1980 - 2
1981 - 1

Zambia (5)

1977 - 1
1978 - 2
1980 - 1
1981 - 1

Other (4)

1973 - 1
1975 - 1
1977 - 1
1980 - 1

NUMBER OF PREDOCTORAL FELLOWS WHO HAVE CONDUCTED THEIR RESEARCH PROGRAM AT CIMMYT

Colombia	1
Egypt	1
Honduras	1
Ivory Coast	1
Malaysia	1
Mexico	3
Tanzania	2
USA	7
West Germany	1
Zaire	1
Zimbabwe	1
Total	20

Appendix I.

MAIZE STAFF

Ernest W. Sprague, USA, Director
R.L. Paliwal, India, Associate Director
Carlos De León, Mexico, Back-Up Unit
N.L. Dhawan, India, Back-Up Unit
Federido Kocher, Switzerland, Training
John Mihm, USA, Across Program
A.F.E. Palmer, UK, Training
Shivaji Pandey, India, Advanced Unit
David Sperling, USA, International Testing
Surinder K. Vasal, India, Quality Improvement
Alejandro Violic, Chile, Training

Pre-and Postdoctoral Fellows
Momcilo Babič, Yugoslavia
Daniel Hinderliter, USA
David Jewell, Australia
Ching-yan Tang, Hong Kong
Richard W. Ward, USA

Andean Region
James B. Barnett, USA (Based in Colombia)
Gonzalo Granados R., Mexico (Based in Colombia)
Suketoshi Taba, Japan (Based in Ecuador)

Asian Region
Bobby L. Renfro, USA (Based in Thailand)
Kenneth S. Fischer, Australia (Based in Thailand)

Central America and Caribbean Region
Hugo S. Córdova, El Salvador (Based in Mexico)
Alejandro Ortega C., Mexico (Based in Mexico)
Willy Villena D., Bolivia (Based in Mexico)

Mideast Region
Wayne L. Haag, USA (Based in Turkey)

East African Region (proposed)
Bantayehu Gelaw, Ethiopia

West African Region
Magni Bjarnason, Iceland (Based in Nigeria)
Hiep Ngoc Pham, USA (Based in Nigeria)

Ghana
Gregory Edmeades, New Zealand

Pakistan
Richard N. Wedderburn, Barbados

Tanzania
James Deutsch, USA

Appendix II.

COMPOSITION OF MAIZE GENE POOLS AT CIMMYT

Pool 1. Highland Early White Floury

Blanco Harinoso Precoz Andino; Cacahuacintle; San Jerónimo; Kullu perico; Maíz Concebido; Huaraz Cuzqueño; Huaca Lurum; Cuzco; Holandes; Cabaña; Grupo Zona Andina Harinoso; Maíz Ancho; Pisankalla; Shima; Mishca; Titicaca 1,4,5,6,7,8,9,10; Parba Amarilla; Caraz Morado; Uchuquillo; Palta Waltace; Amarillo Cochabamba; La Paz Cuzco; Huillcaparu - Ckara-Paulla; Overo Chico; Holandes 1,2,3 & 4; Blando Arquile; Amarillo Chico; Soleanero Blanco; Krug; EC 466; HM-1, 18; Cun.365; RV-7; Montaña B-84; Syn. 4; V503; Nariño 373; V553; Hickory King; H401, 402; Planta corta Grano Morado; Amarillo y blanco, Amarillo Harinoso; Morocho Caraz; Cun. 431; Comp. floury o_2; Pachia; Precoces de Bolivia; Comp. Grano Grande; Cónico compuesto blanco; Cónico compuesto Amarillo; Mezcla precoz; Chalqueño blanco; New England flints; Criollo Baraza; Antioquia 418; Lin. Illinois; UMSS 264; Ver.35, 84; Zac. 34,36,39,41 and 58; Pue. 16,18,21,32,35,55,73,87,116,148,156,159 and 174; Arg. 460,471,481 and 544; Aguascalientes 2,19,26,27,30 & 42; Durango 7,12,14; Mexico 5,9,13,14,15,20,26,44,55,64,66,80,91, 102,106 and 207; Peshawar White; Swabi White; Corn Belt Composite; China 1; Kathmandu Early; Lagositos; Amarillo Bajío; Bannu Yellow; Davao Aroman; Tiniguib; Ghasa Local; Gpo.1 Zona Andina; SLP 137; Mexican Gpo.6,7A, and 10; P62,63,65,102; Tlaxcala 1 and 2; Criollo Guatero de la Virgen; Criollo Blanco Mancilla; Criollo Blanco Precoz; Barbosa; Concebida; Querétaro 25; Hidalgo 8; Oax. 88, 116; Guatemala 583; Criollo Amarillo Escamilla; Mich. 21,27; SSS; Criollo Blanco Gómez; Low Ear Syn.; Criollo Blanco Pico Gorrion; Criollo Blanco Dorsch; World Composite: Hickory King; Compuesto Inter-racial Precoz Amarillo; Dent Chile; MTPHM; Boy 399; Mazorca larga selección blanca; INIAP 101; Chuncula; Puca Checchi; Paro I; Rabo de Zorro I; Pura Capuli; Amarillo de Oro; Am. Ancash; PMC 631; PMV 661, 662; Omo o Kosñi; Oque; Huamanpacpan; Chaque Sara; Chupan Huanta; Luricocha Huanta; Ayacucho; Huanta Bajo; Pampas Huanca Velica; Ccasaccoha Huanta; Variedad Cochabamba; Uripa; Paucalbamba; Churcampa Tayacaja; Mezcla de Andahaylas; Mezclas de Chincula Blanco y Amarillo; Am. Comun Churcampa Tayacajas; Cajamarca Maiz Chochoca 8; Maiz Chochoca Variante Hso. 4; Maiz Chochoca 6 y 5; Hualtaco Bolivia; Mamanaca Tarata; Huilcaparu; Chincula; Blanco Morocho Bolivia; Terciopelo; Huascaran o_2; Comp. Choclero Carahuaz; PMV 461; High Alt.o_2; Comp. I o_2; Pairumani Ancho; Sabanero; Grupo E; Durango 201, 177,178,185,27; Chihuahua 209, 213, 212, 242, 243, 186, 191, 202, 165, 159, 174; Zacatecas 175, 170, & 153.

Pool 2. Highland Late White Floury

Cuzco Gigante - PMV 560; Choclero 1, 2; Hualtaco; PMC 561; Grano Grande; Cuzco-hijos; Maiz Blanco (Cuenca); Chincheros; Blanco (Penipe); Huantabajo; Paraquilla Bolivia; Maiz Blanco (Cuzco); Maiz Blanco (Saraguro); Maiz Blanco (Cajamarca); Chochoca; Chochoca Variante Hijo-2; Blanco Imperial; Agricultor 3; Sintetico B.W.I. Cubano; Olmos; Colección Chillos #7; Amaguaño; Zona de San Pablo (Blanco); Zona de Atuntagui (Blanco); San Luis (Blanco); Morocho Caraz; Cacahuacintle; San Jerónimo; Amarillo Harinoso; Materiales de Kenya; Blanco Mercado de Otavalo; Loja Maiz Blanco; Loja Blanco Ligero; Zona de Atuntagui Maiz Blanco; Zona de San Pablo Blanco; Zona de Bolivar Blanco Tipo Chillo; Blanco Bolivar Ensayo de Inhery; Amaguaña Maiz Blanco; Chunchi Mezcla; Zona de Cayambe Blanco; Penipe Blanco; Zona de Cayambe; Santa Rosa Flores Blanco; San Isidro San Luis Blanco; Cebadas Blanco; Cecel diron blancos; Blanco Huaraz Mercado; Comp. Amilaceo; Sint. B.W. y Cubano; Olmos; Piscorunto E.E. Taray; Blanco Urubamba E.E. Huayacari; Mamanaco Tarata; Chupan Huanta; Casaceoha; Uchunquilla; Maiz Pairumani Ancho; Pampas Huancavelica; Chuncula; Paro 1; Rabo Zorro 1; Maiz Blanco; Rojo Huaratambo 2; Chuta; Maiz Gris 1; Morocho Rojo; Kapia; Maiz Pintado; Umutu; Colorado Oña; Checchi; Cuenca Maiz Blanco; Cuenca Maiz Blanco; Parroquia de Bolivar; Blanco Ligero Rojo; INIAP 101; Blanco Harinoso Precoz; Kullu Perico; Maiz Concebido; Gpo. Zona Andina Harinoso; Cabaña; Holandes 1,2,3 & 4; Maiz Ancho; Pisankalla, Zhima; Mishca; Titicaca 1,4,5,6,7,8,9 and 10; Parba Amarilla; Amarillo Cochabamba; Huillcaparu; Krug; EC 466; HM 1, 18; Cun. 365, RV 7; Montaña B-84; Syn. 4; V503; Nariño 373; V 553; Hickory King; H401; H402; Precoz Bolivia; Lineas Illinois, UMSS-264; Veracruz 35,84; Conico compuesto blanco; Conico compuesto amarillo; New England flints; Mezcla precoz; Zacatecas 34,36,39,41 and 58; Pue.16,18,21,32,35,55,73,87,116,148,156,159 and 174; Argentina 460,471,481 and 544; Aguascalientes 2,19,26,27,30 & 42; Durango 7,12,14; Mexico 5,9,13,14,15,20,26,44,55,64,66,80, 91,102,106 and 207; Criollo Baraza; Peshawar White; Swabi White; Corn Belt Composite; China 1; P. Pakistan, Kathmandu Early; Lagositos; Amarillo del Bajío; Bannu Yellow; Davao Aroman; Tiniguib CMU; Ghasa local; Gpo. 1 Zona Andina; SLP 137; Mexican Gpo. 6, 7A and 10; P62, 63, 65,102; Tlaxcala 1 and 2; Criollo Cuatero de la Virgen; Criollo Blanco Mancilla; Criollo Blanco Precoz; Barbosa; Concebida; Queretaro 25; Hidalgo 8; Oaxaca 88, 116; Guatemala 583; Criollo Blanco Gomez; Low Ear Syn.; Criollo Blanco Pico Gorrion; Criollo Blanco Dorsch; World Composite: Compuesto inter-racial precoz amarillo; Dent Chile; Boy 399; Antioquia 418.

