

Report of a Working Group on Leafy Vegetables

First Meeting, 13-14 October 2005, Olomouc, Czech Republic
L. Maggioni, A. Lebeda, I. Boukema and E. Lipman, *compilers*





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Bioversity International is an independent international scientific organization that seeks to improve the well-being of present and future generations of people by enhancing conservation and the deployment of agricultural biodiversity on farms and in forests. It is one of 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR), an association of public and private members who support efforts to mobilize cutting-edge science to reduce hunger and poverty, improve human nutrition and health, and protect the environment. Bioversity has its headquarters in Maccarese, near Rome, Italy, with offices in more than 20 other countries worldwide. The Institute operates through four programmes: Diversity for Livelihoods, Understanding and Managing Biodiversity, Global Partnerships, and Commodities for Livelihoods.

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Cover illustrations

Stalk lettuce (*Lactuca sativa* var. *angustana*, LAC 192) at bolting stage; butterhead lettuce (*L. sativa* var. *capitata*, LAC 1092 'Fortininer') at harvest maturity; characterization plot with young plants of lamb's lettuce (*Valerianella locusta*, VALE 3 'Deutscher'); courtesy of © F. Kellner, IPK-Gatersleben, Germany.

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PART I. DISCUSSION AND RECOMMENDATIONS

Introduction

Welcome address

Aleš Lebeda welcomed all the participants and expressed his pleasure that this meeting of the ECP/GR¹ Working Group on Leafy Vegetables was taking place in Olomouc, which is a place linked to leafy vegetable conservation and research. The meeting was jointly organized by two institutes, the Research Institute of Crop Production (RICP)², Prague and the Department of Botany, Faculty of Science, Palacký University in Olomouc.

After approval of the agenda, the participants introduced themselves.

Brief description of the national leafy vegetable collections by the participants

Belgium

(full paper in Part II, pp. 21-22)

A report was received from Hervé De Clercq, describing the status of leafy vegetable collections in Belgium, which are held by the following institutes:

1. National Botanic Garden of Belgium, Meise, holding one sample each of *Lactuca serriola*, *Lactuca virosa*, *Cichorium intybus* and *Spinacia oleracea*;
2. Faculté Universitaire des Sciences Agronomiques de Gembloux, holding a small living collection of commercial varieties, maintained as teaching material;
3. Departement voor Plantengenetica en -veredeling (DvP-CLO)³, Melle, with the following working collections: *Cichorium intybus* L. var. *foliosum* Hegi (50 accessions), *Cichorium intybus* L. subsp. *sativum* (Bischoff) (50 accessions) and *Cichorium endivia* L. cv. *crispum* (3 accessions);
4. UG Plantentuin, University of Gent, holding a small living collection with commercial varieties of chicory, lettuce and spinach maintained as teaching material;
5. Kruidtuin Leuven, holding a living collection with *Lactuca sativa* L., *Lactuca virosa* L., *Lactuca serriola* L. f. *serriola*, *Cichorium intybus* L. subsp. *sativum* (Bischoff), *Cichorium intybus* L. var. *foliosum* Hegi, cultivars 'Zoom' and 'Middelvroeg Edellof' and *Spinacia oleracea* L., cultivars 'Nobel', 'Viking', 'Rico' and 'Viroflay'; and
6. vzw Brussels Grondwitloof, an organization grouping a number of traditional witloof farmers near Brussels, producing witloof in the traditional outdoor system.

Bulgaria

Stefan Neykov described the lettuce, spinach and chicory germplasm collections. The lettuce collection is represented by 685 accessions. However, most of these accessions are duplicate introductions from other collections (e.g. Centre for Genetic Resources, the Netherlands (CGN); Warwick Horticulture Research International (WHRI), UK; Research Institute of Crop Production (RICP), Czech Republic; and others). Some local lettuce landraces are maintained, but no wild *Lactuca* material. The evaluation of 470 lettuce accessions was done

¹ Following the decision of the 10th meeting of the ECPGR Steering Committee in September 2006, the name of the Programme was simplified to "European Cooperative Programme for Plant Genetic Resources" and the acronym was also modified to "ECPGR", removing the traditional slash of "ECP/GR".

² Now Crop Research Institute (CRI)

³ Now ILVO-Plant Applied Genetics and Breeding

according to local and VIR (N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russian Federation) descriptors for 28 characters and the data are computerized. The collection is regenerated partly in greenhouses and partly isolated in the field. About 60% of the accessions are maintained in long-term storage at -18°C , the rest are kept in short-term storage at $+5^{\circ}\text{C}$.

The collection includes 185 accessions of spinach and 16 of chicory; a substantial part of this material is made up of duplicates (e.g. from CGN, for spinach). Only 5 spinach accessions are represented by local forms. The whole collection of spinach was evaluated and characterized for 28 traits. Ten accessions of chicory were characterized. Thirty percent of the spinach and 50% of the chicory collections are maintained in long-term storage. Regeneration is made in isolation in the field.

The workplan for the future is based on continuation of characterization, data computerization, and regeneration of lettuce and spinach collections. In the near future, collecting missions are planned within Bulgaria for wild forms and landraces of lettuce.

