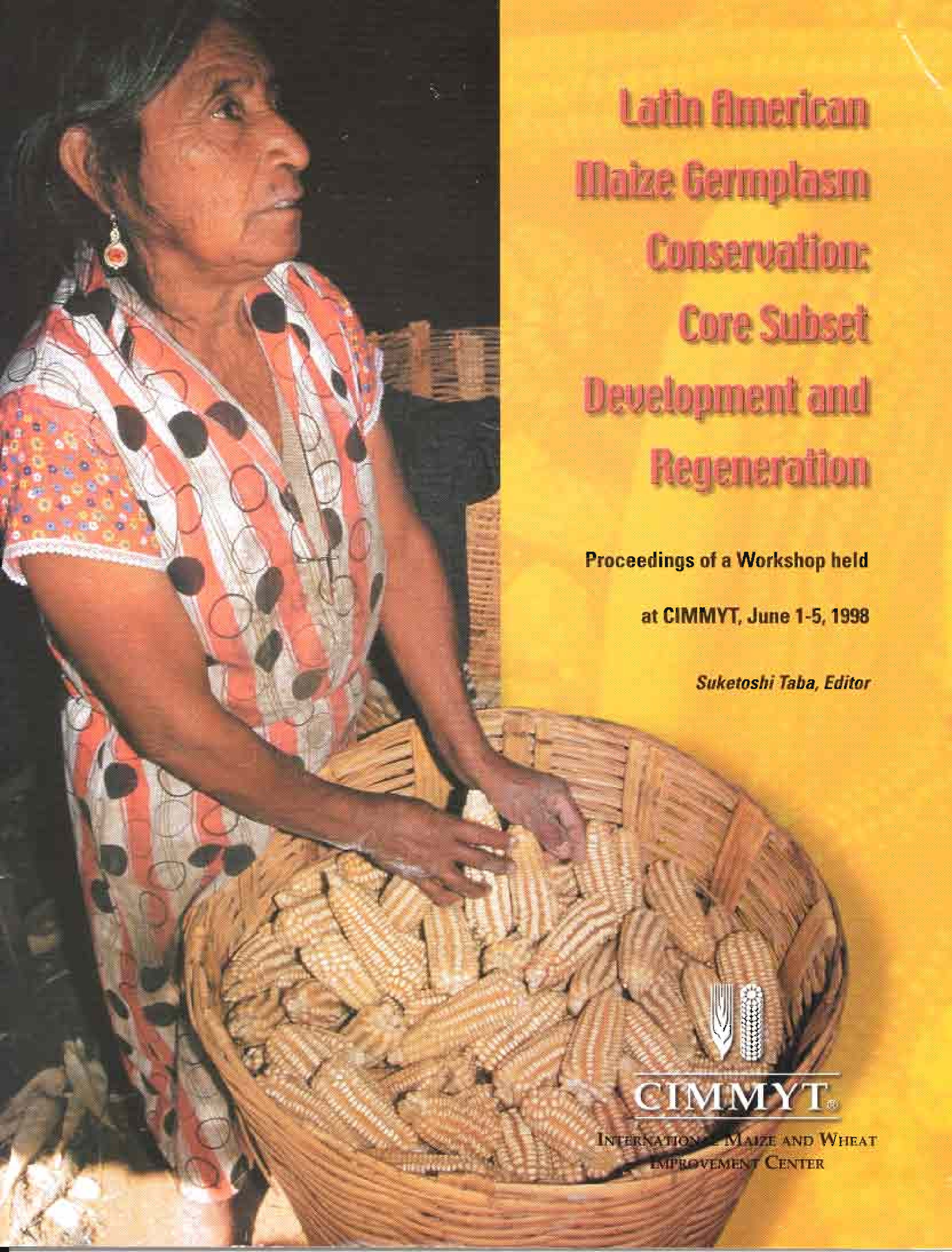

Latin American Maize Germplasm Conservation: Core Subset Development and Regeneration

Proceedings of a Workshop held at CIMMYT, June 1-5, 1998

Suketoshi Taba, Editor

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International Maize and Wheat Improvement Center

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Abstract: This publication describes progress in collaborative efforts to conserve, document, and characterize seed collections of maize from the Americas over the last decade, as reported in a workshop at the International Maize and Wheat Improvement Center (CIMMYT), June 1-5, 1998, and involving participants from North, Central, and South America and the Caribbean. Topics covered include methodologies for forming breeder-targeted core subsets of large seed collections and a specific subset developed based on agronomic evaluations and other data for collections from the Latin American Maize Project (LAMP; 1986-1996). Status reports on collections held in 13 countries of the region are provided, as well as recommendations for further efforts.

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AGRIS category codes: F30 Plant Genetics and Breeding; F70 Plant Taxonomy and Geography.

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Contents

The Status of Latin American Maize Germplasm Conservation

Suketoshi Taba and Steve A. Eberhart

Progress in the conservation of maize genetic resources from the Americas has been dramatic in the last 10 years, including among other things improved passport and seed inventory information, better preservation conditions in banks, and region-wide cooperation in regeneration, documentation, and improving access to germplasm holdings. This was the major conclusion of maize genetic resource experts from 13 countries in the region, who met at a biannual workshop organized and hosted by the International Maize and Wheat Improvement Center (CIMMYT, by its Spanish acronym), in Mexico, 1-5 June, 1998.

CIMMYT alone has nearly 20,000 maize accessions in its germplasm bank, including accessions from its breeding programs. This is almost twice the number of accessions in the bank in 1990, and begins to approach the center's goal of safeguarding all 27,000 accessions believed to exist in Latin America.

Many new accessions have been added as back-ups of collections of endangered samples of landrace seed regenerated as part of a collaborative project funded by the US Agency for International Development and the National Seed Storage Laboratory (NSSL)-US Department of Agriculture specific cooperative project (SCA) during 1993-97 (Table 1). Regenerated samples are also being backed up at the USDA National Seed Storage Laboratory, Fort Collins, Colorado.

Finally, workshop participants identified the need for in-situ conservation of local maize races in Argentina, Chile, Colombia, Bolivia, Ecuador, Guatemala, Mexico, Paraguay, Peru, and Venezuela. Efforts would focus on local races that are grown by farmers and contribute to the local economy but are not yet used in commercial breeding activities (for which reason they are often represented by relatively few accessions in bank collections). As a rule of thumb, any race with fewer than 100 accessions and still extensively cultivated by farmers may need systematic collecting and conservation. Such race accessions can be evaluated in situ, along with new collections from the site, and used to form breeder-targeted core subsets and in participatory breeding with the farmers. CIMMYT began work to help Mexican small holders preserve and use selected maize landraces and improve them for farmer-valued traits in 1997-98.

Evaluation: Key to Effective Use

Documentation efforts have included establishing an easily searchable electronic database that carries passport and other information dating back to the original collections of maize in Latin America (NAS-NRC:1954-55) and is available on the LAMP CD-ROM (see below).

To enhance the usefulness of collections to breeders and other researchers, subsequent projects have sought to round out passport data with information on the agronomic performance of the genotypes represented in the seed. The Latin American Maize Project (LAMP) evaluated more than 12,000 accessions and selected 270 elite accessions from 12 countries during 1986-96 (Salhuana et al. 1998ab).

In 1995, the US Germplasm Enhancement of Maize (GEM) project started pre-breeding of maize for grain yield and value-added grain quality traits using LAMP selected germplasm and has reported significant success (Pollak and Salhuana 1998).

Core Subsets of LAMP Accessions

The study of phenotypic diversity of sets of bank accessions grouped by race, adaptation region, and LAMP trials has progressed. A method for the multivariate statistical analysis of race classifications (Franco et al. 1998) has been developed at CIMMYT and used to form core subsets, based on LAMP data, CIMMYT trials, and characterization data from Bolivian and Colombian banks. A LAMP core subset[1] has been published on CD-ROM (CIMMYT 1999). The publication contains relevant data, designated core accessions, and graphical representations of the groupings formed using statistical analyses (e.g., canonical coordinates and can 1 vs can 2 scatter diagrams). Because of the limited number of traits evaluated in stage 1 of LAMP, the subset includes about 20% of the germplasm evaluated. As additional morphological and molecular data on the materials in the preliminary subset become available, a representative subset will be developed that will comprise only 10% of the stage 1 accessions. The accessions designated in the preliminary maize core subset will be included in the SINGER and the GRIN databases. Interested researchers can request seed of core subset accessions from CIMMYT, from the North Central Regional Plant Introduction Station (Ames, Iowa), and from the national maize germplasm banks of LAMP cooperators.

New Initiatives

A second phase of the germplasm evaluation (LAMP II) is being sought to evaluate accessions regenerated after LAMP and additional samples collected from in-situ conservation initiatives. The results would have varied applications, including the formation of additional core subsets of Latin American maize germplasm and genetic improvement of local races.

New prebreeding and evaluation initiatives (similar to GEM) are envisaged. Use of core subsets to screen for desired traits and form new populations for improvement is one promising avenue. Traditional, "grow-out" evaluation trials can be used to select outstanding per se performers and develop core subsets based on phenotypic diversity. To identify material of potential use in developing hybrids, evaluation of accessions in cross combinations with genotypes of elite genetic backgrounds is needed.

Seed Preservation and Exchange

One strong recommendation from the workshop was to consolidate germplasm accession identifiers from all Latin American maize germplasm banks. Most cooperating national banks now have their inventories in databases. Curators who use their own unique germplasm accession identifiers and many have started using the corresponding CIMMYT identifiers. NSSL uses CIMMYT identifiers for back-up collections from the CIMMYT/USDA-NSSL Latin American germplasm regeneration effort.

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[1] A core subset of a germplasm collection is formed by designating a limited number of accessions to represent most of the genetic variation in a collection, with minimum repetition. Core subsets encourage breeders to draw on useful genetic diversity from seed collections, making searches for source germplasm with desired traits more cost-effective. They are particularly helpful when there is little or no information regarding the most probable source of the trait of interest – for instance, when a breeder seeks a source of resistance to a new pathogen strain or a new pest biotype.

Back-up collections stored at NSSL but not yet preserved at CIMMYT include part of the IBPGR-funded collections from Argentina, Chile, Bolivia, Brazil, and Peru, as well as NAS-NRC collections from Colombia, Mexico, and Peru, which were regenerated by the USDA-ARS/North Carolina State University project directed by Major Goodman. From cooperators' reports there are some 9,000 accessions in the cooperators' banks or NSSL that CIMMYT needs to preserve as part of Latin American maize germplasm collection (Table 2).

Many LAMP accessions have not been safeguarded in long-term seed preservation at CIMMYT or NSSL. The designated core subset accessions should have priority in regeneration for safety duplicates in the base collections of the national and international germplasm banks. Secondly, they can be further evaluated for genetic diversity in prebreeding projects for incorporation of useful genes and QTLs (Tanksley and Nelson 1996, Tanksley and McCouch 1997) into advanced germplasm. They can also be used in marker-assisted genetic diversity studies, results of which will facilitate future management and conservation work (Smith et al. 1997). Finally, agro-morphological evaluation data from field trials still have a role, as they can aid in selecting germplasm sources for in-situ breeding or conservation projects (Taba et al. 1998).

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We gratefully acknowledge the following scientists who were involved in LAMP and provided germplasm evaluation data: Ing. Marcelo Ferrer (Argentina), Dr. Gonzalo Avila (Bolivia), Dr. Manoel Xavier Santos (Brazil), Dr. Carlos Diaz (Colombia), Ing. Orlando Paratori (Chile), Ing. Mario Fuentes (Guatemala), Dr. Salvador Castellanos (Guatemala), Dr. Francisco Cardenas (Mexico), Ing. Mercedes Alvares (Paraguay), Ing. Hugo Sanchez (Peru), Ing. Ricardo Sevilla (Peru), Ing. Jorge Rubio (Peru), Ing. Gerardo Vivo (Uruguay), Dr. Linda Pollak (USA), Dr. Quentin Jones (USA), Dr. Henry Shand (USA), Dr. Wilfredo Salhuana (USA), Ing. Arnordo Bejarano (Venezuela). We also thank Pioneer Hi-Bred Intl. for their financial support to the LAMP project, results of which were used to generate the core subset. Finally, the authors are grateful for support given for data analysis through the "specific cooperative agreement" (SCA) between NSSL-USDA and CIMMYT to regenerate maize landrace collections from Central and South America.

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Table 1. Regeneration and conservation of maize landrace collections in Latin America 1993-1998 in collaboration with the principal investigators of the country.

Country	No. of samples received	No. of unique samples received	CIMMYT new accessions
Argentina	401	328	328
Bolivia	508	421	421
Brazil	602	598	522
Chile	416	298	298
Colombia	1491	1,452	1,108
Cuba	101	101	101
Ecuador	595	323	153
Guatemala	304	304	97
Honduras	42	42	42
Mexico	5,308	3,443	3,146
Paraguay	84	84	84
Peru	537	493	448
Venezuela	149	138	116
TOTAL	10,538	8,025	6,864

Table 2. Numbers of accessions in need of regeneration and introduction to CIMMYT maize bank from Latin America and Mexico.

