Global Strategy for the *Ex Situ* Conservation of Lentil (*Lens* Miller)

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Table of contents

Disclaimer **3**
Acknowledgment **3**
Summary **3**
1) Introduction **4**
1.1 The Strategy Development Process 5
1.2 The genus *Lens* 6
2. Overview of *Lens* collections **6**
2.1 Analysis of information from the regional conservation strategies 7
2.2 Size and composition of collections 7
2.3 Storage facilities 12
2.4 Regeneration needs 13
2.5 Safety duplication 15
2.6 Information and documentation systems 18
2.7 Gaps in the coverage of global genetic diversity in existing collections 20
2.8 *Lens* Germplasm Users 21
3) Training **21**
4) Policy issues **22**
5) Partners in global *Lens* conservation activities **23**
5.1 Networks 24
6) A strategic approach to conserving the genepool **24**
7) Summary and conclusions: a way forward **28**
Annex 1. Survey 31
Annex 2. Institutions contacted through a survey in April 2006 42
Annex 3. Participants List 46
Annex 4 Annotated Agenda 49
Annex 5. Simplified survey in January 2007 53
Annex 6: Other Potential *Lens* Collections and Additional Data 54

Disclaimer

This document, developed with the input of a large number of experts, aims to provide a framework for the efficient and effective *ex situ* conservation of globally important collections of lentil and its wild relatives.

The Global Crop Diversity Trust (the Trust) provided support for this initiative and considers this document to be an important framework for guiding the allocation of its resources. However the Trust does not take responsibility for the relevance, accuracy or completeness of the information in this document and does not commit to funding any of the priorities identified.

This strategy document (dated 3 December 2008) is expected to continue to evolve and be updated as and when circumstances change or new information becomes available.

Acknowledgment

The Strategy outlined here has been developed following extensive consultations with many stakeholders concerned with the conservation and use of the genetic diversity of *Lens*. Valuable information, ideas and insights source from the many genebank managers and national and international programme scientists (listed in Annexes 2 and 3) who attended the Aleppo Workshop in 2007, the Fourth International Food Legume Research Conference in 2005, and/or contributed via the survey. Pertinent and useful input was also received from the technical reviewers of the draft Strategy.

Summary

The current status of *Lens ex situ* genetic resources was assessed via a survey sent to the major lentil collections, meetings bringing together researchers and curators of *Lens* germplasm, database searching, and communications with relevant scientists and experts. Collection composition, facility status, regeneration needs, safety duplication status, information and documentation status, and status of accessibility of germplasm is presented based upon the gat vhered information. Gaps in the world collection of lentil, improved utilization of *Lens* germplasm, training, partnerships, and networks related to lentil are surveyed.

Collection information is currently insufficient for many collections identified in the Strategy, and other collections potentially containing lentil germplasm remain to be verified. From the available information, key collections containing important lentil accessions and meeting international standards for conservation, information, and availability are highlighted. Collections holding priority germplasm and identified as in need of assistance to come to meet full international standards with respect to maintenance, documentation, and/or distribution are also identified. Other collections holding unique germplasm of *Lens* are also highlighted for further investigation. These collections form the basis for a rational global conservation system for lentil and its wild relatives, and the international community should consider supporting the holding institutions in order to ensure the long-term conservation, information availability, and distribution of these globally important resources.

1) Introduction

This Conservation Strategy summarizes information important to the evolution of a rational global *ex-situ* conservation system for lentil and its wild relatives.

Lentil (*Lens culinaris* Medik*)*, is one of the founding crops of agriculture, domesticated at about the same time as wheat and barley in the Fertile Crescent, from today's Jordan northward to Turkey and southeast to Iran. A substantial portion of global lentil production is still concentrated in this area. However, the largest producers of lentils are India and Canada. Sixty percent of lentil production is in the South Asian region, including Bangladesh, Burma, India, Nepal and Pakistan. Worldwide lentil is grown on a total area of 1.8 million hectares[1]. In Bangladesh and Nepal lentil is the most important pulse crop for human consumption. Lentils are an increasingly popular crop worldwide and global production has been rising steadily for the last number of decades, more than tripling since 1980[2].

The wild progenitor of lentil is identified as the species *Lens culinaris* subsp. *orientalis*, which looks like a miniature cultivated lentil and bears ponds that burst open immediately after maturation. Selection by early farmers around 7000 BC led to the cultivated species with non-dehiscent pods and non-dormant seeds, more erect plants and a considerable increase in seed size and variety in color[3]. The crop has developed into a range of varieties adapted to diverse growing areas and cultural preferences, and containing unique nutritional compositions, colors, shapes, and tastes.

Lentils are highly nutritious, containing protein, vitamin A, fiber, starch, potassium, B vitamins, and iron. As a protein source, lentil contains no cholesterol and virtually no fat, and very low levels of antinutrients[4].

Lentil plants provide a number of functions aside from being sources of human food. Lentil straw is an important fodder for small ruminants in the Middle East and North Africa, and the nitrogen sequestrating plant improves soil fertility and therefore increases sustainability of agricultural production systems.

There have been significant breeding achievements in lentil since the late 1970s. The genetic base of the crop has been broadened and tolerance to abiotic (drought and cold) and resistance to biotic stresses from wild genotypes and traditional varieties have been incorporated into new high yielding cultivars[5]. Large collections of lentil are stored in genebanks as genetic resources for further breeding efforts. However, there are gaps in the coverage of the genetic diversity of the crop and some of the collections are endangered or deteriorating.

This Strategy aims to provide a blueprint for a more efficient and effective conservation of the lentil genepool throughout the world, including both cultivated and wild species of the genus *Lens*. Although the holdings of the latter are small compared to the cultivated species, they are potentially very important for research and crop improvement. The genus is included within the multilateral system of access and benefit-sharing provided for by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

[1] Sultana and Ghafoor (2004).
[2] FAOSTAT (2005).
[3] Zohary (1995).
[4] Sultana and Ghafoor (2004).
[5] Sarker and Erskine. (2006).

1.1 The Strategy Development Process

The first consultations on the development of this conservation strategy for *Lens* (as well as for other food legumes) took place at a special seminar held during the Fourth International Food Legume Research Conference, in New Delhi, India, in October 2005. Eighteen people from eleven institutions participated. Subsequently, in March 2006, a questionnaire (Annex 1) was distributed to the curators of 36 genebanks in 27 countries (Annex 2) to seek comprehensive information on the status of *Lens* collections. Unfortunately the response to the questionnaire was not comprehensive.

The major event in the development of this strategy was a workshop that took place at ICARDA in Aleppo, Syria from 19 – 22 February, 2007, entitled: "Global Collaborative *Ex Situ* Conservation Strategies for Food Legumes (chickpea, lentil, faba bean and grass pea)". Annex 3 lists the workshop participants and the annotated agenda is given in Annex 4. A simplified questionnaire (Annex 5) was distributed to participants and other concerned researchers in advance of the meeting, and the responses were collated and verified at the workshop. Participants addressed a wide range of issues relating to increasing the efficiency and effectiveness of *ex situ* conservation and for strengthening links to actual and potential users of the germplasm. Following the workshop, further information was received from some genebanks- both those represented at the workshop itself as well as several that had not been present in Aleppo but were identified at the workshop as possibly having significant collections of *Lens*.

In addition to the process listed above, additional sources of information consulted in drafting this strategy included:

- The regional conservation strategies for West Asia and North Africa; Americas; Southern Africa; South, Southeast, and East Asia; West and Central Africa; Central Asia and the Caucasus; and East Africa.
- Central Asia and Caucasus Plant Genetic Resources Inventory and regional Plant Genetic Resource Network.
- Various databases and information sources available on the internet including:
    - The Consultative Group on International Agricultural Research (CGIAR) System-wide Information Network on Genetic Resources (SINGER) database: http://singer.grinfo.net/
    - USDA – Genetic Resources Information Network (GRIN) database: http://www.ars-grin.gov/npgs/
    - EURISCO: http://eurisco.ecpgr.org/
    - ECPGR *Lens* database: http://www.ecpgr.cgiar.org/databases/Crops/lens.htm
    - FAO – World Information and Early Warning System on PGRFA (WIEWS): http://apps3.fao.org/wiews/germplasm_query.htm?i_l=EN
    - Information Sharing Mechanism on the Implementation of the Global Plan of Action for the Conservation and Sustainable use of PGRFA: http://kctu048:8080/gpa/selectcountry.jspx
    - Global Biodiversity Information Facility (GBIF): http://data.gbif.org/welcome.htm
    - International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) website: http://www.planttreaty.org
    - Bioversity Germplasm Collection Directory:

http://www.bioversityinternational.org/Information_Sources/Germplasm_Databases/Germplasm_Collection_Directory/index.asp

1.2 The genus *Lens*

The genus *Lens* Miller is part of the family Fabaceae (Leguminosae), subfamily Faboideae, tribe Fabeae, or alternatively in subfamily Papilionaceae, tribe Vicieae. According to the latest classification by Ferguson *et al*. (2000) the genus comprises seven taxa split into four species:

- *Lens culinaris* Medikus subsp. *culinaris, L. culinaris* subsp. *orientalis, L. culinaris* subsp. *tomentosus, L. culinaris* subsp. *odemensis*
- *Lens ervoides* (Brign.) Grande
- *Lens nigricans* (M. Bieb.)Godr.
- *Lens lamottei* Czefr.

Taxa contained within *L. culinaris* comprise the primary genepool for lentil. The remaining species constitute secondary-tertiary genepools. All species are diploid (2n=14), annual, and self pollinating with a low outcrossing frequency. *L. culinaris* subsp. *orientalis* accessions have been found to have resistance to drought, cold, wilt, and *Aschochyta* blight. *L. nigricans* can hybridize with *L. culinaris*, but with low seed set[6].

The species is native to parts of Asia, Africa and the Mediterranean region. The Near and Middle East is the primary centre of diversity for both the domestic *L. culinaris* and its wild progenitor, but wild relatives in the genus are found from Spain to Tajikistan[7]. The cultivated species *Lens culinaris* subsp. *culinaris* is divided into two groups: the small seeded, red cotyledon var. *microsperma*, and the large seeded, green var. *macrosperma*.

2. Overview of *Lens* collections

This strategy identified 43 214 accessions of *Lens* held in collections worldwide, gathered from the questionnaire, meetings, and other data sources.

This section provides a brief overview and analysis of the following data:

- total number of *Lens* accessions
- the percentage of landraces
- the percentage of wild relatives
- the percentage of advanced or breeding material
- the percentage originating in the country concerned
- the percentage originating outside the country
- the percentage of the collection formally duplicated, and where
- the nature of the storage facilities (long- and/or short-term)
- whether the data management is computerized, and with or without web access
- whether there are passport and/or characterization data available
- the existence and extent of regeneration requirements
- gaps in collections

[6] Redden *et al.* 2007.
[7] Ibid.

- whether the host country has ratified the ITPGRFA

Note that the information in the tables in this section is in most cases reported by the institutes and genebanks themselves and is in many cases incomplete for some of the categories above.

2.1 Analysis of information from the regional conservation strategies

From 2005 to 2007 with support from the Global Crop Diversity Trust (Trust), regional conservation strategies for the long-term conservation and availability of plant genetic resources were developed for almost all of regions worldwide. The regional approach is to identify key *ex situ* collections of globally important crops (of Annex 1 of the ITPGRFA) on a region-by-region basis. Regional strategies complement the global crop conservation strategies, which prioritize collections on a crop-by-crop basis at the global level.