Pool 3. Highland Early Yellow Floury

Comp. Amarillo Harinoso; PMC 631; PMS 635; Terciopelo; Rojo Huarotambo; Piscorunto; Compuesto Paro; Har. Precoz Chico; Comp. muy precoz de altura; Sabanero; Sacchasa; Checchi; Pura Capulli; Kulli Morado; Mishca Pura; Am. de Oro; Am. Ancash; PMS 631; PMV 661; Almidon; San Geronimo; Huancavelicano; Omo o Kosñi; Rojo Huaratambo; Puca Sara; Oque; Ancashino; Huamanpacupan; Comp. Grano Grande; Planta Corta Grano Morado; Chuta Precoz Morado Azul; Poucabamba Mezcla; Chincheros Andahuaylas; Alequileña Bolivia; Chupan Huanta; Luricocha Huanta; Am. Har. de Bolivia; INIAP 126; Huascaran o_2; Materiales de Cuba; Comp. Cuzco Crist. Am.; Boyaca 399; Cacahuacintle o_2; Chillos; ICA V505; Precoces de Bolivia; Pachia; Negros de Bolivia y Peru; Lineas Illinois; Krug; Long ear Nebraska; Tennesse Low Ear; Corn Belt Composite; Stiff Stalk Synthetic; Amarillo Mississippi; C103; Wf_9; Hy; Jala; Deep Kernel Synthetic; Illinois High Oil; USA 342; Ohio 51A; A344; Mo 211; Alph 14; Rulfo; Holandes 1,2,3,4; Antigua 418; Cun. 365; RV7; M13; A73; L97, L319; Parba; Montaña B Synthetic 5; SLP Mezcla; Veracruz Mezcla; Mezcla Amarilla P.B.; Compuesto de Altura x Mezcla Tropical; Zamora; Synthetic 11; Acajete; Synthetic Mest.; Amarillo Huam; Largo del Día; Michoacan 21; Capio Montaña; Maiz Ancho; Cacahuacintle; Conico compuesto; Zacatecas 39; Mlonda; Mezcla Aguascalientes; Mezcla Puebla; Ver. Mezcla conica x Cuba; Ver. Mezcla Conica x Puerto Rico; Chalqueño; Titicaca 6,8,9, Pisankalla; Amarillo Uchuquillo; Palta Waltace; UMSS-204; INIAP 176; Overo chico; Comiteco; Olotillo; Indian Chief x Jarvis; Bolivia 635; Pachia mezcla; Swabi White; Janey; Chanar; Changarzai; Iyabi; Pakistan precoces mezcla; Hungary 660; Marceño; Criollo Ixtacalco; San Juan Amarillo Syn. 11; Compuesto Amarillo Crist. Templado Argentino; Amarillo Bajío; Zacatecas 34, 36; Conico V10; Conico Compuesto; Bolita; Criollo Baraza; SLP3 x 214203; SLP25 x 245131; Camelia; H49; H55; Mexican Gpo. 7A; Guerrero 26; Veracruz Razas de Mexico granos normales; Selection maices Zona Andina Crist., Hidalgo 7; Guat. 432, 482; Argentina 460, 471, 481, 541; Oaxaca 116; Mexico 3, 5, 6, 9, 13, 14, 19, 20, 26, 38, 55, 56, 85, 91, 106, 207; Puebla 16, 30, 32, 55, 71, 73, 86, 87, 116, 148, 156, 158, 159, 174; Aguascalientes 2, 26, 30, 42; H49, 51, 52, 53, 54; Tlaxcala 1, 5; Ver. 35, 151, 168, 212; Durango 7, 14; SLP3, 25, 137; P1-14, 17, 18, 22, 30, 32, 34, 43, 48, 49, 50-55, 57, 58-65, 67-69, 83-87, 89-111; H-632; SV11, 13,14, 17, 28, 37; SR200; Kitale 11; Ukiriguru BWC3; Blanco Katanga; Zambia Composite A; Celaya P.B. (Cuatera); Mazorca LSB; Qro. 55; Mlonda; Criollo Chimalt.; Hickory King; Long Ear Synthetic; Lineas El Salvador; Tuxpeño P.B.; Sta. Catalina; Har. Mosquera; Antigua 439; Zhima; Uruguay; Oloton; Hidalgo 3; Materiales de Zaire; V553; Maiz Ancho Amarillo; Maices Argentinos; Caraz Morado; Caraz mercado; Huaca Lurum; Amarillo Cochabamba; La Paz Cuzco; Huillcaparu; Huillcaparu Ckara; Huillcaparu Paulla; Kullu perico; Blando Arquile; Amarillo Chico; Soleanero blanco; Callejón de Hueylas; Rojo Chico.

Pool 4. Highland Late Yellow Floury

INIAP 125; Colecciones de Chillos; INIAP 126; Umutu; ICA V506; MB 54; MB 52; Sabanero Blanco; Grano grande; Materiales de Kenya; INIAP 128; Chillo Huandango; Chancho Huandango; Huandango; Chillo; Comp. tolerante al frio; Comp. Internacional tolerante al frio; Comp. Ancashino Tardío; Comp. Marañon 2; Comp. Rabo de Zorro; Comp. Paro; MB 51; MB 56; Mishca; ICA V505; Zona de Bolivar Chinclintina; Zona de Bolivar Am. Hso. tipo Chillo; Zona de San Pablo Am. Hso.; Zona de Natabuela Chaucho Am.; Zona de Atuntagui Am.; Chulpi; Zona de Cayambe Am.; Zona de Cayambe los Chillos Am.; Zona de Imbabura Am. Mishqui; Mercado de Ibarra Am. Hso.; Mercado de Otavalo Am.; Parroquia de Bolivar Am.; Am. Bolivar ensayo de Inhery; Amaguaña Maiz Amarillo; Tena Colección Chillos # 7; Maiz Chinclintina Zona del Tena; Mishca Coleccion # 5; Am. Hso. Quito Colección # 3; Comp. Am. Hso. Quito Km. 15; Mishca Rumiloma Colección # 4; Am. Comp. # 2 and 1; Mercado de Cuenca Am.; Penipe Maiz Amarillo; Flores Am.; Mercado de Natabuela Am. Hso.; Maiz Am. Prov. Imbabura Chachinviro; Cajamarca Agricultors - 1; 2; 3; Cajamarca 78 negro - 1; 2; 6; Rojo Huaratambo Mercado; Huaraz Mercado; Caraz Mercado; Maiz Comun Mercado Huaraz; Terciopelo-2; Terciopelo; Amilaceo Ancashino; Capio Carhuaz; PMC 572; Morocho; Sin. Americano; Comp. Piurano; Morocho Ayacuchano; Comp.Am. Ancashino; Shajatu Precoz; Comp. Am. Morocho; Am. Duro Precoz; Cajamarca Negro 3, 4; Casca Kulli; Chulpi; Chaminco Am. de Oro; Am. Calca Sint.II; San Geronimo Am. Sahuayaco; Poulcalbamba; Hualtaco; Kellu; Huantaco Bajo; Huilcaparu; Paro II; Kulli Morado; Am. Oro; Am. Ancash; Harinoso Precoz Chico; Planta Corta Grano Morado; Cacahuacintle; Rojo Huarotambo; Morocho Am. # 1; Morocho Rojo; Paccho; Tablas Monte; Amarillo de Potosi; Am. de la Remonta; Mez. Am.; Lineas Illinois; Amarillo Harinoso; Grano Grande; Sapieta; INIAP 128; H-632; SV11, 13, 14, 17, 28, 37; SR200; Kitale 11; Ukiriguru BWC3; Blanco Katanga; Zambia composite A; Montaña B; Celaya P.B. (Cuatera); Titicaca 8; Mazorca LSB; Qro. 55; Mlonda; Chalqueño; Criollo Chimalt.; Hickory King; Krug; Long Ear Synthetic; Long Ear Nebraska; Jala; Lineas El Salvador; Tuxpeño P.B.; Sta. Catalina; Han. Mosquera; Antigua 439; Capio Montaña; Zhima, Olotillo; Comiteco; Oloton; Hidalgo 8; Materiales de Zaire; V553; Precoz Bolivia; Lineas Illinois; San Geronimo; Amarillo Huam.; Puerto Rico; Holandes 1; Maiz Ancho Amarillo.