Country	No. Accessions	Collection Initiatives
Argentina	1,611	IBPGR, INTA
Bolivia	665	IBPGR, CIFP **
Brasil	203	IBPGR, CENARGEN
Chile	584	IBPGR, INIA
Colombia	1,777+735*	NAS-NRC, ICA
Mexico	2535	INIFAP, NAS-NRC
Peru	2,390	IBPGR, NAS-NRC
Venezuela	160	NAS-NRC, FONIAP
Total	10,660	

* NAS-NRC Collections of Ecuador (241), Bolivia (193), Chile (77), Panama (147), Peru (77). ** Centro de Investigaciones de Fitotecnia de Pairumani

A Core Subset of LAMP

Suketoshi Taba, Jaime Díaz, Jorge Franco, Jose Crossa, and Steve A. Eberhart

A core subset of a germplasm collection is formed by designating a limited number of accessions to represent most of the genetic variation in a collection, with minimum repetition. Core subsets encourage breeders to draw on useful genetic diversity from seed collections, making searches for source germplasm with desired traits more cost-effective. They are particularly helpful when there is little or no information regarding the most probable source of the trait of interest – for instance, when a breeder seeks a source of resistance to a new pathogen strain or a new pest biotype. Principle investigators from twelve countries (Argentina, Bolivia, Brazil, Chile, Colombia, Guatemala, Mexico, Paraguay, Peru, Uruguay, USA, and Venezuela) participated in the Latin American Maize Project (LAMP) in 1986-1996 (LAMP 1991; LAMP 1997). They planted more than 12,000 accessions in five homologous areas of maize adaptation as stage 1 of the project during 1986-88. Stage 2 comprised an evaluation of the 20% of the stage 1 accessions selected. Argentina started the work from stage 2. Trial and passport data for materials evaluated in both stages were published in a two-volume catalog (Catálogo del Germoplasma de Maíz, LAMP 1991). Because of the limited number of traits evaluated in stage 1 of LAMP, we included about 20% of the germplasm in the preliminary maize core subset. As additional morphological and molecular data on the materials in the preliminary subset become available, we expect to arrive at a representative subset that will comprise only 10% of the stage 1 accessions.

Cluster Analysis for Designating a LAMP Core Subset

LAMP trials were defined by countries, homologous areas, regions, and locations (Table 1). The table below describes trial regions, homologous areas, and numbers of the accessions evaluated in the trials for stage 1 of LAMP and stage 2 from Argentina. Descriptions of the trial germplasm are available in LAMP 1991 catalogues. We used means of the trials as reported in LAMP 1991 catalogs for the cluster analysis. We discarded some accessions for which three or more variables were not available and those with unreasonable values, as well as entire variables for which observations were incomplete across trial entries (when data for a given variable were missing for only a few entries, we simply substituted the overall mean value to complete the dataset). In the case of discrete variables (e.g., grain type and color), we assigned a value to a given seed entry when a particular type accounted for more than 10% of the total observations. Number of ears per plant was assigned binary values of 0 when it was less than 1, and 1 when it was more than 1. Ear quality rating (1-9) was also assigned the value of 0 when it was less than 4.5, and 1 when it was more than 4.5.

We used LAMP stage 1 data from the eleven original participants and stage 2 data from Argentina to analyze the phenotypic diversity of the accessions. Non-overlapping, homogeneous clusters were formed for each trial through cluster analysis as per the modified location model (MLM; Franco et al. 1998) using continuous and categorical variables. To designate a core subset to represent the phenotypic diversity of the accessions (Brown 1995), the upper 20% of best performing accessions from stage 1 or 2 trials were chosen from each cluster first using a selection index based on yield, ear quality, grain moisture (%) at harvest, and erect plant. Later, 270 superior accessions selected in LAMP stage 2 (Salhuana and Sevilla 1995; Salhuana et al. 1998a; Salhuana et al. 1998b) were compared with those selected in stage 1. Accessions ARZM03007, ARZM03025, ARZM06016, ARZM06072, TOL403, PAZM03002, PAS014,

SMTI111, HUI387, NAR481, C.AM.COJ, URZM13052, and URZM13073 were not evaluated in stage 1 or 2 (in Argentina) and are thus not listed in this report. Other accessions selected in stage 2 but *not* in the upper 20% from stage 1 were incorporated in the final LAMP core subset, substituting them for index-selected accessions having either a lower selection index or the same race classification within the same cluster. As a result, the core subset was kept to 20% of all accessions evaluated, taking into account the results of stages 1 and 2. Canonical discriminant analysis was performed to characterize the phenotypic diversity of the core subset among and within the clusters; results are graphed in two-dimensional scatter diagrams (SAS 1996).

Designated Core Accessions of LAMP

The list of accessions of a LAMP core subset will be published and also be available in CD-ROM in 1999. This publication and the accompanying CD contain relevant data, designated core accessions, and graphical representations of the groupings formed using statistical analyses (e.g., canonical coordinates and can 1 vs can 2 scatter diagrams). The accessions designated in the preliminary maize core subset will be included in the SINGER and the GRIN databases. Interested researchers can request seed of core subset accessions from CIMMYT, from the North Central Regional Plant Introduction Station (Ames, Iowa), and from the national maize germplasm banks of LAMP cooperators.

Use of a Core Subset of LAMP

A core subset of LAMP will facilitate conservation of Latin American maize germplasm accessions. Currently many of the accessions evaluated in LAMP have not been safeguarded in the long-term seed preservation banks at CIMMYT and NSSL (NSSL preserves safety backup samples of CIMMYT Latin American maize germplasm accessions). The designated core subset accessions should have priority in regeneration for safety duplicates in the base collections of the national and international germplasm banks. Secondly, they can be further evaluated for genetic diversity in prebreeding projects for incorporation of useful genes and QTLs (Tanksley and Nelson 1996, Tanksley and McCouch 1997) into advanced germplasm and at the same time they can be used for the analysis of maize genetic diversity by DNA markers for future management and conservation of maize genetic resources (Smith et al. 1997). Agro-morphological evaluation data have been useful to choose elite germplasm sources for breeding high yielding varieties. Field evaluations of core accessions are still a valid way to choose the best performing accessions as germplasm sources for in-situ breeding or conservation (Taba et al. 1998).

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Table 1. LAMP evaluation trials, stage 1, 1986-88.

Country	Code	Location	Homologous area	Altitude (masl)	No. of entries	No. of core accessions	Experimental design
Bolivia	1.1	Pairumani	3	2,580	503	96	Randomized complete block design
Brazil	2.1	Sete Lagoas	1	736	660	131	Randomized complete block design
	2.2	Janauba	1	560	652	130	Randomized complete block design
	2.3	Pelotas	5	220	322	64	Randomized complete block design
Colombia	3.1	Turipaná	1	15	430	87	Randomized complete block design
	3.2	Palmira	1	1,020	453	87	Randomized complete block design
	3.3	Tulio Ospina	2	1,450	425	75	Randomized complete block design
	3.4	La Selva	3	2,120	226	44	Randomized complete block design
	3.5	Tibaitatá	4	2,650	217	44	Randomized complete block design
Chile	4.1	La Platina	5	680	761	151	Randomized complete block design
Guatemala	5.1	Cuyuta	1	48	350	74	Randomized complete block design
	5.2	Chimalte-nango	2	1,800	100	20	Lattice design 10x10
	5.3	Xela	3	2,300	25	6	Lattice design 5x5
Mexico	6.1	Chapingo	3	2,250	1460	292	Randomized complete block design
	6.2	Celaya	2	1,752	487	97	Randomized complete block design
	6.3	Cotaxtla	1	60	1419	285	Randomized complete block design
Paraguay	7.1	Caacupé	1	228	257	49	Randomized complete block design
	7.2	Capitán Miranda	5	200	115	21	Randomized complete block design
Peru	8.1	Piura	1	29	378	74	Randomized complete block design
	8.2	La Molina	1	251	208	40	Randomized complete block design
	8.3	Caraz	2	2, 300	87	16	Randomized complete block design
	8.4	Carhuaz	3	2, 600	433	86	Randomized complete block design
	8.5	Calca	4	2, 900	286	56	Randomized complete block design
	8.6	Jauja	4	3, 300	530	105	Randomized complete block design
	8.7	Huánuco	1	1, 900	267	55	Randomized complete block design
Uruguay	9.1	Paysandú	5	61	445	91	Randomized complete block design
U.S.A.	10.1	Ames, Iowa	5	244	265	53	Randomized complete block design
	10.2	Tifton, Georgia	5	103	147	30	Randomized complete block design
	10.3	Isabela, Puerto Rico	1	420	563	114	Randomized complete block design
Venezuela	11.1	Maracay	1	459	301	60	Randomized complete block design
Argentina*	12.1	Pergamino	5	65	342	67	Randomized complete block design
TOTAL					13,114	2,600	

* LAMP evaluation trial data from stage 2.

Classification of Accessions for the Formation of a Core Subset

Jorge Franco and Jose Crossa

To select a group of core subset accessions from a germplasm collection requires stratification of the collection into groups that are homogeneous, clearly differentiated, and mutually exclusive. All data available should be used, assuming they represent the maximum diversity present in the collection. Ordination and classification have proved to be useful tools to obtain subgroups of a germplasm collection. Principal component analysis, cluster analysis, and canonical analysis are often used for that purpose.

A good classification strategy for development of core subsets should have the following properties: 1) it optimizes an objective function according to the problem, 2) it includes a statistical test for finding the optimum number of groups, 3) it measures the quality of the groups, 4) it assigns a probability of membership of the accessions to groups, and 5) it uses all data available (continuous and discrete variables).

Geometric analyses used in the literature satisfy properties of 1, 2, and 3. However, in these analyses the objective function is not defined clearly and statistical methods of classification do not satisfy property number 4.

The Modified Location Model used for development of a LAMP core subset has a classification strategy in two steps that includes all five properties. The detailed procedures of the Modified Location Model are published in Franco et al. (1998). This research was partially funded by the Biometrics Unit and Maize Genetic Resources of CIMMYT through the cooperative agreement with USDA-NSSL, Fort Collins, Colorado.

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Characterization of Maize Race Bolita for Tortilla Yield and Starch Properties

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During the meeting at CIMMYT in 1998, partners in Latin American maize germplasm conservation expressed concerns about the increasing vulnerability of local maize races—they were seen as being in danger of disappearing with no information being saved on their potential use. The increased use of hybrids tends to exert pressure on landraces. Commercial hybrid maize has advantages over landraces in uniformity and commercial acceptability for quality. Those races of maize which are not used in the seed industry could disappear without knowing their potential use since they are not commercialized. In the USA, Tracy (1990) indicated exotic maize races could have potential value for improving grain quality and agronomic traits of US maize, since such races have selected for human consumption (texture, taste, and smell). Li et. al., (1990) found genotype variations for starch properties. Furthermore, Goodman (1985) indicated that only 5% of all maize races have been used in the development of US maize hybrids. The potential genetic vulnerability of such narrow-base germplasm to insects, diseases, and other biotic and abiotic stresses is significant (Ng et. al. 1997).

Environmental factors can influence starch quality. Studies in several plant species indicated that temperature at grain fill, soil fertility, planting date, year, and location may affect amylose content and gelatinization temperature (Juliano et. al. 1969). Cambells et al. (1995) suggested that thermal properties of starch can be used to predict functional properties of starch in different maize types. Maize hybrids having higher starch content than normal are believed to have greater end-use values. Usually hybrids having higher starch content will produce higher starch yield in the dry milling process. Developing hybrids to produce higher starch content and quality should benefit both producers and processors (Fox et al. 1992).

The objectives of this study were to establish a faster method of obtaining thermal properties of starch and to determine yields of dough and tortilla from small samples of the accessions of the maize race collected in the farmers' fields. Starch thermal properties, dough and tortilla yields in the accessions of race Bolita are presented.

The ohmic heating method which was employed for obtaining starch thermal properties in this research used an electric current that generated heat while passing through the sample (Joule effect) to the desired degree of cooking. The apparatus generates heat in-situ by molecular vibrations of chemical constituents of the sample (starch, lipids, water, etc.). Experimental results can be obtained in 2-3 minutes of cooking under controlled conditions. The apparatus of ohmic cooking was developed and used at the Centro de Investigación y de Estudios Avanzados (CINVESTAV) of the Mexican National Polytechnic Institute (IPN; personal communication).

The classic nixtamalization method (soaking the grain in a hot lime and water solution) for dough and tortilla production relies on difference in temperature between the heat source and the food and needs several hours for processing, which can limit use of small samples and the number of samples for characterization.

Materials and Methods

A total of 152 local maize samples were collected in the spring of 1997. They represented variations of the maize race Bolita grown in the fifteen communities of the central valley of Oaxaca state, Mexico. This maize race is grown at elevations from 1,300 to 1,500 masl and on about 100,000 ha, mainly for local consumption. Bolita is characterized by its earliness, is grown mainly under rainfed conditions, and preferred by local farmers for use in food.

The ohmic apparatus used for the thermal analysis comprises a nylamin chamber with two Ni-Cu electrodes wherein the dielectric sample between the electrodes is monitored for measuring gelatinization properties. Other elements of the apparatus are a function generator, an amplifier of signals of energy, an AC-to-DC converter, a thermocouple with a liner temperature ramp, and a computer interface with the controller.

Elaboration of micro-samples of instant maize flours was made from 10 grams of maize. First the sample was ground using a coffee mill and screened through US 60 mesh to obtain a uniform particle size. The maize meal was mixed with water in 80% w/v and placed in the cooker chamber. The wet sample was processed constantly at 80 Volts until it reached a temperature of 110 °C. The cooking time was about 2.5 minutes. The cooked samples were removed from the chamber, dehydrated for a few minutes in an oven, and remilled using a mortar and pestle to obtain a maize flour of small particle size.

Dough yield was calculated by weighing a certain amount of flour and gradually adding water until an appropriate solidity was reached for making tortillas. Tortilla yield was obtained calculating water absorption capacity of the dough and loss of moisture during cooking of the tortilla (26 mm diameter and 1.2 mm thick) on a flat iron dish (comal) at 288 °C for 58 sec. Tortilla quality was evaluated using a Texture Analyzer TA-XT2, simulating chewing. The best quality tortillas had a low cutting force.

Physical analyses of maize samples were made for specific gravity, kernel weight (1,000 kernels), kernel hardness, kernel color, and kernel size. Specific gravity was measured using a pycnometer. 1,000 kernel weight was obtained multiplying 200 kernel weight by 5. Kernel hardness was measured using the Texture Analyzer TA-XT2. The maize kernel was placed under the sharp probe with a 30° angle and a compression force was applied at a speed of 2 mm/s until a penetration into the kernel was 15 mm. Kernel color was evaluated by a MiniScan (Hunter Lab, Reston, Virginia, USA). Kernel size (length, width, and thickness) was measured using an electronic caliper: Vernier.