Lentil is considered a high priority crop in the regional conservation strategy for West Asia and North Africa, with first priority assigned to the crop in West Asia, and very high priority in North Africa. This is both the centre of origin and the primary centre of diversity for the crop. Lentil constitutes the fourth highest number of accessions in the region (7355 accessions), held mostly in NGB Iran, NGB-AARI Turkey, GCSAR Syria, NGB Egypt, NARC Pakistan, and INRA Morocco. Also within the primary centre of diversity, the Central Asia and the Caucasus strategy prioritizes the importance of lentil, especially for food security in Azerbaijan and Tajikistan. Collections of lentil are listed as held and available in Armenia, Azerbaijan, Georgia, and Tajikistan.

The Eastern Africa strategy includes lentil amongst the region's priority crops, given the 19th ranking out of the 21 crop groups listed. The crop is important in Ethiopia and Sudan. Ethiopia maintains the only major collection in the region at the Institute of Biodiversity Conservation (IBC). Screenings of this material have identified earliness, high seed yield, high harvest index, high number of seeds per pod and cold tolerance.

The conservation strategy of South, South-East and East Asia gives lentil an overall priority of 17th out of 28 crops. The ranking is higher in the South Asian sub region where the crop is ranked as the 14th most important crop and is assigned the highest priority category in Bangladesh, India and Nepal, and second priority in Bhutan and Sri Lanka. Lentil is the most important pulse crop in the sub region, with rich variability in India and in Nepal. Collections of lentil in the region identified as of greatest importance as well as priority for support include NBPGR India and the working collection at IIPR India. 3022 lentil accessions are conserved in the region.

The Southern Africa regional strategy does not list lentil as of priority importance to the region, but does assign the crop high priority in terms of importance to specific countries (these not specifically named). Twenty six accessions are listed as conserved in Lesotho. The Americas strategy gives lentil medium priority in the region.

2.2 Size and composition of collections

Tables 1a and *1b* list the main collections of *Lens* by number of accessions, accession type, and collection source.

Table 1: *Lens* collections: Content

Country	Genebanks / institutes	Total number of accessions	Wild relatives %	Land-races %	Breeding material %
GLOBAL	ICARDA	10822		82%	
Australia	Australian Temperate Field Crops Collection	5254	4%	54%	
Iran	Seed and Plant Improvement Institute	3000			
USA	USDA	2875	1%		
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	Yes	80%	Yes
India	National Bureau of Plant Genetic Resources	2285	1%	42%	Yes
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345			
Canada	PGRC	1139		56%	Yes
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	1%	99%	Yes
Syria	General Commission for Scientific Agricultural Research	1072			
Hungary	Research Centre for Agrobotany	1061		3%	Yes
Egypt	NGB	875		5%	
China	Institute of Crop Germplasm Resources (CAAS)	855		60%	
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	8%	91%	Yes
Bangladesh	Bangladesh Agricultural Research Institute	798			
Spain	Centro de Recursos Fitogeneticos, INIA	703	10%	87%	Yes
Ethiopia	Biodiversity Conservation and Research Institute	678	70%	Unknown	Unknown
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	1%	52%	Yes
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600			
Israel	Agricultural Research Organisation, The Volcani center	500			
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	0%	97%	
Chile	Centro Regional de Investigación Quilamapu, INIA	450		64%	Yes
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	0%	0%	100%
Morocco	Institut National de la Recherche Agronomique (INRA)	365			

Country	Genebanks / institutes	Total number of accessions	Wild relatives %	Land-races %	Breeding material %
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361			
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348			
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321			
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295			
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	0%	100%	0%
Slovakia	Research Institute of Plant Production Piestany	239			
Poland	Plant Breeding Station	216			
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200			
Tunisia	Minister of Agriculture	65			
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60			
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34			
Tadjikistan	Makhsumov Scientific Reserch- production Center "Ziroatkor" & Scientific Reserch Institute of Farming & TJK-Genebank (MSRPC)	28			
Azerbaijan	Agricultural Research Institute (ARI)	27			
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22			
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15			
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	0%	100%	0%
Portugal	Banco Portuges de Germoplasma, Braga	5			

Table 1: *Lens* collections: Accession Source

Country	Genebanks / institutes	Total number of accessions	Origin - collecting in country %	Origin - Collected outside country %	Origin - Introduced %	Origin - other %
GLOBAL	ICARDA	10822	17%	26%		
Australia	Australian Temperate Field Crops Collection	5254			99%	
Iran	Seed and Plant Improvement Institute	3000				
USA	USDA	2875				
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	0%	93%	7%	0%
India	National Bureau of Plant Genetic Resources	2285	78%	0%	22%	0%

Country	Genebanks / institutes	Total number of accessions	Origin - collecting in country %	Origin - Collected outside country %	Origin - Introduced %	Origin - other %
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345				
Canada	PGRC	1139			95%	5% (advanced or pure line)
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	100%	0%	0%	0%
Syria	General Commission for Scientific Agricultural Research	1072				
Hungary	Research Centre for Agrobotany	1061	3%			
Egypt	NGB	875				
China	Institute of Crop Germplasm Resources (CAAS)	855	60%	0%	40%	0%
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	60%	0%	40%	0%
Bangladesh	Bangladesh Agricultural Research Institute	798				
Spain	Centro de Recursos Fitogeneticos, INIA	703	60%	53%	41%	8%
Ethiopia	Biodiversity Conservation and Research Institute	678	71%	2%	4%	25%
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	6%	0%	94%	0%
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600				
Israel	Agricultural Research Organisation, The Volcani center	500				
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	97%	0%	3%	0%
Chile	Centro Regional de Investigación Quilamapu, INIA	450	0%	68%	32%	0%
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	0%	0%	100%	0%
Morocco	Institut National de la Recherche Agronomique (INRA)	365				
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361				
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348				
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321				
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295				
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	8%	0%	92%	0%
Slovakia	Research Institute of Plant Production Piestany	239				
Poland	Plant Breeding Station	216				

Country	Genebanks / institutes	Total number of accessions	Origin - collecting in country %	Origin - Collected outside country %	Origin - Introduced %	Origin - other %
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200				
Tunisia	Minister of Agriculture	65				
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60				
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34				
Tadjikistan	Makhsumov Scientific Reserch-production Center "Ziroatkor" & Scientific Reserch Institute of Farming & TJK-Genebank (MSRPC)	28				
Azerbaijan	Agricultural Research Institute (ARI)	27				
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22				
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15				
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	10%	0%	90%	0%
Portugal	Banco Portuges de Germoplasma, Braga	5				

The collections in *Table 1* together conserve 43 214 accessions. This is more than recorded by any earlier survey of the crop, e.g. the Directory of Germplasm of Bioversity International lists 40 982 accessions, the germplasm database of FAO's World Information and Early Warning System (WIEWS) lists 37 526 accessions, and FAO's State of the World's Plant Genetic Resources for Food and Agriculture (1998) lists 27 424 accessions (Annex 6).

Collections are listed in *Table 1* by number of accessions held. There is one international *Lens* collection. Lentil is a mandate crop at the International Centre for Agricultural Research in the Dry Areas (ICARDA), in Syria. ICARDA is the largest collection of *Lens* worldwide, holding 24% of *Lens* germplasm accessions conserved globally, including 583 accessions of wild *Lens*.

The accession type and source data in *Table 1* gives an indication of the uniqueness of the collections. Collections with a high % of wild relatives, landraces, and material originally collected by the institute are most likely to encompass unique accessions prioritized in a rational global system. Complete data regarding accession type and source is currently lacking for many collections, and the degree of intentional and unintentional duplication of accessions among these collections is only partially known.

Although the strategy process involved meetings, correspondence, and a survey sent to major genebanks holding *Lens* worldwide, feedback from some potential collections appearing in the database sources listed above was not successfully obtained. Therefore *Table 1,* albeit representing the major and most active *Lens* collections, should not be considered a comprehensive listing for collections worldwide. Collections holding over 50 accessions of *Lens* identified within the Bioversity International and/or FAO WIEWS databases, regional strategies, or other means and not present in *Table 1* are listed in *Annex 6*. As these yet-to-be

verified collections together potentially conserve over 4 000 accessions, further work is warranted to establish the status and contents of these *Lens* collections, and to incorporate collections holding unique diversity into the Global Strategy.

2.3 Storage facilities

Storage conditions declared by respondents to the survey are listed in *Table 2*. The definition of long-term storage is at the discretion of the reporting institute and in some cases the facilities may not be meeting international standards for long-term conservation. According to the Genebank Standards published jointly by FAO and IPGRI[8] in 1994 the optimum storage temperature for maximum longevity is -18°C or lower and the seed moisture content should be between 3 -7 %. Data on storage conditions for numerous collections is currently lacking, but from available data it appears that long-term storage is in place in most major collections.

Table 2: Storage Conditions Listed by Responding Institutions

Country	Genebanks / institutes	Total number of accessions	Facilities - long-term	Facilities - short-term
GLOBAL	ICARDA	10822	Yes	Yes
Australia	Australian Temperate Field Crops Collection	5254	Yes	Yes
Iran	Seed and Plant Improvement Institute	3000		
USA	USDA	2875	Yes	
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	Yes	Yes
India	National Bureau of Plant Genetic Resources	2285	Yes (100%)	Yes
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345		
Canada	PGRC	1139	Yes (100%)	Yes
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	Yes (100%)	Yes (100%)
Syria	General Commission for Scientific Agricultural Research	1072		
Hungary	Research Centre for Agrobotany	1061	Yes	Yes
Egypt	NGB	875		
China	Institute of Crop Germplasm Resources (CAAS)	855	Yes (100%)	
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	Yes	Yes
Bangladesh	Bangladesh Agricultural Research Institute	798		
Spain	Centro de Recursos Fitogeneticos, INIA	703	Yes (76%)	Yes (medium) (92%)
Ethiopia	Biodiversity Conservation and Research Institute	678	Yes (88%)	Yes (12%)
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	Yes (48%)	Yes (medium) (52%)
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600		
Israel	Agricultural Research Organisation, The Volcani center	500		

[8] Food and Agriculture Organization (FAO) and International Plant Genetic Resource Institute (IPGRI) 1994. Genebank Standards, FAO Rome, Italy and IPGRI. Rome, Italy. 13 pp.

Country	Genebanks / institutes	Total number of accessions	Facilities - long-term	Facilities - short-term
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489		Yes (medium)
Chile	Centro Regional de Investigación Quilamapu, INIA	450	Yes (100%)	Yes (100%)
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423		Yes(medium and short)
Morocco	Institut National de la Recherche Agronomique (INRA)	365		
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361		
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348		
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321		
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295		
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	Yes (100%)	Yes
Slovakia	Research Institute of Plant Production Piestany	239		
Poland	Plant Breeding Station	216		
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200		
Tunisia	Minister of Agriculture	65		
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60		
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34		
Tadjikistan	Makhsumov Scientific Research- production Center "Ziroatkor" & Scientific Research Institute of Farming & TJK-Genebank (MSRPC)	28		
Azerbaijan	Agricultural Research Institute (ARI)	27		
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22		
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15		
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	Yes	
Portugal	Banco Portuges de Germoplasma, Braga	5	Yes	

2.4 Regeneration needs

The urgency of regeneration needs given by respondents to the survey and/or ascertained through communications with the Trust, listed in *Table 3,* depend on individual institution viability testing protocols and standards for regeneration. The general recommendation from the FAO/IPGRI genebank standards dictate that an accession must be regenerated when: (a) seed viability drops to 85% of the initial value and/or (b) numbers of seeds drops below 1500. Adequate data regarding regeneration backlog is currently lacking for a number of collections. More than one assessment of regeneration needs may be presented for a collection in the table due to differences between data sources. From available data, significant regeneration needs

exist in many countries. In addition, it is recognized that research in the establishment of protocols for regeneration of wild species is of priority.

