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The integration of different sectors is a key factor for the conservation, evaluation and utilisation of our Belgian fruit tree biodiversity

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Summary

Since 1975, the Department of Biological Control and Plant Genetic Resources of the Agricultural Research Centre in Gembloux has been collecting and evaluating old fruit tree cultivars (cvs) formerly grown in Belgium. The collection now contains more than 2,830 accessions. One third was recovered from old, often endangered collections in horticultural institutions and two thirds from old orchards on farms and in gardens, thanks to the help of the public and the media. The main criteria for collecting material are: 1) Belgian origin cvs either as 'landraces' or as old-named cvs bred by Belgian amateurs during the late 18th and 19th centuries, 2) old cvs formerly grown in Belgium on a relative large extent, 3) cvs not present in other European institutions and 4) cvs which extend the diversity of characters already recorded in the collection. The informal sector is also active in collecting and conserving old cvs: since 1984, the 'Nationale Boomgaard Stichting' works mostly in the Province of Limburg, promoting high standard tree orchards, and its collections contain about 2,500 accessions; the 'fructuarium' of Rijckel-Borgloon was established at the end of the 1980s, with the aim to increase public awareness on their historical fruit cvs. In the Walloon region, the association 'Flore et Pomone' works also on the same topics and has a collection of about 400 accessions. The only way for managing such diversity and for screening cvs of interest is to collate sufficient documentation as passport data and to devote work to the characterisation of collection material, mainly for its agronomic, disease and pest resistance evaluation. Throughout this active process, a better identification of the material is made possible but the data collected are also of uttermost importance: 1) for the utilisation and valorisation of these genetic resources; and 2) to develop a safe conservation strategy. Different ways of valorisation with the aid of the private sector are presented in this paper. Regional, national and European strategies for long-term conservation of the Belgian fruit diversity are also discussed.

Keywords: fruit tree genetic resources, apple, pear, plum, landrace, disease resistance, breeding

1. Introduction

The future work on plant evolution and breeding -not only for disease or pest resistance but also for fruit taste, specific fruit uses, tree habit, adaptation to low fertilisation, etc.- are dependent on the genetic variation which is in store in old cultivars and some of their wild relatives. Agro-biodiversity is therefore a heritage of the past that must be taken into a dynamic and continuous process for a better adaptation to the present constrains. It represents an inestimable potential value for the present and future mankind.

Modern intensive farming and urbanisation now endanger the existence of agro-biodiversity. One of the main problems is illustrated by the fact that commercial apple growing is essentially based on a narrow genetic base: more than half of the world production comes from only five cultivars. Looking at the parents of those commercial apple cultivars and taking the Belgian production as an example, it should be noticed that the 'Golden Delicious' has been used very extensively as parent in the breeding programmes, leading to the current situation where more than 80% of our commercial cultivars have 'Golden Delicious' in their genetic background (fig. 1). The situation described by WAY *et al.* (1990) is therefore even worse today: "Because much of the world's apple production consists of a rather narrow genetic base of two cultivars, 'Delicious' and 'Golden Delicious', commercial apple production could be vulnerable to a catastrophe".

It is urgent to develop strategies for a better conservation and surely for a better utilisation of the large Belgian fruit biodiversity, which was very famous in the past centuries (POPULER, 1979; POPULER, 1999) and particularly for pear breeding.

The first amateur pear breeder in Belgium was Nicolas HARDENPONT (1705-1774), a priest in the city of Mons. He undertook a large sowing of pear seeds in the period around 1730-1740, with the view of obtaining new pears of superior quality. He is probably the first to have planted pear seeds with the objective to improve them. Nearly all pears before this time were crispy, hard and mostly used as cooking fruit. In 1760, HARDENPONT introduced a dozen new pear cultivars. At least six of them were soft-fleshed, melting dessert pear, what we call in French the '*beurré*' type. It was a revolutionary improvement at that time. The best-known cultivars from his historical work are *Beurré d'Hardenpont* (syn. *Glou Morceau*), a winter melting pear of excellent quality especially when grafted on seedling, and *Passe Colmar*.