Results and Discussions

Table 1 shows ranges of variations found for physical and chemical parameters measured in 152 collections. Kernel colors had white, yellow, red, blue, and black. 1000 kernel weight ranged from 220 to 571 grams. Kernel hardness ranged from 7.91 to18.21 kg (data that are relevant for grain processing). Specific gravity ranged from 1.18 to 1.38 g/cm^3. Similar sample variations were observed for other parameters, indicating good possibilities of identifying genotypes that possess desirable grain quality traits.

The beginning and ending of gelatinization was measured in the small dough sample. Figure 1shows conductigrams of maize samples to characterize structural properties of starch. Ohmic cooking presented the profile of the curves of the current (I) against temperature (°C) as determined by electrical conductivity. Electrical conductivity decreased with the degree of gelatinization at point (b) of the cooking profile, apparently due to structural changes in starch.

The race collections showed differences for starch gelatinization temperature. Those of high dough and tortilla yields are associated with low gelatinization temperatures and also rapid gelatinization. Separating the collections into two groups based on the tortilla yield of 1.63 kg per kg of flour (one group of 65 collections which had a tortilla yield more than 1.63 kg and another group of 87 collections having less than 1.65 kg), means of the two groups were compared for physical-chemical properties (Table 2). Highly significant differences in tortilla yield, dough yield, initial and final gelatinization temperatures, and kernel texture were observed. The lowest initial gelatinization temperature—60.22 °C—was obtained for collection Oaxaca 54. The lowest final gelatinization temperature was for the collection Oaxaca 1. Collection Oaxaca 110 had the highest kernel hardness value of 18.22 kg, followed by collections 118 and 134 (17.79 kg and 17.56 kg). Collections producing high tortilla yields were numbers 148 and 120, with 1.92 and 1.90 kg per kg of flour; this surpassed the national standard of 1.63 kg in Mexico. Genetic variations in starch thermal properties of maize were described by Krugar et al. 1987 and White et al. 1990. On the other hand, means of 1,000 kernel weight, kernel hardness, kernel density, and kernel size were not significantly different between the two groups (Table 3). Watson in 1987 indicated that kernel physical characteristics are not good estimators of maize chemical properties for quality traits.

Conclusions

In evaluating 152 collections of the race Bolita grown in central valley of Oaxaca, Mexico, for starch gelatinization, tortilla and dough yields, and other kernel physical-chemical properties, we found significant differences among the collections. Rapid evaluation of samples for quality parameters was facilitated by the ohmic cooking method using small samples of 10 grams. This method can be used for evaluating tortilla and dough yields and for characterizing gelatinization properties of starch for many maize genotypes. The higher the tortilla yield of the sample genotype or race collection, the more rapid the gelatinization of the starch. Agronomic traits of maize kernels—1000 kernel weight, kernel harness, and kernel size—were not correlated with tortilla yields.

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Table 1. Ranges of physical parameters measured in 152 race Bolita collections from the central valley of Oaxaca, Mexico.

Parameters	Minimum	Maximum	Mean	Standard deviation
1000 kernel weight (g)	220	570.5	394.5	65.03
Hardness (kg)	7.79	18.21	12.56	1.97
Current (a) (Amp)	0.1152	0.2236	0.165	0.019
Current (b) (Amp.)	0.0996	0.204	0.151	0.027
Gelatinization temp. (°C)	60.22	77.86	66.44	2.488
Conclusion temp. (°C)	79.88	101.55	90.55	3.77
Dough yield[1]	2.04	2.6	2.28	10.096
Tortilla yield[2]	1.05	1.92	1.65	0.117
Specific gravity (g/cm^3)	1.175	1.34	1.258	0.033
Kernel length (mm)	1.1	1.54	1.299	0.092
Kernel width (mm)	0.7	1.4	1.07	0.11
Cutting force in tortilla (kg)	0.108	0.984	0.393	0.15

(a) at the beginning of gelatinization in the changing phase, (b) at the conclusion of gelatinization.

1. Dough yield = kg of dough/kg of flour. 2. Tortilla yield = kg of tortilla/kg of flour.

Table 2. Means of quality parameters of two groups of the race collections separated by low and high tortilla yields from tortilla yield of 1.63 kg per kg of flour. Student *t* was calculated to show the difference.

Tortilla yield kg of tortilla/kg of flour	Low yield N= 65	High yield N=87
Tortilla yield kg of tortilla/kg of flour	1.55	1.72**
Dough yield kg of dough/kg of flour	2.22	2.34**
Current at the beginning of gelatinization (Amp)	0.1667	0.1637
Gelatinization temperature (°C)	67.06	65.98**
Current at conclusion of gelatinization (Amp)	0.1515	0.146*
Temperature at conclusion of gelatinization (° C)	89.53	91.31**
Tortilla cutting force (kg)	0.478	0.30**

** highly significant with p= 0.01

Low < 1.63 Kg of tortilla/Kg of flour. High > 1.63 Kg of tortilla/Kg of flour.

Table 3. Means of agronomic traits for high and low tortilla yielding groups (see Table 2).

Tortilla yield (kg of tortilla/kg flour)	1,000 kernel weight (g)	Kernel hardness (kg)	Specific gravity (g/cm^3)	Kernel length (mm)	Kernel width (mm)
Low N=65	387.5	12.5	1.2591	1.31	1.06
High N=87	399.7	12.6	1.2581	1.29	1.08

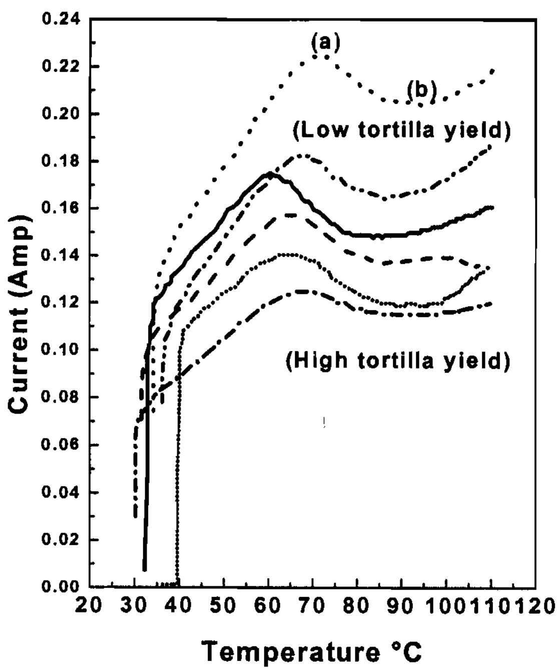

Figure 1. Profile of ohmic cooking in maize samples with differences in tortilla yields.
(The letters represent the levels of current at the onset [a] and completion [b] of gelatinization.)

Argentina

Marcelo E. Ferrer and Lucio R. Solari

Updating Passport Data and Seed Inventory

We have 2,035 maize accessions from 20 provinces of the country. A large part of the collection that was made during 1977-86 was funded by IBPGR (currently the International Plant Genetic Resources Institute, IPGRI). A maize germplasm catalogue was published in 1977 for 1,927 accessions. It includes the accessions collected during 1977-86 and lists characterization data on protein, oil, and tryptophan contents and preliminary results of screening tolerance to the Rio Cuarto disease, in addition to data on morpho-agronomic traits. During 1984-1987, the bank sent 1,624 back-up accessions to NSSL, USA, on the recommendation of IBPGR. Bank passport data is maintained in Excel files and constantly updated, including CIMMYT ID numbers for those accessions duplicated at CIMMYT. We like to document PI numbers for those duplicated in the USA. We are updating seed monitoring data and characterization data. Some accessions are conserved in the base collection of INTA at Castelar, Buenos Aires, and there the inventory is included in the genetic resources network of the country.

Regeneration of Landrace Accessions

We regenerated 337 accessions during 1993-96 and sent the samples to CIMMYT and NSSL for back-up storage. In the planting cycle of 1996-97, we regenerated 83 accessions. The accessions were planted in Pergamino and Salta experiment stations. Among 527 accessions regenerated during 1992-1997, 334 were evaluated under LAMP. Some races are apparently not adapted at the Pergamino or Salta station. It is possible to regenerate about 100 accessions per year if funds are available. The current cost of regeneration per accession is 61.08 dollars. We like to prioritize regeneration of those accessions that have small seed quantity and low seed germination in the active collection of INTA, Pergamino and some of those accessions preserved at NSSL, USA. INTA may want to duplicate IBPGR funded collections at CIMMYT as well as at NSSL.

Seed Preservation

We have remodeled a seed storage room with a capacity of 150 m^3. The seed storage facility is maintained at a temperature of –20°C. It can hold 12,000-15,000 samples for long-term storage. Sample size is about 1-1.5 kg. All samples are stored in aluminum bags after drying the seed to 5-6.5% moisture in the seed dryer adjacent to the storage room. The seed dryer was donated by the regeneration project through the SCA (Specific Cooperative Agreement to regenerate maize germplasm accessions in Latin America, CIMMYT/USDA-NSSL). Other seed storage units with 13 m^3 capacity at 7 °C are also used. We need a safety control system in the new storage room.

Evaluation and Characterization in ex-situ and in-situ (LAMP II)

During LAMP II, we would like to evaluate accessions of flint yellow and orange grain types that are adapted to conditions at the Pergamino station. These landraces disappeared gradually as of the 1950s with use of hybrids in the Pampa regions of Argentina. We may include several entries from LAMP as controls. A total of 350 accessions will be evaluated in LAMP II. Estimated cost per accession will be 12.04 US dollars.

In-situ Conservation

There are three regions where in-situ conservation can have an impact on conserving the local landraces. Farmers in Andean regions of Argentina, like Jujuy and Salta provinces, grow various races of floury and morocho maize. Northeast regions such as Corrientes and Misiones grow lowland floury and popcorn races, such as Avati moroti and Pisingallo. And the temperate Patagonian regions (Chubut and Rio Negro province) grow yellow and white flint races. These local races can be conserved on farm. Access to the regions from Pergamino would be a problem, however.

Bolivia

Gonzalo Avila and Lorena Guzman

Updating Bank Inventory and Regeneration

We have 1,080 bank accessions documented with passport information and CIMMYT ID and PI numbers of USDA-NSSL. In addition, seven racial composites are registered in the bank. The racial composites are formed by recombining the accessions of the same race in one cycle. The bank has characterized 616 accessions, 591 of which have more complete characterization data. The BOZM prefix is used for Bolivian maize bank accessions. The current bank inventory does not include the NAS-NRC collections (NAS-NRC: 1954-1955) of Bolivia. We conserve all collections made after 1970, but have lost some of them due to inadequate seed storage conditions. Some accessions can be recovered from NSSL back-ups. The numbers of accessions by race are listed in Table 1.

Early Bolivian maize collections of NAS-NRC have been conserved in Colombia; some are now in the CIMMYT and NSSL banks, through the regeneration project. We would like to have them in Bolivia in the future. We preserve over 700 accessions with more than 85% germination. Regeneration of about 50 accessions per year should maintain the collection well. A total of 76 accessions were regenerated and sent to CIMMYT and NSSL in 1996-98. A bank catalogue was published in 1998. We respond to about 20 seed requests per year.

Seed Preservation

We have a seed storage facility of 70 m^3 at 5°C with 60-70% RH (relative humidity). One cold room has 45 m^3 capacity and the other has 30 m^3. Seed moisture is in the range of 12-13%, which is quite high for seed preservation. A seed dryer donated by the regeneration project is now installed. We will dry all seed samples and preserve them in the active and base collections.

Characterization and Evaluation Ex-Situ and In-situ (LAMP II)

We evaluated half the bank accessions under LAMP. We still need to evaluate the remaining half in the LAMP II project. Local maize races that can be evaluated are Blando Amazónico, Blando Cruceño, Bayo, Argentino, Morocho Grande, Aperlado, Morocho, Hualtaco, Huilcaparu, and Kajbia. The trials will be planted at four locations, 250 entries at each. A core subset of the races will be developed from the results of evaluation trials. In-situ conservation can be applied for site specific races.

We have breeding populations developed from the results of LAMP. Synthetic 103 was derived from the cross between BOZM 093 (race Argentino with introgression of Cuban yellow) and Suwan (Caribbean flint and dent), and synthetic 104 originated from Chiapas 775 (Tuxpeño) x BR-106 (some Tuxpeño germplasm). Both populations yielded 13.5% more than the mean of parental populations.

Table 1. No. of bank accessions for each Bolivian maize race.

Race	No. of entries	Race	No. of entries
Aperlado	31	Karapampa	2
Argentino	9	Kèlu	72
Bayo	13	Kulli	23
Blanco mojo	2	Morado	2
Blando amozónico	79	Morochillo	6
Blando cruceño	20	Morocho	165
Canario	7	Morocho Grande	10
Chakeasara	4	Oke	3
Checchi	61	Paru	22
Cholito	3	Perla	12
Chuncula	33	Perola	21
Churitongo	11	Pisanckalla	25
Chuspillo	37	Pororó	3
Concebideño	11	Pura	5
Cordillera	4	Purito	5
Cubano	97	Tuimuru	22
Duro amazónico	30	Uchuquilla	42
Huacasongo	7	Yungueño	2
Huilcaparu	47	Popcorn (raza introducida)	4
Hualtaco	26	Suwan (raza introducida)	2
Jampetongo	30	No clasificables	5
Kajbia	47		

Brazil

Ramiro Vilela de Andrade

Updating Bank Passport Information

In 1975 the National Research Center for Maize and Sorghum (EMBRPA) in Sete Lagoas, Minas Gerais (MG), established an active maize germplasm bank, holding 283 accessions from the college of agriculture Luiz de Queirôz (ESALQ/USP), Piracicaba, Sao Paulo (SP). In 1978-81 Brazilian genetic resources and biotechnology (CENARGEN) made 10 collection missions with IBPGR's financial support and collected 1,207 accessions. One duplicate sample of new collections was sent to CIMMYT and another to the active collection at Sete Lagoas. We received 593 Brazilian accessions of NAS-NRC collection from CIMMYT in 1987 and CIMMYT also sent an additional 1,396 accessions to CENARGEN in 1998. Current total accessions held in the active bank are 2,404, of which 1,743 are landraces. Other accessions include 222 improved varieties, 288 exotic materials, 143 racial composites, and 7 maize wild relatives. Passport data is compiled in the accession editor (CIMMYT-IBPGR).