Pool 5. Highland Early White Morocho

INIAP 151; Durango 159; Chihuahua 153; Durango 27, 203; Planta Corta Grano Morado; Comico Amarillo; Blanco Sabanero de Colombia; Comp. Hungria; Criollo Baraza; Titicaca; UNCAC 242; Grano Grande; Comp. muy precoz; Bolivia Negro precoz morado; Chuto; Huaraz Morado; Precoz Blanco; Precoces tropicales; Sabanero muy precoz; Comp. Cristalino Blanco; Cun. 431; Diacol 551; Gaspe; ICA 553; Uchuquillo; Zhima; INIAP 153; Chalqueño A; Cuzco Gigante; Pairumani Ancho; Pairumani Comp. 10; Mercado San Gabriel Morocho Blanco; Zona de Tena Morocho Blanco; Zona Bolivar; Mercado de Tulcan; Mercado de Ibarra Morocho Blanco; Hda. de la Providencia; Via Quito Colección # 2; Cuenca Morocho Blanco; Rocamex; Comico Comp. Blanco; Mezcla Precoz; Chalqueño Blanco; New England Flints, Krug; EC-466; Cun. 365; RV7; Boy 393; Antioquia 418; MTPHM; Lineas Illinois; Pisankalla Titicaca; Precoz Bolivia; San Jeronimo; UMSS 264; Cacahuacintle; Veracruz 35,84; Zacatecas 34, 36, 39, 41 and 58; Puebla 16, 18, 21, 32, 35, 55, 73, 87, 116, 148, 156, 159 and 174; Arg. 460, 471, 481 and 544; Aguascalientes 2, 19, 26, 27, 30 and 42; Durango 7, 12, 14; Mexico 5, 9, 13, 14, 15, 20, 26, 44, 55, 64, 66, 80, 91, 102, 106 and 207; Peshawar White; Swabi White; Corn Belt Composite; China 1; Kathmandu Early; Lagositos; Amarillo Bajío; Bannu Yellow; Davao Aroman; Tiniquib; Ghasa Local; Gpo. 1 Zona Andina; SLP 137; Mexican Gpo. 6,7A, and 10; P62, 63, 65, 102; Tlaxcala 1 and 2; Criollo Cuatero de la Virgen; Criollo Blanco Mancilla; Criollo Blanco Precoz; Barbosa; Concebida; Queretaro 25; Hidalgo 8; Oax. 88, 116; Guatemala 583; Criollo Amarillo Escamilla; Mich. 21, 27; Stiff Stalk Synthetic; Criollo Blanco Gomez; Low Ear Syn.; Criollo Blanco Pico Gorrion; Criollo Blanco Dorsch; World Composite; Comp. Inter-racial Precoz Amarillo; Dent Chile; P. Pakistan; Tiniquib; Amarillo del Bajío; Holandes 1, 2 & 3.

Pool 6. Highland Early Yellow Morocho

PMV 569-Amarillo Morocho; C.R. Morocho II; C.R. Morocho I; Comp. Piurano; C.R. Cus. Crist. Am. I, II & III; Morocho Ayacuchano Sint. 1; Pool Amarillo Morocho; Amarillo tipo Conico; Blanco Sabanero Colombia; Chihuahua; Titicaca; Bolivia Negro; Chuta; Precoz Huaraz - Blanco, Morado, Amarillo; Comp. Hungria; UNCAC 242; Maiz de Indonesia; Maiz Ancho; Grano Grande; Introgression Cubano; PMC 563; Comp. Cuzco Cristalino Am.; Amarillo de Oro; Morocho Ayachano; Morocho Am. Duro; Boyaca 400; Boyaca 399; Baraza; Sabanero; Muy precoz de Altura; Comp. tolerante al frio; Aysuma; Morochillo; Harinoso precoz chico; Mezcla Amarilla; Lineas Illinois; INIAP 125; Am. Harinoso; MB 51; Morocho Amarillo 2; High alt. o_2; Mercado de San Gabriel; Morocho Blanco; Zona de Tena; Párroquia de Bolivar (Morocho Blanco); Mercado de Tulcan (Morocho blanco); Mercado de Ibarra (Morocho blanco); Hda. de la Providencia (Mor. bl.);

Colección # 2 via Quito; Zhima Mercado Cuenca; Cuenca (Mor. bl.); Blanco (Mercado de Cuenca); Comp. Internacional tolerante al frio; INIAP 151; Krug, Long Ear Nebraska; Tennesse Low Ear; Corn Belt Composite; Stiff Stalk Synthetic; Amarillo Mississippi; C103; Wf_9; Hy; Jala; Deep Kernel Synthetic; Illinois High oil; USA 342; Ohio 51A; A344; Mo 211; Alph 14; Rulfo; Holandes 1,2, 3,4; Antigua 418; Cun. 365; RV7; M13; A73; L97, L319; Parba; Montaña B Synthetic 5; SLP Mezcla; Veracruz Mezcla; Mezcla Amarilla P.B.; Compuesto de altura x mezcla tropical; Zamora; Synthetic 11; Acajete; Synthetic Mest.; Amarillo Huam; Largo del Día; Michoacan 21, Capio Montaña; Cacahuacintle; Cónico compuesto; Zacatecas 39; Mlonda; Mezcla Aguascalientes; Mezcla Puebla; Ver. Mezcla conica x Cuba; Ver. mezcla conica x Puerto Rico; Chalqueño; Titicaca 6, 8, 9, Pisankalla; Amarillo Uchuquillo; Palta Waltace; UMSS-204; INIAP 176; Overo Chico; Comiteco; Olotillo; Indian Chief x Jarvis; Bolivia 635; Precoz Bolivia; Pachía mezcla; Swabi white; Janey; Chanar; Changarzai; Iyabi; Pakistan precoces mezcla, Hungary 660; Marceño; Criollo Ixtacalco; San Juan Amarillo Syn. 11; Compuesto Amarillo Crist. Templado Argentino; Amarillo Bajío; Zacatecas 34, 56; Conico V10; Conico Comp.Bl.; Bolita; Criollo Baraza; SLP3 x 214203; SLP25 x 245131; Camelia; H49; H55; Mexican Gpo. 7A; Guerrero 26; Arroz Amarillo; Dent Chile; New England Flints; Comp. Criollo Puebla o_2; Puerto Rico; Cuba; Compuesto Razas de Mexico granos normales; Selection maices Zona Andina Crist.; Hidalgo 7; Guat. 432, 482; Argentina 460, 471, 451, 541; Oaxaca 116; Mexico 3, 5, 6, 9, 13, 14, 19, 20, 26, 38, 55, 66, 86, 91, 106, 207; Puebla 16, 30, 32, 55, 71, 73, 86, 87, 116, 148, 156, 158, 159, 174; Aguascalientes 2, 26, 30, 42; H49, 51, 52, 53, 54; Tlaxcala 1, 5; Ver. 35, 151, 168, 212; Durango 7, 14; SLP3, 25, 137; P1-14, 17, 18, 22, 30, 32, 34, 43, 48, 49, 50-55, 57, 58-65, 67-69, 83-87, 89-111; Uruguay; Rojo Chico; H-632; SV11, 13, 14, 17, 28, 37; SR200; Kitale 11; Ukiriguro BWC3; Blanco Katanga; Zambia Composite A; Celaya P.B. (Cuatera); Mazorca LSB; Qro. 55; Criollo Chimalt.; Hickory King; Long ear synthetic; Lineas El Salvador; Tuxpeño P.B.; Sta. Catalina; Har. mosquera; Antigua 439; Oloton, Hidalgo 3; Materiales de Zaire; V553; Maiz ancho amarillo; Conico comp. Am.; MTPHM; Mazorca larga selección blanca; Swabi White; China 1; Kathmandu Early; Lagositos; Bannue Yellow; Davao Aroman; Tiniguib; Ghasa Local; Gpo.1 Zona Andina; SLP 137; Mexican Gpo. 6, and 10; P62, 63, 65, 102; Tlaxcala 2; Criollo Cuatero de la Virgen; Criollo Blanco Mancilla; Criollo Blanco Precoz; Barbosa; Concebida; Queretaro 25; Hidalgo 8; Oax. 88; Guatemala 583; Criollo Amarillo Escamilla; Mich. 21, 27; Criollo Blanco Gomez; Criollo Blanco Pico Gorrion; Criollo Blanco Dorsch; World Composite; Comp. Inter-racial Precoz Amarillo; Dent Chile.

