

The network of the “German National Fruit Genebank”, a new concept for sustainable preservation of fruit genetic resources

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Introduction

Fruit production is of economical importance in Germany. In 2009, a total of 1.4 Mio metric tons of fruit were produced on 65.500 ha of land. This amount is equivalent to a production value of 923 Mio Euro (AMI-Marktbilanz Obst- 2010). The most important fruit crop in cultivation is apple (73.2 %) followed by strawberry (10.8 %), plum (5 %), pear (3.6 %), sweet cherry (2.7 %), and sour cherry (2.1 %). The number of fruit-production farms in 2005 was approximately 16,600 (Steinborn and Bokelmann 2007). In 2007 a total of 11,454 farms produced tree fruit crops.

Hundred to 150 years ago fruits were mainly produced in house gardens, abbeys or small farms. Today the lion's share of the world's need is produced in a relative small number of very specialized farms and production is focused on a very limited number of cultivars. This consequently results in the loss of traditional cultivars as seen e.g. for apple (Way et al. 1990, Höfer 2006). During the last decades the loss of biodiversity has been developed to a worldwide problem. Ensuring a sustainable fruit production for the future is only possible by preservation of a high number of fruit species and a high diversity of genotypes. Nobody can prophesy which traits will be of importance in the future, when climatic changes lead to the occurrence of new pathogens (or new races of known pathogens), when changes in dietary practice or consumer preferences appear or when new requirements for fruit production are

needed. On this account in the early 1990th the Convention on Biological Diversity (CBD) was concluded and many national programs for plant genetic resources were designed to provide long-term preservation, utilization, research and development for a large number of plant species. Since that time large crop specific germplasm collections were established. The European gene bank curators of the member states work together within the European Cooperative Program for Plant Genetic Resources (EC/PGR). This program operates through networks in which activities are carried out either in the framework of working groups or as ad hoc actions. In Germany the “National Program for Genetic Resources of Agricultural and Horticultural Plants” was established, which was designed to provide long-term preservation, evaluation, utilization, research and development for agricultural and horticultural plant species. The program is also aimed on the re-introduction of old varieties in meadow orchards, in breeding programs, in botanical gardens, and in landscape architecture. The gentle use of such genetic resources is the best way for ensuring a sustainable preservation. To realize this goal the German National Fruit Genebank has been recently established. The German National Fruit Genebank is a local network, which is aimed on the coordination of different germplasm collections in Germany.

The history of preservation activities for fruit species in Germany

The preservation of fruit genetic resources has a long tradition in Germany. First collections were established at the Institute for Breeding Research of the Emperor-Wilhelm-Institute in Müncheberg (Germany) in the early decades of the 20th century. These collections mainly consisted of land races, primitive forms and wild species (Flachowsky and Höfer 2010). At this time a number of expeditions have been made to collect genotypes which could be of importance for future breeding activities. The most popular expedition was the “Hindukusch” expedition which was initiated by Th. Roemer and W. Troll. In 1971 during the time of socialism in the former German Democratic Republic (GDR) the fruit breeding activities were

centralized at the Institute for Fruit Research in Dresden-Pillnitz. Since that time extensive *ex situ*-on farm collections of cultivars and wild species belonging to different genera (e.g. *Malus*, *Pyrus*, *Prunus* and *Fagaria*) were maintained in Pillnitz. These collections were mainly aimed on preservation and evaluation of fruit genetic resources as for identification of unique genotypes in view of their introduction into existing breeding programs. In 1991 after political changes, the Institute for Fruit Research ceased its activities and the group working on preservation of fruit genetic resources became part of the Institute for Plant Genetics and Research on Cultivated Plants headquartered in Gatersleben (nearby Quedlinburg, 350 km northwest of Dresden). However, the fruit collections and the working group remained in Pillnitz. Based on the former Institute for Fruit Research three new institutions were established. As a result of this reorganization the breeding groups became part of the Institute of Fruit Breeding Dresden in the frame of the Federal Institute for Breeding Research on Cultivated Plants headquartered in Quedlinburg. In 2002, the responsibility for the fruit collections was re-transferred to the Institute of Fruit Breeding in Dresden. Since that time Dr. Monika Höfer is the new curator of the “Fruit Genebank” focusing activities on maintenance and restructuration of the collections, and on evaluation of the existing plant material. In 2008, a new structure of research has been established at the Federal Ministry of Food, Agriculture and Consumer Protection. The former Institute of Fruit Breeding was integrated into the Institute for Breeding Research on Horticultural and Fruit Crops in Dresden-Pillnitz. The fruit collections are now belonging to this institute which is part of the Federal Research Institute for Cultivated Plants, Julius Kühn-Institute (JKI).