Regeneration of Bank Accessions

Bank accessions are regenerated at three locations in Brazil. Collections from the South, Southeast, and West Central maize growing regions (except the northern region of Mato Grosso) can be regenerated at Sete Lagoas. Those of North and Northeast regions can be regenerated at Janaúba, Minas Gerais. Janaúba is located 500 km north of Sete Lagoas. And collections from northern part of Mato Grosso and Amazonian regions are regenerated in the same regions, since they are not adapted elsewhere. Janaúba is dry and irrigated. Sete Lagoas has supplemental irrigation. We have a cooperative project with the Amazonian forest station of EMBRAPA (CPATU) in the state of Pará since 1995 to regenerate about 50 accessions collected from northern Mato Grosso and the Amazonian region of Pará.

We regenerate accessions when there is less than 2 kg of seed available or germination falls below 80%. In regeneration, at least 500 plants are sib-pollinated via chain crosses. Up to 20 kg per accession is stored in the bank. For some accessions an isolation plot of 300 m^2 is planted for regeneration, when they have poor nicking. More than 100 ears of good quality and true type are dried in the shade or sun, obtaining a seed moisture content of about 13%. Characterization data is taken as recommended for each accession. For long-term storage, two balanced bulk samples of 45-50 seeds from each ear are sent to CENARGEN and CIMMYT (Table 1). Currently some 93 of our accessions are tagged for regeneration. We regenerated 307 accessions received from CIMMYT and will continue to regenerate the rest. We plan to regenerate 240 accessions each year.

During 1992-1997, 1,312 accessions were planted for regeneration, from which 599 accessions were regenerated and duplicated at CIMMYT. About 50% of these accessions were planted twice to harvest more than 100 ears.

Seed Preservation

We have three cold rooms (total capacity 235 m^3) at 10 °C and 30% RH. Two large rooms of 84 m^3 and 124 m^3 are equipped with mobile shelves, increasing available space 40%. Seed moisture content is maintained around 6% in the seed storage rooms. Initial seed viability (% germination) is maintained during 10 years in the cold rooms with a minimum of change (maximum 2%). Seed is stored in cotton bags and seed moisture is balanced to cold room conditions. We monitor seed viability every three years. As of 1997, CENARGEN in Brasilia, DF, preserves 1,800 seeds per maize accession in aluminum foil bags for long-term storage at –18 °C.

In-situ Conservation

In-situ conservation initiatives have been conducted by non-governmental organizations to conserve local landraces. However, we do not have a plan to conduct in-situ conservation of local landraces at the moment.

Characterization and Evaluation of Ex-situ Accessions (LAMP II)

Under LAMP (1986-1996), 1,633 bank accessions were evaluated in Brazil. We evaluated an additional 286 accessions in Janaúba station, Minas Gerais. As part of LAMP II, 1,233 accessions will be evaluated, dividing them into 4 groups by region of adaptation (Central, Northwest, South, and North). A work plan has been developed. Some of the trial sites are far from Sete Lagoas, so that extra travelling costs are expected.

Table 1. Bank accessions and accessions distributed to CIMMYT, CENARGEN, and other institutions from the active bank of EMBRAPA, 1992-1997.

Year	No. of bank accessions	No. accessions shipped to CIMMYT	CENARGEN	Others
1992	2280	-	-	442
1993	2280	99	71	661
1994	2280	185	112	2098
1995	2280	63	85	582
1996	2287	43	70	1026
1997	2287	209	117	458
TOTAL	2287	599	455	6267

A Core Subset of Brazilian Maize Germplasm

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The Brazilian maize germplasm collection comprises 2,263 accessions that have adequate passport data and are currently conserved at the Centro Nacional de Recursos Genéticos (CENARGEN-EMBRAPA), and the Centro Nacional de Pesquisa de Milho e Sorgo (CNPMS-EMBRAPA). The objective of this research was to develop a core collection of the collection to facilitate its use by breeding programs. The subset and related research was developed by an interdisciplinary group of curators, breeders, and statisticians.

Developing a core collection is basically a sampling excercise. The two main problems to solve are the size of the sample and the sampling strategy to be used. In our case, 300 accessions were considered an adequate sample size. This represents 13% of the base collection, which is more than the 10% limit recommended by Brown (1989). In addition, 300 is a number of accessions that can be handled with relative low cost by the curator.

A two-level sampling strategy was used. At the first level, the accessions were classified into three strata according to origin of the germplasm: 1) landraces (1,753 accessions); 2) improved materials (222 accessions); and 3) introductions (288 acccessions). Each stratum was proportionately represented in the core collection.

At the second level, specific sub-classifications were used within each stratum. Landraces were classified in 27 groups, based on ecogeographical origin and grain type (Table 1), as suggested by Abadie et al. (1997). The ecogeographical regions used in this case were the same as those used by Cordeiro et al. (1995) for the classification of Brazilian cassava accessions. A logarithmic strategy was used to assign the proportional representation of each group in the core collection. Within each group, the accessions were selected by the curators taking into account their experience and knowledge of the crop when possible, or otherwise at random.

The improved materials were classified as pops (pop maize), non-pops from CNPMS, and non-pops from other breeding programs. This classification followed from the principal components analysis done on the data of Feldman and Silva (1984), following the methodology used by Abadie et al. (1997) in the study of the landraces. The introductions were classified based on their origin as tropical or temperate, and within each of these groups based on the four main grain types (pop, flint, floury, dent), as suggested by the experience of the curators and breeders. The representation of each group of the latter two strata was proportional to their size. The core collection samples belonging to each group were selected by the breeders trying to maintain maximum genetic variation and to include those accessions representative of the main genetic pools used in the breeding programs.

The development of this maize core collection has resulted in a new classification of the Brazilian maize collection, based on experimental results (Abadie et al. 1997) and on the knowledge and experience of curators and breeders. In addition, the classification was developed using available passport and characterization data, without the need for additional expensive research. The appeal of the new classification system is both its simplicity and its intuitively sound biological and practical basis. We expect that this will encourage breeders to use Brazilian maize germplasm in their programs.

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Table 1. Distribution of Brazilian landraces based on grain type and ecogeographical region of origin, in the base collection (BC) and core collection (CC).

	Pop		Flint		Floury and other		Dent	
Origin	BC	CC	BC	CC	BC	CC	BC	CC
South	29	10	23	9	5	5	279	17
Cerrados	26	10	77	13	50	12	321	19
Cerrados North	12	8	9	7	6	5	110	14
Amazonia	35	12	94	15	19	8	121	14
Caatinga	17	8	38	11	1	1	169	16
Agreste Litoral	1	1	14	8	0	0	62	12
Non-class	4	0	5	0	7	0	10	0

Landraces in the CC = 235.

Chile

Orlando Paratori and Alberto Cubillo

Passport Documentation and Seed Viability

The bank database contains 945 accessions in the active collection. The base collection has 839 accessions in Intihuasi near Vicuña in the province of Coquimbo. Samples collected in 1981 and 1982 under IBPGR funding were 536. Samples of 1953 and 1955 NAS-NRC collections from CIMMYT and other samples from collaborating banks in the region, as well as some new samples, were included in the bank during 1984-87. Most newly collected samples are duplicated at NSSL. A bank catalog was published in 1990 covering 923 accessions. According to our records, NSSL and CIMMYT maintain 617 and 327 Chilean accessions, respectively. We need to add 110 accessions to our base collection in Intihuasi. Seed germination tests during October 1997-February 1998 indicated that 854 accessions in the active bank had more than 80% germination. There was insufficient seed of 91 accessions for germination tests, and 4 accessions had germination levels below 80%.

Regeneration of Accessions

About 100 accessions require regeneration to replenish seed supplies. Certain accessions from the north (CHZM 01 035, CHZM 01 055, and CHZM 02 007) should be regenerated in in-situ.

Seed Preservation

The seed facility for the active collection has a capacity of 120 m^3 and is maintained at 5 °C with 30% RH. It can hold 100,000 samples in 380 ml transparent plastic bottles. The base collection is maintained at –18 °C with less than 30% RH. It can hold 50,000 samples in the same bottles. A seed dryer will be installed near both active and base collection banks.

Characterization and Evaluation Ex-situ

Characterization of bank accessions includes race classification, 38 descriptors of plant/ear/grain, and ratings of resistance to *Puccinia sorghi* and *Heliothis zea*. All data are compiled in a catalog of maize genetic resources published in 1990 (available in an Excel file). Evaluation data of bank accessions under LAMP during 1986-87 and 1987-89 included 16-19 descriptors (data also available in an Excel file).

We evaluated 78 entries of LAMP homologous area 5 (temperate region) in 1990-91. They were top crossed with OH43 x Mo17 and B73 x B14. 16 Chilean accessions were included in the topcrosses. Some of the best entries were used to form racial composites in S_2 or S_4 and stored in the active bank. INIA would like to initiate characterization of the accessions using molecular biotechnology.

In-situ Conservation and New Initiatives

Resource limitations (lack of personnel) currently limit INIA's capacity to take on new germplasm evaluation initiatives alone, but collaborative efforts would be possible with University Tarapacá in Arica and University of Arturo Prat in Iquique to regenerate and evaluate accessions from the north and with the University of Chile for use of forage maize in the central part of the country.

For in-situ conservation, races Aracuano (yellow, round and flint grain, and short ear length) and Amarillo de Malleco (long ear, yellow flint) can be included, since they are grown by farmers in the south. A non-governmental organization has worked with them in local communities. An improved variety of race Choclero is grown on 6-8,000 ha and race Camelia is still grown locally on a lesser area. The rest of Chilean maize production involves hybrids.

Table 1. Maize races in Chile and number of accessions for each in the maize germplasm bank, 1998.

Number	Race	No. of accessions
1	Harinoso Tarapaqueño	17
2	Limeño	6
3	Chulpi	3
4	Polulo	2
5	Capio Chileno Grande	25
6	Capio Chileno Chico	18
7	Chucutuno	4
8	Morocho Amarillo	4
9	Negrito Chileno	2
10	Marcame	1
11	Caragua	70
12	Choclero	96
13	Morocho Blanco	34
14	Camelia	120
15	Diente de Caballo	78
16	Critalino Chileno	53
17	Pisankalla	21
18	Semanero	12
19	Maiz de Rulo	23
20	Amarillo de Ñuble	27
21	Ocho Corridas	77
22	Amarillo de Malleco	3
23	Araucano	79
24	Unclassifiable	72

Colombia

Carlos Díaz Amaris

Updating Passport, Bank Seed Inventory, and Characterization

Passport data have been partially compiled in an Excel file for 1,467 bank accessions that originated from Colombia (national collection). For the other accessions (foreign collection), passport data are available in written form. Characterization data for the Colombian national collection (2,050 accessions) have been compiled in an Excel file. The seed inventory for all bank accessions is available in electronic form. Associated CIMMYT accession identification numbers and PI numbers of NSSL are documented in the passport file. Significant progress has been made in documenting bank information.

Regarding the national collection of Colombia, a study to develop a core subset should be made using characterization data. Foreign collections include duplicate accessions from the Mexican and CIMMYT germplasm banks. Some duplicates (from the Caribbean islands and from several states of Mexico) are clearly identified with original collection numbers. We need to pursue identification of duplicates with CIMMYT and Mexico. CIMMYT can have a copy of the passport book to check seed sources of foreign collections in Colombia. An accession editor loaded with the passport data of the NAS-NRC collection was useful when we compiled the information.

We have 5,206 accessions in the bank. In addition to the Colombian accessions mentioned above, those from breeding programs (composites of collections, synthetic, and improved varieties) number 518. The 2,638 foreign accessions come from Venezuela (636), Ecuador (496), Bolivia (479), Mexico (283), the Caribbean islands (255), Chile (86), Panama (156), Peru (195), and others (52). We have regenerated 1,191 of these (286 from Bolivia, 255 from Ecuador, 102 from Mexico, 40 from Panama, 118 from Peru, 179 from Venezuela, 183 from Caribbean islands, 9 from Chile, and 19 others) as part of the cooperative project with CIMMYT and USAID/USDA/NSSL.

The NAS-NRC Andean accessions number 735 and come from Ecuador (241), Bolivia (193), Chile (77), Panama (147), and Peru (77). These should receive first priority in any future regeneration efforts. Given that most Venezuelan collections are duplicated in Venezuela through LAMP, they should be regenerated in Venezuela.

Most accessions in the national collection were regenerated by the USDA-ARS/North Carolina State University cooperative project in the mid-1980s. They were deposited at the North Central Plant Introduction Station, Ames, Iowa. Some of them are being regenerated at CIMMYT for addition to the CIMMYT collection. As we define a core subset using LAMP stage 1 data, we will prioritize them for regeneration. Characterization data for foreign collections are being compiled for core subset development.

Regeneration of Ex-situ Collections

Priority of regeneration should be placed on 735 accessions from the foreign collection and 121 accessions from the national collection that are not duplicated at CIMMYT or NSSL. LAMP core subsets of bank accessions may also be preserved at CIMMYT for seed distribution and long-term conservation. CIMMYT and Colombian banks can collaborate in regeneration and conservation.