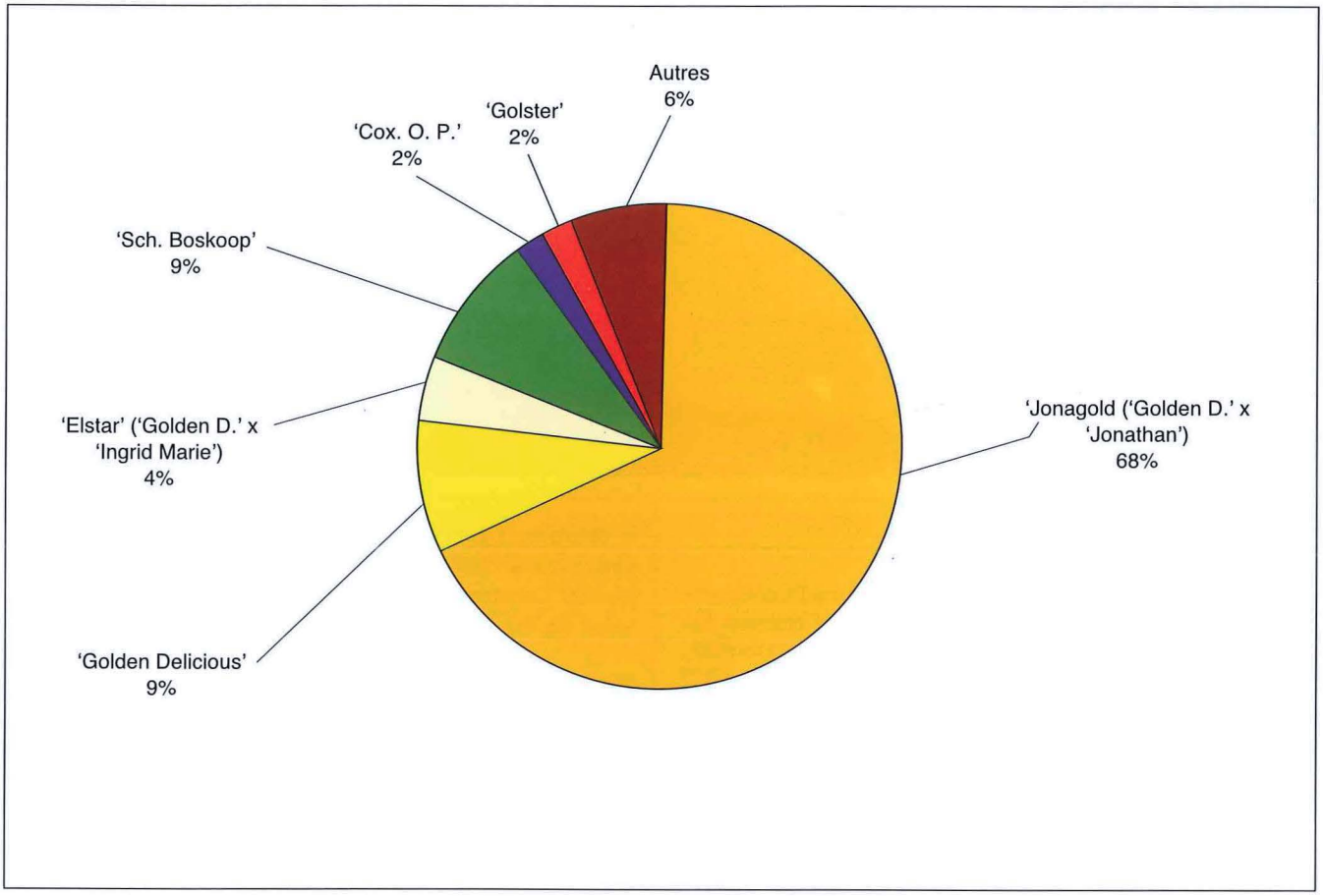

Fig. 1. Commercial apple cultivars grown in Belgium, percentage of the production in 2000 (0,56 Mt) (FAO, 2001).

How did HARDENPONT obtain his superior pears? It seems that he was a pioneer in making controlled hybridising pears long before KNIGHT (1759-1838), who is said to be the first to have undertaken the controlled breeding of apples. HARDENPONT had soon many imitators in Belgium and all over Europe. One of the most famous is VAN MONS (1767-1842), also of Belgian origin. He has released more than 400 pear cvs from his own work. In 1874, the pomologist GILBERT recorded 146 Belgian amateur breeders, who bred during the 18th and 19th centuries more than 1,100 pears cultivars. However, he made no references to the large diversity of pear landraces.

The famous American pomologist HEDRICK wrote in 1921: "the pear was improved more in one century in Belgium than in all the centuries before" and further: "now, mostly owing to the work of the Belgians, the buttery pears predominate". Therefore Belgium can be considered as an important secondary centre of diversification for cultivated pears.

One of the most important sources of diversity for disease resistance, soil and climatic conditions adaptation and long-keeping ability of the fruit consists in collecting and studying old fruit cultivars formerly selected as chance seedlings by rural people and peasants. These people have created several hundreds original cultivars classified as '*landraces*', which in most cases have never been described nor included in the famous and rich old pomological literature. It is also a rich source for traditional ethno-botanical and historical knowledge on old local fruit uses and on applied horticulture.

2. Collection and conservation of fruit tree biodiversity

2.1. FORMAL SECTOR

2.1.1. *Agricultural Research Centre, Gembloux*

A long time before the negotiation of the Convention on Biological Diversity (CBD) and its ratification by Belgium, individual actions started in Belgium in the 1970s such as the research programme on 'Fruit Tree Genetic Resources (FTGR) and Disease Resistance' at the formerly named 'State Plant Pathology Station' of the Agricultural Research Centre, Gembloux (POPULER *et al.*, 1998). Since 1975, the Department has been intensively collecting old fruit tree cultivars formerly grown in Belgium. The number of accessions currently held in our collections exceeds 2,832 (fig. 2). It should be noticed that the term 'accession' represents an entry in a collection, but which still needs to be controlled for its real identity before being classified into a cultivar name.