Table 3. *Lens* Regeneration needs, as of June 2007

Country	Genebanks / institutes	Total number of accessions	% of accessions for regeneration
GLOBAL	ICARDA	10822	0%
Australia	Australian Temperate Field Crops Collection	5254	21%
Iran	Seed and Plant Improvement Institute	3000	60%
USA	USDA	2875	0%
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	50%
India	National Bureau of Plant Genetic Resources	2285	0%
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345	75%
Canada	PGRC	1139	0%
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	24%
Syria	General Commission for Scientific Agricultural Research	1072	50%
Hungary	Research Centre for Agrobotany	1061	76%
Egypt	National Genebank (NGB)	875	
China	Institute of Crop Germplasm Resources (CAAS)	855	100%
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	30-70%
Bangladesh	Bangladesh Agricultural Research Institute	798	75%
Spain	Centro de Recursos Fitogeneticos, INIA	703	12%
Ethiopia	Biodiversity Conservation and Research Institute	678	10%
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	50%/ 9%
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600	50%
Israel	Agricultural Research Organisation, The Volcani center	500	0%
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	100%/ 0%
Chile	Centro Regional de Investigación Quilamapu, INIA	450	50%
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	0%
Morocco	Institut National de la Recherche Agronomique (INRA)	365	100%/ 75%
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361	50%
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348	
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321	0%
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295	0%
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	63%
Slovakia	Research Institute of Plant Production Piestany	239	0%
Poland	Plant Breeding Station	216	0%
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200	75%
Tunisia	Minister of Agriculture	65	
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60	
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34	
Tadjikistan	Makhsumov Scientific Research- production Center "Ziroatkor" & Scientific Research Institute of Farming & TJK-Genebank (MSRPC)	28	
Azerbaijan	Agricultural Research Institute (ARI)	27	

Country	Genebanks / institutes	Total number of accessions	% of accessions for regeneration
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22	
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15	
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	1%
Portugal	Banco Portuges de Germoplasma, Braga	5	

2.5 Safety duplication

Degree of safety duplication as stated by responding institutions is listed in *Table 4*. Adequate data regarding safety duplication is currently lacking for numerous collections. While more information is needed on the extent and location of materials duplicated for safety purposes, it is apparent that many important collections are inadequately duplicated and are thus at risk. A large proportion of accessions are not currently reported as safety duplicated in a number of countries, particularly India, Pakistan, Turkey, Ukraine, Portugal BPGV, Ethiopia, Spain INIA, and Ecuador.

Table 4. Status of Safety Duplication of *Lens* Collections

Country	Genebanks / institutes	Total number of accessions	% Collection safety duplicated	Duplication location
GLOBAL	ICARDA	10822		
Australia	Australian Temperate Field Crops Collection	5254	67%	67%In process
Iran	Seed and Plant Improvement Institute	3000		
USA	USDA	2875	94%	94%In country?
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	100%	84%In country/32%ICARDA
India	National Bureau of Plant Genetic Resources	2285	0%	
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345		
Canada	PGRC	1139	?%	%?-VIR/IPK/Ukraine
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	2%	2%(recently started, in country/ 4%ICARDA)
Syria	General Commission for Scientific Agricultural Research	1072		
Hungary	Research Centre for Agrobotany	1061	100%	100%In country(medium term)
Egypt	NGB	875		
China	Institute of Crop Germplasm Resources (CAAS)	855	100%	100% In country
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	29%	29% IBPGR
Bangladesh	Bangladesh Agricultural Research Institute	798		

Country	Genebanks / institutes	Total number of accessions	% Collection safety duplicated	Duplication location
Spain	Centro de Recursos Fitogeneticos, INIA	703	0%	
Ethiopia	Biodiversity Conservation and Research Institute	678	0%	
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	61%	61%Ukraine/VIR/ICRISAT/ICARDA
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600		
Israel	Agricultural Research Organisation, The Volcani center	500		
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	100%	ICARDA
Chile	Centro Regional de Investigación Quilamapu, INIA	450	100%	100% In country
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	60%	60%In country
Morocco	Institut National de la Recherche Agronomique (INRA)	365		
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361		
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348		
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321		
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295		
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	13%	13%ICARDA
Slovakia	Research Institute of Plant Production Piestany	239		
Poland	Plant Breeding Station	216		
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200		
Tunisia	Minister of Agriculture	65		
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60		
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34		
Tadjikistan	Makhsumov Scientific Research-production Center "Ziroatkor" & Scientific Research Institute of Farming & TJK-Genebank (MSRPC)	28		
Azerbaijan	Agricultural Research Institute (ARI)	27		
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22		
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15		

Country	Genebanks / institutes	Total number of accessions	% Collection safety duplicated	Duplication location
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	100%	100%In country
Portugal	Banco Portuges de Germoplasma, Braga	5	0%	

The workshop in Aleppo agreed that all unique materials should be safety duplicated in a genebank meeting international standards for conservation and capable of distribution, ideally in a second country. Ideally, in order to enhance access to plant genetic resources, and under the terms and conditions of the IT, these safety duplication arrangements would be free of constraints (i.e. not black-box). Both ICARDA and NBPGR (India) expressed a willingness to provide facilities for safety duplication and it is likely that other institutions would also be prepared to offer such facilities if so requested. Amongst the collections tentatively nominated as priority collections (see Section 6 below) there are 26 163 accessions. Only a small percentage of these are reported to be safety duplicated outside the holding country. It is important to note that safety duplication requires a formal arrangement. The fact that an accession is present in another collection does not immediately signify that the accession is safety duplicated in long-term conservation conditions.

It was also agreed that in addition to normal safety duplication in a "conventional" genebank, a second level of safety duplication is highly desirable. The Svalbard Global Seed Vault, Norway, would be a highly appropriate location for such a second level safety net. To achieve this it was proposed that:

- ICARDA will send 100% of its collection to Svalbard.
- Unique accessions in collections that are not already duplicated in large and well-funded collections should be supported for duplication in both a large and well-funded collection (ideally at ICARDA) and at Svalbard.
- South Asia Network on Plant Genetic Resources (SANPGR) is willing to facilitate/coordinate safety duplication activities for South Asian collections. ICARDA will coordinate safety duplication in collections in Central Asia, West Asia and North Africa, East Asia and elsewhere.

Some arrangements for safety duplication were agreed upon in Aleppo:

- Spain: Safety duplicate at Nordic Genebank.
- Pakistan: Safety duplicate most accessions at ICARDA and USDA.
- ICARDA: lentil to be safety duplicated at NBPGR India.
- The Global Crop Diversity Trust would make available to the international and some national collections standard containers and packaging materials for safety duplication at Svalbard.

As of July 2008, 3 352 *Lens* accessions have been deposited at Svalbard Global Seed Vault, the overwhelming majority of which came from ICARDA. VIR Russian Federation and IPK Germany have safety deposited a limited percentage of their respective collections.

2.6 Information and documentation systems

Status of information and documentation systems given by respondents to the survey and questionnaire are listed in *Table 5*. Adequate data regarding information systems is currently lacking for the collections that were not participatory in the survey or planning meetings. In general, responding institutions hold computerized *Lens* databases containing passport as well as characterization and evaluation data. Degree of each type of data held was not quantified. From available data, internet access to collections databases exists for most collections, with a number of exceptions, including India, Hungary, China, Ukraine, Portugal, Chile, and Ecuador. The European and Caucasus countries are included in the EURISCO and in the ECPGR *Lens* databases, providing some passport, but no characterization or evaluation data.

Table 5. *Lens* collections: Documentation

Country	Genebanks / institutes	Total number of accessions	Data compu-terised	Passport	Charac-terisation	Web access
GLOBAL	ICARDA	10822	Yes	Yes	Yes	Yes
Australia	Australian Temperate Field Crops Collection	5254	Yes	Yes	Yes	Yes
Iran	Seed and Plant Improvement Institute	3000				
USA	USDA	2875	Yes	Yes	Yes	Yes
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	Yes	Yes	Yes	Yes
India	National Bureau of Plant Genetic Resources	2285	Yes	Yes		
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345				
Canada	PGRC	1139	Yes	Yes	Yes	Yes
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	Yes	Yes	Yes	Yes
Syria	General Commission for Scientific Agricultural Research	1072				
Hungary	Research Centre for Agrobotany	1061	Yes	Yes		EURISCO/ ECPGR
Egypt	NGB	875				
China	Institute of Crop Germplasm Resources (CAAS)	855	Yes	Yes	Yes	
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	Yes			
Bangladesh	Bangladesh Agricultural Research Institute	798				
Spain	Centro de Recursos Fitogeneticos, INIA	703	Yes	Yes	Yes	Yes
Ethiopia	Biodiversity Conservation and Research Institute	678				
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	Yes	Yes	Yes	EURISCO/ ECPGR

Country	Genebanks / institutes	Total number of accessions	Data compu-terised	Passport	Charac-terisation	Web access
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600				
Israel	Agricultural Research Organisation, The Volcani center	500				
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	Yes	Yes (100%)	Yes (40%)	No
Chile	Centro Regional de Investigación Quilamapu, INIA	450	Yes	Yes	Yes	
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	Yes	Yes	Yes	Yes
Morocco	Institut National de la Recherche Agronomique (INRA)	365				
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361				EURISCO/ ECPGR
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348				EURISCO/ ECPGR
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321				EURISCO/ ECPGR
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295				
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	Yes	Yes		
Slovakia	Research Institute of Plant Production Piestany	239				EURISCO/ ECPGR
Poland	Plant Breeding Station	216				EURISCO/ ECPGR
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones Agrícolas	200				
Tunisia	Minister of Agriculture	65				
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60				
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34				EURISCO/ ECPGR
Tadjikistan	Makhsumov Scientific Research-production Center "Ziroatkor" & Scientific Research Institute of Farming & TJK-Genebank (MSRPC)	28				
Azerbaijan	Agricultural Research Institute (ARI)	27				EURISCO/ ECPGR
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22				
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15				EURISCO/ ECPGR
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	Yes	Yes	Yes	EURISCO/ ECPGR
Portugal	Banco Portuges de Germoplasma,	5	Yes	Yes	Yes	EURISCO/

Country	Genebanks / institutes	Total number of accessions	Data compu-terised	Passport	Charac-terisation	Web access
	Braga					ECPGR

The Aleppo meeting concluded a number of points regarding information systems:

- IPGRI and ICARDA published a crop descriptor specifically for lentil in 1985[9], and IPGRI offered forage legume descriptors in 1984. IPGRI also publishes multicrop passport descriptors (revised, December 2001), and the European Cooperative Programme for Crop Genetic Resources Networks' (ECPGR) information sharing mechanism (EURISCO) offers an extension of these descriptors. These resources are adequate for documenting *Lens* germplasm. The development of a minimum list of descriptors based upon the above Descriptors was identified as needed.
- Many *Lens* accessions have yet to be characterized and evaluated. A considerable amount of the data that has been generated is not electronically available.
- Training is needed on recording passport, characterization, evaluation and other related data.
- Standardization of databases is needed, and would be aided by the creation of procedures for information databases.
- Investments are needed for upgrading the information management systems in some priority collections.
- The creation of a global information system linking lentil collections is vital to an analysis of collections worldwide, and to increased utilization. The International Lentil Information System (ILIS) combines databases of ICARDA, USDA and ATFCC Australia, enabling a more comprehensive search of the combined genetic resources over large collections for multiple trait expressions. 13 858 accessions have been included in the database[10]. Further efforts to consolidate *Lens* collection information should collaborate with, or build off of, this program as well as other regional databases (e.g. EURISCO/ECPGR).
- Geo-referencing accessions is an important task for the improvement of the Global Strategy. Geo-referencing will identify gaps requiring further collection of existing *in situ* resources, aid in indicating the degree of coverage of the *Lens* genepool in *ex situ* collections, and may help to clarify accession duplication questions.