Pool 7. Highland Late White Morocho

INIAP 151; C.R. Morocho-I, II; C.R. Cus. Crist. Amar. I, II, III; Comp. Piurano; Morocho Ayacuchano Sint. I; Pool Am. Morocho; Blanco Ligero; Maiz Blanco; Chupan Huanta; Mamanaka Tarata; Morocho Blanco; Morocho; Cecel Arron; Chochoca variante har. 2; Cebadas Blanco; Chunchi Mezcla; Huaraz Mercado Blanco; Comp. Amilaceo; Blanco Amilaceo Precoz; Zhima; Morocho Andino; Grano Grande; Sabanero Blanco; H-632; SV11, 13, 14, 17, 28, 37; SR 52, SR 200; Kitale 11; Ukiriguru BWC3; Blanco Katanga; Zambia Composite A; Montaña B; Celaya P.B. (Cuatera); Titicaca 8; Mazorca LSB; Qro. 55; Mlonda; Chalqueño; Criollo Chimalt.; Hickory King; Krug; Long ear synthetic; Long Ear Nebraska; Jala; Lineas El Salvador; Tuxpeño P.B.; Sta. Catalina; Har. mosquera; Antigua 439; Capio Montaña; Olotillo; Comiteco; Oloton; Hidalgo 8; Materiales de Zaire; V553; Precoz Bolivia; Lineas Illinois; San Jeronimo; Puerto Rico; Holandes 1; Maiz Ancho Amarillo.

Pool 8. Highland Late Yellow Morocho

INIAP 151; CR. Morocho-1, II; C.R. Cus. Crist. Amar. I, II, III; Comp. Piurano; Morocho Ayacuchano Sint. I; Pool Am. Morocho; Blanco Ligero; Maiz Blanco; Chupan Huanta; Mamanaka Tarata; Morocho Blanco; Morocho; Cecel Arron; Chochoca variante har. 2 ; Cebadas Blanco; Chunchi Mezcla; Huaraz Mercado Blanco; Comp. Amilaceo; Blanco Amilaceo Precoz; Zhima; Morocho Andino; Grano Grande; Sabanero Blanco; H-632; SV11, 13, 14, 17, 28, 37; SR 52, SR 200; Kitale 11; Ukiriguru BWC3; Blanco Katanga; Zambia Composite A; Montaña B; Celaya P.B. (Cuatera); Titicaca 8; Mazorca LSB; Qro. 55; Mlonda; Chalqueño; Criollo Chimalt.; Hickory King; Krug; Long ear synthetic; Long Ear Nebraska; Jala; Lineas El Salvador; Tuxpeño P.B.; Sta. Catalina; Har. mosquera; Antigua 439; Capio Montaña; Olotillo; Comiteco; Oloton; Hidalgo 8; Materiales de Zaire; V553; Precoz Bolivia; Lineas Illinois; San Jeronimo; Puerto Rico; Holandes 1; Maiz Ancho Amarillo.

Pool 9. Highland Late White Dent

SR-52; Kitaly Syn. II; Ecuador 573; Tuxpeño Pools 11-14 (previous highland pools); Race Montaña; and the following Guatemala "criollos" Criollo 34, Criollo 48, Criollo 89, Criollo 4; B-71.

Pool 15. Tropical Early White Flint

Maiz blanco harinoso; Taveron; Pujagua Rojo; Pujagua Blanco; Mocho precoz; Minita; Dahorney 1, 2, 3, 4, 5; Zapalote Chico; Antigua Gpo. 2; Maiceno Blanco; Guatemala 225; Aroman White Flint; White Segregates from crosses of Compuesto Tropical precoz with mezcla amarilla; Cristalinos Blancos and Aroman white; Blancos Cristalinos P.B.; White segregates from crosses of Aroman white with Antigua Gpo. 2 (granos blancos); Cubano; Cuprico and St. Croix; Nicaragua Synthetic 2; Mezcla precoz Pakistan; Mezcla precoz Philippines; Putih-Nusa; Impa-Impa; R.D. 650; Pendudok; NO-650; Blanco Cristalino-1; Eto Blanco; Comp. Blanco Pfister x varios tropicales; Tuxp. x Nicarillo; Sint. 10 Lin.; (Mix.1-Col.Gpo.1)Eto; ES88-ES Gpo. 1A-Nicaragua Syn. II; Compuesto Caribe; Guatemala 335; Guerrero 100, 176; Nicaragua 55; Sonora 55; Mata Hambre; Guajira 314; Materials resistant to downy mildew; El Salvador 85; Honduras 46; Honduras 32; Nicaragua 80; Nic. 64; Jalisco 282; Uruguay 720; Pool 15-Selections from Colombia.

Pool 16. Tropical Early White Dent

Maiz blanco harinoso; Taveron; Pujagua Rojo; Pujagua Blanco; Mocho precoz; Minita; Dahorney 1, 2, 3, 4, 5; Zapalote Chico; Antigua Gpo. 2; Maiceno Blanco; Guatemala 225; Aroman White Flint; White Segregates from crosses of Compuesto Tropical precoz with mezcla amarilla; Cristalinos Blancos and Aroman white; Blancos Cristalinos P.B.; White segregates from crosses of Aroman white with Antigua Gpo. 2 (granos blancos); Cubano; Cuprico and St. Croix; Nicaragua Synthetic 2; Mezcla precoz Pakistan; Mezcla precoz Philippines; Putih-Nusa; Impa-Impa; R.D. 650; Pendudok; NO-650; Tuxpeño-1; Mezcla Tropical Blanca; Tuxpeño Caribe; (Mix.1-Col. Gpo.1)Eto; Honduras Gpo. 13A; Honduras 58, 68, 69, 84, 87; Guatemala Gpo. 13-2A; El Salvador 77, 82, 87, 103; San Luis Potosi 100; Mata Hambre; Guajira 314; materials resistant to downy mildew; El Salvador 56; Guatemala 93; Guat.94; Hondruas 33; Honduras 60; Pool 16-Selections from Colombia.

Pool 17. Tropical Early Yellow Flint

Maiz blanco harinoso; Taveron; Pujagua Rojo; Pujagua Blanco; Mocho precoz; Minita; Dahorney 1,2, 3, 4, 5; Zapalote chico; Ant. Gpo. 2; Maiceno blanco; Lousiannurn flint; Guatemala 225; NO-1034; KP4; Bogor Comp. 10; Genjah Kodok; Genjah Warangan; NO-1039; Penjalinan; Krase Kan; Nagung Tgngkol; Amarillo Cristalino-1; Mezcla Amarilla; Tuxpeño x Nicarillo; Sint. 10 Lin.; Eto Blanco; (Mix.1-Col.Gpo.1)Eto; Mata Hambre; Guajira 314; Antigua 2, 4; Barbados 1, 3, 5; Cuba 40, 75; Guadalupe 3,4, 11; Honduras 97; Israel 1; St. Vincent 3; Uruguay 643, 684, 698, 711; Local Flints (80 and 90 days) from Malaysia; Indonesian Comp.; Pairumani Syn.; Corn Belt materials; Materials resistant to downy mildew; Puerto Rico 5; Uruguay 665; Antigua 1; 5; Guadalupe 15; Uruguay 691; 747; Pool 17 - Selections from Colombia.

Pool 18. Tropical Early Yellow Dent

Maiz Blanco Harinoso; Taveron; Pujagua Rojo; Pujagua Blanco; Mocho precoz; Minita; Dahorney 1, 2, 3, 4, 5; Zapalote Chico; Antigua Gpo. 3; Marceno Blanco; Lausiannurn flint; Guatemala 225; Kuning; Ketoyong; Genjah Kodok; NO-1030; Pernalinan; Krase Kan; Nagung Tgngkol; Amarillo Dentado 1 & 2; Ant. x Rep. Dominicana; Amarillo Dentado Sel. Misc. P.B.; Santa Croix 6; Guatemala 73; Jalisco 279; Oaxaca 244; Diacol V206; Nayarit 36; Amarillo Bajío; Mata Hambre; Guajira 314; Dominican Republic 203, 240, 243, 258, 271, 274, 275, 277; El Salvador 105; Guatemala 262; Israel 2; materiales resistant to downy mildew; Dom. Rep. 246; Pool 18 - Selections from Colombia.