Czech Republic

Research Institute of Crop Production (RICP), Prague

(full paper in Part II, pp. 23-26)

Kateřina Karlová reported that the vegetables collection includes 8889 accessions of which 1550 are leafy vegetables. There are 1435 accessions of *Lactuca* spp., 831 accessions of *L. sativa* and 604 accessions of wild *Lactuca* species. The collection includes 3 accessions of *Cichorium endivia*, 18 of *Cichorium intybus* and 17 of *Spinacia oleracea*. Several accessions of other leafy vegetable crops are also available. The database of Czech plant genetic resources can be found on the Web (<http://genbank.vurv.cz/genetic/resources>).

About 65% of the *Lactuca* collection has already been regenerated. Every year about 90 accessions are regenerated. All accessions are stored in the Genebank in Olomouc as a working collection at -5°C . All regenerated accessions are stored in the central stock of the Genebank in Prague at -20°C . The 39 most important *Lactuca sativa* cultivars (Czech varieties such as 'Lednický', 'Safír', 'Smaragd', 'Kamýk', 'Valašský', etc.) are also stored in the Slovak Genebank in Piešťany. The lettuce collection is being described according to national descriptors and the agreed minimum descriptors. Distribution of *Lactuca* spp. was of 90 samples in 2003, 60 in 2004 and 41 in 2005.

Department of Botany, Faculty of Science, Palacký University in Olomouc

(full paper in Part II, pp. 27-33)

Aleš Lebeda informed the Group that the lettuce working collection is located at the Department of Botany and is used for conservation and study of *Lactuca* spp., natural population structure, biodiversity, ecobiology, disease resistance and the taxonomic status of *Lactuca* germplasm in genebank collections. The collection contains 557 germplasm accessions of 19 *Lactuca* spp. and hybrids, and 1381 seed samples of 9 wild *Lactuca* spp. originating from Europe, Asia, Africa and North America. Part of the collection also comprises a set of differential genotypes (with different resistance genes) for *Bremia lactucae*, which is represented by 60 *L. sativa*, *L. serriola* and *L. saligna* accessions.

Regeneration is carried out in an insect-free glasshouse under controlled conditions following international standards for *Lactuca* genetic resources. Accessions of allogamous species are isolated and pollinated manually. Seed sample viability ranges between 85 and 90%. Seeds are dried to a moisture content of about 5% before packing. Accessions/seed samples are preserved in laminated aluminium bags in medium-term storage at $+4^{\circ}\text{C}$ and/or in deep-freezer at -20°C for long-term storage.

Morphological descriptors were developed for the characterization of wild *Lactuca* spp. and lettuce (Doležalová et al. 2002, 2003; Křístková et al. 2008)⁴. Resistance to downy mildew and powdery mildew is evaluated. The evaluation database of the collection includes information on chromosome number, relative 2C nuclear DNA content, isozymes and amplified fragment length polymorphism (AFLP) analysis of ca. 100 samples. Photographic documentation of some anatomical features is available.

Collecting missions were carried out in unexplored areas of the Czech Republic, Europe (12 countries), the USA (11 states) and Canada. Research activities are focused on the following topics: geographic distribution, ecology, genebanking methodology, morphological and anatomical characterization, karyology and DNA content, isozyme and AFLP variation, taxonomy, resistance to fungal diseases, mechanisms of resistance, and utilization of germplasm in lettuce breeding.

Staff of the Department have been and are currently involved in various research national and international projects (e.g. GENE-MINE, Variability of Components and Interactions in Plant Pathosystem and Impact of Environmental Factors on their Expression; National Programme of Conservation and Utilization of Genetic Resources of Plants and Microorganisms Important for Nutrition and Agriculture; etc.). There is very broad international cooperation in the area of research and utilization of *Lactuca* genetic resources.

France

Valérie Cadot explained that the role of the Group for the Study and Monitoring of Varieties and Seeds (Groupe d'Etude et de contrôle des Variétés et des Semences, GEVES) includes description and evaluation of new varieties for registration in the official catalogue, protection and certification (>10 000 varieties of vegetables in a reference collection), management of genetic resources, seed quality testing and methodological research.

She also explained the function of the Genetic Resources Board (Bureau des Ressources Génétiques, BRG) as the French organization coordinating the management of plant, animal and microbial genetic resources.⁵ Among the different networks on genetic resources established in France, the chicory network is the only one involving leafy vegetables (the estimated acreage of chicory cultivated in France is 20 000 ha, with 15 000 ha of witloof and 5000 ha of endive).

All the accessions belonging to the National Collection have to be identified, documented, located and available. They are freely accessible on the principle of reciprocal exchanges.

The network collection of chicory is maintained by state organizations (GEVES, Brion; Station Nationale d'Essais de Semences (SNES), Angers; Institut National d'Horticulture (INH), Angers; and the Centre Régional de Ressources Génétiques Nord Pas-de-Calais (CRRG), Villeneuve d'Ascq); breeding companies (Clause Tezier, Enza Zaden, Florimond Desprez, Gautier, Hoquet Graines, Novartis, Momont, Seminis, Vilmorin and Rijk Zwaan); and an interprofessional institute (Fédération Nationale des Producteurs d'Endives, FNPE). The collection includes 600 accessions and a subset of 205 accessions belongs to the national

⁴ Doležalová I, Křístková E, Lebeda A, Vinter V. 2002. Description of morphological characters of wild *Lactuca* L. spp. genetic resources (English-Czech version). Horticultural Science (Prague) 29:56-83.