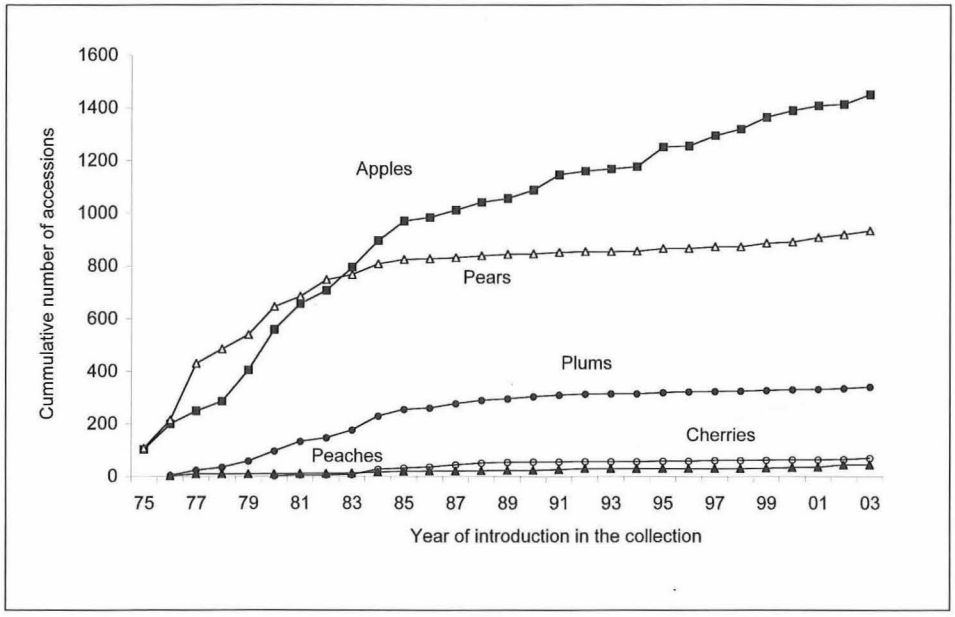

Fig. 2. Growth of the Fruit Genetic Resources collections at the Department of Biological Control & Plant Genetic Resources, 1975 to 2003.

The initial aim of the research programme, which is still a priority, was to screen old cultivars for disease resistance. Apple and pear cultivars presently used in commercial fruit growing have been chosen on criteria such as high and sustained yield, attractiveness and cold storage fitness but they are on the whole rather susceptible to diseases and require numerous fungicide applications. This has also been the case in the last decades with many of the fruit cultivars sold for amateur growing in our country. With the increasing concern for a cleaner environment, there is now an interest for cultivars with some measure of disease resistance, which can be grown with a significantly reduced number of fungicide applications or, even better, without any treatment (e.g. in the case of amateur growing). As the project expanded, a conservation objective was developed and the experimental orchard, initially meant for disease resistance screening, now also functions as a reserve of fruit tree biodiversity.

Approximately one fourth of the collection was recovered at the outset of the project from old and endangered collections in horticultural schools and other research institutes. A preference was given to cultivars that originated in Belgium or to foreign cultivars that were not listed in the catalogues of the larger official collections in neighbouring countries. The other three quarters of the material were collected from old standard tree orchards on farms, and in a minor measure from gardens, with the spontaneous help of the public, from which we received more than 3,000 proposals. In this case, a preference was given to named landraces and to any other material, even unnamed, which seemed of practical interest or which presented original characters that would enhance the diversity of the collection. Up to now, 1,038 gardens and orchards have been visited for collecting graft-wood of old endangered fruit cultivars.

The standard procedure is to visit old orchards and gardens in August, assess the trees for vigour, disease and pest severity and fruit type, record information from the owner and take the decision to cut bud wood for grafting in our nurseries back at the Department. Another way of collecting consists in collaborating actively with the public and NGOs, and to examine the several hundreds of fruit samples brought to us for cultivar identification and select the accessions with the most interesting features.

As the collection expanded, the criteria for introducing new cvs in the collection became more and more severe. Table 1 shows the general criteria used for introducing new accessions in the collections.

Our collecting work of unique material is surely not finished yet, but it currently proceeds at a slower pace. Additional work involves safety management of the collections and, where it is possible, their field evaluation.

At the Department of Biotechnology, collections of different botanical species of *Prunus* represent a total of 150 accessions and a collection of 150 modern cultivars of cherry is evaluated for agronomic features.

2.1.2. *National Botanic Garden, Meise*

Nowadays the mission of botanic gardens involves mainly activities in the horticultural, botanical and ecological fields and constitutes an interesting instrument in the management and conservation of biological diversity.