Pool 19. Tropical Intermediate White Flint

Blanco Cristalino (White segregates recovered from crosses among materials such as Antigua; Cuban flints, Cuprico, St. Croix, Aroman, Tuxpeño, and white segregates from Mezcla amarilla); Mix. Col. Gpo. 1; Eto Blanco; Syn. 10 lineas; Compuesto blanco tipo Caribe; Antigua Gpo. 2 seleccion blanca; Compuesto de Philippine precoces (Advanced generation crosses among materials such as Manolo, Fortich blanco, Fortich 3, Aroman, Lagositos, Mit selection, Bukidnon mix, Cotabato white flint, Mimis); Compuesto de Philippine precoces e intermedio - blanco cristalino; Compuesto de Philippine precoces y tardios - blanco dentado; Palung valley white; Syn. 66; Pando; Población cristalina; Tuxpeño - Caribe; Tennesse Lines; Celaya; Eto P.B.; Tuxpeño Antigua Gpo.2; Pfister hybrids; Lineas Illinois; PD(MS)6; Tuxpeño br_2 x Nicarillo; Compuesto Ecuador; Mexico; Argentina and India (Var. 13 Pichilingue, $L_{115-3\#}$, $L_{210-3\#}$, $L_{13-2\#}$, 242 Tep. x (120 LM_2A_1), $L_{110-3\#}$, 584 Pion, 302 x 242 Tep., $L_{115-2\#}$, 536 P-10ñx304, 5667, PD(MS)6, VS2-1-1-1-1-2#, INIAP 504, 536 Pion, x-304, L_{39-2}, 5662, Leales Cristalinos Argentinos, Sikkim amarillo, Tuxpeño amarillo, Mezcla amarilla P.B. 83 intercruzados); IDRN; Compuesto Blanco Pfister; Sicarigua Mejorado; Guatemala Gpo. 26-1A; Nayarit 22; Panama 138, 141; materials resistant to downy mildew; Compuesto Caribe; materials from Colombia; materials resistant to tar spot; Honduras 46; El Salvador 52; Pool 19 - Selections from Colombia.

Pool 20. Tropical Intermediate White Dent

Compuesto Philippine precoz x tardio; compuesto blanco intermedio para India & Southeast Asia; Tuxpeño Caribe-1; W.C., IDRN; Honduras Gpo. 13-A; San Luis Potosi Gpo. 10, 14, 54, 56, 58; Nigeria 1; Guatemala Gpo. 13-5A; Guatemala 786, 794; Nuevo Leon 8, 12; Jalisco 274, 286; Nayarit 165; Sinaloa 21; Tabasco 2; Oaxaca 225; Katumani Comp.; Blanco Comun; Nicaragua Syn. 11; Zapalote Grande; materials resistant to downy mildew; materials from Colombia; materials resistant to tar spot; Guatemala 90; Honduras 58; El Salvador 46; El Salvador 59; Honduras 54.

Pool 21. Tropical Intermediate Yellow Flint

(Mix.1-Col. Gpo. 1) Eto x Sint. 10 lineas; Compuesto Ecuador; Mexico, Argentina and India; Mezcla Amarilla P.B. C_7; Ant. Gpo. 2 x Republica Dominicana C_7; Compuesto material resistente Achap. (Advanced generation crosses of Mezcla amarilla and Ant. x Ver.181 with PD(MS)6, Cuba x Rep. Dominicana, and Nicarillo); Serie Cris.; Thai composite; Cuprico x flint compuesto; IDRN; Materials resistant to downy mildew; Amarillo Salvador; Guatemala Gpo. 72; Tuxpeño FF; Haiti Gpo. 3; Guadalupe 16; Compuesto Caribe; Panama 114, 148, 149; Costa Rica 47; St. Vincent 4, St. Vincent 6; St. Vincent 8; Cuba 9, 11; Guatemala 73; Guadalupe 6, 16; Surinam 796; Uruguay 699; Pool 21 - Selections from Colombia.

Pool 22. Tropical Intermediate Yellow Dent

Antigua x Ver.181 P.B. (C_6); Amarillo Dentado-1 (crosses among selected families of V520C x A6, Recife, Cristalino-dentado, Amarillo precoz, Cuba 11J, Eto, PD(MS)6, Granos amarillos, Tuxpeño amarillo); Mezcla amarilla x varios amarillos (Ant.x Ver.181, Compuesto amarillo Central Americano, LACP, V520C, Sint. 10 lineas, Pob. Cristalina, Crist. Dentado, and Nicarillo); Misc. sel. dent. amar. tropical (yellow segregates from crosses among materials from Brazil, Peru, Mexico and Caribbean islands plus yellow segregates recovered from crosses among materials such as Cuba, Antigua, Tuxpeño and Republica Dominicana); Compuesto Ecuador, Mexico, Argentina and India; W.C.; IDRN; U.S. Corn Belt materials, materials resistant to downy mildew; Puerto Rico 7; Brazil 1280; Rep. Dom. 119; Rep. Dom. 248, 245, 45 237, 238, 38, 169, 241, 249; Brazil 3024; Cuba 22.

Pool 23. Tropical Late White Flint

(Mix.1 Col. Gpo.1) Eto x Sint. 10 lineas; Sint. 10 lineas; Compuesto IACP blanco (Advanced generation crosses among materials such as J_1; College white x Tuxpeño; UPCA Var.1, 2, 3; Bogor Comp. 2; E.H. 4207; Jawahar syn. 44; Kisan; Cuprico x Flint Compuesto, Kisan Syn. 70, Ganga 5, Sona Syn. 72, Vijay, Composite D, Metro, Guatemala P.B. 5, Harapan); Nicarillo x Sint. 10 lineas; Tuxpeño P.B. x Sint. 10 lineas; Compuesto blanco Central Americano (Salco; Sint. Nil. 2; Nicarillo; Tocumen 70; H_3, 5, 101; Poey T23, 27, 66 and 72; ICA-H104, 154, 207, 302; Comp. precoz SM/H111; Pioneer X304A, X306A, XB101, XB101A, X-354; TR-1; Desarrural H-B101, 105; A0Doble 6; B-Doble 2; Cuyuta H2; and H507); Tuxpeño-Caribe 2; Mezcla tropical blanca; Compuesto Caribe; materials resistant to downy mildew; materials from Colombia; Trinidad 34; White flint segregates - selections from Colombia.

Pool 24. Tropical Late White Dent

Tuxpeño P.B. C_{11} x La Posta C_2; Tuxpeño-Caribe 2; Mezcla tropical blanca; Eto Mix.1-Col.Gpo.1; Blancos cristalinos; Pfister hybrids; Compuesto IACP (Blanco); Compuesto resistente a Pudrición; Compuesto resistente a tallo; Compuesto grano duro; Nicarillo; Compuesto blanco Central Americano; V520C, A6, A21, N12; PD(MS)6 - Seleccion blanca; IDRN, materials from Zaire; materials from Colombia; materials resistant to downy mildew; materials resistant to tar spot; Guatemala 88, 104; Pool 24 - Selections from Colombia.

Pool 25. Tropical Late Yellow Flint

Mix.1-Col.Gpo.1; Eto; Sint. 10 lineas; Compuesto Ecuador, Mexico, Argentina, and India; Mezcla amarilla x varios amarillos (Ant. x Ver.181, Comp. Amarillo Central Americano, IACP, V520C, Pob. Cristalina, Crist. Dentado, and Nicarillo); Cuba; Republica Dominicana; Serie Cris.; Tuxpeño; Nicarillo; Tuxpeño Caribe-2; Amarillo Cristalino-1 (Yellow flint segregates recovered from advanced generation crosses among materials such as Cuba 11J, Eto amarillo, PD(MS)6, Granos amarillos & Tuxpeño amarillo - sel. crist. C_3); Cogollero; Materials resistant to downy mildew; materials resistant to tar spot; Costa Rica 71; Cuba 2, 3, 13, 65, 16; Panama 64; Surinam 800; Pool 25 - Selections from Colombia.

Pool 26. Tropical Late Yellow Dent

Amarillo Bajío; Sint. 10 lineas; Mezcla amarilla x varios amarillos (same as in Pool 25); Compuesto Central Americano; Compuesto IACP (Amarillo); Tuxpeño; Nicarillo; Tuxpeño Caribe-2 (yellow segregates); Dentado amarillo P.B. (same as in Pool 22); Amarillo Dentado 2 (involves materials such as Cuba 11J, Eto amarillo, Gr. amarillo, Tuxpeño amarillo sel. dentado, V520C, A6, A21, Nicarillo); Comp. materials resistente achap. (Advanced generation crosses of mezcla amarilla and Ant. x Ver.181, Cuba x Republica Dominicana); Cogollero; IDRN; Materials resistant to downy mildew; materials resistant to tar spot; Puerto Rico 2; Trinidad 20; Cuba 25, 47, 56, 95, 107, 121; Dom. Rep. 150, 206; Brazil 820; Cuba 33, 167; Puerto Rico 9; Haiti 30; St. Vincent 2; Pool 26 - Selections from Colombia.