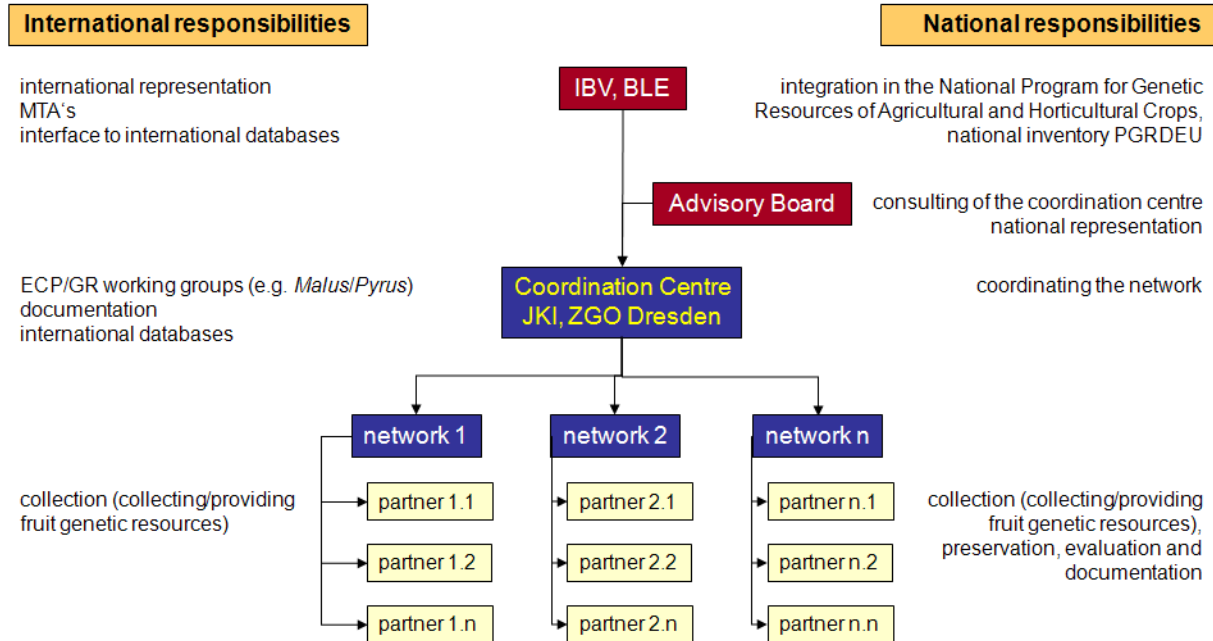
Beside the fruit collections at the Institute for Breeding Research on Horticultural and Fruit Crops in Dresden-Pillnitz there are numerous other collections in Germany. These collections belong to universities, other governmental institutions, districts and communes, non-governmental organizations and private people. The risk for loosing of individual cultivars by

using such a strategy for preservation cannot fully be excluded. Some cultivars are present in several collections whereas others are only present in one or a few different collections.