The 121 accessions from national collection that are not duplicated at NSSL and Iowa State University are: Amazonas 310; Antioquia 565, 567, 570, 573, 574, 576, 578, 583, 584, 585, 586, 587, 588, 589, 890, 591, 592; Bolivar 389; Boyacá 517, 518, 519, 520, 521, 522, 524, 525, 526, 527, 531, 532, 539, 540, 543, 545, 546, 548, 552, 553, 561, 562, 563, 564; Caquetá 354; Cauca 470, 472, 474, 478, 480, 482, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497; Chocó 417, 418, 419, 420, 423, Córdoba 301, 313; Cundinamarca 353, 371, 428, 571, 572, 573, 574, 575, 576; Guajira 314, 315, 317, 318; Huila 314; Magdalena 412, 477; Meta 337, 338, 339, 340, 341, 342; Nariño 407, 584, 594, 608, 617, 629, 630, 632, 634; Putumayo 375; Santander 355, 356, 360, 361, 362, 363; Santander Sur 304, 305, 306, 404, 408, 409; Tolima 418, 419, 420, 421; Valle 440, 442.

Seed Preservation

The seed storage room has a capacity of 133 m^3 with 8 °C and 60% RH. Humidity control is not adequate for medium term seed storage—33% of the bank's accessions had seed germination levels below 80% in April 1998. We need to improve storage conditions. The current bank facility may be transferred to La Selva station, Rionegro, Department of Antioquia, in the next one-to-two years. A seed dryer will be installed in the new facility. The La Selva station will hold the active collection and the Tibaitata station, Mosquera, Deparment of Cundinamarca, will provide base collection storage. The active collection may represent about 1,000 accessions from LAMP core subset, race core, and breeding core, etc.

LAMP II Project

There are 303 accessions of the national collection which were not evaluated under LAMP in 1987-1991, and we like to evaluate them in the LAMP II project. Accessions in the foreign collection could be evaluated in LAMP II in Colombia, but they can be best evaluated in the countries of origin. Cooperating countries like Ecuador, Venezuela, Peru, and Chile may be interested in evaluating them in LAMP II.

Conservation In-situ

Race Cacao has been improved by mass selection with the farmers in Department of Santander. However, CORPOICA does not have a research program in this area. Another landrace Puya can be improved in the same manner in the region of Darien Colombiano (Urabá Antioqueño and Chococeano) where the local landrace are cultivated in 100,000 ha.

Development of a Core Subset

We formed 139 racial composites using landrace accessions of Colombia. We intend to develop core subsets by race, climatic adaptation, and geography. The LAMP core subset will be useful. Table 1 indicates numbers of accessions of Colombian maize races.

Table 1. Number of accessions of Colombian maize races, April, 1998.

	Colombian races	No. of accessions
1	Amagaceño	161
2	Andaquí	35
3	Cabuya	10
4	Cacao	99
5	Capio	17
6	Cariaco	13
7	Clavo	25
8	Chococeño	109
9	Común	658
10	Costeño	280
11	Dulce	2
12	Guirúa	12
13	Harinoso Dentado	10
14	Imbricado	6
15	Montaña	152
16	Netgrito	15
17	Pira	31
18	Pira Naranja	16
19	Pollo	29
20	Puya	74
21	Puya Grande	12
22	Sabanero	216
23	Yucatán	68
	TOTAL	2,050

Ecuador

Edison Silva C.

Updating Passport Data and Bank Inventory

In May,1998, the bank inventory totaled 813 accessions. Passport information is compiled in Excel and Fox BASE files for Macintosh. Landrace accessions from Ecuador number 532, including 102 accessions from the NAS-NRC collection that were received through the regeneration project of Colombia. The rest are from the breeding program (201 accessions) and from other foreign countries. In 1992-97 we regenerated 350 landrace accessions and would like to regenerate 155 accessions—including 102 NAS-NRC accessions—in 1998-2000.

Regeneration of Bank Accessions

We have regenerated 350 accessions since 1992, all highland materials from Ecuador. Some were recently collected and others were collected in 1968 in collaboration with CIMMYT. All are now duplicated with CIMMYT and NSSL. We received part of the NAS-NRC collection from CIMMYT during 1997-98. We would like to recover all NAS-NRC accessions from Ecuador, including those from the lowland regions, by 2000. Each year some 100-150 accessions will be regenerated and duplicated with CIMMYT and NSSL.

Seed Conservation in the Bank

In 1997 the Instituto Nacional de Investigaciones Agropecuaria (INIAP) built a germplasm bank facility for active and base collections. The base facility will hold 12,000 samples at –10° C and the active bank 9,000 samples at 0-5 °C. A dehumidifier (SEEDBURO) and cooling system are installed in the seed drying room through donation by the regeneration project with CIMMYT. The seed drying room is maintained at 2-10% RH and 15-18 °C. Seed is kept in aluminum laminated bags at 4-6% moisture. We now have a good seed storage facility.

Ex-situ and In-situ Characterization (LAMP II)

In Ecuador highland maize is grown on 260,190 hectares and local varieties occupy 90% of highland maize growing areas. Collection number Ecuador 573 of NAS-NRC was introduced in the highlands of Kenya in 1959 and has been used there extensively in maize breeding and hybrid maize production. Recently Pool Andino 7, which has Ecuadorian germplasm such as morocho blanco, is also grown in Burundi and other countries where adapted. Judging from experience regarding the use of Ecuadorian maize germplasm and the fact that no systematic evaluation has been done, we plan to evaluate 600 accessions.

We will group the bank accessions into yellow floury, white floury, and other grain types such as morocho, sugary, popcorn and others, all of which have production niches in Ecuador. The first evaluation trial will be at our experiment station and another in-situ. Plant and ear data will be taken to choose a core subset. Further evaluation of a preliminary core (25%) will be conducted at the in-situ sites. We have started a few evaluation trials on the experiment station. When funds for LAMP II become available, we will conduct all the trials.

In-situ Conservation

We have started breeding work with local varieties, improving them and promoting on-farm conservation by farmers who have grown them. We used participatory breeding to develop the improved varieties INIAP 122 (from the landrace Chucho) and INIAP 111 (from the landrace Guagal). New race collections and bank accessions of the races were evaluated in farmers' fields. We developed breeding populations with the best collections and accessions evaluated under farmers' criteria. Half-sib family selection has been practiced in two populations. We multiply the last cycle of selection on 20 hectares each year to meet the significant demand for seed by farmers. We started similar work for races Mishca and Blanco Blandito in 1996, each grown on about 25,000 ha. Two to three years of selection are needed to release an improved variety of the race. We will continue in-situ conservation work with the above two races in the provinces of Pichincha and Chimborazo. Results of LAMP II are integrated with in-situ conservation of the local races through participatory breeding. We will expand in-situ conservation as funds become available.

Guatemala

Mario R. Fuentes L.

Seed Preservation

We have gone through difficult times in conserving maize germplasm accessions, due to changes in personnel and institutional reorganization. Our accessions suffer from low seed germination. There is a plan to construct a medium-term seed conservation facility.

Mexico

Juan Manuel Hernández

Passport Documentation and Updating the Bank Inventory

Mexico preserves 9,988 accessions. We would like to recover 478 accessions that were lost because of poor viability, if they are safeguarded at CIMMYT or NSSL. We have added 598 new accessions to the inventory from eleven states of Mexico and updated our passport data. We have documented race classifications for 6,738 accessions from the regeneration data (Table 1). We do not have adequate computing facilities in the bank. All seed shipments should be approved by the director's office.

Regeneration of Landrace Collection and Preservation of Duplicates

We shipped seed of 2,024 accessions to CIMMYT as part of the regeneration project in 1996-98. We planted 3,438 accessions for regeneration in the same period. CIMMYT underwrote costs for regenerating 1,733 accessions, after checking for duplicates among shipments. We plan to regenerate about 700 accessions yearly over 1998-2000. Certain accessions of Mexican maize preserved at NSSL that are not in our bank will be received through future regeneration efforts. Back-up duplicates of Mexican bank accessions at CIMMYT and NSSL should help conserve them in the long-term storage. We need an expanded seed storage facility. Accessions duplicated with CIMMYT should be available at any time when needed by our bank.

Seed Preservation in the Bank

The seed dryer has worked fine, but there are problems with the automatic control of temperature and humidity. One kg seed with 6-8% seed moisture is stored in aluminum foiled bags. It takes 3-4 weeks to dry seed. The seed storage room has a capacity of 77.63 m^3 at 0-5 °C and 40-80% RH. There is a plan to have another seed storage room with 42.5m^3. The rest of the seed kept at room temperature is used for seed shipments. There is a need to renovate the current seed storage room or build a new facility to hold regenerated accessions.

In-situ and Ex-situ Characterization and Evaluation (LAMP II)

We will evaluate 4,225 accessions under LAMP II (Table 2). They are divided into three groups by altitude of the collection site and constitute bank accessions not evaluated under LAMP or in CIMMYT bank evaluation trials. They will be planted on INIFAP experiment stations located in the adaptation zones. The results from LAMP II will be used to develop core subsets of Mexican accessions.

In Mexico local cultivars are used on some 80% of maize growing area. In-situ conservation implies farmer participatory breeding. Current and past cultivars of the farmers will be evaluated in-situ. Elite cultivars will be used for in-situ conservation of the race or race complex. Farmers will help identify desirable traits.

Sub-regions are listed below where in-situ conservation work can be pursued in Mexico. Relevant maize races and the farmers who cultivate them most in the regions are listed.

Chihuahua: Races Cristalino de Chihuahua, Apachito, Blanco harinoso de Chihuahua, Azul, etc. Indigenous farmers include the Tarahumara and others.

Jalisco-Nayarit-Zacatecas-Durango: Races Tabloncillo, Celaya, Reventador, Dulce, Vandeño, Elotes Occidentales, etc. Target farmer include the Huicholes and others.

Morelos-Guerrero: Races Ancho, Tuxpeño, Pepitilla, Celaya, Elotes Occidentales, Conejo, etc. Local farmers include the Chontal and others.

Coahuila-Nuevo Léon-San Luis Potosí: Races Ratón, Tuxpeño Norteño, Cónico Norteño, etc.

Istmo de Tehuantepec (Oaxaca-Veracruz): Races Zapalote chico, Zapalote grande, Olotillo, Vandeño, Tuxpeño, etc. Target farmers include the Mixe and Zoque.

Oaxaqueña (highland and midaltitude in Oaxaca): Races Chalqueño, Mushito, Olotón, Cónico, Bolita, Nal-Tel Altula, etc. Farmers include the Mixteco, Triquis, and others.

Chiapas: Races Tuxpeño, Vandeño, Tepecintle, Olotillo, etc. Farmers include the Tzotzil and Tzetal, among others.

Guanajuato: Races Celaya, Conico Norteño, Elotes Occidentales, Tabloncillo, etc.

Michoacán: Races Zamorano Amarillo, Celaya, Cónico Norteño, etc. Farmers include the Tarasco and others.

Mexico-Puebla: Races are Chalqueño, Cónico, Elotes Cónicos, Cacahuacintle, etc.

Table 1. Number of accessions by race in the Mexican maize germplasm bank.

Race	No. of Accessions	Race	No. of Accessions
CONICO	923	ZAMORANO AMARILLO	40
TUXPEÑO	784	CACAHUACINTLE	37
CONICO NORTEÑO	619	ZAPALOTE GRANDE	35
CELAYA	584	NALTEL DE ALTURA	30
CHALQUEÑO	465	BOFO	30
TABLONCILLO	369	JALA	29
ELOTES CONICOS	215	APACHITO	28
TUXPEÑO NORTEÑO	208	BLANDITO	27
ARROCILLO	170	MAIZ DULCE	24
PEPITILLA	155	TABLILLA DE OCHO	23
OLOTILLO	152	CHAPALOTE	20
MUSHITO	146	CONEJO	19
RATON	136	COMPLEJO CONICO	19
TABLONCILLO PERLA	134	TEHUA	15
BOLITA	129	GORDO	15
COMITECO	121	CUBANO AMARILLO	12
NALTEL	110	MIXEÑO	11
VANDEÑO	100	SERRANO DE JALISCO	10
TEPECINTLE	82	AZUL	8
ANCHO	78	ELOTERO DE SINALOA	7
CRISTALINO DE CHIHAHUA	76	PALOMERO DE CHIHUAHUA	6
DZIT BACAL	77	TABLONCILLO AHUMADO	6
ELOTES OCCIDENTALES	75	HARINOSO DE OCHO	3
OLOTON	68	MIXTECO	3
COSCOMATEPEC	57	QUICHEÑO	2
DULCILLO DE NOROESTE	51	SEÑÑANO MIXE	2
ZAPALOTE CHICO	50	MOTOZINTECO	1
ONAVEÑO	50	SERRANO DE GUATEMALA	1
REVENTADOR	49	NEGRO DE TIERRA FRIA	1
PALOMERO TOLUQUEÑO	41		
TOTAL RACES = 59		TOTAL ACCESSIONS	6,738

Table 2. Numbers of accessions of Mexican maize races for characterization and evaluation in LAMP II.