2.7 Gaps in the coverage of global genetic diversity in existing collections

The Aleppo meeting identified landraces in Morocco and in China as potentially under-sampled and hence under-represented in germplasm collections. More information is needed to determine the uniqueness of these resources and whether it has been included in *ex situ* collections.

Survey results show that a low percentage of *ex situ* holdings are comprised of wild species (*Table 1*). The collection of crop wild relatives is therefore prioritized. Redden *et al*. (2007) affirm studies by Ferguson and Erskine (2001) and Ferguson *et al*. (1998), which analyse wild *Lens* germplasm holdings, and conclude that germplasm from North African countries such as

[9] International Board for Plant Genetic Resources (IPGRI) and International Center for Agricultural Research in the Dry Areas (ICARDA). 1985. *Lentil descriptors*. IPGRI Secretariat, Rome, Italy, pp 15.
[10] http://www.icis.cgiar.org/icis/images/1/1f/G_ICIS_ATFCC_2007.pdf

Algeria, Libya, Sudan and Tunisia are under-represented in the world collection, as well as taxa from the new central and west Asian republics of the former Soviet Union. However the overall collection priority for the wild species remains southwest Turkey, particularly the provinces of Burdur, Isparta and Afyon.

2.8 *Lens* Germplasm Users

Lens genetic resources are under-utilized due to deficiencies in accession level data; sub-optimal availability and accessibility of that data; lack of pre-breeding, core-collection creation, and other 'value-adding' work in genebanks; and few collaborative relationships with user communities. Use of these resources will be greatly enhanced through generation of accession-level data, and open access to that data. Connections with farmers groups (e.g. via farmer assessment of germplasm), breeders, and other users should be cultivated. In Turkey successful connections have been established via asking breeders to become involved in evaluation for traits of their interests, resulting in more adoption of genetic resources by breeders.

A number of projects are currently active in making lentil germplasm more attractive to users. ICARDA is participating in a lentil project within the Generation Challenge Program (GCP) of the CGIAR, identifying a "composite collection" of germplasm, representing the range of diversity of lentil and its wild relatives, and performing molecular characterization on the collection. A global composite collection of 1000 lentil accessions has been established representing the overall genetic diversity and the agro-climatological range of lentil, including landraces, wild relatives, elite germplasm and cultivars[11].

A core of 234 accessions was selected in the USDA collection based on country of origin (Simon and Hannan 1995). Recently, the core was extended to 384 accessions to add mapping population parents, cultivars and wild accessions, and a subset of pure lines was created[12].

3) Training

During the Aleppo meeting, the working group on *Cicer* and *Lens* identified the following training needs within collections:

- General genebank management.
- Database development/management.
- Characterization and evaluation, including molecular characterization.
- Seed management and technology.
- Seed health.
- Taxonomy.
- Understanding and use of the ITPGRFA- a lack of awareness amongst collection holders regarding the implications of the ITPGRFA for their activities is apparent. Making the content of the Treaty understandable and clarifying the obligations for collection holders within the Treaty is important to creating a global *ex situ* conservation system for this crop.

[11] Redden *et al*. (2007).
[12] Ibid.

4) Policy issues

The status of countries hosting collections with respect to the International Treaty on Plant Genetic Resources for Food and Agriculture is given in the *Table 6*. Twelve of the total 34 countries have not yet ratified the Treaty.

Table 6: Status of Ratification of the ITPGRFA, as of March 2008

Country	Genebanks / institutes	Total number of accessions	Ratification, Acceptance, Approval or Accession of ITPGRFA
GLOBAL	ICARDA	10822	Yes
Australia	Australian Temperate Field Crops Collection	5254	Yes
Iran	Seed and Plant Improvement Institute	3000	Yes
USA	USDA	2875	**Signed but not yet Ratified (NO)**
Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry	2556	**NO**
India	National Bureau of Plant Genetic Resources	2285	Yes
Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca	1345	**Signed but not yet Ratified (NO)**
Canada	PGRC	1139	Yes
Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst.	1095	Yes
Syria	General Commission for Scientific Agricultural Research	1072	Yes
Hungary	Research Centre for Agrobotany	1061	Yes
Egypt	NGB	875	Yes
China	Institute of Crop Germplasm Resources (CAAS)	855	**NO**
Pakistan	Plant Genetic Resources Institute, National Agricultural Research Center	805	Yes
Bangladesh	Bangladesh Agricultural Research Institute	798	Yes
Spain	Centro de Recursos Fitogeneticos, INIA	703	Yes
Ethiopia	Biodiversity Conservation and Research Institute	678	Yes
Ukraine	Institute of Plant Production n.a. V.J. Yurjev of UAAS, Kharkiv	666	**NO**
Chile	Instituto de Investigaciones Agropecuarias,C.R.I. La Platina	600	**Signed but not yet Ratified (NO)**
Israel	Agricultural Research Organisation, The Volcani center	500	**NO**
Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council, Agricultural Botany Division	489	**NO**
Chile	Centro Regional de Investigación Quilamapu, INIA	450	**Signed but not yet Ratified (NO)**
Portugal	Estacao Nacional Melhoramento Plantas, Elvas	423	Yes
Morocco	Institut National de la Recherche Agronomique (INRA)	365	Yes
Bulgaria	Institute for Plant Genetic Resources "K.Malkov"	361	Yes
Italy	Istituto di Genetica Vegetale (IGV)-Bari	348	Yes
Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito	321	Yes
Ecuador	Instituto de Ciencias Naturales Universidad Central del Ecuador	295	Yes
Ecuador	Estacion Experimental Santa Catalina, DENAREF, INIAP	252	Yes
Slovakia	Research Institute of Plant Production Piestany	239	**NO**
Poland	Plant Breeding Station	216	Yes
Mexico	Estación de Iguala, Instituto Nacional de Investigaciones	200	**NO**

Country	Genebanks / institutes	Total number of accessions	Ratification, Acceptance, Approval or Accession of ITPGRFA
	Agrícolas		
Tunisia	Minister of Agriculture	65	Yes
Yemen	Agricultural Research and Extension Authority (AREA-NGRC)	60	Yes
Armenia	Institute of Botany, Botanical Gardens (IBNAS)	34	Yes
Tadjikistan	Makhsumov Scientific Research- production Center "Ziroatkor" & Scientific Research Institute of Farming & TJK-Genebank (MSRPC)	28	**NO**
Azerbaijan	Agricultural Research Institute (ARI)	27	**NO**
Turkemenistan	Turkmen Scientific Research Institute for Cereals	22	**NO**
Azerbaijan	Azerbaijan National Academy of Sciences, Genetic Resources Institute	15	**NO**
Portugal	Banco de germoplasma Genetica, EAN Oieras	15	Yes
Portugal	Banco Portuges de Germoplasma, Braga	5	Yes

As *Lens* is included within the multilateral system for access and benefit-sharing under the Treaty (i.e. it is a so-called 'Annex 1 crop'), all countries that are party to the Treaty are obliged[13] to make public domain *Lens* genetic resources available under the terms specified in the Treaty, for the genetic improvement of lentil.

Quarantine Requirements

Countries vary considerably in the extent to which they operate strict quarantine measures in relation to the movement of lentil germplasm. To the extent possible it would be preferable to rationalize and harmonize quarantine regulations, at least on a regional basis, but it must be recognized that different countries have different abilities to regulate germplasm flows, have different national requirements, and are subject to different pest threats. At the Aleppo meeting, the representative from Pakistan expressed the need to build its national capacity to handle quarantine matters.

5) Partners in global *Lens* conservation activities

In order for *ex situ Lens* collections to be optimally managed, it is important that all key partners involved in the effort work in a coordinated manner. Within the emerging global conservation system for *Lens,* different collection holders will play differing and complimentary roles, according to their interests and capabilities, including for such activities as regeneration, evaluation, long-term storage, information systems management, pre-breeding, etc. Participants of the Aleppo meeting recognized that international distribution of germplasm is an expensive task that many smaller collections may not be able to undertake. Duplicating the material held in such collections in other larger, better-resourced collections with a strong distribution capacity will help circumvent these constraints and will ensure that the materials in such collections are accessible under the terms of the ITPGRFA.

[13] With a few exceptions, such as for material that is under development or that is subject to pre-existing intellectual property protection.

Characterization and evaluation are areas in which the development of effective partnerships may be particularly valuable. These partnerships could also involve institutions not maintaining lentil germplasm collections, via facility sharing, technology transfer, etc.

The Aleppo meeting identified the following countries as having particular expertise that could be put to use for the lentil germplasm community as a whole:

- Spain INIA: training and storage
- India NBPGR: *Fusarium* wilt, rust.
- Turkey: training
- ICARDA: storage
- Canada: *Aschochyta* blight resistance screening.

5.1 Networks

Several formal and informal international networks and cooperative programmes exist, some of which are dedicated solely to lentils while others cover all grain legumes or are geographically focused. These include:

- The European Cooperative Programme for Plant Genetic Resources (ECPGR) established a Grain Legumes Working Group in 1991. The European Database for *Lens* is being developed by the Aegean Agricultural Research Institute (AARI), Izmir, Turkey and contains passport data on cultivated material, breeding material and wild *Lens* accessions maintained in germplasm collections in European research institutes and genebanks[14].
- West Asia and North Africa; Central Asia and the Caucasus; and South Asia, East Asia and South-east Asia all have genetic resources networks that recognize the conservation of *Lens* as being important to their region. However, these networks are generally under-funded and thus are unable to contribute to the extent desirable.

The Aleppo meeting recognized that crop networks are very important to successful conservation work, are needed for development and the coordination of training, and will require sustainable sources of funding for maximized utility. Previous attempts at networks have failed in part due to funding constraints. These constraints may be mitigated to some degree by increased use of internet based communication, but increased support for networks remains an priority.

6) A strategic approach to conserving the genepool

A conceptual approach to a strategy for conserving the genetic diversity of a particular crop *ex situ* is described in the paper "The Role of the Global Crop Diversity Trust in Helping Ensure the Long-term Conservation and Availability of PGRFA"[15]. The concepts presented in this paper were discussed at the Aleppo workshop and it was agreed that they constituted an appropriate strategic approach for conserving the *Lens* genepool. This approach thus forms the basis of the strategy proposed in the following paragraphs.

The genepool of a crop comprises the genetic diversity contained within all unique accessions that are found within existing *ex situ* collections, together with the related genetic diversity

[14] http://www.ecpgr.cgiar.org/databases/Crops/lens.htm
[15] http://www.croptrust.org/main/role.php

that remains to be collected and that currently remains only under *in situ* conditions (on-farm or in the wild). In terms of the material that already exists within collections, there are clearly some collections that contain within them a larger percentage of the total genetic variation than others and it is on these larger and more diverse collections - especially those that are well maintained and readily available - that, in general, the international community depends for the genetic variation needed for crop improvement. Such collections include the international collection maintained at ICARDA as well as other major collections maintained in a number of both developing and developed countries. A rational approach to conserving the genepool would see the largest efforts of the international community being devoted to supporting such collections: to ensuring they are able to achieve and maintain international conservation standards and are capable of distributing good quality seed in a timely manner.

However, large, well-maintained and accessible collections are not the only collections that contain important genetic resources. A number of smaller collections contain genetically unique material that could be extremely important for the future genetic improvement of the crop. Such collections are likely to include those that have a large number or percentage of accessions of local origin (see *Table 1*) and that have not already been extensively duplicated within another collection. However, in cases where only a relatively small number of accessions are involved, it is hard to justify the provision of external financial and other resources for upgrading the collection, and the holding and distribution facilities, to meet international standards. In such cases, in order to ensure the materials are adequately conserved and can be distributed in a safe and timely manner, the collection holders should consider duplicating all unique materials to the international collection maintained by ICARDA, or other similar large, well-maintained and internationally available collections. As there is a cost associated with any such activity (e.g. for the production of fresh seed, quality control, packaging, shipping, documentation etc.), the international community should be encouraged to consider providing the financial support needed.