Doležalová I, Křístková E, Lebeda A, Vinter V, Astley D, Boukema IW. 2003. Basic morphological descriptors for genetic resources of wild *Lactuca* spp. Plant Genetic Resources Newsletter 134:1-9.

Křístková E, Doležalová I, Lebeda A, Vinter V, Novotná A. 2008. Description of morphological characters of lettuce (*Lactuca sativa* L.) genetic resources. Horticultural Science (Prague) 35(3):113-129.

⁵ A new structure called "Fondation pour la Recherche sur la Biodiversité" (French Foundation for Research on Biodiversity, FFRB) was created in March 2008, bringing together the BRG and the Institut Français de la Biodiversité (IFB).

collection. Morphological characterization is carried out on the basis of the International Union for the Protection of New Varieties of Plants (UPOV) descriptors or national descriptors. Evaluation is made for disease resistance (*Thielaviopsis basicola*, *Alternaria dauci* f.sp. *cichorii*, *Puccinia cichorii*, *Phytophthora cryptogea* and *Dickeya dianthicola*). Conservation of seeds is carried out in deep freezers at -18°C at GEVES, Brion (long-term) and at SNES (safety-base).

Italy

Agostino Falavigna explained that the Italian national collection is not well organized, but several institutions have their own collections. Public institutions with leafy vegetable collections are the following:

- Consiglio per le Ricerche Agricole (CRA)⁶:
 - Istituto Sperimentale per l'Orticultura, Montanaso Lombardo (Lodi)⁷ and
 - Istituto Sperimentale per l'Orticultura, Monsampolo del Tronto (Ascoli Piceno)⁸;
- University of Bari, Dipartimento di Scienze delle Produzioni Vegetali;
- Centro Ricerche e Sperimentazione in Orticultura (CReSO), Cuneo;
- Veneto Agricoltura, Legnaro (Padova);
- Agenzia Regionale per lo Sviluppo e l'Innovazione nel Settore Agricolo-forestale (ARSIA) – Toscana, Firenze;
- University of Catania, Dipartimento di Orto-Floro-Arboricoltura e Tecnologie Agro-Alimentari; and
- University of Perugia, Dipartimento di Biologia.

The production areas for lettuce and radicchio in Italy are 22 000 ha and 14 500 ha respectively. Radicchio 'Treviso tardivo' is the origin of all other types ('Chioggia', 'Verona', 'Castelfranco' and 'Mantovano'). Growers select and use their own seed and do not share it. They are not interested in including their varieties in the official list. *Cichorium indivia* is grown on 11 000 ha, and spinach on 6700 ha, but spinach has decreasing importance in Italy. Several types of cultivated and wild *Asparagus* growing in Italy were shown, including *Asparagus officinalis* (6500 ha), *A. scaber* (only from northeast Italy and Slovenia, wild but also selected in the course of the last century for cultivation, resistant to salt and *Puccinia asparagi*), *A. albus* (only from Sardinia and Sicily, wild with some cultivation), *A. acutifolius* (spontaneous, but increasingly cultivated, can be crossed with *A. officinalis* to give drought resistance and good flavour), *A. aphyllus* (found in Sicily as a diploid, it can be crossed with *A. officinalis* to improve resistance to drought) and *A. stipularis* (Sicily, Sardinia and Spain, interesting for drought resistance and strong taste).

The Netherlands

Ietje Boukema reported that the status of the CGN leafy vegetable collections had not changed much compared to the situation in 2003 (see report of 2003)⁹.

The number of accessions available for use is now 2518 for lettuce and 388 for spinach. 95% of both collections have been regenerated and breeders associated in Plantum NL are

⁶ Now Consiglio per la Ricerca e la sperimentazione in Agricoltura

⁷ Now Unità di ricerca per l'orticoltura (Montanaso Lombardo LO) (CRA-ORL)

⁸ Now Unità di ricerca per l'orticoltura (Monsampolo del Tronto AP) (CRA-ORA)

⁹ Boukema I, de Groot L. 2005. Status of the CGN leafy vegetables collection. In: Thomas G, Astley D, Boukema I, Daunay MC, Del Greco A, Díez MJ, van Doijeweert W., Keller J., Kotlińska T., Lebeda A., Lipman E., Maggioni L., Rosa E., compilers. Report of a Vegetables Network. Joint Meeting with an *ad hoc* group on Leafy Vegetables, 22-24 May 2003, Skierniewice, Poland. International Plant Genetic Resources Institute, Rome, Italy. pp. 113-116.

assisting in spinach regeneration. The breeders are evaluating parts of the lettuce collection for 21 races of *Bremia*, and the spinach collection for 7 races of *Peronospora*. Results will become available in 2006-2010. The usage of both collections is high: for lettuce ca. 1300 accessions/year and for spinach ca. 350 accessions/year are distributed. Passport and evaluation/characterization data of both lettuce and spinach are searchable online and downloadable from www.cgn.wur.nl/pgr.

CGN has adopted the quality management system ISO9001:2000. This helps to create transparency in the organization, and for its responsibilities and operations. The CGN Quality Manual also describes topics on seed management in detail. An English translation of the CGN Quality Manual can be found on the CGN Web site.