Race	No. of Accessions	Race	No. of Accessions
CONICO	612	CRISTALINO DE CHIHUAHUA	16
CELAYA	385	JALA	15
CONICO NORTEÑO	268	PALOMERO TOLUQUEÑO	14
TUXPEÑO	266	TABLILLA DE 8	13
CHALQUEÑO	194	BLANDITO	13
COMITECO	125	NALTEL DE ALTURA	12
ARROCILLO	105	CACAHUACINTLE	10
TABLONCILLO	101	MIXEÑO	10
MUSHITO	82	ZAPALOTE GRANDE	9
ELOTES CONICOS	76	BOFO	9
TUXPEÑO NORTEÑO	73	CONEJO	9
RATON	58	COMPUESTO CONICO	9
PEPITILLA	54	DULCE	6
TABLONCILLO PERLA	50	TEHUA	6
BOLITA	49	SERRANO DE JALISCO	5
ANCHO	47	HARINOSO DE 8	4
COSCOMATEPEC	47	ELOTERO DE SINALOA	4
NALTEL	46	CHAPALOTE	3
OLOTON	43	CUBANO AMARILLO	3
ELOTES OCCIDENTALES	41	APACHITO	2
OLOTILLO	40	SERRANO MIXE	2
VANDEÑO	38	AZUL	1
DZIT BACAL	27	GORDO	1
ZAPALOTE CHICO	25	MOTOZINTECO	1
TEPECINTLE	24	SERRANO DE GUATEMALA	1
ONAVEÑO	23	QUICHEÑO	1
DULCILLO	19	No race classification	1,071
ZAMORANO	18		
TOTAL RACES = 55		TOTAL ACCESSIONS	4,225

Paraguay

Regeneration of Bank Accessions and New Collections

In 1996-97, we planted 188 bank accessions for regeneration. However, most of them were lost through poor germination-only 22 accessions were regenerate. They were collected in 1987 under LAMP. We collected 478 samples of landraces in 1998 from 11 Departments in the country (Tablke 1) with the financial help uf USDA-ARS, since most of previous collections were lost and were not duplicated in other institutions. There is also a possibility of genetic erosion from the use of hybrids. Among 478 samples, we have 164 of Avati Moroti, 12 of Avati Mitá , 17 of Avati Ti, 2 of Avati Guapy, 39 of Pichinga Redondo, 32 of Pichiga Aristado, 37 of Tupi Pyta, 52 of Tupi Moro Ti, 105 of Sape Pyta, 7 of Sape Moro Ti, and 11 introduced maize varieties. We would like to regenerate as many as 141 accessions for which small quantities of seed are on hand.

Seed Conservation

All bank accessions are preserved at the CRIA experiment station, Capitan Miranda. Using donations from the regeneration project, we plan to construct a seed storage room of 30 m3 where accessions would be stored at 0*C and 30-40 % RH.

Table 1. Number of collections made from Paraguay in 1998.

Department	No. of Samples	No. of Races
Alto Paraná	51	6
Amambay	26	6
Caaguazú	37	7
Caazapá	35	8
Canindeyú	75	9
Concepción	53	6
Guirá	23	7
Itapúa	51	7
Misiones	32	8
Paraguari	17	5
San Pedro	78	8
Total	478	

Peru

Ricardo Sevilla and Julian Chura

Updating Passport, Bank Seed Inventory, and Characterization

The Programa Cooperativa de Investigaciones de Maize (PCIM), La Molina, Peru, preserves 3,023 accessions. The total number of original collections documented was 3,931. Table 1 shows the number of accessions available by political division (Department). Passport information (identifiers, accession numbers, political division or province of collection site, latitude and longitude and altitude, race class, seed source, and collection date) is compiled in an electronic file. Some accessions, such as racial composites and improved varieties, are kept in 20-liter containers to meet the demand for seed. Seed requests from farmers are met with 250 grams of seed.

Under stage 1 of LAMP, 2,189 accessions were evaluated (Catalogo del LAMP 1991). An additional 834 accessions need evaluation. The current documentation on characterization has progressed to 1,806 accessions in our database.

Regeneration of Ex-situ Collection

The regeneration project with USDA-ARS/North Carolina State University in the early 1980s generated 1,819 accessions (Table 2). The current project with CIMMYT/NSSL/USAID regenerated 537 accessions, 44 of which were found to have duplicates among the shipments to CIMMYT (Table 3). Several hundred accessions remain to be regenerated and backed-up with CIMMYT, considering that the total number of accessions available is 3,023. Table 4 shows racial collections that have specific adaptation to the collection sites.

Seed Preservation

The seed storage room has 167.9 m^3 capacity. The room is usually kept below 10°C and the relative humidity of the room varies from 70 to 90%, although it should be kept at 5 °C and 40% RH. The seed is stored in 10 or 20 liter glass jars. A forced air seed dryer (7 m^3 capacity) donated by the regeneration project was installed in 1998. In three days, the seed is dried to 8% moisture. A seed germination test is performed after 10 years of storage. We need to improve storage conditions, because since seed longevity is less than 20 years.

LAMP II

Regeneration efficiency has been less than desired for bank accessions that are poorly adapted to regeneration sites. Under LAMP II, we would like to evaluate about 700 accessions not evaluated under LAMP and including recently regenerated accessions. Some new collections will be included in the evaluation of racial complexes in their growing environment.

In-situ Conservation

Three races of the north coast region—Alazán, Pagaladroga, and Arizona—and all highland races will be considered for in-situ conservation. Racial composites can be used. PCIM has formed 25 racial composites and incorporated the *opaque-2* gene in the highland composites.

Development of a Core Subset

About 600 accessions—20% of the total—will represent PCIM bank accessions. Racial composites are included in the subset.

Table 1. Numbers of original accessions from each Department of Peru, subsequent numbers of accessions conserved before and after 1985, and net loss of the accessions and the accessions viable, 1998.

Department	Original accessions	No. lost before 1985	No. lost after 1985	Total lost	No. available
Amazonas	54	9	0	9	45
Ancash	628	86	77	163	465
Apurimac	306	48	27	75	231
Arequipa	244	23	37	60	184
Ayacucho	149	18	6	24	125
Cajamarca	221	17	47	64	157
Cuzco	382	80	27	107	275
Huancavelica	195	65	8	73	122
Huánuco	211	64	29	93	118
Ica	52	0	0	0	52
Junín	244	47	13	60	184
La Libertad	251	23	19	42	209
Lambayeque	154	2	5	7	147
Lima	134	15	15	30	104
Loreto	47	0	10	10	37
Madre de Dios	50	4	3	7	43
Moguegua	30	0	2	2	28
Pasco	39	1	1	2	37
Piura	234	47	14	61	173
Puno	52	2	3	5	47
San Martín	140	1	1	2	138
Tanca	62	5	5	10	52
Tunbes	17	0	0	0	17
Ucayali	35	0	2	2	33
Total	3,931	557	351	908	3,023

Table 2. Number of Peruvian accessions sent to Iowa (NC-7) and /or USDA-NSSL.

Shipment No.	Accession No.	Year of shipment
1	224	1986
2	113	1986
3	183	1987
4	108	1987
5	105	1987
6	101	1987
7	135	1988
8	177	1989
9	80	1989
10	65	1989
11	93	1989
12	73	1990
13	69	1990
14	81	1991
15	82	1991
16	48	1994
17	82	1995
Total	1,819	

Table. 3. Number of accessions sent to CIMMYT, Mexico.

Shipment No.	Accession No.	Year of shipment
1	74	1993
2	59	1994
3	46	1994
4	67	1995
5	106	1996
6	102	1996
7	83	1998
Total	537	

Table 4. Peruvian races that have site-specific adaptation for regeneration.

Race	Collection Site	Adaptation Area
Tumbesino	Tumbes, Piura	Costa Norte
Mochero	Piura, Lambayeque	Costa Norte
Pagaladroga	Piura, Lambayeque	Costa Norte
Alazán	Piura, Lambayeque	Costa Norte
Coruca	Arequipa, Moquegua, Tacna	Costa Sur
Confite Puneño	Islas Lago Titicaca	Sierra Sur (more than 3,000 masl)
Arequipeño	Arequipa	Sierra Sur (2,500 to 3,000 masl)
Morocho Cajabambino	Cajamarca, Amazonas	Sierra Norte (1,800 to 2,500 masl)
Capio	Cajamarca, Amazonas, La Libertad	Sierra Norte (2,200 to 2,800 masl)
Morado Canteño	Siera de Lima	Sierra Central (2,200 to 2,800 masl)
Amarillo Huancabamba	Sierra de Lima	Sierra Norte (1,800 to 2,500 masl)
Huarmaca	Sierra de Piura	Sierra Norte (1,800 to 2,500 masl)
Blanco Ayaca	Sierra de Piura	Sierra Norte (1,800 to 2,500 masl)
Huanuqueño	Sierra de Huánuco	Sierra Norte (1,500 to 2,500 masl)
Enano	Madre de Dios	Selva Baja
Chimlos	Selva del Cuzco	Selva Alta (100 to 1,800 masl)

Uruguay

Tabaré Abadie [1], Federico Condón [2], Alberto Fassio [2], Martín Jaurena [1], and Marcos Malosetti [1]
Facultad de Agronomia, Montevideo, Uruguay [1]
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Updating Passport Information and Formation of the National Collection

Maize germplasm collections of Uruguay are duplicated at CIMMYT, INTA, and NSSL. Two collection missions obtained the accessions currently available. The mission funded by IBPGR in 1978 collected 855 samples and duplicated them with CIMMYT and INTA. Subsequently, CIMMYT regenerated them and also duplicated them with NSSL. Some of the samples (113) collected under NAS-NRC sponsorship are conserved at CIMMYT, which received them from NSSL in the 1960s and regenerated them. NSSL has a few more samples from Uruguay that are not in the CIMMYT bank. CIMMYT and/or NSSL preserve a total of 990 accessions from Uruguay, according to the current database. We have compiled all available passport data for these accessions.

We would like to preserve all Uruguayan accessions in the seed storage bank at the La Estanzuela station of the National Institute of Agricultural Research (INIA), Colonia, Uruguay. We have regenerated 223 original accessions repatriated from INTA, Castelar, Argentina, during 1995-96 (Table 1).

Seed Conservation

A seed storage facility is under construction. Storage conditions for long-term conservation are at –18 °C with seed moisture content of 6-7%. The storage capacity is 60 m^3. A medium-term seed storage room has a capacity of 13 m^3 and will be kept at 5 °C and 35% RH. The seed drying room has 12 m^3 at 15-25 °C and 15% RH.

Core Subset

Using the published catalogue of the Uruguay collection (Fernandez et. al., 1983), we designated 90 accessions as a core subset of the total 845. We grouped the accessions by grain texture and collection sites, resulting in five sets: white dent (90 accessions), floury (90 accessions), popcorn (23 accessions), southern flint-semi flint (449 accessions), and northern flint-semi flint (193 accessions). The number of core accessions of the group were determined by the logarithmic proportion corresponding to the number of the accessions of the group. Cluster analysis employed the method of Crossa et al. (1995) to choose core accessions at random to represent the phenotypic diversity within the group.

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Fernandes, G., E. Bauchan, and M.S. McIntosh. 1983. Cátalogo de Recursos Genéticos de Maíz de Sudamérica-Uruguay. E.E.R.A. Pergamino INTA CIRF. Pergamino, Argentina.

Table 1. Number of accessions repatriated from Argentina and those which have been regenerated in Uruguay.

Race names	No. of accessions available at INIA	No. of accessions returned to INIA	No. accessions regenerated
Blanco Dentado	90	90	90
Morotí	91	84	84
Pisingallo	23	23	23
S.D. Riograndense	68	68	9
D. Riograndense	25	1	1
Cateto Sulino	454	26	9
C.S. Grosso	51	4	4
Cristal	6	6	0
Cuarentino	40	39	0
Canario de 8	4	3	3
Total	852	330	223

USA NCRPIS

Mark J. Millard

The North Central Regional Plant Introduction Station (NCRPIS) at Ames, Iowa, USA, is one of four regional stations set up within the National Plant Germplasm System (NPGS) to maintain and distribute a group of species. It celebrated its 50th anniversary in 1998. The NCRPIS maintains 44,847 accessions of 1,890 taxa in 330 genera. The staff dedicated to maize alone at the NCRPIS is a curator, a technician, and 5-8 full-time equivalents worth of temporary help from college students. This staff handles planting, pollinating, processing, viability monitoring, and data maintenance. Support staff is shared with other crops for seed storage, seed order processing, passport data maintenance, computer maintenance, secretarial support, and field preparation and maintenance. Additionally, staff is provided on the island of St. Croix to handle the preshelling operations of the St. Croix quarantine nursery. Staff were provided at the federal USDA-ARS Puerto Rico station, but this work was shifted to the private sector starting in 1998.

The NCRPIS has 14,997 accessions in its collection belonging to the genus *Zea*. The NCRPIS has 10,504 (70%) of these accessions fully available for distribution. There are 2,229 accessions that originated or were developed in the United States. Of these, 1,389 (61%) are fully available. There are 861 inbreds among the U.S. accessions. Many of those unavailable are newly acquired, old U.S. public lines. Landraces and old open pollinated farmer varieties account for 900 accessions; 820 (91%) are available for distribution.

The NCRPIS regenerates an average 200 accessions in Ames, Iowa; 100 accessions in Puerto Rico; and 100 accessions in association with the quarantine station on the island of St. Croix per year. We have had limited success in obtaining increased funding to regenerate accessions on a 20-year cycle and to catch up on unavailable accessions.

Accessions of maize are regenerated by planting 400 seeds. These are thinned to 200 plants at pollination time. Plant-to plant crosses are made among these 200 plants within the population. We plan to use each plant as a male or female only once, but at times some plants may be used both as a male and as a female. We attempt to obtain at least 100 healthy ears. Additional regenerations are attempted in later years and bulked until 100 healthy ears are obtained per population. Inbred lines are selfed using approximately the same plant populations.

Time permitting, agronomic data such as plant height, ear height, nodes above ground, etc. are obtained during the regeneration process. Currently there are no resources for separate plantings to obtain these data and others including yield on replicated plots. Rough ear characterization is done during processing, but we are currently relying on ear and kernel imaging to archive such data for future data acquisition.

Each regeneration is imaged in color. We are imagining 25 healthy representative ears in profile and in cross section at full size on an HP4C color flatbed scanner. A bulk sample of kernels is imaged at twice normal size. These images are kept on a local network. Since November 1996 we have obtained over 8,000 images on 1,936 accessions. A sample of these images will be placed on the GRIN network.

At processing, we obtain 16 balanced samples each containing a kernel from every healthy ear in the regeneration. Half of these are deposited with the NSSL and half are kept at Ames. This allows us to regenerate two times at Ames and keep the seed for two more cycles of regeneration at NSSL. The remaining seed is bulked and stored for distribution.