In many cases the passport and other data currently available on individual collections is inadequate to gain an accurate picture of the extent of duplication within and among collections and hence to estimate the number and location of those unique accessions that it would be desirable to duplicate within an international collection. The further development of accession level data and subsequent comparison of this data across collections would greatly facilitate the identification of unique accessions.

Results of the Aleppo meeting and subsequent information gathering permits the division of existing *Lens* collections holding unique germplasm into a number of categories:

Group A
A number of collections have significant coverage (whether national or international), contain large amounts of unique material, are generally maintained according to international standards, and both the information on them, and the materials within them are generally readily available under the terms of the ITPGRFA (or are available without constraint). Such collections are the ones on which lentil breeders currently depend the most in seeking for suitable traits for genetic improvement purposes. Due to their global importance, the international community should support these collections in addressing any outstanding needs for reaching international standards for conservation and distribution.

- GLOBAL- ICARDA
- Russian Federation- VIR

- India- NBPGR
- United States- USDA

Group B
In addition a number of other collections were identified at the workshop that, while not meeting full international standards with respect to their maintenance, documentation, distribution, or other, nevertheless contain within them important material and with suitable support could, over time, meet such standards. It was recommended that assistance be provided to enable them to do so. An alternative approach to such collections – particularly in cases when the amount of unique material within them turns out to be less than envisaged, would be for their handling in a similar method to that for collections in group C (below).

- China- CAAS
- Nepal- NARC
- Pakistan- PGRI
- Turkey- AARI
- Ethiopia- BCRI
- Iran- SPII
- Spain- INIA

Together the collections in Groups A and B hold 26 163 accessions (61% of total accessions worldwide).

Group C
A third group of collections is comprised of those that likely only have a relatively limited amount of unique material and for this reason it would be hard to justify the provision of external financial and other resources for upgrading the collection, and the holding and distribution facilities, to meet international standards. Such collections in general warrant duplication within a collection in category A-B above, although further information is necessary for all collections in order to determine the extent of uniqueness of collections. The following list also includes some larger collections but with currently limited assessment of holdings.

- Italy- IGV
- Bangladesh- BARI
- Israel- ARO
- Chile- INIA, Quilamapu
- Egypt- NGB
- Ukraine- IPP
- Azerbaijan- ARI
- Azerbaijan- GRI
- Armenia- IBNAS
- Tadjikistan- MSRPC
- Turkmenistan- TSRIC

Financial and other resources may be needed to enable the holders of collections to either upgrade to Categories A-B, or to duplicate unique accessions to a Category A-B collection. Such resources might be found nationally or internationally. The Global Crop Diversity Trust is one such source that intends to make resources available for upgrading or duplication based

on an analysis of the most efficient and effective use of its funds. The Trust has begun this process for lentil with the regeneration-characterization-duplication grants initiated in 2007.

Although the strategy process involved meetings, correspondence, and a survey sent to major genebanks holding *Lens* worldwide, feedback from some potential collections appearing in the database sources listed above was not successfully obtained. Therefore the collections treated in this Strategy, albeit representing the major and most active *Lens* collections, should not be considered a comprehensive listing for collections worldwide. Collections holding over 50 accessions of *Lens* identified within the Bioversity International and/or FAO WIEWS databases, regional strategies, other means, and not treated in this Strategy are listed in *Annex 6*. As these yet-to-be verified collections together potentially conserve over 4 000 accessions, further work is warranted to establish the status and contents of these *Lens* collections, and to incorporate collections holding unique diversity into this Global Strategy.

Table 7 summarizes potential priority *Lens* collections and future needs and questions related to those collections.

Table 7. Summary of potential priority collections

Country	Institute	Status	Total number of accessions	% of accessions for regeneration	Collection Comments
GLOBAL	ICARDA	A	10822	0%	
USA	USDA	A	2875	0%	
Russian Federation	VIR	A	2556	50%	Not Party of ITPGRFA
India	NBPGR	A	2285	0%	Need to safety duplicate accessions? Accessibility of data?
Iran	SPII	B	3000	60%	Status of information and data? Long-term storage capability?
Turkey	AARI	B	1095	24%	Need to safety duplicate accessions.
China	CAAS	B	855	100%	Not Party of ITPGRFA. Accessibility of data?
Pakistan	PGRI	B	805	30-70%	Need to safety duplicate accessions. Accessibility of data? Collection 40% Introduced from ICARDA and USDA
Spain	INIA	B	703	12%	Need to safety duplicate accessions. Needs reconciliation with other Spanish collections
Ethiopia	BCRI	B	678	10%	Need to safety duplicate accessions. Status of information and data?
Nepal	NARC	B	489	100%/0%	Not Party of ITPGRFA. Accessibility of data? Long-term storage capability? Collection 100% duplicated at ICARDA.

Table 8 summarizes *Lens* collections likely to be holding some degree of unique germplasm, and/or in need of further information for an assessment of duplication and/or funding needs.

Table 8. *Lens* collections containing some unique germplasm, to investigate further

Country	Institute	Status	Total number of accessions	% of accessions for regeneration	Collection Comments
Egypt	NGB	C	875		Need to safety duplicate accessions? Status of information and data? Long-term storage capability?
Bangladesh	BARI	C	798	75%	Need to safety duplicate accessions? Status of information and data? Long-term storage capability? Likely duplicated in BGRC? Needs clarification with BGRC collection
Ukraine	IBP	C	666	50%/9%	Not Party of ITPGRFA. Need to safety duplicate accessions? Long-term storage capability?
Israel	ARO	C	500	0%	Not Party of ITPGRFA. Need to safety duplicate accessions? Status of information and data? Long-term storage capability?
Chile	INIA Quilampu	C	450	50%	Not Party of ITPGRFA. Needs clarification with other Chile collections.
Italy	IGV	C	348		Need to safety duplicate accessions? Status of information and data? Long-term storage capability?
Armenia	IBNAS	C	34		
Tadjikistan	MSRPC	C	28		
Azerbaijan	ARI	C	27		
Turkemenistan	TSRIC	C	22		
Azerbaijan	GRI	C	15		

7) Summary and conclusions: a way forward

Key tasks necessary for the formation of a rational global conservation effort for *Lens* include the completion of necessary regeneration, safety duplication, and storage in long-term conditions of unique accessions within the collections outlined in the Strategy. In order to accomplish this task, research into the development of successful regeneration protocols for wild related species is of high priority. Of equal importance is upgrading the documentation on the various collections and to creating an accessible sharing mechanism for this information.

Key collections should be upgraded to meet international standards for conservation and distribution, and the international community should be called upon to support this process where needed. For other collections, the international community should be encouraged to provide assistance with replicating genetically unique materials to the ICARDA or other large and secure collections. All genetically unique germplasm should be duplicated for safety reasons, preferably in a second country, and with a safety backup sent to the Svalbard Global Seed Vault.

Gaps in information regarding *Lens* collections and the status of germplasm held in these collections currently constrain the comprehensiveness of the Strategy. Missing information on *Lens* resources should be gathered for all collections listed in the Strategy, and other institutions potentially containing *Lens* collections (Annex 6) should be verified and incorporated into the Strategy.

Further work is needed on characterizing and evaluating the collections and on making the information openly available. A common platform on information on *Lens* germplasm is of high priority. Through the generation of accession-level data and by improving the accessibility of information on accessions globally, genetically unique genetic resources will be identified and prioritized for support. Only through such efforts, as well as the formation of stronger collaborative relationships with user communities, is there likely to be a significant increase in the use of collections by plant breeders and others.

Additional collecting should be undertaken, most importantly for wild species, to fill the gaps identified in Section 2.7. Once more comprehensive accession-level data becomes available it will be possible to carry out further analyses to identify additional gaps in the collections.

Training needs to be organized to meet the needs identified in Section 3. Networks need support regionally and globally. Countries having important collections of *Lens* that have not yet ratified the ITPGRFA (see *Table 6*) should be encouraged to do so.

The strategy outlined here should evolve as new data and information become available, especially regarding collections not currently included in the strategy, as well as additional accession-level data in general in all collections. Through such efforts it is hoped that genepool of this important crop can be efficiently and effectively conserved for the benefit of current and future generations.

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List of Acronyms

AEGIS- A European Genebank Integrated System
CGIAR- Consultative Group on International Agricultural Research
ECPGR- European Cooperative Programme for Plant Genetic Resources
FAO- Food and Agriculture Organization
FIGS- Focused Identification of Germplasm Strategy
GBIF- Global Biodiversity Information Facility
GCP- Generation Challenge Program
GRIN- Genetic Resources Information
ICARDA- International Center for Agricultural Research in the Dry Areas
ILIS- The International Lentil Information System
IPGRI- International Plant Genetic Resources Institute. Now Bioversity International.
ITPGRFA- International Treaty on Plant Genetic Resources for Food and Agriculture
MCPD- Multi-Crop Passport Descriptors
SANPGR- South Asia Network on Plant Genetic Resources
SINGER- System-wide Information Network on Genetic Resources
USDA- United States Department of Agriculture
WIEWS– World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture, FAO.

Annex 1. Survey

Lentil Conservation Strategy Survey - May 2006

1. Background

The Global Crop Diversity Trust is undertaking a series of studies to support the development of international collaborative conservation strategies for different crops. As such strategies evolve, they will provide a basis for the allocation of resources from the Trust to the most important and needy collections.

This questionnaire has been developed in order to seek the advice and input of representatives of the world's major lentil collections in the development of the lentil conservation strategy. In particular the questionnaire aims to assess the status of lentil conservation throughout the world. As the strategy document is intended to be made available publicly, results of the survey could be included and therefore published.

As curator of a key lentil collection, we kindly request you to complete the sections 1-17 of the questionnaire. We estimate that his procedure may take approximately 1 hour of your time. We appreciate your patience. If there are no *ex situ* lentil collections in your institute, please can you complete sections 16-17 only. **Please return the questionnaire no later than Friday 26 May 2006 to:**

Geoff Hawtin, PhD, Senior Advisor
Global Crop Diversity Trust
Manor Farm House, 17 Front Street, Portesham, Dorset, DT3 4ET, UK
Phone: +44 (0) 1305 9871043, Email: geoffhawtin@hotmail.com

Please also send a copy to:

Brigitte Laliberté, Scientist
Global Crop Diversity Trust, C/o International Plant Genetic Resources Institute
Via dei Tre Denari 472/a, 00057, Maccarese, Rome, Italy, Tel:+39-06-611-8272, Fax:+39-06-619-79661
Email:b.laliberte@cgiar.org

The Global Crop Diversity Trust is keen to have your active participation in the development of the lentil conservation strategy and will be pleased to keep your informed on its progress. If have any questions about this questionnaire or about the proposed strategy in general, please contact Geoff Hawtin.