The structure of the German National Fruit Genebank

The preservation of fruit genetic resources will currently be realized in the German National Fruit Genbank, a local network which has been build up on the basis of existing structures. The objective of this network is to utilize existing structures and capacities, personal and financial resources as efficiently as possible. The network consists of the Information and Coordination Center for Biological Diversity which is part of the Federal Centre for Agriculture, the JKI as the coordination centre, the collection holders, and the advisory board. The collection holders are organized in fruit species specific sub-networks (e.g. apple network, strawberry network etc.) which are coordinated by the coordination centre. The structure of the whole network is given in figure 1.

Fig. 1 Schematic application of the structure of the German National Fruit Genebank



The Information and Coordination Center for Biological Diversity (IBV)

The IBV of the Federal Centre for Agriculture has an advisory function. The IBV represents the German National Fruit Genebank in international affairs. Furthermore, it integrates the data of the German National Fruit Genebank into international databases for plant genetic resources. One of these databases is the PGRDEU database (<http://pgrdeu.genres.de/>), which is the main documentation of plant genetic resources in Germany. The PGRDEU is the national inventory for plant genetic resources for food and agriculture in Germany. It contains comprehensive information about species and their utilization as well as about the endangerment of species occurring in Germany. This database includes data of *ex situ* collections of German plant collections as well as a first data compilation (prototype) of *in situ* occurrences of wild species and landraces. The PGRDEU provides web-based access to information such as scientific name, common name, utilization categories and endangerment. Additional information about passport data, e.g. accession (variety) name, accession number, maintaining institute and country of origin, is available for genebank accessions (see also <http://pgrdeu.genres.de/>). In the context of national and international obligations PGRDEU serves as a national interface for international information systems like:

- the Federal Information System Genetic Resources (BIG),
- the European Plant Genetic Resources Search Catalogue (EURISCO) of the European Cooperative Program for Plant Genetic Resources (ECPGR),
- the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS) of FAO and,
- the Global information system of the International Treaty on Plant Genetic Resources for Food and Agriculture.

The German National Fruit Genebank is integrated in the “National Program for Genetic Resources of Agricultural and Horticultural Crops” and contributes to an internationally coordinated strategy for preservation of fruit genetic resources in Europe.

The coordination center

The coordination center of the national fruit collection network is located in Dresden-Pillnitz as a part of the Institute for Breeding Research on Horticultural and Fruit Crops of the Federal Research Institute for Cultivated Plants, Julius Kühn-Institute. The coordination center is responsible for the establishment of new fruit specific collection networks. It has to find new partners (collection holders) and to sign contracts with them. The coordination centre defines the cultivars/genotypes which should be preserved within the network and the criteria for their preservation and evaluation. Furthermore, the coordination center organizes the cooperative work between all network partners. It is responsible for the national database for fruit genetic resources and for the introduction of new, until now not registered, fruit collections into the national network. The coordination center gives advice to the network partners to improve their work and consequently the quality of the national collection.

Network partners

Network partners can be federal or state governmental research institutions, districts, communes, clubs and non-governmental organizations. These partners undertake themselves on a voluntary base to maintain the plant genetic resources of their own collections and, if possible, to evaluate and document them. The documentation is performed on an online platform which can be visited at <http://www.deutsche-genbank.de/>. Furthermore, the partners agreed to send plant material (e.g. graft sticks) of their own collections to anyone who is interested on planting of these fruit genetic resources. The transfer of plant material will be realized after the interested person has signed a Standard Material Transfer Agreement (sMTA). The sMTA is a private legal contract between the collection holder and the recipient of the plant material. The contract regulates the rights and responsibilities of both partners and represents an important tool to realize the aims of the International Convention on Preservation of Biodiversity (CBD). The CBD regulates the financial support originating from

the commercialization of plant genetic resources to developing countries for preservation and use of plant genetic resources in these countries.

The network partners can present themselves as part of the network. They receive information and advertizing material and they can use the logo of the German National Fruit Genbank for their correspondence. The partners will be presented by the coordination centre at exhibitions, meetings and in scientific and popular scientific journals. Their collections will be evaluated for trueness-to-type based on morphological and molecular characters free of charge. They bring in their own collections and the resources necessary for maintenance.