The National Botanic Garden of Belgium has a long-established tradition as a centre of excellence in science and horti-

Named cultivars from other collections	Landraces or unknown cvs discovered in old orchards
1. Cvs of Belgian origin 2. Cvs formerly cultivated in Belgium and originated from neighbour countries with similar climatic conditions 3. Cvs older than the common fungicide use time (before 1850) 4. Cvs well known in the literature for their fair disease resistance 5. Cvs not present in other important foreign collections	1. Named landrace cvs with a peasant origin and with a local traditional use 2. Unknown cvs with specific disease and pest resistance characters or adapted to marginal situations 3. Cvs with remarkable characters that enlarge the collection diversity

Tab. 1. General criteria for selecting new accessions introduced in the collection.

culture, especially in the field of systematics and related disciplines. They have the responsibility of safeguarding the heritage of the past, such as plant collections, historic buildings, herbaria, libraries and craftsmanship, and to provide a legacy for the future. Their collections contain a considerable body of information on the worldwide diversity of plants. These collections are put at the disposal of Belgian and foreign researchers; information and education, by which the knowledge of plants increases, are provided for a wide audience. In brief, they devote attention to the conservation of biodiversity *ex situ* and *in situ*.

The FTGR held in the collections are represented mostly by different botanical species and almost not by cultivars. There are 85 accessions of *Malus* ssp., 60 of *Prunus* and twelve of *Pyrus*.

2.2. INFORMAL SECTOR

2.2.1. *Nationale Boomgaard Stichting (NBS)*

This association works in collaboration with the Limburgs Universitair Centrum and started officially its activities in 1984 in collecting old fruit cvs, mostly in the Province of Limburg.

Its specificity is to try to conserve an important part of their collection inside a network of standard trees orchards and to promote such kind of orchards with the financial support of the Province of Limburg. The aim is to protect the old cultivars and the traditional landscape as an historical heritage.

For the moment the NBS manages both a mother collection grafted on dwarf rootstocks planted at different locations and a network of at least 20 standard trees orchards, covering more than 65 ha of apple, pear, plum and cherry cultivars. To this date, no extensive list of accessions is available. The number of apple and pear accessions is estimated to be around 1,500, while the numbers of grape, plum and cherry accessions are around 400, 250 and 120 respectively. There are also a few dozen of other fruit tree species. Because of their specific activities concentrated on standard tree orchards management, very little work can be devoted for the moment to the evaluation and characterisation of the material. More information is available on their web site (www.nbs-vzw.be).

2.2.2. *Fruitstreekmuseum 'Fructuarium', Rijkel-Borgloon*

This organisation was set up officially in 1988, but had already started collection work around the open-air museum of Bokrijk in 1977. They concentrate on local old farming cultural heritage that includes old traditional and local fruit cultivars. They manage at least two standard tree collection orchards, which are open to the public and where the famous 'cherry days' manifestations are organised annually. Their cultivars lists are available and hold 120 different old cherry cultivars, 50 plum, around 40 pear and around 50 different 'Reinette' apple types. For more information, see www.vzw-fruitstreekmuseum.be.

2.2.3. *Flore et Pomone*

The association started in 1989 and focuses essentially on old amateur-bred pear cultivars that originated from the past famous work of breeders in the surroundings of Jodoigne. Their work encompasses also old apple cultivars and old roses collection, as well as the organisation of pedagogic activities. Their collections are grafted on dwarf rootstocks and hold approximately 230 old apple and 195 old pear accessions.

There are also many other private collections that are active in conserving old fruit cultivars but their activities are often not open to the public.

2.3. REVIEW OF BELGIAN FRUIT COLLECTIONS

As Belgian representative to the fruit tree Working Groups of the European Programme for Plant Genetic Resources Networks (ECP/GR) belonging to IPGRI, several enquiries on the status of the Belgian fruit collections of apple, plum, cherry and pear were realised (LATEUR & POPULER, 1996b; LATEUR, 1996, 1997). The review of the Belgian fruit collections shows that, at the moment, there is a lack of information on duplications and that there are identification problems both within and between most collections. Many of the identification gaps in collections come out inconsistent synonyms, misspellings, mislabellings or interstocks overgrowing and a real lack of evaluation work. Most curators from the informal sector have no time for evaluation or characterisation, which leads to the current situation.

3. Evaluation and characterisation of fruit tree genetic resources at our Department

With the large diversity of characters present in our collection, cultivars suitable for specific applications may be discovered only through a dynamic evaluation process. Evaluation and characterisation of a collection of this magnitude ask a huge amount of work and are time consuming; therefore each curator has to define its specific priority characters that fit with his objectives. In our situation, disease resistance and the main agronomic features were chosen as priority characters (tab. 2).

It is interesting to underline that the evaluation process plays a key role in the management and the dynamic of utilisation of the genetic resources. What value would have a national library without a catalogue and without a database wherein the contents of the books are described?

Disease resistance, physiological disorders, pest resistance and other agronomic and pomological characters	
Diseases & disorders	Fruit and leaves scab (*Venturia inaequalis*) Powdery mildew (*Podosphaera leucotricha*) European canker (*Nectria galligena*) Brown rot (*Monilinia fructigena, M. laxa*) Fire blight (*Erwinia amylovora*) Bitter pit Water core
Pests	Rosy aphid (*Dysaphis plantaginea*) Coddling moth (*Cydia pomonella*)
Agronomic & pomological characters	***Flowers*** Phenology Flowering period Flowering intensity Frost tolerance Pollen quality and ploïdy ***Fruits*** *Yield* Total yield / tree Fruit average weight *Quality & technological properties* Firmness Texture Sugar/acid ratio Juiciness Aroma Processing ability ***Fruit description*** Shape Colour, over-colour, russeting Aperture of eye, crowning Number of pits ***Tree*** Rootstock adaptation Growth in nursery Vigour Fructification type Control of identity

Tab. 2. Example of priority characters that are systematically evaluated and characterised in our apple experimental orchards during a period of, at least, 6 growing seasons.