Future changes: in 2006 Ietje Boukema will retire. The CGN activities in Leafy Vegetables will be passed on to Rob van Treuren. Rob has a background in population genetics and molecular biology. He has much experience in lettuce because he coordinated the lettuce work in the EU project GENE-MINE and was workpackage leader in other EU projects (e.g. ICONFORS). He is responsible for molecular research in lettuce at CGN and project leader in acquisition strategies of modern cultivars for the CGN lettuce collection (in cooperation with Dutch breeders).

Poland

Teresa Kotlińska explained that the National Programme on Genetic Resources of Vegetable Crops is a branch of the National Gene Bank in Radzików. The Programme is supported by the Ministry of Agriculture. The collections of the Research Institute of Vegetable Crops (RIVC) include 8500 accessions of vegetables. The leafy vegetable collection contains 571 accessions representing 10 genera. During 2003–2004 the collection increased by 56 accessions. The collection of asparagus (*Asparagus officinalis* L.) has been maintained since 1974 at the Agricultural University Poznań “Marcelin” and includes 96 accessions. Characterization and evaluation are carried out for 16 traits on 28 accessions per year. Considerable variation was found among the tested cultivars in yield and spear quality and in summer stalk traits. The collection of rhubarb (*Rheum rhabarbarum*) has been maintained since 2000 at the Department of Vegetable and Medicinal Plants, Agricultural University in Warsaw (SGGW) and contains 12 accessions. RIVC gathered information about rhubarb landraces growing in different regions of Poland and the intention is to progressively introduce them into the collection. The collection of lettuce was maintained until 2000. After the reorganization of the Polish breeding companies, this collection was no longer active. It is now stored in the Centre for Plant Genetic Resources in Radzików, but is no longer managed.

Seeds of the Polish collections are dried at room temperature, cleaned, labelled and sent to the central genebank store in the Plant Breeding and Acclimatization Institute (IHAR) in Radzików. Seeds are then dried to 5–7% moisture content and stored in screw-top glass jars at -18°C. Regeneration and evaluation are carried out by breeding companies or agricultural universities. Seed samples of the accessions are freely available if there are enough seeds. The accessions of leafy vegetables have not yet been safety-duplicated.

Passport data for all accessions are based on the FAO/IPGRI *Multi-crop Passport Descriptors* and are included in the ECP/GR International *Lactuca* Database.

Characterization was carried out for 188 accessions (51 red beet, 82 asparagus and 55 lettuce). During the last two years 31 accessions have been assessed.

In the southern part of Poland, five organic farms were selected for an on-farm conservation initiative. These farmers receive a small monetary incentive to grow traditional landraces of vegetables, including lettuce, rhubarb, sorrel and red beet. This type of cultivation attracts agro-tourists who appreciate traditional dishes.

During the period 2003-2005, 11 collecting missions were organized in Poland and Ukraine and 401 accessions were collected, including 16 accessions of leafy vegetables.

Seed samples of 75 accessions were sent to users within the country and 3 samples of asparagus were sent abroad.

Slovakia

(full paper in Part II, pp. 34-36)

Tibor Tóth reported that the number of varieties grown in Slovakia in 2005 was 11 for spinach and 69 for lettuce.

The working collection in the Research Institute for Vegetables (RIV) in Nové Zámky consists of 17 lettuce accessions, collected for the purpose of increasing diversity for pre-breeding. These accessions will be characterized following the descriptors agreed by the Leafy Vegetables Working Group. Long-term conservation in the national genebank in the Research Institute of Plant Production (RIPP), Piešťany is planned. RIV is looking forward to increasing international collaboration within the framework of the ECP/GR Working Group in the near future.

Slovenia

Jelka Šuštar-Vozlič reported that three institutes are involved as part of the Slovenian Plant Gene Bank (SRGB):

1. The Agricultural Institute of Slovenia (AIS), including vegetables (common bean, lettuce, cabbage, onion), forage crops and grasses, potato, faba bean, grapevine and berry fruits;
2. The Biotechnical Faculty, Agronomy Department, conserving maize, buckwheat, fruit trees, medicinal and aromatic plants; and
3. The Slovene Institute of Hop Research and Brewing, which is concerned with hops, medicinal and aromatic plants.

The lettuce collection of SRGB was collected in the period from 1988 to 1992. It includes 170 accessions of *Lactuca sativa*, distributed as follows:

- *L. sativa* var. *capitata*: 70% crisp, 20% butterhead;
- *L. sativa* var. *longifolia*, *L. sativa* var. *crispa*: 10%.

The most common name is 'Ljubljanska ledenka' (16 accessions). Multicrop passport data are available for all accessions. Characterization and evaluation data are available for some accessions only. Regeneration is carried out every year for a certain number of accessions. The storage conditions are for the medium term at +4°C.

Research activities are carried out on the genetic origin and diversity of the Slovene National Lettuce Collection (Slovene Science Agency and Ministry of Agriculture, Food and Forestry). Studies are conducted in collaboration with the Palacký University Olomouc on the characterization of Slovene accessions for *Bremia lactucae* resistance and the evaluation of genetic variability.