The advisory board

The advisory board was appointed in 2009 for a period of five years by the President of the Federal Research Institute for Cultivated Plants, Julius Kühn-Institute. The advisory board has the duty to advice the coordination center on questions about preservation and sustainable use of fruit genetic resources. Its advice is mainly focused on evaluation and characterization of genetic resources, documentation, preservation, collection management, and public relationship. The members of the advisory board are experts of regional offices for agriculture and/or horticulture, the German Nurseries Association, the Competence Center for Fruit Production Lake Constance, the JKI, the Information and Coordination Center for Biological Diversity, the Federal Office for Plant Varieties, the Fachgruppe Obstbau and non-governmental organizations like the German Pomological Society and the Nature and Biodiversity Conservation Union.

Fruit specific networks in operation

Currently there are three fruit specific networks (apple, cherry and strawberry) in operation. The cherry network is divided into two sub-networks, one for sweet cherry and one for sour cherry. The state of the fruit specific networks is shown in table 1.

The apple network

The preservation of apple cultivars is performed in at least two collections located at different places in Germany with at least two trees per cultivar/collection. Additionally one tree per cultivar will be preserved in a third collection. In one collection the trees will be grafted onto dwarfing rootstocks and in the second collection on dwarfing, semi-dwarfing or standard rootstocks. An evaluation based on morphological characters of the cultivars has been started in 2009. Within two years (2009 and 2010) all apple cultivars were evaluated for trueness-to-type. This evaluation was performed under the guidance of the Competence Center Fruit Production Lake Constance in cooperation with the German Pomological Society. Subsequently a molecular fingerprint will be performed for each cultivar.

The strawberry network

The preservation of strawberry cultivars is performed in at least two different collections. One collection has to be preserved in the field with at least three plants per cultivar whereas the second collection can be preserved in the field or by *in vitro* cold storage and cryopreservation, respectively. The number of plants per cultivar which has to be preserved by *in vitro* cold storage and cryopreservation depends on the methodological security. To guarantee trueness-to-type all cultivars will be evaluated based on morphological and molecular characters. The evaluation based on morphological characters is not so easy, because no experts were found in Germany who can really identify all these cultivars. The solution of this problem is currently under discussion between the coordination centre and the advisory board.

The cherry network

The preservation of cherry cultivars (sweet and sour cherries, respectively) is performed in at least two different collection located at different places in Germany with at least two trees per cultivar/collection. Additionally one tree per cultivar will be preserved in a third collection. In one collection the trees will be grafted onto dwarfed rootstocks and in the second collection on dwarfed or standard rootstocks. A morphological evaluation has been started in 2010. Within two years all cultivars will be evaluated for trueness-to-type. This evaluation is performed by the German Pomological Society. Subsequently a molecular fingerprint will be performed for each cultivar.

Table 1 State of the fruit specific networks in operation

Network	Cultivars				Cultivars planted in <i>n</i> collections of the network		
	present ¹	selected ²	not selected ³	no decision ⁴	<i>n</i> = 2	<i>n</i> = 1	<i>n</i> = 0
Apple	2,397	950	1,315	132	512	322	94
Cherry							
Sweet cherry	646	289	231	126	116	93	46
Sour cherry	174	97	65	12	38	46	12
Strawberry	732	389	271	72	65	277	47

¹cultivars found in Germany after a survey commissioned by the federal government

²cultivars classified by experts as worthy for preservation in the national fruit collection network

³cultivars not fulfilling any of the selection criteria stated by experts or synonyms of cultivars which have already been preserved

⁴passport data are missing

The representation of the German National Fruit Collection

The German Fruit Genbank is represented at the website <http://www.deutsche-genbank-obst.de/>. The development of an improved online platform is in progress. Furthermore, the German Fruit Genbank has the possibility to present any information about fruit genetic resources in Germany (news, research results, data of events etc.) in the Journal of Cultivated Plants which is edited by JKI.

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