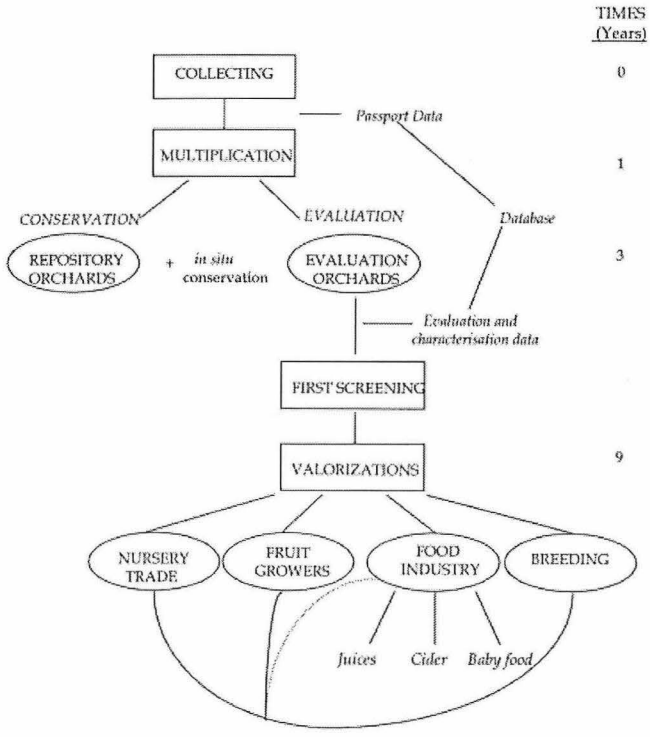

Fig. 3. General scheme of the fruit tree genetic resource research programmes at the Department of Biological Control and Plant Genetic Resources.

Figure 3 shows the general scheme of research activities devoted to fruit biodiversity in our Department. During the collecting, all valuable information on cultivars and their history are collected and represent the passport data which follows the international 'Multi Crops Passport Data' rules edited by the International Plant Genetic Resources Institute (IPGRI).

For each accession, five rootstocks are grafted in our experimental nurseries, in order to plant two exemplars in the repository orchard and one to three in an evaluation orchard. A network of *in situ* repository orchards is also still expanding in different geographical regions (VILLETTE *et al.*, 2003)

Once transplanted in the experimental orchard, the accessions are submitted to a continuous evaluation for ten years, starting from the time of grafting, in growing conditions where no pesticides are used at all, in order to allow the natural dispersion of pests and diseases.

All evaluation and characterisation data are collected with the help of portable computers (OGER & LATEUR, 1995) and progressively encoded into a working database where passport data are also stored.

Much methodological work has been developed by our Institute, especially concerning the definition of practical standard methods for the evaluation process of fruit tree genetic resource collections (POPULER *et al.*, 1985; LATEUR & POPULER, 1994; LATEUR & POPULER, 1996a; POPULER *et al.*, 1998; LATEUR, 1999; LATEUR, 2001; TIGNON *et al.*, 2001).

During the evaluation and characterisation phase, we are able to point out gaps in the identity of the cvs and to determine the numerous synonyms given over time to the best-known cvs. This part of the work is capital for an efficient management of the collection because, accordingly, we can concentrate our conservation efforts only to original and unique material without redundancy.

After the first screening of our own evaluation data, we can decide how the cvs emerging from the process can be best used. In general, we need a second phase of evaluation more focused on specific characters and which involve standard experimental designs at different places representing a larger pedoclimatic diversity.

4. Valorisation of the FTGR at Gembloux

4.1. NURSERY TRADE

At the start of the project, the intention was to screen for material with a sufficient level of resistance to be used as parents in breeding work. However, as the project developed, it became apparent that amateur gardeners would welcome old cultivars as such, if easy to grow -i.e. with a low susceptibility to disease- interesting from the viewpoint of taste, and ranging in maturity to cover an appreciable length of time. Yield should be sufficient without necessarily breaking records.

Since 1985, our Department has developed a new market for diversity of old fruit tree cvs emerging from the evaluation process and which were recommended initially for amateur growers in collaboration with the Belgian professional nursery sector. Between 1985 and 2002, it reintroduced 17 'RGF' cultivars (Ressources Génétiques Fruitières) emerging from the evaluation into the nursery trade (tab. 3). Thirty-two commercial nurseries are currently multiplying them on the base of an understanding with the Department. They obtain their scions from the Department, and a total of 6,000-7,000 bud wood sticks are supplied yearly to these nurseries. 'Pirate' multiplicators have also been active lately. The commercial success of the 'RGF' cultivars recommended for amateurs has led to search for further cvs for professional growers.

4.2. COMMERCIAL GROWERS

This paragraph refers to commercial growers following integrated production (IP) or organic production system (OPS) for dessert fruit and/or processing.