2. Information about your organization

2.1 Name and address of your organisation holding/maintaining the lentil collection			
Address:			
City:		Postal Code:	
Country:			
Web site:			
2.2 Curator in charge of the lentil collection			
Name:			
Full address:			

Telephone:		Fax:	
Email:			
2.3 Contact details of respondent to this questionnaire (only if he/she is not the curator of the lentil collection)			
Name:			
Full address:			
Telephone:		Fax:	
Email:			

2.4 Date of response of this questionnaire: _____

3. Additional key contacts for the lentil germplasm collection

Name(s)	Title(s)/Function(s)	Email/Address

4. Description of your organization

4.1 Please describe your organization

- ☐ Governmental organization
- ☐ University
- ☐ Private organization
- ☐ Other (please specify): _____

4.2 Is the institution in charge of the lentil collection the legal owner of the collection?

☐ YES ☐ NO

4.2.1 If NO, who is the owner (including no owner identified)?

_____

4.3 Is the lentil collection subject to the terms and conditions of the International Treaty on Plant genetic Resources for Food and Agriculture? ☐ YES ☐ NO

4.3.1 If NO, is expected to become under the International Treaty in the near future?

☐ YES ☐ NO

4.3.1.1 If YES, indicate expected date: _____

5. Overview of your lentil collection

5.1 Please describe the main objectives of the lentil collection (long-term conservation, working collection, breeding collection etc.**):**

_____

_____

5.2 Indicate the species and the respective number of accessions from the lentil germplasm types that are included in your collection (Please write the number of accessions in brackets after each species name, e. g. *L. culinaris* (30), *L.orientalis* (15), etc.)**:**

Type of lentil germplasm	**Species name (number of accessions per species in brackets)**
Wild related species of lentil	
Landraces	
Obsolete improved varieties	
Advanced improved varieties	
Breeding/research materials	
Inter-specific derivatives	
Unknown	
Other	

5.3 Please indicate the share (in %) from each specific type of germplasm that is AVAILABLE for distribution:

Type of lentil germplasm (where known**)**	**% available for distribution**
Wild related species of lentil	
Landraces	
Obsolete improved varieties	
Advanced improved varieties	
Breeding/research materials	
Inter-specific derivatives	
Unknown	
Other	

5.4 Origin of the lentil collection: please indicate the proportion (%) of accessions on the total amount that were... *(Note: the sum should be 100 %!)*

Origin	**Proportion %**
...collected originally in your own country (national origin)	
...collected originally in your own region (regional origin)	
...introduced from a collection abroad	
...from other origin (please define the origin):	

5.5 Are there major gaps in your lentil collection? Please indicate major gaps concerning your lentil collection:

Species coverage of the crop: ☐ YES ☐ NO
Population (sample) representation per species: ☐ YES ☐ NO
Ecological representation of the species: ☐ YES ☐ NO
Other, please specify the gap concerning your lentil collection:

_____

5.5.1 If there are major gaps, please provide details on the plans to fill these gaps:

_____

_____

_____

_____

6. Aspects on the potential of the lentil collection

6.1 What would you consider to be the most interesting aspects of your lentil collection, making it unique?

_____

_____

_____

_____

6.2 Please describe the main potential/importance of your lentil collection for use and breeding:

_____

_____

_____

_____

_____

7. Conservation status (germplasm management)

7.1 Please indicate the proportion (in %) of the lentil accessions maintained under different facilities: *(Note: if the same accessions are maintained under more than one storage condition the sum may exceed 100%)*	**Percentage %**
Short-term storage conditions	
Medium-term storage conditions	
Long-term storage conditions	
Other, please specify:	

7.2 Please indicate the proportion (in %) of the lentil accessions conserved as: *(Note: if the same accessions are stored as different types of germplasm the sum may exceed 100%)*	**Percentage %**
Seeds	
Field accessions	
In vitro	
Cryopreservation	
Pollen	
DNA	
Other, please specify:	

7.3 Please describe the MAIN storage facility available for your lentil collection:
*(If you have **more than one** facility, please use the fields for 'additional facilities' too)*

	Main Facility 1	**Additional facility 1**	**Additional facility 2**
Type of facility			
Temperature			
Relative Humidity (%)			
Packing material			
Other, please specify:			

	Additional facility 3	Additional facility 4	Additional facility 5
Type of facility			
Temperature			
Relative Humidity (%)			
Packing material			
Other, please specify:			

7.4 Please mark for which activity you have established a genebank management system and/or have written procedures and protocols:

- ☐ Acquisition (*including collecting, introduction and exchange*)
- ☐ Regeneration
- ☐ Characterisation
- ☐ Storage and maintenance
- ☐ Documentation
- ☐ Health of germplasm
- ☐ Distribution
- ☐ Safety-duplication
- ☐ Other please specify: _____

7.5 In case you have procedures and protocols, are you able to provide the Global Crop Diversity Trust with this information (i.e. provide a copy)? ☐ YES ☐ NO

7.6 Please describe your quality control activities, in terms of frequency, protocols/methods and actions upon results:

Activities	Description of quality control
Germination tests:	
Viability testing:	
Health testing:	
True-to-typeness of *in vitro* plantlets:	
Other, please specify:	

7.7 Is the lentil collection affected by diseases that can restrict the distribution of the germplasm? ☐ YES ☐ slightly, only few accessions ☐ NO

7.7.1 If you indicated YES or slightly above, are knowledge and facilities available at your institution for eradication of these diseases? ☐ YES ☐

7.8 What is the normal regeneration interval to maintain the viability of the lentil collection?

_____

7.9 Indicate the proportion (%) of each germplasm type that requires urgent regeneration

Type of lentil germplasm	% of lentil accessions with urgent regeneration need
Wild related species	
Landraces	
Obsolete improved varieties	
Advanced improved varieties	
Breeding/research materials	
Inter-specific derivatives	
Unknown	
Other, please specify:	

7.10 Please indicate the current situation of the lentil collection with respect to the following conditions: (*where: 1 = high/good, 2 = adequate/moderate, 3 = not sufficient/bad, NA = not applicable*)

Condition	Current situation	Expected situation in 2010
Funding for routine operations and maintenance		
Retention of trained staff		
Interest for Plant Genetic Resource Conservation by donors		
Genetic variability in the collection as needed by users/breeders		
Access to germplasm information (passport, charact., evaluation)		
Active support/feedback by users		
Level of use by breeders		
Other factors (please specify):		

8. Safety duplications in other institutions

(Safety duplication: defined as the storage of a duplicate/copy of an accession in another location for safety back-up in case of loss of the original accession.)

8.1 Are lentil accessions safety-duplicated in another genebank? ☐ YES ☐ NO

8.1.1 If YES, please specify in the table (and add lines as necessary):

Name of institute maintaining your safety duplicates:	Number of accessions	Storage conditions (short, medium, long term)	Nature of the storage (e.g. black box, fully integrated in host collection, etc.)
1.			
2.			
3.			
4.			
5.			
Etc.			

9. Institutions storing safety duplicates of lentil in your genebank

9.1 Is there any lentil germplasm of other collections safety-duplicated at your facilities?

☐ YES ☐ NO

9.1.1 If YES, please specify in the table (and add lines as necessary):

Name of holder of the original collection:	**Number of accessions**	**Storage conditions (short, medium, long term)**	**Nature of the storage (e.g. black box, fully integrated in host collection, etc.)**
1.			
2.			
3.			
4.			
5.			
Etc.			

10. Further issues on duplication of lentil collection

10.1 To what extent do you consider the lentil accessions in your collection to be unique and not duplicated extensively elsewhere (i.e. EXCLUDING safety-duplication)?

☐ Fully unique
☐ Mostly unique
☐ Partially unique
☐ Fully duplicated elsewhere

10.2 Are there any constraints to duplicating the lentil collection elsewhere outside your country? ☐ YES ☐ NO

10.2.1 If YES, please specify: _____

11. Information management

11.1 Do you use an electronic information system for managing the lentil collection (data related to storage, germination, distribution, etc.)? ☐ YES ☐ partly ☐ NO

11.1.1 If YES, what software is used? _____

11.2 Please indicate the proportion (%) of the following types of data is: (1) documented and (2) the proportion that is available electronically:

Type of lentil germplasm	**Passport data**		**Characterization data**		**Evaluation data**	
	Doc.	**Electr.**	**Doc.**	**Electr.**	**Doc.**	**Electr.**
Wild related species	%	%	%	%	%	%
Landraces	%	%	%	%	%	%
Obsolete improved varieties	%	%	%	%	%	%
Advanced improved varieties	%	%	%	%	%	%
Breeding/research materials	%	%	%	%	%	%
Inter-specific derivatives	%	%	%	%	%	%

Unknown	%	%	%	%	%	%
Other, specify:	%	%	%	%	%	%

11.3 In case the information on the lentil collection is not computerised, are there plans to do so in the future?

☐ No plans
☐ Computerisation planned within 3 years
☐ Other

11.4 Is information of the lentil collection accessible through the Internet?

☐ YES ☐ Partly ☐ NO
If YES, please indicate the address of the website: http://_____

11.4.1 If there is NO data available in the internet, is an electronic catalogue distributed on CD or by Email? ☐ YES ☐ NO

11.4.1.1 If YES, would you be able to provide the Trust with a copy? ☐ YES ☐ NO
If YES, please include a copy to Dr Geoff Hawtin when returning the completed questionnaire.

11.4.2 If there is NO data available electronically do you produce a printed catalogue?
☐ YES ☐ NO
If YES, please include a copy to Dr Geoff Hawtin when returning the completed questionnaire.

11.5 Are data of the lentil collection included in other databases?

National	☐ YES	☐ partly	☐ NO
Regional	☐ YES	☐ partly	☐ NO
International	☐ YES	☐ partly	☐ NO

11.5.1 If YES or partly, indicate the database (e.g. GRIN, SINGER, EURISCO etc.):

_____

11.5.2 Would you consider an international crop specific catalogue for lentil genetic resources (International *Lens* Database) to be useful? ☐ YES ☐ partly ☐ NO

11.5.3 Would you like to contribute data to an international *Lens* Database?

Passport data	☐ YES	☐ partly	☐ NO
Pedigree data	☐ YES	☐ partly	☐ NO
Characterization and evaluation data	☐ YES	☐ partly	☐ NO
Molecular data (Marker, Genome, Proteome)	☐ YES	☐ partly	☐ NO
Pictures	☐ YES	☐ partly	☐ NO

Other data (please indicate): _____

12. Distribution and use of material

12.1 What proportion (%) of the total lentil collection is AVAILABLE for the following distributions? Nationally: _____% Regionally: _____% Internationally: _____%

12.2 Please fill in the number of lentil accessions DISTRIBUTED annually, and indicate the expected change over the next 3-5 years, where: + = increasing, 0 = no change, - = decrease

	Number of accessions distributed annually (average of last 3 years)	**Expected change for the next 3-5 years**
Nationally		
Regionally		
Internationally		

12.3 Do you put specific conditions or requirements for distribution of lentil accessions?

☐ YES ☐ NO

12.3.1 If YES, please specify: _____

12.4 What is the proportion of lentil germplasm sufficiently available in terms of QUANTITY for distribution? _____% of accessions is sufficiently available

12.5 Is the distribution of lentil germplasm limited because of its HEALTH status?
☐ YES ☐ partly ☐ NO

12.6 Do you have adequate procedures in place for...

…Phytosanitary certification?	☐ YES	☐ NO
…Packaging?	☐ YES	☐ NO
…Shipping?	☐ YES	☐ NO
…Other, please specify: (_____)	☐ YES	☐ NO

12.7 Do you keep records of the lentil accession distribution? ☐ YES ☐ NO
(e.g. who received it, quantity, date of shipment, nature of distributed material etc.)

12.8 Please indicate the proportion (in %) of users who received lentil germplasm from you in the past 3 years:

12.8.1 Provenance of users:	**Proportion of total distribution %**
Domestic users	
Foreign users	
12.8.2 Type of users:	**Proportion of total distribution %**
Farmers and Farmers' organisations	
Other genebank curators	
Academic Researchers and Students	
Plant breeders - public sector	
Plant breeders - private sector	
NGOs	

12.8.1 Provenance of users:	Proportion of total distribution %
Others, please specify:	

12.9 Describe briefly how you inform potential users about the availability of lentil accessions and their respective data in your collection?

