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Biodiversity and State of Agricultural Plant Genetic Resources in Korea

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Plant genetic resources (PGR) include genotypes or populations representative of cultivars, genetic stocks and wild species, which are maintained in the form of plants, seed, tissue culture, etc (Frankel and Soule, 1981). Functionally, plant genetic resources constitute landraces, advanced/improved cultivars and wild and weedy relatives of crops. The genepools which include the cultivated diversity of a crop species and its wild, ancestral and weedy relatives are essential to human life and survival. And also, these are frequently used by breeders for crop improvement and this has offered new opportunities for agricultural development (Hawkes, 1983). The great wealth of genetic diversity existing in the genepools holds vast potential for current and future uses by humankind. Generally speaking, the genetic resources are irreplaceable and it should be concerned at species level, genepool level or at the ecosystem level (Ramanatha Rao and Riley, 1994).

It was realized that the plant genetic resources would be reduced or became extinct if not conserved. Conservation programes usually involve a series of activities on germplasm collection, characterization, regeneration, documentation and storage.

Of particular concern is the need to safeguard the diversity of agricultural plants in Korea. Researchers must take the leadership in educating decision-makers, urban consumers, farmers on the vital issues related to biodiversity in food crops (Chang, 1994). In the following disscussion the focus is mainly on the state of PGR in Korea on the global basis.

GLOBAL CONSERVATION

It has been estimated that there are between 300,000 and 500,000 species of higher plants (i.e. flowering and corn-bearing plants) of which approximately 250,000 species have been identified or described. About 30,000 species are edible and about 7,000 have been cultivated or collected by humans for food at one time or another. Of those, only 30 major crops are widely grown and consumed (CGRFA, 1996).

Conservation is implemented under two major approaches: (1) *ex situ* conservation by storing seeds, plants, and plant parts outside the home habitat of the collections, usually in a PGR center, and (2) *in situ* conservation by maintaining plant communities in natural environments (for many crop plants, both approaches can be used as complementary means).

Ex Situ Conservation

Ex situ collections consist of seed genebanks, field genebanks and in vitro collections. Species with orthodox seeds are stored in seed genebanks, while the latter two methods are used mainly for vegetatively propagating crops and for species with recalcitrant seeds which cannot be dried and stored for long periods under cold conditions. In addition, perennial species which produce small amounts of seed (e.g. some forage species) and species with long life cycles (e.g. trees) are also maintained in such way. Other forms of conservation include cryopreservation, and pollen and embryo storage. The botanical gardens worldwide have also germplasm collections and play an important roles in *ex situ* conservation systems.

Until recent, most conservation efforts have concentrated on *ex situ* conservation, particularly seed genebanks. It is estimated that, existing global *ex situ* collections contain approximately 6.1 million accessions. Of those, 527,000 accessions are stored in field genebanks, while fewer than 37,600 accessions are conserved *in vitro*. Clearly, seed storage is the predominant form of plant genetic resources conservation, accounting for about 90% of the total accessions held in *ex situ*. In addition, 1,500 botanical gardens worldwide have germplasm collections for the conservation of ornamental species, indigeneous crop relatives, medicinal species, forest species, wild food plants and

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Table 1. *Ex situ* conservation of PGR.

Conservation system	Methods /Condition	Stored PGR
Field genebank	-Green house -Field	-Orthodox seeds -Recalcitrant seeds -Vegetatively propagating plants
Botanical garden	Artificialy controled natural habitat	-Perrennials -trees -vegetatively propagating plants
Seed genebank	Low temperature (-20°C~-10°C) and humidity (<40% RH)	-Orthodox seeds
In vitro	*In vitro* culture	-Vegetatively propagating plants (clones)
Others	-Cryoconservation -Others	-Recalcitrant seeds

other non-cultivated species for local use. Such species are frequently lacking in other *ex situ* germplasm collections.