4.2.1. *Production of dessert fruit*

The 'RGF' cultivars developed, so far, are not regarded as suitable for professional growers. However, as an experiment, some professional growers have planted some of these cultivars with two objectives:

Cultivars	Origin		Eating time	Flowering season	Pollen quality	Eating quality
Apple			(a)	(b)	(c)	(d)
1. Grenadier[RGF]	UK	1862	Su/Aut	2-3	+	C
2. Reinette Evagil[RGF]	B	1863	Su/Aut	4	+	D/C/P
3. Président Roulin[RGFa]	B	1912	Aut	(2)-3	+	C/(D)
4. La Paix[RGF]	B?	?	Aut	3-4	+	D/P
5. Cwastresse Double[RGFa]	B?	?	Aut	3-4	-	D/P
6. Reinette de Blenheim[RGFa]	UK	1740	Aut	2-3	-	D/C/P
7. Radoux[RGF]	B	1873	Aut/(Wint)	4	+	D
8. Joseph Musch[RGFa]	B	1873	Aut/(Wint)	2	-	D/C/P
9. Reinette Hernaut[RGF]	B	1925	Aut/Wint	4	-	D/C/P
10. Gris Braibant[RGFa]	B?	?	Wint	3-4	-	D/C/P
11. Godivert[RGF]	?	?	Wint	3-4	-	C
12. Président H. Van Dievoet[RGF]	B	1878	Wint	4	+	D/C/P
Plums and Peach						
1. Belle de Thuin	?	?	08 (II)	1-2	+	D
2. Wignon	B	?	09 (II)	3	+ S	D/C
3. Prune de Prince	B/F/	?	09 (II)	1-2	+ S	D/C
4. Sainte Catherine	L	?	09-10	3 (4)	+ S	C/D
5. Fertile de Septembre	B/F	?	09		+ S	C/D
(Peach)	B					

Eating time: evaluation in a naturally ventilated fruit shed at 2-9°C; (a) Su = Summer; Aut = Autumn; Wint = Winter; 01 = January; 12 = December; II = Second half of the month; (b) 1 = very early; 7 = very late; (c) + = good pollen quality; - = poor pollen quality (often connected to triploïd); S = Self-fertile; (d) D = Dessert quality; C = Culinary quality; P = Processing quality.

Tab. 3. Old fruit-tree cultivars ('RGF' cultivars) recommended, during the 1985-2002 period, to the nursery trade by the Department of Biological Control and Plant Genetic Resources. These cvs combine a satisfactory yield, light to moderate disease susceptibility and good fruit quality. RGFa = cvs under trial in Integrated Fruit Production (IFP) professional orchards.

1) to incorporate in their orchards, cvs with a lower susceptibility to diseases (particularly scab), thereby reducing considerably the use of fungicides which represent 65-80% of the total pesticide use (NIEUWENHUIZE 1997a, 1997b);
2) to evaluate a new market opportunity, focused on old traditional cvs with specific taste qualities in the context of overproduction of standard commercial cvs (DE NEEF, 1998).

Experimental orchards with old apple cvs

In 1992, the 'Centre Régional de Ressources Génétiques' (CRRG) of Lille (France) and the 'Groupement d'Arboriculteurs pratiquant en Wallonie les techniques Intégrées' (GAWI) developed an INTERREG project with a view to planting a selection of old apple cultivars with low disease susceptibility in trials with the aim of commercial development (MARC, 1993). Five hectares in France and the same surface in Belgium were planted in 1994-1995 following a one-row system with an average density of 1,800 trees/ha. Most were grafted on M9 rootstock.

Without being involved in the project as a financed partner, our Department was asked for the choice of the cvs representing 80% of the surface of the Belgian orchards and 20% of the French orchards. The other cvs were selected by the CRRG. As these cultivars possess a polygenic disease resistance, disease management is simpler than with other commercial cvs and they can be grown under a very light spray scheme. It should be noticed that the leaves of these cvs are often more susceptible to scab than the fruits (LATEUR & POPULER, 1994).

This INTERREG project aimed to test orchard training methods suited to the specific characters of these cvs, e.g. plant health management, pruning system, picking time, fruit conservation, etc. Another objective was to study better ways for marketing the fruit. Furthermore, other commercial growers have asked us to collaborate in supplying old apple cvs with good fruit quality for experimental plots.

4.2.2. *Production of food processing fruits*

Research projects in collaboration with industrial partners are being developed in our Department. The two main objectives are:
1) to select cvs with specific technological qualities and which are of better quality in accordance with the rising demand for quality food products;
2) in response to public demahd for organically grown products, to seek cvs with low disease susceptibility, good agronomic characters and fruit adapted to modern technology.

The most important projects concern the production of apple juice and compote. Given specific technological characters defined by the processing industry, we are searching in our fruit genetic resource database for cvs that seem to fit these requirements. Samples of fruits are therefore analysed for their chemical compounds and process tests are executed (SINNAEVE *et al.*, 1997). Two experimental orchards are planted by the cider-juice manufactory Stassen-Bulmer with nine old apple cvs selected by our Department in order to evaluate their agronomical characters (LATEUR *et al.*, 1998). Since 1990, thirty old apple cvs selected by our Department have been under trial in a first screening orchard on MM106 rootstock, and the trees trained according to the principle of 'Axe Central' (LESPINASSE, 1980).