Pool 27. Temperate Early White Flint

Intercrosses among materials such as Swabi; Janey; Changarzai; Chanar; Changez; Kohot precoz; Bannu precoz; Zacatecas 58; Lyabi; Materials resistant to downy mildew; Mata Hambre; Guajira 314; Minita; Pujaguas; Pai Pao Mi; King Ting Tse; Shiao Sui Hua; Ki Tan 102-SC; Ki Shun 83-DC; Ki Shun 107-DC; Ian Shan No. 6-TC; Pe Rhe Su; Hsiao Pai Chi; NEMP-3, BK-FS (Early); NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS; NEMP-1, BK-FS (Bekka 1); NEMP-1, BK;

White flint segregates (Argentina 565, Arg. 567, Guatemala 246, Guat. 317, Guat. 313); Mex. Mix.; Super Mix.; Exotic Gene Pool; BS-8; IDRN-Cornell; Pennsylvania Gene Pool; USA 342; GR-9; PRMP-1; GR-8; GR-10; YB-8430; B-58; YB-8431; CBC-77; Pai Syn. 5; 71 SAPB-581; HIYF; Largo del Día; Am. Subtropical; 71 SA PB-579; Andaluz, Perla; Local var. of Zala; Samsun 63; INRA 310; Queixale; Tremesino; 63A; Yellow Dent of Midszentpuszta; 61A; 65A; F.B. of Mortonvasar; HMV 979; 71A; Bannu Yellow; Blanco; Hembrilla Norteña; INRA 400; MV-MSC 342; Kohot #1; 14A; Germany 504; Swabi White; Changez; HMV 833; 105A; Cuña; Norteño; Daxa; Enano Levantino; 12A; Basto; Avanyoson; "F" early yellow dent; 108A; MV-SC 429; MV-MSC 342; Rastrojero; MV-TC 281; 22A; 27A; MV-TC 610; MV-SC 620; Puenfeareas; HMV 979; Fino; Grano de Trigo; Rosero; Germany SCQ; MV-TC 596; Germany TC 182; Bierre; 191-13; Synth. Ct. Fd. 741; GC 4; MK-1-2-1; MK-3, VSH; Micca; MK-1-2-2; German Pool - White flint segregates.

Pool 28. Temperate Early White Dent

Materials resistant to downy mildew; Mata Hambre; Guajira 314; Minita; Pujaguas; Dent segregates from Pool 27 x Corn Belt; Hungary (materials making up pool 30); Dent segregates from Blanco Pakistan; Taveron; Tla. Syn. C-62; Pai Pao Mi, King Ting Tse; Shiao Sui Hua; Ki Tan 102-SC; Ki Shun 83-DC; Ki Shun 107-DC; Ian Shan No. 6-TC; Pe Rhe Su; Hsiao Pai Chi; NEMP-3, BK-FS (Early); NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS (Sel.); NEMP-1, BK-FS-Sel. (Bekka No. 1); NEMP-1, BK; (Argentina 565; Guatemala 246; Guat. 317; Guat. 313; Arg. 567; Mex. Mix.; Super Mix.) - White Dent Selections; CBC; GR-6; Minn. Syn. AS3; BS-8; GR-7; GR-5; YB 8432; B-58; GR-2; BS-7; Pennsylvania Gene Pool; Illinois-high oil-protein; Hawaii 5; Westigua; 77: SJ-3300, 3374, 3286, 3271, 3718, 3533, 3702, 3443, 3207, 3422; BSUL-1; Funk's "F"; DDCAD1C-2; DDCH1C-2; DDCH1C-1; DDCKZ1C-1; Andaluz; Hembrilla; Vasco; MVSC 370; INRA 402; INRA 310; MVMSC 291; Puenfeareas; Fino; 16A; Gallego; Bannu Yellow; 59A; 45A; 105A; 106A; 108A; 121A; 53A; 40A; 63A; 76A; 81A; 102A; 12A; 105A; 115A; 118A; 7A; Blanco; Rosero; Avanyoson Yellow Dent; MVTC 540; MVSC 370; Queixale; Tremesino; HMV 719; "F" early Y-D; MVTC 540; Local var. of Zala; MVDC 460; Daxa; HMV 832; Dent of Szeged; AT 633; Kohot; Swabi White; Changez; Perla; Molledo; F-2; F-1256; F-1615; F-1772; 364; 9; 1307; Z.P. - SK 28T; Yuzpdc-94; Pau 564; 3216/2-8; Zplt 193; Concorde 560; 1318; MV-21; 129-16; 165-17; 164-2; 138-1; USA Pool - White Dent segregates.

Pool 29. Temperate Early Yellow Flint

Materials resistant to downy mildew; Amarillo Bajío Precoz; Indonesian Comp.; Pairumani Syn.; Materials from Holland - Aurelio; Capella; Diana; Elina; Florina; Fronica; Fortha; Leopard; Pastora; Sandrina; Tamira; Rheintaler; Uruguay Composite; Amarillo Bajío; MV.SC.202; MV.TC.281; MV.TC.290; MV.MSC.201; MV.MSC.262; MV.MSC.342; BE-KE 270; UNCAC 242; Cornell Precoz; Compuesto Indonesia; Pai Pao Mi; King Ting Tse; Shiao Sui Hua; Ki Tan 102-SC; Ki Shun 83-DC; Ki Shun 107-DC; Ian Shan No. 6-TC; Pe Rhe Su; Hsiao Pai Chi; NEMP-3, BK-FS (early); NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS-Sel.; NEMP-1, BK-FS-Sel. (Bekka 1); NEMP-1, BK; Yellow Flint Segregates (Argentina 565, Arg. 567, Guatemala 246, Guat. 317, Guat. 313); Mex. Mix.; Super Mix.; GR-5; GR-4; GR-8; GR-11; GR-13; YB 8432; B-58; Exotic Gene Pool; BS-8, YB 8430; Pennsylvania gene pool; Minn. Syn. ASA; YB 8431; CBC 77; Andaluz; Perla; Local var. of Zala; HMV 719; MVDC 59; MVTC 281; MV.SC.587; MVTC 540; MV.SC.429; MV.SC.587; HMV 978; 69A; 60A; 61A; 101A; 115A; 19A; 125A; 22A; Kohot; Queixale; Tremesino; AT 633; FB of Martonvasar; Basto; Enano Levantino; INRA 188; Vasco; Cuña; Bannu Yellow; Blanco; Perla; Dent of Szeged; Norteño Largo; Rosero; Hembrilla; "F" early yellow dent; Swabi White; Puenfeareas; Grano de Trigo; Yellow dent of Mindszentpuszta; German Pool - YF segregates; Cónico compuesto blanco & amarillo; Mezcla precoz; chalqueño blanco; New England Flints; Criollo Baraza; Krug; EC-466; Cun. 365; RV7; Boy 399; Holandes 1,2 & 3; Antioquia 418; MTPHM.

Pool 30. Temperate Early Yellow Dent

Materials resistant to downy mildew; Amarillo Bajío Precoz; Indonesian Comp.; Pairumani Syn.; Materials from Holland - Aurelio; Capella; Diana; Elina; Florina; Fronica; Fortha; Leopard; Pastora; Sandrina; Tamira; Rheintaler, (Ht_1A; Ht_1B to Pool 30 only); Sabana Grande; Canda; Los Altos; El Viejo; Santa Ana; Maicillo; Tola Rivas; MV.MSC.342; MV.TC.281; MV.TC.290; MV.MSC.201; MV.SC.202; MV.MSC.201; MV.MSC.262; BE-KE 270; UNCAC 242; Cornell Precoz; Compuesto Uruguay; Amarillo Bajío; Titicaca Precoz Amarillo; Chihuahua Gpo. E; Pool 1; Syn. 107; Syn. 137; MV.SC.291; MV.SC.370; MV.TC.431; MV.DC.59; MV.DC.460; MV.DC.520; MV.SC.530; MV.SC.590; MV.SC.405; MV.SC.587; MV.TC.596; MV.TC.610; MV.SC.620; MV.TC.635; MV.SC.660; MV.SC.380; MV.SC.429; MV.SC.598; Mazorca Larga; MV.TC.540; MV.DC.350; KSC.360; GK-TC 433; Low Ear Syn. (Early) Tenn; Eto (M) C_6 Iowa; Comp. Indonesia; Compuesto Colorado Precoz de Argentina; Eta; Tau; Pai Pao Mi; King Ting Tse; Shiao Sui Hua; Ki Tan 102-SC; Ki Shun 83-DC; Ki Shun 107-DC; Ian Shan No.6-TC; Pe Rhe Su; Hsiao Pai Chi; NEMP-3, BK-FS (Early); NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS-Sel.; NEMP-1, BK-FS (Bekka 1);

NEMP-1, BK; Yellow Dent segregates (Argentina 565, Arg. 567; Guatemala 246, Guat. 317, Guat. 313); Mex. Mix.; Super Mix; CBC 62A; GR-4; GR-12; GR-3; GR-7; GR-5; GR-8; GR-13; YB 8429; YB 8430; CBC 77: Min. Syn. AS3; Pennsylvania Gene Pool; IDRN-Cornell; BSCB (R); USA 342; BS-7; Exotic Gene Pool; Westigua; 77: SJ 3120, 3080, 3443, 3773; Funks "D"; DDCSR1C0; DDCHT2C2; Tremesino; Queixale; 71A; Kohot; Bannu Yellow; Andaluz; Dent of Szeged; Rosero; Basto; MV.SC.47A; 74A; Gallego; Vasco; Puenfeareas; Blanco; "F" early yellow D; Red. King; Samsun 63; INRA 240; Seg. from 4; FB of Martonvasar; INRA 310; Hembrilla Norteña; Cuba; Enano Norteño; AT 209; BT; AT 633; Local var. of Zala; HMV 424; Germany 504; USA Pool - YD segregates.