We store seed in hand sealed gallon plastic jars along with a reference ear. These jars are held in storage maintained at 5 °C and 25% relative humidity. Most seed orders are filled in seed storage. Each accession has one jar ordered in PI sequence. Additional seed is stored in processing sequence in large sealed foil lined bags made of the same material that NSSL uses for storage. Each bag contains approximately another gallon of seed. We currently hold additional seed of almost 2,000 accessions and we will ship this seed to any bank wishing it. We have begun to move original seed to -18°C storage. If freezer space permits, balance samples will also be stored at -18°C in the future.

Seed packet distributions were up again in 1997, but were sent to slightly fewer cooperators. 5,021 packets of seed from 3,275 accessions were sent to 168 cooperators in 212 orders in 1997. 4,415 packets of seed from 2,780 accessions were sent to 180 cooperators in 252 orders over all of 1996. In 1997, 215 packets of 175 accessions were sent to foreign countries.

Forty accessions not previously backed up were sent to the National Seed Storage Lab (NSSL) for back-up in 1997. 85 accessions were sent in 1996. PI assignment of several hundred accessions will occur soon and these will then be sent to the NSSL. The percent of accessions with PI numbers backed up at the NSSL is 91.6% (9,734 of 10,623).

In 1997, 274 germination tests were performed as compared to 340 germination tests during 1996. A new Oracle Forms-based data entry procedure is nearing completion. This will enable the maize project to return to the 3,000 germination tests done per year in previous years. Tests are done on each accession every 5 years or more often when germination falls below 85%. Accessions are queued for regeneration when viability falls below 85%.

International Networking

The biggest challenge to the free exchange of germplasm among countries is phytosanitary restrictions. The NCRPIS pathologist has been inspecting growout nurseries since 1990 in Ames, and the other tropical nurseries are also being inspected. However, there are thousands of accessions in the NCRPIS bank that have never been observed during regeneration in the field. We may never be able to exchange these accessions with other banks without regeneration. I encourage all germplasm banks to have nurseries inspected by an accredited pathologist during regeneration and to keep these records on hand so that seed can be exchanged more easily.

Treatment of bank seed is difficult. If seed must be treated, make sure that it is the most human friendly treatment available. Records of these treatments must be maintained and exchanged with the seed. Again, our bank has thousands of treated accessions received from regeneration nurseries over which we had no control. It will be years before this situation can be remedied.

Cross-checking accessions for duplications among banks is difficult. It would be helpful if some international system for maize identification could be worked out to minimize the creation of new identifiers. This internationally recognized identifier would be included with all exchanges of germplasm. Hopefully, each nation's recognized national identifier would be strongly considered as the internationally recognized identifier, especially where several nations have worked out a similar system. One site may need to be designated to handle this international identifier, even though it does not hold all the world's maize accessions.

A system needs to be worked out to label accessions that have the same identifier but *are not* the same accession.

USA USDA-NSSL

S.A. Eberhart

Introduction

Maize is extremely important to the US economy, being used for food, animal production, industrial products, and export. The USA is also the world leader in maize production, with about 80 million acres planted each year. About 20% of the production is exported.

Very little of the valuable germplasm from Latin America has been used in commercial hybrids in the USA (Pollak 1997b). After superior materials were identified in LAMP (LAMP 1991; Pollak 1997a; Salhuana and Sevilla 1995; Salhuana and Sevilla 1998), the USA Germplasm Enhancement of Maize Project (GEM) was initiated to assist US maize breeders in using these elite sources to decrease genetic vulnerability and improve hybrid performance (Pollak 1997; Salhuana et al. 1993/1994).

Of about 28,000 landrace collections that had been made in Latin America, only 12,113 were evaluated in LAMP because many collections had poor viability or low seed numbers. Hence, CIMMYT, USAID, USDA-NSSL, and 13 Latin American countries initiated a maize regeneration project in 1992. Currently, 11,636 maize landrace accessions have been regenerated and stored in local, CIMMYT, and NSSL genebanks under this project. Table 1 lists the inventory of Latin American maize landrace collection accessions in these genebanks. Information on accessions listed in the column for local genebanks was updated from the reports submitted for this workshop.

CIMMYT, NSSL, and the North Central Regional Plant Introduction Station, Ames, Iowa, have received deposits at different times with slightly different country identifiers (IDs). Hence, there is some duplication that needs to be found. We expect that with the detailed list of accessions recently provided to each country, most of these duplicates can be identified and removed to produce a more accurate inventory.

Seed Preservation Status

Seed quality and numbers for accessions from Latin America that are in long-term storage at NSSL are summarized in Table 2, and similar information will be provided to the PI for each country's accessions. Information on germination is not complete, as some of the recently regenerated samples have not yet been tested and others do not have adequate seed numbers for germination tests. Once duplicates have been identified, additional regenerations will be required for those with sub-standard germination or seed numbers in the cooperative maize regeneration project.

Maize Core Subsets

Franco et al. (1997a, b) have developed improved methodologies to designate accessions for maize core subsets that represent most of the diversity in a large collection using only a small portion of the samples. CIMMYT staff are using these methodologies, together with data from LAMP and from special evaluation experiments, to develop core subsets that will facilitate use of germplasm bank accessions by breeders and other interested researchers (Taba et al. 1998).

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Table 1. Inventory of Latin American maize landrace collections.

Country	Total	Local	CIMMYT	NSSL Backup			NC7 NPGS	US total
				CIMMYT	NPGS	Total		
Argentina	2,035	2,350	425	1,501	316	1,817	336	1,837
Bolivia	1,080	1,080	776	1,380	10	1,390	439	1,819
Brazil*	3,169	1,743	2,966	2,440	33	2,473	177	2,617
Chile	945	945	370	266	544	810	547	813
Colombia	2,050	5,206	142	278	2,038	2,316	2,256	2,534
Guatemala	855		588	449	32	481	257	706
Mexico	9,988	9,510	6,975	5,584	1,105	6,689	2,436	8,020
Paraguay	563	563	184	190	7	197	60	250
Peru	3,023	3,023	723	759	1,619	2,378	1,970	2,729
Uruguay	859	223	974	525	32	557	43	568
Venezuela	724	724	572	254	6	260	44	298
Anguilla					1	1	1	1
Antigua and Barbuda	8		18	7	8	15	9	16
Bahamas			1	1		1		1
Barbados	13		26	17	3	20	4	21
Belize			7	8	1	9	4	12
Costa Rica	399		393	172		172	48	220
Cuba	323	323	302	264	23	287	40	304
Dominican Republic	235		216	103	85	188	98	201
French Guiana			9	1	1	2	1	2
Ecuador	813	813	855	889	4	893	103	992
El Salvador	105		105	99		99	6	105
Grenada	17		35	24	3	27	3	27
Guadeloupe	16		34	21	4	25	4	25
Guyana			15	3		3		3
Haiti	31		59	50	7	57	7	57
Honduras	390	390	180	158	2	160	71	229
Jamaica	6		9	3	5	8	5	8
Martinique	10		10	9	1	10	2	11
Nicaragua	94		88	58	2	60	26	84
Panama	199		195	155		155	10	165
Puerto Rico	25		43	33	14	47	20	53
Saint Croix			15	2		2		2
Saint Lucia			8	4		4		4
St. Vincent/Grenadine	22		20	15	1	16	1	16
Suriname	11		11	11		11		11
Tobago/Trinidad	53		72	58	5	63	8	66
British Virgin Islands	14		54	25	4	29	13	38
U.S. Virgin Islands	4			6	5	11	7	13
U.S. Outlying Islands				1	1	2	1	2
Total Latin America	28,079		17,475	15,823	5,922	21,745	9,057	24,880
% of 28,079	100%		62.2%			77.4%		88.6%

*All accessions including breeders materials

Table 2. Status of Latin American maize landrace collection accessions at NSSL.

Category	Backup with CIMMYT ID	Backup without CIMMYT ID	NPGS Backup	Total	Percent
Security Backup in NSSL	13,602	2,471	5,920	21,993	
Not tested for germination	1,185	1,162	1,152	3,499	16%
Low seed number	256	1,159	1,123	2,538	73%
Not yet tested	929	3	29	961	27%
Tested for germination	12,417	1,309	4,768	18,494	84%
85% or more; 1,500 or more seeds	10,567	43	3,457	14,067	76%
85% or more; 550 to 1,499 seeds	621	71	305	997	5%
85% or more; 1 to 549 seeds	134	780	280	1,194	6%
65 to 84%; 1,500 or more seeds	484	7	318	809	4%
65 to 84%; 550 to 1,499 seeds	109	5	27	141	1%
65 to 84%; 1 to 549 seeds	45	268	93	406	2%
45 to 64%; 1,500 or more seeds	161	3	58	222	1%
45 to 64%; 550 to 1,499 seeds	22	0	7	29	0%
45 to 64%; 1 to 549 seeds	24	53	64	141	1%
1 to 44%; 1,500 or more seeds	150	7	47	204	1%
1 to 44%; 550 to 1,499 seeds	48	0	8	56	0%
1 to 44%; 1 to 549 seeds	49	56	94	199	1%
0%; 1500 or more seeds	0	0	0	0	0%
0%; 550 to 1499 seeds	0	1	0	1	0%
0%; 1 to 549 seeds	3	15	10	28	0%
Sub-total 85 to 100%	11,322	894	4,042	16,258	88%
Sub-total 65 to 84%	638	280	438	1,356	7%
Sub-total 45 to 64%	207	56	129	392	2%
Sub-total 1 to 44%	247	63	149	459	3%
Sub-total 0%	3	16	10	29	0%
Sub-total 1,500 or more seeds	11,362	60	3,880	15,302	83%
Sub-total 550 to 1499 seeds	800	77	347	1,224	6%
Sub-total 1 to 549 seeds	255	1,172	541	1,968	11%

Venezuela

Victor Segovia, Francia Fuenmayor, and Elena Mazzani

Updating Passport Data

We have 724 accessions in the bank. We now use FoxPro to store the passport data, following the IPGRI and FAO format. For some NRC collections from Venezuela, there is no information on collection sites. We are in the process of implementing bank identification numbers like VEN ZM.001 in the database.

Regeneration and Preservation of Bank Accessions

We have 124 accessions duplicated with CIMMYT during 1996-1998. We plan to regenerate as many as 100 accessions by the year 2000. The conditions of seed storage have not changed since 1996. We have a cold room of 46 m^3 maintained at 8-10°C and 50% RH. A seed dryer is now installed to dry the seed samples to 6-8% moisture. The dried seed samples will be stored in aluminum foil bags and placed inside chest freezers for long-term preservation. Other seeds are stored in the cold room in tin cans.

Evaluation of Bank Accessions and In-Situ Conservation

In addition to work conducted under LAMP, we evaluated accessions from the southern provinces in 1991. We plan to evaluate about 400 accessions as part of LAMP II. Landraces still grown in Amazons and Sucre states can be maintained through in-situ conservation.

Recommendations for Agendas I -V

From the meeting of principal investigators, CIMMYT, June 1-5, 1998

Germplasm Identifiers and Passport Data

We recommend that each cooperator bank should keep its own identifier numbers, CIMMYT identifier numbers, and NSSL identifier numbers for the accessions that the national germplasm bank maintains as duplicates at CIMMYT and NSSL.

We also recommend that the cooperator banks provide complete passport information for their accessions to CIMMYT, and that the CIMMYT database be accessible via Internet by users and cooperators.

Germplasm Exchange and Regeneration Project: Need for a New Contract with CIMMYT

We recognize the need to renew previous, outdated contracts for the cooperative regeneration project. The new contracts will be for 5 years and regeneration work will be done in consultation with the cooperator banks, as funds become available. Drafts of the new contracts will be reviewed with national authorities by the principle investigators (PIs) for each country. Any regeneration work conducted from now on should be under the new contract and should conform to current international agreements (CBD, FAO-CIMMYT, MTA, GAA) on germplasm exchange and use.

Seed Shipment and Germplasm Exchange among Cooperators

More stringent regulation of germplasm introduction to Mexico has been observed beginning this year. Detailed documentation on the seed health status requires accurate assessment of diseases in the seed increase plots. Whenever possible, we recommend consultation with plant pathologists for accurate documentation and proper seed treatment before shipment. All shipments to Mexico require prior consent from Dr. Taba, who will obtain the import permit from Mexican customs before shipping seed. Mexico also requires that all seed be treated with fungicide and/or insecticide. NSSL receives seed without treatment. Dr. Eberhart states that direct shipment to NSSL is preferred over shipment via CIMMYT.

Collection Data Format for Sampling New Germplasm

In in-situ conservation projects, there may be a need to sample local germplasm for inclusion in germplasm evaluation trials. Collection data may include socioeconomic and standard passport information, as well as information on use, plant density, and seed selection practices. In-situ conservation work may involve agro-ecological, socioeconomic, agronomic, and ethnic components. How to document in-situ conservation is another challenge.

Curatorial Responsibility of the CIMMYT Bank

Given its large germplasm holdings from recent introductions, CIMMYT should now be responsible for conserving germplasm for the future. We recommend an increase in CIMMYT's regeneration capacity, supported by adequate funds. Excess seed from regeneration will be shared among cooperators.

Conservation of Duplicates Among Cooperators

We encourage cooperator banks to preserve duplicate samples for other banks as needed, thus contributing to the long-term security of germplasm in the region.

LAMP II Guidelines

We discussed the LAMP II project in terms of in-situ conservation of extant landraces and of forming core subsets. We recommended that germplasm to be evaluated include accessions not evaluated during the original LAMP (1986-1996), accessions regenerated under the cooperative regeneration project, and new accessions acquired by national banks. Entries should be grouped according to race and adaptation for each trial set. We will employ descriptors used in LAMP and additional descriptors of grain and ear traits recommended by IPGRI-CIMMYT in 1991. Check entries will comprise two superior accessions identified in LAMP and several known cultivars that meet the same grower preferences as the accessions being tested. Trials will be grown on at least two sites with two replications and using a lattice design. Plots will comprise two, 5-meter rows.