We are also working in collaboration with two important manufactures of fruit compotes, using the same schedule as described above. One of them aims to develop industrial orchards for producing apple adapted to the baby food processing (Nestlé-France).

4.3. BREEDING PROGRAMME FOR DURABLE DISEASE RESISTANCE, USING FTGR AS PARENT

Using an existing collection like this, a large part of the work of a standard breeding programme is avoided because the diversity has already been created and partially selected in the past, though with a different spectrum of objectives. Many of our 'landraces' have, for example, good disease resistance and good keeping qualities but lack the characters required for a modern dessert apple.

The object of this programme is to develop new commercial cvs with durable disease resistance induced polygenically. A combination of polygenic resistance and that provided by major resistance genes (mostly *Vf*) is also considered. The screening of our fruit tree gene bank includes the search for new sources of polygenic disease resistance for scab, powdery mildew and European canker, in order to develop novel strategies for durable resistance following the recent breakdown of the *Vf* scab resistance gene (PARISI *et al.*, 1993; ROBERTS & CRUTE, 1994; SCHOUTEN, 1998; LATEUR *et al.*, 2002.).

The principal focus is directed to the development of new specific selection methods for quantitative scab resistance at an early stage of seedling growth (LATEUR *et al.*, 1999, 2000). New gene sources for fruit quality, long storage and shelf life, and hardiness are also selected for inclusion of a broader genetic base in modern apple breeding programmes with the aim to create new apple commercial cvs possessing durable disease resistance, high quality ('Reinette' type or firm, juicy and crispy flesh) and long keeping ability that characterise some old traditional cvs, combined with precocity and high yield. Since 1988, several thousands of hybrids of promising old apple cultivars are produced yearly at the Department. The parents with quantitative disease resistance and good agronomic features come from the evaluation of our germplasm collections. This is a new step in the use of fruit genetic resources and a long-range process.

4.4. OTHER ACTIVITIES

Research on dietary properties of fruit diversity has been carried out by the determination of some C vitamin content (PLANCHON *et al.*, 2003), flavonoids (catechin, epicatechin, rutin, phloridzin and quercitrin) and chlorogenic acid, in association with the Organic and General Chemistry Section of the Agricultural Faculty of Gembloux. These molecules present an interesting antioxidant activity for cancer prevention. Another chemical analysis was made in association with the Agricultural Systems Unit to determine the dietary fibre concentration in apples. Large differences exist between some old cultivars and commercial cultivars as 'Golden Delicious' and 'Jonagold'. Furthermore, we attempt to expand the range of processing products with carbonated juice and aromatised juices.

In collaboration with the Section of Biometry, Database Management & Agrometeorology, the Department is in charge of setting up the European ECP/GR-IPGRI *Pyrus* Genetic Resources Database that now contains 43 lists of cultivars from 18 European countries with a total of 9,510 names of accessions.

Much scientific work is still needed for a better definition of the principle of 'core collection', which refers to an optimal sample of a collection that contains the larger genetic and phenotypic diversity. A first priority would be to develop complementary strategies for long-term conservation of such a 'core collection'.

Other topics concern the conviviality enhancement of our databases for a better diffusion to scientists and breeders, and finally the research on cryo-preservation and the elimination of viruses for an easier material transfer.

5. Towards a national programme for fruit genetic resources

5.1. INTERNATIONAL CONTEXT

Since the Belgian ratification, in November 1996, of the legally-binding 'Convention on Biological Diversity' (CBD), and even more since the adoption in June 1996 of 'The Global Plan of Action for the Conservation and sustainable Utilization of Plant Genetic Resources for Food and Agriculture' (GPA), under the auspices of the 'Food and Agriculture Organisation' (FAO), Belgian has more than ever a moral obligation to set up a National Programme and to provide *'ad hoc'* financial support for the planning and coordination of the conservation and the utilisation of its 'Plant Genetic Resources', also called 'agricultural biological diversity'.

Specifically on agricultural matters, the CBD asks each Party to implement the Convention for the conservation and sustainable use of agricultural biological diversity by setting up and/or making progress in the following actions:

- implementing a national strategy, programmes and plans which ensure the development and successful implementation of policies and actions that lead to sustainable use of agrobiodiversity components;
- identifying and assessing relevant ongoing activities and existing instruments at the national level;
- establishing or enhancing mechanisms for increasing public awareness and understanding of the importance of the sustainable use of agrobiodiversity components;
- using any methods and indicators to monitor the impacts of agricultural development projects, including the intensification and extensification of production systems, on biological diversity;
- promoting mobilisation of farming communities for the development, maintenance and use of their knowledge and practices in the conservation and sustainable use of biological diversity;
- helping to implement the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources;
- collaborating with other Contracting Parties to identify and promote sustainable agricultural practices and integrated landscape management;
- reviewing agricultural biological diversity: national programme of work of phase I and adoption of a multi-year work programme;
- promoting regional and thematic co-operation within this framework of the programme of work on agricultural biological diversity;
- providing financial support for implementation of the programme of work on agricultural biological diversity;
- supporting actions to raise public awareness in support of sustainable farming and food production systems that maintain agricultural biological diversity;
- co-ordinating its position in both the Convention on Biological Diversity and the International Undertaking on Plant Genetic Resources.