_____
_____
_____

12.10 Describe briefly what are the most important factors limiting the use of the lentil material maintained in your collection?

_____
_____
_____

12.11 Indicate if users have to pay money or not when they request material from you:

for accessions: ☐ free ☐ cost (in US$/accession): _____
for the shipment: ☐ free ☐ cost (in US$/accession): _____

12.12 Do you use a Material Transfer Agreement when distributing material? ☐ YES ☐ NO
12.13 Do you have any restrictions on who can receive lentil materials? ☐ YES ☐ NO

12.13.1 If YES, please specify: _____

13. Networks of lentil genetic resources

13.1 Do you collaborate in (a) network(s) as a lentil collection holder? ☐ YES ☐ NO

13.2 If you collaborate in (a) network(s) please provide the following information of them:

*(**A**) name, (**B**) type (national, regional or worldwide), (**C**) main objectives, and (**D**) a brief description of the main reasons to participate in the network.*

A Name of network	B Type of network National/Regional/Worldwide	C Main objectives of the network	D Brief description of the main reasons to participate in the network

14. Additional crop collections maintained in your Institute: please indicate additional crops and number of accessions in the table below:

	Crop or species	Number of accessions	% of wild relative species
1.			
2.			
3.			
4.			
5.			

6.			
7.			
8.			
9.			
10.			

15. Major constraints: Please list the 5 major limitations you are facing in the management of the lentil collection:

1. _____
2. _____
3. _____
4. _____
5. _____

16. Question concerning institutes NOT maintaining lentil *ex situ* collections

16.1 If your institute does not maintain an *ex situ* collection of lentil, please indicate to the best of your knowledge, the following:

Current lentil conservation activities:	
Institute focal person to contact for further details:	
Plans for any lentil *ex situ* conservation:	
Any other information:	

17. Please add any further comments you may have:

_____
_____
_____
_____

Thank you for your important contribution!!!

Please return this questionnaire, **no later than Friday 19 May 2006**, to:

Geoff Hawtin, PhD, Senior Advisor
Global Crop Diversity Trust
Manor Farm House, 17 Front Street, Portesham, Dorset, DT3 4ET, UK
Phone: +44 (0) 1305 9871043
Email: geoffhawtin@hotmail.com

Please also send a copy to:

Brigitte Laliberté, Scientist
Global Crop Diversity Trust
C/o International Plant Genetic Resources Institute
Via dei Tre Denari 472/a, 00057, Maccarese, Rome, Italy
Tel:+39-06-611-8272, Fax:+39-06-619-79661
Email: b.laliberte@cgiar.org Web: www.croptrust.org

Annex 2. Institutions contacted through a survey in April 2006

No	Country	Institute's name	Email address	Survey sent 20 April 06
1.	Afghanistan	Plant Genetic Resources Unit Crop Improv. Div., Min. of Agric., Kabul	Sharif_moal_afg@yahoo.com	Yes
2.	Algeria	Institut National Agronomique (INA), Alger	aabdelguerfi@yahoo.fr	Yes
3.	Australia	CSIRO Division of Plant Industry, Institute of Plant Production and Processing, GPO Box 1600, Canberra	enquiries@csiro.au	Yes
4.	Australia	Australian Temperate Field Crops Collection, Private Bag 260, Horsham, Victoria	kevin.a.murray@dpi.vic.gov.au	Yes
5.	Australia	Australian Medicago Genetic Resources Centre, SARDI SARDI, PRC GPO Box 397 Adelaide, South Australia	pirsa.sardi@saugov.sa.gov.au	Yes
6.	Bangladesh	Genetic Resources Centre Bangladesh Agric. Research Inst. GPO Box 2235, Joydebpur Gazipur	baridss@bttb.net.bd	Yes
7.	Bulgaria	Institute for Plant Genetic Resources "K.Malkov" Druzba 2 Sadovo, Plovdiv district	shamov@yahoo.com	Yes
8.	Chile	Centro Regional de Investigación Quilamapu, INIA Avda. Vicente Mandez 515 Chillán	hacuna@quilamapu.inia.cl	Yes
9.	Chile	Inst de Inv. Agropecuarias, Centro Regional de Investigación Carillanca Camino Cajón Vilcun Km 10 Temuco	info@carillanca.inia.cl	Yes
10.	China	Institute of Crop Germplasm Resources (CAAS) 12 Zhongguancun Nandajie Beijing	xxlu@caas.net.cn	Yes
11.	Cyprus	National (CYPARI) Genebank, Agricultural Research Institute, P.O. Box 22016 Nicosia	Athena.Della@arinet.ari.gov.cy	Yes
12.	Ethiopia	Biodiversity Conservation and Research Institute POB 30726 Addis Ababa	aibk2002@yahoo.com	Yes
13.	Ethiopia	International Livestock Research Institute (ILRI) PO Box 5689 Addis Ababa	j.hanson@cgiar.org	Yes
14.	France	IBEAS, Lab. d'Ecologie Moleculaire Universite de Pau Ave. de l'Université, Pau	daniel.combes@univ-pau.fr	Yes
15.	Germany	Genebank, Inst. for Plant Genetics and Crop Plant Research (IPK) Corrensstrasse 3	knupffer@ipk-gatersleben.de	Yes

No	Country	Institute's name	Email address	Survey sent 20 April 06
		Gatersleben		
16.	Hungary	Institute for Agrobotany Kulsomezo 15, Tápiószele	lhorvath@agrobot.rcat.hu	Yes
17.	India	National Bureau of Plant Genetic Resources, Regional Station, Akola	dikshitn@yahoo.com	Yes
18.	India	Department of Plant Breeding, Indian Institute of Pulses Research, Uttar Pradesh	root@iipr.up.nic.in	Yes
19.	India	Department of Plant Breeding and Genetics, Indira Gandhi Agricultural University, Raipur	sharmarn@yahoo.com	Yes
20.	Israel	Dept. of Botany, Institute of Life Science, Hebrew Univ. of Jerusalem Berman Building, Givat Ram Campus, Jerusalem	ilanahs@vms.huji.ac.il	Yes
21.	Italy	CNR - Istituto di Genetica Vegetale Via G. Amendola 165/A, Bari	galasso@ibba.cnr.it	Yes
22.	Jordan	National Center for Agricultural Research and Technology Transfer Baqa'a	Fardous@ncartt.gov.jo	Yes
23.	Nepal	Central Plant Breeding and Biotec. Nepal Agricultural Research Council P.O. Box 1135, Khumaltar	cpdd@mos.com.np, cpdd@narc.gov.np	Yes
24.	Pakistan	Institute of Agricultural Biotechnology and Genetic Resources G-5/1, P O Box 1031, Islamabad	chair@comsats.net.pk	Yes
25.	Poland	Plant Breeding and Acclimatization Institute (IHAR) Radzikow, Blonie	postbox@ihar.edu.pl	Yes
26.	Portugal	Sector de Pastagens e Forragens Dept Past., Forrag., Proteaginosas Apartado 6, Elvas Codex	enmp.inia@mail.telepac.pt	Yes
27.	Russian Federation	N.I. Vavilov All-Russian Scientific Research Institute of Plant Industry 42, B.Morskaya Str., St. Petersburg	vir@vir.nw.ru	Yes
28.	Spain	Servicio de Investigacion Agraria Junta de Castilla y Leon Ctra. de Burgos, km 118, Apdo. 172 Valladolid	ciubaufr@jcyl.es	Yes
29.	Spain	Centro de Recursos Fitogeneticos, INIA Aut. Aragón A-2, km 36 - Apdo 1045 Alcala de Henares, Madrid	cuadra@inia.es	Yes
30.	Spain	Banco de Germoplasma,Centro de Investigacion Agraria de Albaladejito Ctra. Toledo-Cuenca km 174 Cuenca	jcuadrado@jccm.es	Yes
31.	Syria	General Commission for Scientific Agricultural Research P.O. Box 113, Douma Damascus	gcsarpbio@mail.sy	Yes
32.	Syria	Int. Centre for Agricultural Research in Dry Areas (ICARDA) PO Box 5466, Aleppo	icarda@cgiar.org	Yes

No	Country	Institute's name	Email address	Survey sent 20 April 06
33.	Turkey	Plant Genetic Resources Dept. Aegean Agricultural Research Inst. PO Box 9, Menemen, Izmir	AARI@EGENET.COM.TR	Yes
34.	Ukraine	Ustimovskaya Experimental Station for Plant Cultivation Ustimovka, Globino dist., Poltava region	sluds@kot.poltava.ua	Yes
35.	United Kingdom	International Centre for Underutilised Crops University of Southampton, Highfield Southampton	rgs@soton.ac.uk	Yes
36.	USA	Western Regional Plant Introduction Station, USDA-ARS, Washington State Univ. 59 Johnson Hall,P.O.Box 646402 Pullman, WA 99164-6402	mmwelsh@wsu.edu	Yes

Annex 3. Participants List

Global Collaborative *Ex situ* Conservation Strategies for Food Legumes (chickpea, lentils, faba beans and grasspea)

ICARDA, Aleppo, Syria, 19-20-21-22 February 2007

No	Country	Contact information	Emails
1.	Australia	Dr. Maarten van Ginkel Principal Research Scientist, Molecular Plant Breeding, Department of Primary Industries Horsham, Victoria 3400; Australia Tel: +3-5362 0789 Fax: +3-5362 2187	maarten.vanginkel@dpi.vic.gov.au
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Annex 4 Annotated Agenda

Global Collaborative *Ex situ* Conservation Strategies for Food Legumes (chickpea, lentil, faba bean and grasspea)
A Workshop at the International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria, 19-22 February 2007

Objective:
To consult representatives of relevant food legumes collections on key elements of global strategies for the efficient and effective *ex situ* conservation of the genetic resources of *Cicer, Lathyrus, Lens* and *Vicia*.

Expected Outcomes:
1. Identification and assessment of key global, regional and national collections of food legumes genetic resources,
2. Identification of critical overlaps and gaps in existing collections
3. Recommendations for increased collaboration and sharing of responsibilities, leading to more effective and efficient conservation and greater utilization
4. Identification of major needs and opportunities for upgrading key collections and building the capacity managers to maintain and distribute them efficiently and effectively over the long term.

Monday 19 February

09:00 – 10:30 Chair: Dr Mahmoud Solh
1) Opening Session:
- Welcome by ICARDA DG , Dr Mahmoud Solh
- Welcome by Global Crop Diversity Trust, Dr Cary Fowler
- Introduction to participants
- Discussion and approval of agenda
- Logistical arrangements, Dr Bonnie Furman

2) Food legume genetic resources conservation in the CGIAR (B. Furman, C.L.L. Gowda, H. Upadhyaya, P. Mathur)
Overview of the work on cool season legume genetic resources conservation at ICARDA, ICRISAT, Bioversity International, and SGRP
3) Global Crop Diversity Trust (C. Fowler)
Overview of the origin and history of the Trust, its vision, goals, major achievements, etc including an introduction to the Svalbard Arctic Seed Vault.

10:30 – 11:00 Coffee

11:00 – 12:30 Chair: G. Hawtin
4) The International Treaty on PGRFA (C. Fowler)
Latest developments in the International Treaty of relevance to the meeting, including an overview of the Standard Material Transfer Agreement (SMTA)
5) Conservation Strategies – general overview (C. Fowler)
Overview of the objectives of the regional and crop strategies being supported by the Trust: the need for them, how the Trust will use them, their main elements and the process followed in their development – based on the paper "The role of the Global Crop Diversity Trust in helping ensure the long-term conservation and availability of PGRFA".