Descriptors to record will include the following: Plant height, ear height, root lodging, plant lodging, days to silk, days to tassel, ear length, ear diameter, grain length, grain width, tillers per plant, shelling %, number of ears per plant, ear quality, ear rot rating, grain type, race classification, yield, biotic and abiotic factors limiting plant growth, and other regional factors (i.e., preferences in use).

Environmental descriptors will include the following: Soil analysis results, precipitation during the growing period (from a nearby meteorological station), minimum and maximum temperatures, irrigation (by numbers), fertilization rates, planting and harvest dates, and problems encountered during the trial.

Data analysis: Each PI will analyze the data and send the dataset to CIMMYT for cluster analysis to form core subsets. The core subset will be determined jointly by the national staff and CIMMYT.

Additional guidelines include the following:

First cycle: Plant evaluation trials as described above in two locations. If necessary, sample germplasm in the regions where in-situ conservation will be initiated (collecting the germplasm to supplement the germplasm accessions in the bank).

Second cycle: Plant evaluation trials of collected samples and superior fractions selected from the trial in the first cycle. The data will be used for in-situ conservation and core subset development.

Third cycle: Regenerate and increase seed of core subset accessions for conservation and/or prebreeding selection.

Fourth cycle on: Conduct prebreeding/breeding and in-situ utilization/conservation. Enhanced germplasm accessions will be preserved in the bank.

In-Situ Conservation Guidelines

Sampling germplasm from the region: Usually sample 30 ears or more (3 kg seed samples) using the collection data format described above. The number of samples should be more than 20 from a race or sub-region for better representation.

Contact the communities, cooperators, institutions, and farmers with whom you will work. Use participatory selection (select accessions according to farmer criteria) in the trial phase and participatory breeding (combined farmer and breeder criteria) in prebreeding phase (enhancement of the selected accessions in germplasm conservation). Gender and socioeconomic differences in preference and use should be recorded and used in developing and applying the criteria for selection and enhancement. Genetic variability should be insured for the traits under selection.

Seed should be increased and distributed by farmers and local institutions, according to opportunities.

Seed of accessions enhanced through prebreeding for characteristics such as ear rot resistance, grain quality, maturity, yield, etc., should be preserved in the bank, with back-up preservation and use elsewhere.

Use superior accessions representing the race diversity used by farmers.

For seed increases (certified seed of open pollinated cultivars), make a balanced bulk from selected ears and sow them in a seed increase plot, designating two rows as females and one row as males. Detassel female rows and select plants in male rows. At harvest select desired ears from female rows for the next cycle of seed increase.

Forming Core Subsets

We recognize that racial classification, geographic distribution, and grain type are useful characteristics for grouping accessions, as well as the use of multivariate cluster analysis on the evaluation dataset. However, a consolidated core subset is more useful for further evaluation and enhancement.

There is a need to train maize genetic resource specialists in the cluster analysis procedure used by CIMMYT to determine the phenotypic diversity of a race.

Appendix

Provisional Agenda and Tentative Schedule of the PI Meeting on the Latin American Maize Regeneration and Conservation Program

Agenda I. Passport Documentation and Updating Bank Inventory

We have sent you the accession inventory from NSSL corresponding to the germplasm from your country. You can compare the list of the accessions in NSSL and the accessions in your bank, as well as completing passport data for the accessions regenerated by the cooperative project (the reference list has been sent to you) and reporting to the meeting on this work. You can update your Passport Data and Accessions Inventory. It is recommended that the USA PI number and CIMMYT ID number be included as associated numbers in your passport database. The new updated passport database should show duplicate accessions in the network. Please report on this at the meeting, so CIMMYT can update the relevant passport data.

Please provide a report on germplasm holdings in your bank, so that the maize germplasm conservation network for Latin America can update its information, as agreed in the last PI meeting. State the number of accessions, the number of accessions with enough viable seeds, and the number of accessions by race classification (this is needed for LAMP II and to develop racial core collections).

You may report the number of seed requests you have received and shipments to users inside and outside your country, by year, as a measure of the extent of germplasm use from the network.

If you are experiencing difficulties in maintaining and updating the passport database, you may specify what is needed to do the task properly.

IPGRI has sent you a survey on the use of the CIMMYT-IBPGR ACCESSION EDITOR software. Please indicate if you have used or still use the software to compile the passport data. What is your recommendation on any future use of the software?

You may share the format you use to record data on new samples collected from farmers (we need this in the in-situ conservation project). You can comment on the CIMMYT format attached.

Finally, please write your recommendations and conclusions on the status of the Passport Data and Seed Inventory of your Bank.

Agenda II. Ex-situ Regeneration of Landraces and Duplicate Accessions in Partner Banks

Please summarize the progress made in 1996-98: The number of accessions that were regenerated at each site and sent to CIMMYT and NSSL and the number of the accessions for regeneration over 1998-2000. Based on a comparison of the NSSL inventory and holdings in your bank, what is your proposal to regenerate NSSL accessions not preserved your bank? Note that we recommended *not* to regenerate NSSL accessions for which there is enough viable seed. Please consider this point after checking the duplicate accessions in NSSL (see the Agenda I).

Some banks have already duplicated nearly all NSSL accessions but, because of the historical consequences of duplicating accessions in partner banks in the past, CIMMYT does not hold the same numbers of accessions from each country as those deposited in NSSL (for example, CIMMYT holds about 30% of the accessions of Chile). To strengthen the maize germplasm conservation network, CIMMYT could receive those samples as duplicates in its new facility. Those samples could be introduced to CIMMYT independently by your initiative. How would you consider duplicating them at CIMMYT as designated germplasm under the FAO-CIMMYT agreement and CBD?

Duplicate accessions may be deployed among the partner banks in the region. I will send a draft of the new MOU on regeneration and seed exchange for five years for your consideration. Please write your recommendations and conclusions on the current status of regeneration work and duplicate accessions.

Agenda III. Seed Preservation in the Bank

We are pleased to report that most banks have improved their seed storage facilities. Please indicate the temperature, relative humidity, seed moisture, storage capacity, and types of seed container used in your active and long-term storage facilities. A seed dryer has been installed in the national banks of most countries. Please report on its functionality. Finally, please provide pertinent recommendations and conclusions on seed preservation.

Agenda IV. Ex-situ and In-situ Characterization and Evaluation (LAMP II)

As recommended in the last PI meeting at CIMMYT, we will develop a LAMP II project proposal. The principal objective of the project is to evaluate accessions regenerated under the cooperative regeneration project, thus obtaining characterization and evaluation data to develop core subsets. However, we know that an evaluation trial should include all accessions of a particular race complex, to form a core subset of the race complex for planting at the best sites (in-situ). Plan trials and bring the proposals to the meeting based on the number and type of accessions you intend to evaluate in LAMP II. In the meeting we will discuss experimental design, data recording and analysis, and costs. Logistics for the proposal for each trial (you may have several trials for the different races or geographical groups) are attached. In the end we will develop a LAMP II proposal for use in seeking funding. Please indicate the estimated growing area of the race complex that you will evaluate in LAMP II. We expect the project to last 2-3 years.

We may need to deal with LAMP II and the in-situ conservation project separately, although both share the same germplasm complex for in-situ evaluation. LAMP II will evaluate ex-situ bank accessions that were not evaluated as part of the original LAMP, may also include newly collected samples of the same race complex, and feature trials at sites of best adaptation. Thus, trial results may be used for in-situ conservation work (i.e., purification and improvement of selected accessions through participatory breeding). Core subset will also be developed using trial results.

Many cooperators have published germplasm catalogs and germplasm characterization data is available from some banks. You may want to compile and analyze the data for core subset development. Would you consider using such data, and how? Analysis of data from similar environments across the years could provide useful information on germplasm diversity. Could you bring your own data files to the meeting, if they could be used for core subset development? (For example: Chile has a good data on ears and plants from experiments at the La Platina station, in addition to data published under LAMP. Bolivia and Argentina have catalog data. Colombia and Mexico may have extensive data as well.)

Agenda V. In-Situ Conservation and New Initiatives

In-situ conservation efforts will include in-situ germplasm evaluation and participatory breeding (on-farm conservation). The in-situ conservation project is planned to last for 2-3 years. The first phase of the project is in-situ characterization, which will include the best germplasm accessions from the ex-situ bank collections and/or newly collected samples from farmers. (LAMP II activities will in some cases meet the initial objectives of in-situ characterization.)

On-farm conservation will require a suite of innovative approaches.[2] You are encouraged to bring proposals to the meeting, including a strategy for participatory breeding in the local community. Breeding procedures are another issue. In any proposals you present, please cover all steps in the process, from identification of the best accessions to their enhancement and use by farmers. Please comment as well on future perspectives for local use and conservation of specific races (e.g., what is current growing area?). Once a proposal is developed, we will seek funding. Please report as well on any progress in breeding work as a result of LAMP; for example, use of LAMP germplasm. USA-GEM has advanced few more cycles.

We will recommend that all banks develop core subsets of holdings. What is your current approach to this work?

[2] Ecuador uses INIAP seed production unit to multiply the improved seed accessions for sale to the farmers. The local races are for the in-situ conservation project.

PI Meeting Schedule

Monday June 1, 1998. Moderator: Suketoshi Taba (Sasakawa conference room)

Report on the Agenda I, II, and III.

07:00-08:00	Registration
08:00-08:10	Welcome by Director General
08:10-08:25	Opening of the meeting by Maize Program Director
08:25-08:40	Discussion of the meeting agendas
08:40-10:25	PI report on the agenda I, II, III (Ecuador, Venezuela, Peru, Bolivia, and Paraguay)
10:25-10:40	Coffee break and group photo in front of the main building.
10:40-12:40	PI report on the agenda I,II, III (Brazil, Chile, Argentina, Mexico, Guatemala, and Colombia)
12:40-13:40	Lunch at Cafeteria
13:40-14:30	Update of seed preservation and passport documentation at NSSL
14:30-15:20	Update of seed preservation and passport documentation at CIMMYT
15:20-15:35	Coffee break
15:35-17:00	Discussions and conclusions on the agenda I, II, III. Moderator: Juan Manuel Hernandez, Mexico. Rapporteur: Victor Segovia, Venezuela.

Tuesday June 2, 1998. Moderator: Gonzalo Avila

08:00-09:40	PI report on the agenda IV and V. (Ecuador, Venezuela, Peru, Bolivia, and Paraguay)
09:40-10:00	Coffee break
10:00-12:00	PI report on the agenda IV and V (Brazil, Chile, Argentina, Mexico, Guatemala, and Colombia)
12:00-12:30	In-situ conservation work in Chihuahua, Sergio Ramirez/Felipe Alayza, Mexico
12:30-13:30	Lunch at Cafeteria
13:30-14:00	In-situ conservation project in Oaxaca: Jaime Diaz, CIMMYT
14:00-15:00	Development of non-overlapping groups for core collection: Jorge Franco, Uruguay
15:00-15:20:	Coffee break
15:20-16:20	Core collection for Bank management: Tabare Abadie, Uruguay
16:20-17:00	Discussions and conclusions on development of LAMP II and in-situ conservation projects and core collection. Moderator: Alberto Cubillo, Chile. Rapporteur: Edison Silva, Ecuador

Wednesday June 3, 1998. Travel to Oaxaca

07:00-07:30	Breakfast at Cafeteria
07:30-	Departure for Oaxaca in front of the Cafeteria.
14:30	Visit experimental plot at Huitzo, Oaxaca.
18:00	Arrive at a hotel in Oaxaca city.
19:30-21:30	Cocktail and Dinner in a restaurant

Thursday June 4, 1998. Field Visit at Trinidad Zachila, Oaxaca.

07:00-08:30	Breakfast in a restaurant
08:30-14:00	Field visit and lunch
14:30-	Return to El Batán, CIMMYT.

Friday June 5, 1998. Departure and/or PROCISUR meeting (Dr. Taba's office)

09:00-10:00	PROCISUR meeting. Moderator: Tabare Abadie, Uruguay.

Passport data to record when collecting seed of farmer varieties.

Collector names

____ ____________

Collector initial(s) and Collector Number: _______________

Collector institution(s):______________________________

Name of the farmer and his/her age: ___________________

The farmer's address_______________________________

And his/her telephone/fax:___________________________

Collection date: ________________ ______

Country of collection:__________________

Collection site: field plot name:_____________ village:____________________ community:_________

district:_______________ latitude:______ : ______ longitude: _______ : _______

altitude:________(masl)

Collection source: (1) farmer's stock (___); (2) farmer's field (___);(3) rural store (___); local market (___); (5) institution (___); (6) other (___) specify _____________

Collection types: (1) farmer's variety which is cultivated for how many years?____ (2) varietal mixture which is cultivated for how many years_____ (3) what varieties are included in the varietal mixture?____________(4) an introduced variety which is cultivated for how many years? ___(5) where the introduced variety come from?_______ (6) an improved variety which is cultivated for how many years?______.

No of ears collected:__________

Amount of seed collected:______

local name/ vernacular name: what is the best known name of the variety? _______

How does the farmer use it: (1) grain (__), maize flour (__), forage(__), fuel (__) other (__); what do they make of it: ____________

Registration of photography if taken:_____________________

Sample descriptions: grain color a).______ b).______ grain texture:

a).____b)_____Ear form:_________ No of kernel rows:______

On maize growing: which month for planting: 1.____ 2.____ which month at flowering: 1.____2._____which month in maturity (full size ear): 1.____2._____which month for harvest: 1____2___

What problems have been observed on plant, root, stalk, leaf diseases, and insects:.____

What problems have been observed during the grain storage?

____

Do you fertilize the maize? ____If yes, what kind of the fertilizer do you use?

What are the characteristics of the variety that you like?

What are those characteristics of the variety that you do not like?

Do you want to change your variety?_______

How do you plant ? in rainfed: ______ or with supplemental irrigation:_____ or with full irrigation:___

Is it drought resistant? resistant ____ susceptible___ not known:____

How many different types of maize do you grow? What are they? What is the plant density do you use?

____

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