United Kingdom

(full paper in Part II, pp. 37-40)

Dave Astley informed the Group that there have been no changes since the Skierniewice meeting (2003). A number of leafy vegetable crop collections exist in the United Kingdom with varying responsibilities as base and working collections, each having a different mandate:

Warwick HRI Wellesbourne - The Genetic Resources Unit (HRIGRU)

Mainly lettuce is conserved, but there are also smaller collections of chicory, endive and spinach. This unit has collaborated with CGN, the Netherlands over many years. In 1989 it was agreed, following discussion with IBPGR (now Bioversity International), that CGN take on the primary role for lettuce. However, it was decided that all the HRIGRU *Lactuca* material would remain in the HRIGRU long-term store. CGN has access to all passport data.

The data for available material have been included in the International *Lactuca* database.

An agreement was made between HRIGRU and CGN to store "black box" safety-duplicates. The percentage of the HRIGRU collection in safety-duplication with CGN varies between taxa and there is a need to improve the safety-duplication of these collections.

HRIGRU was involved in the GENE-MINE project, collecting *L. serriola* in the UK. From a UK perspective there is the need to collect more representative samples of *L. virosa* and *L. saligna*. Other collections including spinach, chicory and endive are documented, conserved and distributed following the standard HRIGRU protocols.

Current research utilizing *Lactuca* genetic resources (contact: David Pink) includes:

- Using the old variety 'Iceberg' (syn. 'Batavia blonde à bord rouge') as a source of quantitative resistance to *Bremia lactucae*;
- Using the old variety 'Iceberg' as a parent in the construction of a genetic linkage map for lettuce and a mapping population of F6 and F7 recombinant inbred lines (the other parent is 'Saladin' – itself probably becoming a genetic resource accession!);
- Using the mapping population and the genetic linkage map to carry out a genetic analysis (quantitative trait loci, QTL) of nitrate accumulation in lettuce;
- Using genetic resources of lettuce and *L. serriola* (24 accessions) to assess for variation in nitrate accumulation and assessment of both 'Iceberg' and 'Saladin' for postharvest discoloration in bagged salad packs.

Scottish Agricultural Science Agency (SASA)¹⁰, Edinburgh

SASA stores seed collections of cultivars for UK Distinctness, Uniformity and Stability testing and for post-control checks of seed in commerce. The leafy vegetable collections include lettuce (821), leaf beet (41), spinach (9) and endive (3). Passport, administrative and characterization data are stored in MS Access. Morphological descriptions are available for some, but not all accessions. Seed is only available to testing and certifying authorities. All accessions are safety-duplicated.

Henry Doubleday Research Association (HDRA)¹¹ - Heritage Seed Library (HSL)

This association conserves heritage vegetable varieties that are no longer available commercially. Seed is distributed to HSL members who are amateur gardeners. Many of the accessions are also held in long-term storage at Warwick HRIGRU. Over 800 vegetable varieties are conserved in this way. Leafy vegetables include chard (1), chicory (3), cress (1), lettuce (30), sorrel (1) and spinach (1).

Royal Horticultural Society (RHS)

This society maintains the UK national collection of rhubarb varieties plus accessions of *Rheum* sp. This collection of over 130 accessions includes wild Asian species, medicinal and decorative species like *Rheum palmatum* and Victorian culinary favourites such as 'Prince Albert' and 'Victoria'.

¹⁰ Now Science and Advice for Scottish Agriculture

¹¹ Now Garden Organic

Millennium Seed Bank (MSB), Kew Gardens, Wakehurst Place

The UK Flora Programme of the MSB Project has already collected seed from around 90% of the UK's native higher plants including the wild relatives of leafy vegetable crops. This is the first time that any country has underpinned the conservation of its wild flora in this way. Valuable assistance with the collection of the UK flora has been given by a number of national organizations.

ECP/GR update**Briefing on ECP/GR – Phase VII**

Lorenzo Maggioni gave an introduction to describe the current status of the ECP/GR programme. He explained that the ECP/GR had entered its VIIIth Phase (2004–2008) with some modifications made to the structure and mode of operation by the Steering Committee in its last meeting in Izmir, Turkey, October 2003.¹² With specific relevance for the Working Group on Leafy Vegetables, it should be noted that two Networks (Vegetables and Minor Crops) were merged into a single one (Vegetables and Medicinal and Aromatic Plants Network, VEGMAP), including seven Working Groups (*Allium*, *Brassica*, Cucurbits, Leafy Vegetables, Medicinal and Aromatic Plants, Solanaceae and Umbellifer Crops).¹³ The Steering Committee endorsed four priority areas for Phase VII: 1) Characterization and evaluation, 2) Task sharing, 3) *In situ* and on-farm conservation and 4) Documentation. The Steering Committee also requested a Network Coordinating Group (NCG) to define five priority Working Groups within the Network and to make proposals, in consultation with the Working Groups, for actions on the basis of a budget of about 200 000 euro allocated to the Network. As a result of this exercise, which went on during 2004, the Working Group on Leafy Vegetables was included among the priority Working Groups for Phase VII. The following use of funds relevant for Leafy Vegetables was eventually approved:

- October 2005: first meeting of the Working Group on Leafy Vegetables
- March 2006: meeting of all Networks' Coordinating Groups
- 2007: Vegetables and MAP Network meeting (all 7 Working Groups)
- Publication of meeting reports
- Reserve funds for priority Groups (EU project preparatory meetings, data or sample acquisition, public awareness actions): 30 000 euro.