Discussion

12:30 – 13:15 Lunch 13:15 – 14:00 Tour of Genetic Resources Unit of ICARDA

14:00 – 15:30 Chair: B. Furman
6) Outcome of the Regional Strategies (B. Laliberté)
Overview of the rationale and process for developing the regional strategies, some lessons learned and the main findings relating to Cicer, Lathyrus, Lens and Vicia.
7) Food Legume Conservation Strategies (G. Hawtin)

Overview of the nature of the legume strategies, steps taken so far to develop them and the steps still needed to complete them. Note: The data and information brought by participants will be compiled during the first day for presentation on the second day.

Discussion

15:30 – 16:00 Coffee

16:00 – 17:30 Chair: C.L.L. Gowda
8) Information Systems for Food Legume Genetic Resources
- Overview of international information sources (J. Konopka)
Overview of international and internationally available national databases (including e.g. SINGER, ECP/GR, EURISCO, GRIN, ILDIS, WIEWS, CGN database, etc…) covering such aspects as the availability of accession level data on food legumes, the range of data and their suitability as a tool to help identify duplicates.
9) Focused Identification of Germplasm Strategy - FIGS (K. Street)
Overview of a project to assemble passport data on major pulse collections worldwide into a single database linked with GIS data. The primary aim is to identify subsets of the material likely to include variation for a particular constraint.

Discussion on information needs to promote effective and efficient collaborative conservation activities as well as the use of pulse genetic resources.

Dinner Reception invitation from Dr Mahmoud Solh, Qaser El Wali restaurant, hotel pick up at 19:45

Tuesday 20 February

08:30 – 09:30 Chair: B. Laliberte
10) Overview of the task to be undertaken for the next two days (G. Hawtin)
A list of topics to be addressed by each group is appended to this agenda
11) Overview presentation of the data provided by participants and other data sources (O. Westengen)

Discussion to clarify the assignments, allocation of participants to working groups on a) *Cicer* and *Lens* b) *Lathyrus* and c) *Vicia,* and appointment/approval of chairs and rapporteurs for each group

09:30 – 16:00
Working groups meet in parallel sessions to consider items 1 – 5 in the Appendix to this agenda. Coffee/lunch breaks at 10:30, 12:30 and 15:30.

16:00 – 17:30 Chair: Geoff Hawtin
12) Plenary session for working groups to report back and raise any issues and concerns

Wednesday 21 February

08:30 – 12:00
Continue working group sessions, to consider items 6 – 12 in the Appendix to this Agenda. Coffee break at 10:30

12:00 – 12:30 Chair: Geoff Hawtin
13) Plenary session (if needed) to take stock and raise any further issues and concerns

12:30 – 14:00 Lunch and tour of ICARDA laboratory facilities

14:00 – 17:30
Continue working group sessions, with a coffee break at 15:30. Sufficient time should be left at the end of the day for the Chairs/Rapporteurs to prepare their reports and recommendations.

Thursday 22 February

08:30 – 10:30 Chair: Cary Fowler
14) Report of the working group on *Cicer* and *Lens* and discussion on the proposed strategies (Chair/rapporteur of the working group) – 40 minutes
15) Report of the working group on *Lathyrus* and discussion on the proposed strategy (Chair/rapporteur of the working group) – 40 minutes
16) Report of the working group on *Vicia* and discussion on the proposed strategy (Chair/rapporteur of the working group) – 40 minutes

10:30 – 11:00 Coffee

11:00 – 12:30 Chair: Cary Fowler
General discussion of conservation strategies

12:30 – 14:00 Lunch and field tour

14:00 – 15:30 Chair: Cary Fowler
17) Continue discussion
18) Conclusions of the meeting and next steps
19) Closure (ICARDA and Trust representatives)

Appendix: Topics to be discussed in parallel sessions on days 2 and 3
With reference to *Cicer*/*Lens*, *Lathyrus* or *Vicia*:

1. Review and verify the data presented on the various collections.
   Identify:
   a. any additional collections to be included
   b. any collections that should be dropped from the table
   c. major items of missing data and how they can be filled

2. Consider the proposed criteria for a reference collection, i.e.:
   a. collections on which the world depends:
   b. substantial size and diversity
   c. generally international or regional in coverage
   d. secure - managed to international standards - and in general adequately funded
   e. readily available on request under terms of International Treaty on PGRFA
   Identify the main collections that meet these criteria.

3. Identify other significant collections, and sets of accessions within collections, taking into account criteria such as:
   a. collection size and diversity (number and origin of accessions)
   b. uniqueness of the material
   c. type of material (landraces, released cvs., wild spp. genetic stocks, etc)
   Where possible, indicate the major support needs of any such collections identified

4. Identify potential partners who are able to provide conservation services such as: characterizing or evaluating material for key characters, indexing for diseases, providing specialized assistance with regeneration or storage, providing information or germplasm distribution services, etc.
5. Identify major gaps in the total genetic diversity coverage of existing collections
6. Assess the current status of data and information systems and indicate how they could be strengthened and the data made more accessible.
7. To what extent are collections already duplicated for safety and how can the situation be improved? What standards/guidelines should apply (consider both second-country safety duplication and duplication at the Svalbard International Seed Vault
8. What are the major policy and technical impediments to a greater distribution of materials (e.g. with respect to seed quantity, seed quality, quarantine/phytosanitary arrangements, a clear policy on distribution, agreed MTA etc.) and how can they best be overcome?
9. Identify and assess the effectiveness of any networks and international cooperative programmes that exist for the crop in question. How can collaboration best be strengthened?
10. Assess the effectiveness of links to users (plant breeders and farmers). How can a greater use of the genetic materials best be promoted?

11. What are the most important training needs and how might they best be addressed?
12. Identify key next steps in further development of the strategy and its implementation.

Annex 5. Simplified survey in January 2007

Global Collaborative *Ex situ* Conservation Strategies for Food Legumes (chickpea, lentils, faba beans and grasspea)
ICARDA, Aleppo, Syria, 19-20-21-22 February 2007

Information request in preparation of the consultation meeting

Participants to the meeting should send in advance, or bring with them to Aleppo, information on the following issues relating to the collections of Cicer, Lathyrus, Lens and Vicia held in their institute and, if possible, at other institutions in their country. Ideally the data and information should be provided in electronic form.

1. The size and composition (landraces, current and obsolete cultivars, wild species, genetic stocks, etc.) of the collections.
2. The proportion of the collections that originated in a) their own country and b) their region. For material not originating nationally, which are the main countries and collections from which it originated?
3. The proportion of the collections that has been collected by the institute concerned *vs.* that obtained from other sources nationally and internationally.
4. The current status of the collections with respect to regeneration (e.g. % in need of urgent regeneration now, % in need of regeneration within the next 5 years etc...).
5. The extent to which the collections have been duplicated a) in their own country and b) abroad, and willingness to duplicate internationally (e.g. under black box arrangements including in the global arctic seed vault in Svalbard).
6. The extent (numbers of samples per year) to which the collections are distributed a) nationally and b) internationally.
7. The storage facilities available and conditions (temperature, humidity) under which the collections are held.
8. The main management practices followed in conserving and distributing the materials.
9. The documentation and information systems followed, and the availability of data and information nationally and internationally.
10. The major constraints (financial, staffing, facilities, policies, pests/diseases, etc.) to conservation, documentation and distribution (national and international), and ideas on how these constraints can be overcome - including, where possible, indicative costing.
11. Participation in relevant networking and other international activities.
12. Any other information relevant to the development of international collaborative conservation strategies.

Annex 6: Other Potential *Lens* Collections and Additional Data

Adopted from FAO's State of the World's Plant Genetic Resources for Food and Agriculture, 1998:

Crop		Genebank			Accessions		Storage facilities (%)				Type of accession (%)				Dupl.
Grouping	Genus	Institute	Country		No.	%	LT	MT	ST	Others	ws	lr/oc	ac/bl	Oth	%
Food legumes															
Lentil	Lens	ICARDA	CGIAR	●	7,911	29	40	60	0	0	5	79	15	0	91
Lentil	Lens	VIR	Russia	◑	2,358	9	0	0	0	100	0	0	0	100	-
Lentil	Lens	W-6	USA	◑	2,259	8	0	100	0	0	0	0	0	100	100
Lentil	Lens	SPII	Iran		1,885	7	17	83	0	0	17	83	0	0	-
Lentil	Lens	ATFGRC	Australia		1,400	5	100	0	0	0	0	0	0	100	-
Lentil	Lens	Others			11,611	42				100				100	-
Lentil	Lens	Total			27,424	100	13	31	0	51	3	28	4	59	

Lens Collections Identified in Bioversity International and/or FAO's World Information and Early Warning System (WIEWS) databases, regional strategies, or other means, not contained within *Table 1* (only collections with over 50 accessions listed).

Country	Genebank/ Institute	Source	Date Recorded	Accessions
Portugal	Sector de Proteaginosas - Dept. de Past., Forragens e Proteaginos-	Bioversity/ WIEWS	1995	500
Spain	Banco de Germoplasma de Horticolas- Diputacion General de Aragon	Bioversity	1995	321
Spain	Junta de Castilla-La Mancha. Centro de Investigación Agraria de Albaladejito	WIEWS		321
India	Indian Institute of Pulses Research (IIPR)	SSEEA Strategy	2005	248
Poland	Plant Genetic Resources Laboratory Research Inst. of Vegetable Crops	Bioversity/ WIEWS	1996	216/ 6
Mexico	Unidad de Recursos Genéticos, Centro de Investigación Agrícola Bajío	Bioversity	1998	199
Mexico	Banco Nacional de Germoplasma Veget, Dep. de Fitotecnia, Univ. Aut. de Chapingo	Bioversity/ WIEWS	2002	199/ 167
Mexico	Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP)	Bioversity/ WIEWS	1999	199
Mexico	Centro de Investigaciones Forestales y Agropecuarias, INIFAP	Bioversity/ WIEWS	1988	199
Australia	Australian Medicago Genetic Resources Centre, SARDI	Bioversity/ WIEWS	2002	150
Brazil	Centro Nacional de Pesquisa de Hortaliças (CNPH), EMBRAPA	Bioversity/ WIEWS	1999	150
Peru	Facultad de Agronomia, Universidad Nacional del Centro del Perú	Bioversity/ WIEWS	1999	150
United Kingdom	International Centre for Underutilised Crops	Bioversity/ WIEWS	1995	136
Greece	National Agricultural Research Foundation, Agricultural Research Centre of Northern Greece, Greek Gene Bank	Direct communication	2008	119
Colombia	Corporacion Colombiana de Investigacion Agropecuaria - CORPOICA	Bioversity/ WIEWS	1988	100
Libyan Arab Jamahiriya	Agricultural Research Centre (ARC)	Bioversity/ WIEWS	1998	100
Germany	Federal Centre for Breeding Research on Cultivated Plants (BAZ)	Bioversity	2002	99
Czech Republic	AGRITEC, Research, Breeding and Services Ltd.	Bioversity/ WIEWS	2002	80

Germany	Genebank, Inst. for Plant Genetics and Crop Plant Research (IPK)	Bioversity/ WIEWS	2002	69/ 59
Poland	Plant Breeding and Acclimatization Institute (IHAR)	Bioversity/ WIEWS	1995	67
Italy	Institute of Agronomy and Field Crops	Bioversity/ WIEWS	1998	60
Spain	Servicio de Investigacion Agraria Junta de Castilla y Leon	Bioversity/ WIEWS	1994	56
Israel	Dept. of Field and Vegetable Crops Hebrew University of Jerusalem	Bioversity/ WIEWS	1995	50
Afghanistan	Plant Genetic Resources Unit Crop Improv. Div., Min. of Agric.	WIEWS		50