Storage Facilities

The number of storage facilities has increased dramatically over the past two decades. Many countries, in fact have more than one *ex situ* facility or collection. Of the 1,308 genebanks registered in the WIEWS data base, 496 (38%) are located in Europe, 327 (25%) in America, and 292 (22%) in Asia (Table 2). Most genebanks are seed stores, but there are also many field collections. These are particularly important among the small island and developing states (CGRFA, 1996).

In Situ Conservation

In contrast to *ex situ* conservation, maintaining plant communities in their home habitat as natural reserves is considered by many biologists as a more dynamic form of conservation by allowing continuous evolution within natural environments. This approach can be used for landraces by growing them in original ecological niches under traditional agro-ecosystems and for wild species preserved in natural plant communities. This method is paticularly suited for forest germplasm. It is estimated that there are 9,800 places of 930 million hectars *in situ* conservation.

Table 2. Genebanks and accessions in *ex situ* collections according to region (PGRFA, 1996)

Region	Accessions		Genebanks	
	Number	%	Number	%
Africa	353,523	6	124	10
Latin America and Caribbean	642,405	12	227	17
North America	762,061	14	101	8
Asia	1,533,979	28	293	22
Europe	1,934,574	35	496	38
Near East	327,063	6	67	5
Total	5,554,505	100	1,308	100
CGIAR Total	593,191		12	

CONSERVATION OF PGR IN KOREA

The Korean peninsula is narrow shaped and located in temperate monsoon zone. However, the vegetation in Korean is very diverse due to the critically different four seansons as well as mountainous regions which make up 65% of the total area of Korean peninsula. Different kinds of plants growing and adapted to different ecological zones could be divided into forest of subtropic zone, forest of temperate zone and forest of arctic region.

There are 4,165 species of plants growing in natural habitat of Korea (Lee, 1978, 1982). Of those, 2,568 species are utilized as medicine, foods grasses and industrial purpose, and 39 species are classified as rare and endangered species (Ministry of Environment, 1994).

Korea has been rapidly industrialized for the last 20 years. Due to that reason, some plants are on the verge of extinction by pollution and wide range of development. Therefore, there is a felt need to conserve PGR while it is not too late.

Activities of the RDA Genebank

The Rural Development Administration (RDA) plays a basic role in planning and supporting the national program on crop genetic resourecs conservation and use. The National Agricultural Science & Technology Institute (NASTI) of RDA is undertaking researches on germplasm collection, characterization/evalua-

Table 3. Preservation facilities of RDA Gene Bank.

Farcility	Condition	Practical duration	Preserved accessions	Type of gemplasm
Long-term	-18°C, Vaccumed, Frost free	>100 years	53,536	Seeds
Medium-term	4°C, 30% RH	>10 years	118,106	Seeds
Field Genebank	-Field, -Green house	1-50 years	10,285	Vegetatives

tion, conservation, documentation and use. RDA Gene Bank (RDAGB) was established in 1988. The Genetic Resources Council (GRC) and the Germplasm Advisory Committee (GAC) advice on developing national strategies for germplasm activities such as priority collecting mission, and providing recommendations to carry out characterization, evaluation and utilization of genetic resources in the country. Evaluation and multiplication of the plant genetic resources should be done at related research institutions jointly with RDAGB. The seeds multiplied and the data evluated at those institutions should be sent to RDAGB for conservation and utilization.

Several research projects are being conducted to improve collection, conservation and characterization of PGR in RDA. Some international projects on PGR have been established between the RDA Genebank and foreign countries-Mongol, Russia, Nepal, South Asia, and Africa, for collection and evalution.

Storage Facilities

Seed storage facilities of RDA genebank were built according to the international standards. It has the capacity to store as many as 250,000 accessions and has seed storage rooms both for short-and long-term use. However, a few national as well as private research institutes have short-term storage where temperature could be maintained at 5°C to 12°C. The eighty eight square meter long-term storage room is set at -18±1°C and is maintained at frost free condition. The one hundred and seventy six square meter short-term storage room is set at 4±1°C temperature with 40% relative humidity. Seed drying room is maintained at 15±3°C temperature with 15% relative humidity. Seeds are dried until their moisture content declines to 3% to 8%. Packing room is set at 20±3°C with 30% relative humidity (Table 3).