For further information on ECP/GR, the ECP/GR Web site was recommended, where several reference documents are available, including the Networks' budget and the Terms of Reference for the ECP/GR operational bodies. A specific Web page is also dedicated to the Working Group on Leafy Vegetables and this can be improved with the help of Group members and to respond to the needs of the Working Group.

AEGIS: A European Genebank Integrated System

A short account was given of the ECP/GR-funded project AEGIS (A European Genebank Integrated System), which is planning, through a feasibility study, to promote the creation of a rational European plant genetic resources genebank system of genetically unique and

¹² See Report of the Ninth Steering Committee Meeting, also available on the Internet at <http://www.ecpgr.cgiar.org/SteeringCommittee/SC9.htm>

¹³ During the tenth meeting (mid-term of Phase VII) of the ECPGR Steering Committee held in Latvia, September 2006, it was decided to move the MAP WG to the Sugar, Starch and Fibre Crops Network, hence reverting the Network's name to the original Vegetables Network.

important accessions, in order to conserve them safely in the long term, at the same time ensuring their genetic integrity, viability and availability to users. More information on AEGIS is available from www.ecpgr.cgiar.org/AEGIS/AEGIS.htm.

EURISCO: Status of the European Catalogue and update on documentation projects

The future development of EURISCO (European Plant Genetic Resources Search Catalogue) and the overall mechanism of data flow in Europe will be relevant for this Working Group as well. Although for the moment it is recommended that the specific Central Crop Databases (CCDBs) should continue to be developed in the traditional way (i.e. by gathering all the available data from any available sources), in the medium term, it should become possible to download all the necessary passport data from EURISCO and to focus the attention of the central databases on characterization and evaluation data and on the analysis of the database in order to offer other services to the users of the specific crop genetic resources.

A briefing was then given about the recently launched first call for submission of project proposals under Council Regulation (EC) No 870/2004, with a deadline of 30 September 2005. Several Groups submitted proposals, ranging from the further development of the European Plant Genetic Resources Information System to the characterization of several specific crops (Cucurbits, Leafy Vegetables, Maize, *Vitis*, etc.).

Among the documentation projects, one is dedicated to the "Further development of the European Plant Genetic Resources Information Infrastructure" (EPGRIS-2). The overall objective of EPGRIS-2 is to develop the information infrastructure supporting the curators, providers and users of plant genetic resources conserved *ex situ* throughout Europe. The proposal aims to:

- increase the quantity of data in EURISCO;
- improve its quality, including characterization and evaluation as well as passport data;
- develop an IT architecture to facilitate efficient and user-friendly methods for data exchange between EURISCO, other databases, data providers and users;
- train and support National Focal Points and others in the new capabilities of EURISCO, and build up the human network to promote and disseminate EURISCO to maximize its usage throughout Europe;
- implement demonstrator portals for four crops of European importance (barley, beet, lettuce and *Lolium*), bringing together information about the crops, their uses, plant genetic resources, germplasm access and other useful data;
- provide a Web-based service for visualizing geographical origins of accessions and the distribution pattern of characterization and evaluation data;
- improve the quality of plant names in EURISCO and original providers' databases, and extend EURISCO search capability to include synonyms and common names in European languages.

The preparation of a proposal to establish a "European Genetic Resources *In Situ* Inventory" (EGRISI) was advanced, but eventually not submitted under the first call. This project will aim at establishing a European inventory of wild crop relatives and on-farm landraces. It will also aim at capitalizing on the PGR Forum Crop Wild Relative Information System (CWRIS), incorporating the PGR Forum Crop Wild Relative (CWR) Catalogue for Europe and the Mediterranean, which was launched on 14 September 2005 at the First International Conference on CWR Conservation and Use in Agrigento, Sicily, Italy. CWRIS is the first information management system specifically designed to facilitate CWR conservation and use, and has been designed to facilitate access to CWR data for a diverse range of user communities, including plant breeders, protected area managers, policy-

makers, conservationists, taxonomists and the wider public. The CWR Catalogue itself contains more than 23 000 species records and over 243 000 records of taxon occurrences in 130 geographical units across the region. For more information and to access CWRIS, visit <http://www.pgrforum.org/CWRIS.htm>.

The ECP/GR Working Group on Leafy Vegetables

Conclusions and Workplan of the ad hoc meeting on Leafy Vegetables, Skierniewice 2003

A. Lebeda and I. Boukema summarized the workplan defined at the First Vegetables Network Meeting (Skierniewice, 2003), and the achievements, main problems and proposed solutions which were identified during the meeting with regard to documentation, characterization, regeneration, safety-duplication, duplication, conservation and management of wild relatives.

It was noted that most of the solutions proposed for resolving the respective problems were successfully implemented during the last two years, namely:

Databases

- The responsibilities for establishing the European Central Database for *Cichorium* and for *Spinacia* were taken up respectively by GEVES, Brion, France and CGN, Wageningen, the Netherlands.

Characterization and evaluation

- Basic descriptors for wild *Lactuca* spp. were published in the Plant Genetic Resources Newsletter as a result of international cooperation (the GENE-MINE project).¹⁴
- The minimum list of descriptors for *Lactuca*, *Spinacia* and *Cichorium* were finalized and published in the report of the Skierniewice meeting (Appendix E).
- A collaborative project to screen lettuce, spinach and *Cichorium* for disease resistance and quality aspects was submitted for funding to the EU under Council Regulation (EC) No 870/2004.