Pool 31. Temperate Intermediate White Flint

Materials resistant to downy mildew; White flint segregates from Comp. Ecuador, Argentina, India and Mexico; White flint segregates from Temp. Intermediate White Dent (Pool 32); Temp. Intermediate Yellow Flint (Pool 33); Blanco Pakistan; Hua Ma Ya; Kun Lung Pai; Ki Tan 101-SC; Lu Shan No. 9-TC; Lu Tan No.31-SC; Lu Tan No. 33-SC; Lu Tan No. 34-SC; Liao Tan No.2-SC; Shen Tan No. 1-SC; Ian Shan No. 10-TC; Cheng Tan No.1-SC; Huan-1-1; Wu 102; Wu 105; Hsiang Yuan Huang; Ta Ba Tang; Liao Tung Pai; Tun Liao Huang Ma Ya; Sha Ling Tse Pai Ma Ya; Huang Hua Tsuo; NEMP-3, BK-FS (Early); NEMP-3, BK-FS-Sel.; NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS-Sel.; NEMP-1, BK-FS (Bekka 1); NEMP-1, BK; Venezuela 568; Guatemala 143; Guat. 151; Guat. 232; Sonora 141

Pool 32. Temperate Intermediate White Dent

White segregates from Amarillo Bajío; White segregates from Temperate Yellow Flint Composite (See In Pool 33 for materials involved in this composite); Eto; PD(MS)6; Sint. 10 lineas; Pob. Cristalina; Tuxpeño Caribe; Tuxpeño br_2; Nicarillo; Eto; Tuxpeño; Lineas Illinois; South Carolina 228; Materials resistant to downy mildew; Compuesto Blanco Dentado de Argentina; Hua Ma Ya; Kun Lung Pai; Ki Tan 101-SC; Lu Shan No. 9-TC; Lu Tan No. 31-SC; Lu Tan No. 33-SC; Lu Tan No. 34-SC; Liao Tan No. 2-SC; Shen Tan No. 1-SC; Ian Shan No.10-TC; Cheng Tan No. 1-SC; Huan 1-1; Wu 105; Wu 102; Hsiang Yuan Huang; Ta Ba Tang; Liao Tung Pai; Tun Liao Huang Ma Ya; Sha Ling Tse; Pai Ma Ya; Huang Huo Tsuo; NEMP-3, BK-FS (Early); NEMP-3, BK-FS (Sel.); NEMP-1, BK-FS (Bekka 1); NEMP, BK; (Guatemala 143; Guat.151; Guat. 232; Sonora 141; Coahuila 12) - White Dent Selections.

Pool 33. Temperate Intermediate Yellow Flint

Temperate yellow flint composite (Abati 2, Morgan Rendidora, Cargill 103, Cargill 110, Holandesa, Precoz Simoni, Población Cristalina, PD(MS)6, Eto amarillo, Cuba 11J, China 1, Tuxpeño amarillo, Composite AC, Cuban flints, Tuxpeño x New England Flints, Corn Belt composite, Antigua 2D, Nariño 330 - Peru 330, Colorado-Manfredi, Westigua, Cuba 16, P. Pakistan and Mazorca larga); Crosses of Temperate yellow flint with Hungary 660; Kfardan Lineas Illinois; Republica Dominicana; Long Ear Nebraska; Mazorca larga; Jala; Peru; Ghasa loca; Kathmandu early; Inbreds from Yugoslavia; Zacatecas 58; Bannu yellow; Kohot early; Tiniguib Aroman; Uruguay 625, 630, 641, 664, 669, 671, 672, 683, 685, 688, 689, 690, 693, 699, 730, 667, 716; Brazil 2115; Amarillo Bajío; Same as Pool 31 except Yellow flint grains selected from Comp. Ecuador, Argentina, India and Mexico; Huang Huo Tsuo; NEMP-3, BK-FS(early); Hua Ma Ya; Kun Lung Pai; Ki Tan 101-SC; Lu Shan No. 9-TC; Lu Tan No. 31-SC; Lu Tan No. 33-SC; Lu Tan No. 34-SC; Liao Tan No. 2-SC; Shen Tan No. 1-SC; Ian Shan No. 10-TC; Cheng Tan No. 1-SC; Huan 1-1; Wu 105; Wu 102; Hsiang Yuan Huang; Ta Ba Tang; Liao Tung Pai; Tun Liao Huang Ma Ya; Sha Ling Tse; Pai Ma Ya; NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS; NEMP-1, BK-FS (Bekka 1); NEMP-1, BK; Guatemala 242; Honduras 49; Sonora 141; Venezuela 336; Guatemala 151.

Pool 34. Temperate Intermediate Yellow Dent

Crosses of tropical x Highland materials; Cuba; Puerto Rico; US 342; Zamora; Syn. 11; San Vicente; Amarillo de Cajete; Veracruz 151; Veracruz 168; Veracruz 212; Aguascalientes; Guadalupe; Puebla; Veracruz mezcla conica; San Luis Potosi; Rulfo; Amarillo Huamantla; Corn Belt composite; Stiff Stalk Synthetic; Amarillo Mississippi; Reacción largo del día; Mezcla amarilla P.B.; Lineas Illinois; Hungary 660; Long Ear Nebraska; Jala; Mazorca larga; Peru; Tuxpeño amarillo; Población cristalina; Antigua; Cuba; Republica Dominicana; Amarillo Bajío; Sint. 10 lineas; Compuesto Intermedio de Altura; Yugoslavian inbreds; Cogollero x USA; Lineas Illinois resistente a Puccinia sorghi and Helminthosporium turcicum; BSSS(R)C_6; BSCB1(R)C_6; Alph 14; Swabi; Janey; Changarzai; Materials resistant to downy mildew; Ht_1A; Ht_1B; South Carolina 229; Yellow dents from Amarillo Pakistan; Hua Ma Ya; Ku Kung Pai; Ki Tan 101-SC; Lu Shan No. 9-TC; Lu Tan No. 31-SC; Lu Tan No. 33-SC; Lu Tan No. 34-SC; Liao Tan No. 2-SC; Shen Tan No. 1-SC; Ian Shan No. 10-TC; Cheng Tan No. 1-SC; Huan 1-1; Wu 105; Wu 102; Hsiang Yuan Huang; Ta Ba Tang; Liao Tung Pai; Tun Liao Huang Ma Ya; Sha Ling Tse Pai Ma Ya; Pai Ma Ya; Huang Huo Tsuo; NEMP-3, BK-FS (Early); NEMP-3, BK-FS (Sel.); NEMP-2, BK-FS (Mount Lebanon); NEMP-2, BK-FS (Sel.); NEMP-1, BK-FS (Bekka 1); NEMP-1, BK; Guatemala 143; Guat. 242; Honduras 49; Sonora 141; Chile Z30; Guat. 279.