Seeds to be stored for a long term are packed in aluminum foil to avoid getting moisturized and kept into -18°C storage room. On the other hand, seeds for short-term storage are packed into PET bottle with silicagel and kept into 4°C storage room. RDA was designated as one of the Sesame World Base Collection in 1991 by IPGRI. The seeds are stored in RDA genebank. A small genebank is under construction in Youngnam area for safe duplication of accessions.

Preservation

RDA seed genebank has 102,267 cereal crops, 11,627 vegetables and fruit trees, 16,084 industrial and medicinal plants, and 5,027 forage crops and other germplasms which have introducted from domestic or foreign countries (Table 4).

In addition, for the vegetatively propagating germplasms, 41 field genebanks are maintaining 10,285 accessions which consist of fruit trees, flowers, vegetables, medicinal plants, tuber crops, shrurbs, grasses, and other germplasms (Table 5).

Table 4. Collections in seed genebank of RDA

Crops	Number of species	Number of accessions
Cereal crops	174	102,267
Vegetables & Fruit trees	447	11,627
Industrial & medicinal plants	246	16,084
Forage crops & others	681	5,027
Total	1,548	135,005

Table 5. Collections in field gene banks of RDA.

Crops	Number of species	Number of accessions
Fruit trees	25	3.532
Flowers	32	1.762
Vegetables	24	1.560
Medicinal plants	46	1.159
Tuber crops	4	694
Shrubs & Grasses	322	1.043
Others	39	535
Total	492	10.285

Table 6. Germinability level of PGR holdings in RDA Gene Bank.

Germinability level	<30%	31~60%	61~80%	>81%
Distribution of germplasm (%)	8.0	10.3	14.3	67.4

Table 7. Status of characterization of germplasms of RDA.

Crops	Number of preserved accessions	Number of characterized accessions	Ratio (%)
Cereal crops	102,267	65,439	64.0
Industrial & Medicinal plants	16,084	5,228	32.5
Vegetables	11,627	4,558	39.2
Forage crops	3,895	1,198	30.8
Others	1,023	0	0
Total	135,005	76,423	56.6

Regeneration

Regeneration of stored seed is an important part of the work of genebank. Even under optimal *ex situ* storage conditions, viability declines by year. In the case of unique material, such losses may be irreplaceable. Therefore, the monitoring of viability and timely regeneration must be a priority activity of genebank.

Seed viability test is done whenever seeds are 5 to 10 years old in the short-medium term storage and 10 to 20 years old under long term storage. Seeds with less than 80% germinability have to be regenerated. Regeneration of stored germplasm have been carried out in coordination with genebank and RDA affiliated research institutes. Nearly 33% of total accessions in RDA genebank requires regeneration urgently (Table 6).

Evaluation and Characterization

Evalution and Characterization data can help researchers to search for disired combinations of trait and ask for the appropriate seed samples. Characterization and evaluation of the stored germplasm samples are carried out by scientists working in both genebank of RDA and experiment stations for various crops under RDA. It is done by using partially modified IBPGR/IPGRI descriptors for international network. About 56% of the stored germplasm by RDA genebank has gone through the characterizartion and evaluation which may include physiological responses, disease and pest susceptibility, yield productivity, and other agronomic features (Table 7).

CONCLUSION

All the countries have been tried to collect and utilize PGR for crop improvement and research materials for biology. Research infrastructure of PGR is very important in order to improve and utilize the collections. However, there are numerous problems encountered in the conservation and utilization of plant genetic resources in Korea.

Social understanding and consensus about the importance of genetic diversity or plant genetic resources are needed urgently. For realizing further development of food and agriculture and archievement of the three objectives of the Convention on Biological Diversity, the followings are needed; a) construction of national and international network to access germplasm and information exchange, b) estabilishment of curator system for collection, classification, regeneration and evaluation efficiently in managing germplasm, c) maximum utilization of PGR through the strenthening the genetic and biochemical works.

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