Regeneration

- Information about the status of regeneration of several collections was received and included in Appendix C of the Skierniewice meeting report. The VIR collection includes 1540 lettuce accessions, 660 spinach accessions and 370 accessions of *Cichorium*.

It was also noted that the letter of application to establish a formal Working Group on Leafy Vegetables was prepared by A. Lebeda and I. Boukema and the proposal was accepted by the Steering Committee in 2003. The application letter was printed in the report of the Skierniewice meeting as Appendix II.

On the other hand, no real progress could be recorded regarding the following items:

¹⁴ Doležalová I, Křístková E, Lebeda A, Vinter V, Astley D, Boukema IW. 2003. Basic morphological descriptors for genetic resources of wild *Lactuca* spp. Plant Genetic Resources Newsletter 134:1-9.

Safety-duplication

- Information was not obtained on the status of safety-duplications of minor leafy vegetables.

Duplication

- The Most Original Samples (MOS) for wild *Lactuca* species in the collections were not yet identified. The database manager decided to wait for decisions and recommendations expected to result from the AEGIS project, in particular the definition of a concept of Most Appropriate Samples and for the update foreseen in 2006.

Conservation and management of wild relatives

- There is still low availability of accessions of some wild *Lactuca* species and of wild *Cichorium* and *Spinacia*.

Reviewing the achievements and workplan of the ad hoc group on Leafy Vegetables since 2003

(See Report of a Vegetables Network, Joint meeting with an ad hoc group on Leafy Vegetables, 22-24 May 2003, Skierniewice, Poland - Discussion and workplan, pp. 83-85).

International Leafy Vegetables Databases (progress and recent status)**International *Lactuca* Database (ILDB)**

I. Boukema informed the Group that the status of the database has not changed since 2003. The FAO/IPGRI *Multi-crop Passport Descriptors* are mainly used, plus some additional descriptors. The database is available on line from www.cgn.wur.nl/pgr.

The database includes about 12 000 accessions, of which ca. 10 000 are *L. sativa* and 1375 *L. serriola*. It also includes the species *L. virosa*, *L. saligna*, *L. perennis* and others.

Within *Lactuca sativa*, the accessions are distinguished in phenotypic groups. Unfortunately, for over 5000 accessions, the phenotypic group is not yet identified.

The next update of the database is planned for 2006, possibly in the context of the GENRES project, provided it is funded. It is planned to request collection holders to send their data when changed or if not yet included. The database should include only material that is or will be available. Characterization and evaluation data will be added only if the GENRES project is funded. Characterization data will be collected according to the finalized minimum descriptors and will be accessible in downloadable Excel files.

Although the Most Original Samples for wild species are not yet identified, pending discussion within the AEGIS project about the concept of Most Appropriate Sample, it is however possible to look for duplicates by checking donor numbers or other numbers.

European Database for Spinach

I. Boukema explained that the database will be developed starting in 2006, possibly in the context of the GENRES project, provided it is funded. The EURISCO passport data will be used as a base. As with the *Lactuca* database, it is planned to request collection holders to send their data and the database should include only material that is or will be available. Characterization and evaluation data will be added only if the GENRES project is funded. Characterization data will be collected according to the finalized minimum descriptors and will be accessible in downloadable Excel files.

This database is expected to become comparable to the ILDB and the Bras-EDB (*Brassica* European Database).

According to the EURISCO Catalogue, the estimated number of data to be collected amounts to 1279 accession data from 20 collections. The seven largest collections, totalling 1252 accessions, are: CGN, Wageningen (388); VIR, St. Petersburg (218); Institute for Plant Genetic Resources (IPGR), Sadovo (200); Institut für Pflanzengenetik und Kulturpflanzenforschung (IPK)¹⁵, Gatersleben (169); WHRI, Wellesbourne (103); Ustymivka Experimental Station of Plant Production (UDS), Ustymivka (84); and the Nordic Gene Bank (NGB)¹⁶, Alnarp (73). Thirteen other smaller collections have been identified.

European *Cichorium* Database

V. Cadot presented the French database of chicory genetic resources. The database was constructed in the French language, but an English version is also available. The database includes passport and characterization descriptors, photos of the accessions and a list of varieties with descriptive cards. It is possible to sort varieties for the character of interest. The database also incorporates a structure for the management of the network (including information related to multiplication activities and to seed distribution).

Regarding the development of the European *Cichorium* Database, this will largely depend on the approval of the GENRES project proposal. Otherwise, GEVES will in any case try to start gathering passport data, also with the help of EURISCO, as a starting base. The important collections in Europe are probably only six or seven, including those from Belgium, France, Germany, Italy, Russia, UK and elsewhere. Considering that the Italian collection is distributed in several institutions, the Group welcomed the offer of the Italian representative to gather the data and transfer them to the central database which is under development.

Storage of safety-duplicates

Status of safety-duplication and review of storage conditions (Appendix I)

The status of safety-duplication (Appendix B of the Skierniewice report) was reviewed for changes and updates. Changes were signalled by the Czech Republic and France and new data were added for Slovakia and Slovenia. The revised table is attached as Appendix I (p. 47).