The 'Global Plan of Action' is more detailed and strengthens the implementation of national programmes for the conservation and sustainable utilisation of plant genetic resources for food and agriculture (COOPER *et al.*, 1998).

Many European countries have already developed regional and national structures which have the responsibility to manage the genetic resources (LEFORT *et al.*,1998; SCHIERSCHER & KLEIJER, 1999).

5.2. CONCEPT OF 'NATIONAL AND EUROPEAN COLLECTIONS'

Due to the large diversity of fruit cultivars and the scarce financial support at the different regional, federal and European levels, there is a need to develop a coordinating strategy for a safe conservation of our FTGR. For example, a compilation of diverse information sources revealed that there are over 90,000 *Malus* accessions in the European collections (LATEUR, 2001).

One of the proposals that gains more and more adhesion inside the ECP/GR Working Group is the concept of sharing

the responsibility between regional, national and European collections by the establishment of decentralised collections of fruit accessions, to ensure long-term conservation and easy access to the important biodiversity for European horticulture, sylviculture, cultural heritage or science. The different steps are as follows:

- the first step is to define which criteria will be used for selecting the accessions that belong to the virtual 'National collection'. The decision is taken in collaboration with all collection curators and following some priority criteria. Criteria could be for example Belgian origin or strong socio-cultural and historical relation to Belgium and a good adaptation to our pedoclimatic conditions, extraordinary traits of cultivars that have a potential interest for our country;
- secondly, the original material from all collections have to be sorted out by collecting passport data and minimum evaluation and characterisation data;
- thirdly, comparing data from different collections and pointing out unique and original material to avoid unknown redundancy;
- fourthly, establishment of the 'National collection' list;
- fifthly, establishment of protocols for the network structure and sharing the responsibility for the save conservation strategy of this priority collection list.

Such procedures have to be followed both at the regional level, at the national level and finally at the European level where the 'European Collection' is considered as the sum of the different national collections. The global management of the network will be coordinated by the ECP/GR, in collaboration with the respective European Central Crop Database managers.

5.3. SAFE DUPLICATION AND '*IN SITU*' OR 'ON FARM' CONSERVATION

The Department collaborates in numerous projects of regional and local administrations, schools, environmental and historical associations aiming to preserve, restore or plant standard trees orchards with old local fruit cultivars. Some of these orchards are used as a network of multi-local evaluation and others will be used as a saved duplication site for our *ex situ* collection (VILLETTE *et al.*, 2003). Some associations and administrations in the Flemish and Walloon regions are also very active on this topic but there is very little coordination between those initiatives, which finally do not contribute significantly to an efficient and save conservation policy.
Other projects include farmers who benefit from the EU agri-environmental measures, and aim to contribute to the conservation of fruit biodiversity and to landscape and nature protection, in combination with economical profit by producing 'terroir' products.

Such an 'on farm' conservation network is only feasible if there is a link with well documented and characterised *ex situ* collections. Organising this kind of strategy before the characterisation and the evaluation of the material is really risky because we do not know the real percentage of unique material that will be safely conserved. On the other hand, old standard tree orchards play as such an important role for landscape and environmental quality.

Raising public awareness

Both the collecting and the reintroduction operations have been a large popular success in our country, extending even to the neighbouring north of France. Since 1978, our research and development project has been the subject of 192 papers in dailies or weeklies and more specialised periodicals, and 58 radio or television programs. There were also more than 278 conferences, participations to exhibitions and group visits to our fruit tree collections organised on request of institutions or associations.

6. Conclusions

There are many facts that clearly underline the importance of coordinating our efforts by integrating different sectors and stakeholders and by developing a diversity of approaches if we want to achieve the objective of the conservation and the sustainable utilisation of our agricultural biological diversity.

The best approach for developing coordinated strategies for the conservation of agricultural biodiversity is to put the priority on the documentation, the evaluation and the characterisation of the material held in the collections. CHAPMAN (1989) wrote "Until a collection has been evaluated and something is known about the material it contains, it has little practical use. Such situation has been likened to a library where none of the books are catalogued". This process is of utmost importance for pointing out the potential utilisation of fruit biodiversity and for a better knowledge of the material.

Collaboration with different sectors for its valorisation in many different fields creates a dynamic interaction that represents the best situation for a safe conservation of FTGR. Following this approach many concrete valorisation actions have already been achieved and promising results are of potential interest for the next future.

We need efficient and well-coordinated programmes at the regional and national levels that can contribute to socio-economic development at both levels. If agricultural biological diversity activities are to meet current and future broad needs, they require effective coordination, both horizontally, across different sectors, different regional and federal Ministries and administrations but also stakeholders groups, and vertically, between policy, institutional and field-level activities. It is the only way to minimise duplication of effort and to ensure complementarities between activities.

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