Gene Pool for the Northern Temperate Region

Corn Belt Composite; Westigua; Super Mix.; Sperling Early Composite; Sperling Extra Early Comp.; Long Ear Nebraska; Corn Belt Dent Comp.; IDRN Cornell; Assinbaing; Hawaii 5; Wisconsin P.R.; Florida Syn.; Illinois High Oil (1); Illinois High Oil (2); Illinois High Protein; USA 342; Ohio Hybrid 1; OH 2; OH 3; Ohio Inbred A; OI C; S. Carolina 228; S. Carolina 229; Adopted Gene Pool; Exotic Gene Pool; Penneg. Luvannia Gene Pool; BSCB (R) C-6; BSSS (R) C-6; SA 65A Escapes; SA 65B; CA 65 Escapes; Syn. B. High 34 d. cycle SI-128-70-301-340; CB entry No damage; BS 7 (S_2) C-1; BS 8 (S_2) C_1; Sample 1; Minn. Syn. ASA; Minn. Syn. ASB; Minn. Syn. ASD; Minn. Syn. ASG; Minn. Syn. ASDK (S)C-3; Minn. Syn. AS 3 (HT) C-3; PR MP 1; PR MP 4; Pioneer X 352; Pioneer X 354; Pioneer X 356; Tlade; YB 8430 B58 (SB) C-2; YB 8431 B58 (SB) C-3; YB 8432 B58 (SB) C-4; YB 8429 B58 C-9; WF 9; W 32; M 14; Zea Maiz Undenlata 163; ZMU 165; ZMU 166; ZMU 578; ZMU 579; ZMU 580; ZMU 187-R; Kansas Drought Syn.; Pai Pao Mi; King Ting Tseñ Shio Sui Hua; Pai Tuo Sua; Hua Ma Ya; Kun Lung Pai; Ki Tan 101; Ki Tan 102; Ki Shun 83; Ki Shun 107; Lu Shan No. 9; Lu Tan No. 31; Lu Tan No. 33; Lui Tan No. 34; Liao Tan No. 2; Shen Tan No. 1; Ian Shan No. 10; Ian Shan No. 6; Cheng Tan No. 1; Huan-1-1; Wu 105, Wu 102; Hsiang Yuan Huang; Ta Ba Tang; Liao Tung Pai; Tun Liao Huang Ma Ya; Sha Ling Tse Pai Ma Ya; Pe Rhe Su; Pai Ma Ya; Huang Huo Tsuo; Hsiao Pai Chi, NEMP-3 BK-FS (Early); NEMP-3 BK-FS; NEMP-2 KB-FS (Mount Lebanon); NEMP-2 BK-FS; NEMP-1 BK-FS (Bekka No. 1); NEMP-1 BK-Mex. Mix.; Locar Early Jutiapa; Selections tolerant to drought; SP 109; Agroceres 28; Saye 231; Cargill 501; Cargill 464; Pioneer X307; Agroceres 30; Pioneer 28034; Mezcla (Agroceres 64 + Mezcla Saye 334 + Pioneer X313 + Cargill 413); Yugoslavia GR (1-18); 37 lines from Kansas; Eleven materials from Korea; BS 10(FR); BS 11 (FR); BS 13 (S_2); BSSS$_2$(SCT); BS (SCT); BS UL-2; BS CT 235; BS CT 234; BS UL-1; 868 H. maydis resistant; B-80; B-81; B-82 Yellow; B-83; Lancaster type; Reid type; Funks "F"; Funks "D"; H3992; H3993; H3994; DeKalb DD (CAD1C2; CHT1C2; CPM1C1; CHC1C1; CKZ1C1; CSS1C1; CCG1C0; CMD1C1; CSR1C0; CSQ1C0; CON1C0; CONT1C0; CHM1C2; CAD2C2; CHT2C2; CHM2C2; CPM2C1; CHC2C1; CKZ2C1; CSS2C1; CCG2C0; CMD2C1; CSR2C0; CSQ2C0; CON2C0; CONT2C0; CAD3C2; CHT3C2; CHM3C2; COM3C1; CHC3C1; CKZ3C1; CSS3C1; CCG3C0; CMD3C1; CSR3C0; CSQ3C0; CON3C0; CONT3C0; 200F; 200M; 400F; 400M; 600F; 600M; 800F; 800M; LO-F; LO-M; EO-F; EO0M).

Andaluz; Basta; Blanco; Cuña; Daxa; Enano Levantino; Enano Costeño; Fino; Gallego; Hembrilla; Norteño; Norteño Largo; Queixale; Rastrojero; Tremesino; Vasco; Grano de Trigo; Perla; Rosero; Andaluz; Mengacia; Tolsa; Molledo; Puenfeareas; MV-SC 202; MV-TC 281; MV-TC 290; MV-MSC 291; MV-SC 370; MV-TC431; MV-DC 59; MV-DC 460; MV-DC 520; MV-SC 530; MV-SC 570; MV-SC 580; MV-SC 405; MV-SC 587; MV-TC 596; MV-DC 602; MV-TC 610; MV-SC 620; MV-TC 635; MV-SC 660; MV-SC 380; MV-SC 429; MV-SC 598; MV-SC 630; MV-TC 540; MV-TC 201; MV-MSC 262; MV-MSC 342; MV-DC 350; BE-KE 270; GK-SC 513; 1A to 34A; 36A to 78A; 80A to 85A; 87A; 90A to 94A; 96A; 97A; 99A to 131A; Yellow Dent of Mindszentpuszta; Dent of Szeged; Avayozon Yell Dent; "F" early Yell. Dent; Red King; White Flint of Midszentpuszta; FB of Midszentpuszta; FB of Martonvasar; Local Var. of Bodrogkoz; Local var. of Zala; Local var. of Fehervar; HMV 969-1; HMV 1024-3; HMV 719-2; HMV 832; HMV 833-5; HMV 929; HMV 978; HMV 979; HMV 1027; HMV 424-3; OH 51A; Kutumbuli Selec. Large; Samsun 63; INRA 258; INRA 230; INRA 240; INRA 260; INRA 310; INRA 400; INRA 402; INRA 188; AT; AT1 to AT6; AT 203; AT 209; AT 564; AT 630-S; AT 633; BT; 002; 007; 500; 504; SCP; SCQ; D373; TC 11; TC 182; W 401; Yugoslavia Kol 77 GR 1 to GR 18; Seg. from 1-5; Kohot, Swabi White; Changez; Janey; Chanar; Bannu Yellow; Pinot-France (Italie, Roux de Landes, Bierre, Guchen, Flint French S.C.'s, Yugoslavie, Doue du Rouest, Pyrenes); Kovacs-Hungary (F5 Fix (-), (J.T.E.S.) F_4, (Z.P.-SK-28T)F_4); Jakacki-Poland (SC (1-12), (1-2-1, 1-2-2, 1-3, 3, 10, 12, 21, 32, 34, 41, 42, 72 RF, 79 RF, 129-26, 164-2, 165-17, 191-1, 191-12, 191-13, 192-9, 194-1, 196-2, 200-2, 209-8, 164-2 x 138-1, 200-2 x 138-1, S72 HST x MK8-2, S72 HST x 138-1); GIE-Pioneer-France (Flint Synt. x #, CB Synt. x #, CDS x ##); KWS-Germany (Garbo, Ibo, Hit, Granat, Iso, Iris, Irha, Micca, Massa, Forla, Garoche, Hausa, Erox, Miris, Moco, Ferro, Edo, Gavott, Giga, Inka, Gabix, Ira, Perdux, Hai, Harpun, Illo); Kojic-Yugoslavia (Yu ZPL (3259/11, 3261/8-10, G-54/1.14, 518-3-12, 2039-9-12, 1703/4-12, 3028, 3216/2-18), Yuzpdc (94/1-77, 16/1-77, 269/1-77, 75/1-76, 42/1-77, 50/1-77, 44/1-77, 45/1-77), Yuzptc 391/3-77, zpdc-150/1-77, zpbl-98-1, zplt-193/1, zpbr-386, zpl 373); Pollacsek-France (Massat, Bareilles, (F-2. F1256) (F1615. F1772); Bossuet-France (GC (1-15), Primeur 170, Silac 233, Master 243, Rega 246, Royal 255, Star 304, Visa 324, Major 560); Majester-France (1190, 1198, 1218, 31H30, 364, 0005, 1307, 1318, 1323, Typhon 204, Beaufort 221, Survit 241, Cuzco 251, Astron 252, P-362, P-365, Phoebus 365, Pau-564, Concorde 560, Synt. ct.f.d.79-1, Synt. Ryrale, Pop. 31, VSH, Synth. Flint 73, Synth. Dent 73, Synth. totale 73, Melange Lardony, BKB, BKA); Kiss-France (20-14, 60-205, 60-206, 60-209, 60-215, 60-216, 60-226).

Gene Pool for the Southern Temperate Region

CIMMYT Maize Gene pools (HEWF, HEWD, HEYF, HEYD, HIWD, HIYF, HIYD, HLWF, HLWD, HLYF, HLYD); Eto x Illinois; Amarillo Bajío; Largo del Día; Blanco-Subtropical; Amarillo Subtropical; Blanco Pakistan; Amarillo Pakistan; Pairumani Syn. 5; Amarillo Bajío x Varios Templados; Pakistan Precoces; 71 S APB - 483, 231, 581, 495, 579, 487, 174, 313, 314, 346, 347, 491, 492, 582, 585, 199-228, 494, 474, 532, 505, 235, 344, 345, 525, 584, 540, 485, 336, 337, 539, 300-303, 366, 367, 534, 526, 527, 528, 573, 576, 577, 579, 521, 533, 340-342, 529, 538, 526, 588, 524, 625, 626, 350, 351, 493, 490, 359, 372, 373, 390, 399-403, 348, 349, 356, 496, 486, 506, 511, 472, 482, 481, T5 111.

CIMMYT-Germany Maize Exotic Gene Pool

Chihuahua Comp.; Precoz Titicaca; Largo del Día; Morocho; Corn Belt; Blanco Pakistan; Temp. x Trop. H.E.o_2; Comp. Hungary; Amarillo Pakistan; Temperate Early White Flint (Pool 27); Precoz Pisankalla; Confite Puneno; Cornell Early; Zac. 58; 2417 x 2421; Criollo Barraza; Pakistan Precoz; UNCAC 242; Pairumani Synth.; Lineas Illinois; Shingrachuon White Dent; Peking White Dent; Yellow Ken Chin; Highland materials from Mexico; Synth. 5; LBA; TALAT.

Brachytic-2 material

Brachytic-2 versions of Tuxpeño-1; TIWF (Pool 19); TIWD (Pool 20); TIYF (Pool 21); TLWF (Pool 23); TLYF (Pool 25); TLYD (Pool 26); and Brachytic-2 versions of Yellow Flint and White and Yellow Dent materials from CIAT (Colombia).