Characterization and evaluation

Status of characterization and regeneration (Appendix II)

The percentage of accessions that have been characterized and regenerated (Appendix C of the Skierniewice report) was reviewed for changes and updates. Changes were signalled by representatives from Bulgaria, the Czech Republic, France and Poland and new information was added for Slovakia and Slovenia. The revised tables are attached as Appendix II (p. 48).

Minimum descriptors for leafy vegetable crops

The discussion focused on the possibility of revising the minimum descriptors and a few modifications were agreed upon (see below).

¹⁵ Now the Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung

¹⁶ Now the Nordic Genetic Resource Center (NordGen)

The revised descriptor lists will be published as a separate document available on the WG's Web page (http://www.ecpgr.cgiar.org/Workgroups/Leafy_Vegetables/Leafy_Vegetables.htm).

These revised lists were submitted to Bioversity for approval.

Cultivated lettuce

- Descriptor "Homogeneity": correct state 5 to "moderately homogeneous".

Wild *Lactuca* spp.

- Descriptor "Flowering time" was changed into an optional descriptor. The reason for this decision is that the character is influenced by environmental conditions, as well as by artificial vernalization and is also dependent on the time of sowing. The results scored by different genebanks are therefore not comparable, due to the adoption of different growing methods. However, an indication of the flowering time can be useful for breeders, when the characterization is made under similar conditions.

Spinach

- Descriptor "Monoeciousness": change states 0 and 9 to numerical values (0 = 0%; 9 = 100%) and in the corresponding "Note" change writing to "Percentage of monoecious plants".

Leaf chicory

- Descriptor "Head: colour of outer leaves":
 - Move the comment "Main colour of outer leaves" into the "Note" section
 - Add state "99 = other"
- Descriptor "Morphotype": add two states: "8 = Variegata di Castelfranco" and "9 = Bianco di Mantova".

Endive

- Descriptor "UPOV n°2":
 - Correct wording is "Plain-type varieties only: Plant: sub-type"
 - Add state "99 = other".

Industrial chicory

- It was agreed to change the name of this type into "Root chicory", since all the chicory used for industrial purposes is root chicory, while some root chicories are also used for food consumption.
- Correction of the respective UPOV Guidelines number: TG/172/4 (Industrial chicory).

General remarks

- It was agreed to standardize the scoring of "absence/presence" by adopting the IPGRI¹⁷ notation (0/1) rather than the UPOV notation (1/9). It was acknowledged that the UPOV notation would create confusion in a genetic resources database, where the notation 1/9 usually implies that there is a scale of variation from 1 to 9.
- It was agreed to use the IPGRI standard for the state "other", using the code 99, i.e.: "99 = other".
- Whenever state "99 = other" is available, add a descriptor "Remarks" to the list to record the corresponding information.

¹⁷ With effect from 1 December 2006, IPGRI and INIBAP operate under the name "Bioversity International", Bioversity for short. This new name echoes their new strategy, which focuses on improving people's lives through biodiversity research.

Regeneration protocols (Appendix III)

The regeneration protocols (Appendix D of the Skierniewice report) were reviewed for changes and updates. Changes were signalled by Bulgaria and new data were added for Slovakia and Slovenia. The revised table is attached as Appendix III (p. 49).

It was also specified that for spinach the number of plants used for regeneration is the total number of plants (male and female) and not the number of female plants.

Other items on the leafy vegetable collections

Identification of gaps in the leafy vegetables collections

It was considered that there is a gap in existing collections of wild and cultivated lettuce from North Africa (Egypt, Libya, Tunisia, etc.). This area is considered very important as it is part of the area of origin and domestication.

South Africa also represents a serious gap for wild lettuce, since there are several species there, but it seems that these are not available in any collection. Also very little information is available on their geographic distribution and ecology.

Central Asia and China are also considered gap areas.

The Group asked the ECP/GR Secretariat to approach IPGRI offices in Aleppo, Nairobi, Tashkent and Beijing, to enquire what is the situation of the Lactuca collections in the respective regions and to recommend the establishment of appropriate collections.

It was also considered important to strengthen contacts with Moldova, Romania, Russian Federation and Ukraine and seek information on the occurrence of landraces and variation of lettuce in these countries. A suggestion was made to seek information from the Balkan area as well.

The Group asked the ECP/GR Secretariat to contact the WG member in Romania and appropriate experts in the Russian Federation and Ukraine and offer them the opportunity to write an article on lettuce genetic resources in their respective countries for publication in the present report. These articles should include information on the existing collections (storage status and location, level of regeneration, characterization and safety-duplication) and on the presence of wild species and of landraces cultivated in situ, with specific reference to the risk of genetic erosion.¹⁸

R. van Treuren mentioned molecular analysis of modern lettuce varieties which were introduced to the Dutch part of the common European variety list between 1997 and 2002. These marker data are compared to those already available for the current CGN collection. The aim is to investigate whether the marker data are useful in deciding which of these new varieties to add to the current collection in order to improve its composition. Recommendations for acquisitions provided by plant breeding companies will be used to validate the marker-based results.

It was considered essential to regenerate important material (at least something from each morphotype) which is deleted from the variety list of each country and to keep it in long-term storage. In the case of France, lettuce and spinach cultivars are kept in storage, but no longer regenerated and there is a risk of losing this material.

¹⁸ Articles in preparation at the time of publication will be included in the report of the Second Vegetables Network Meeting, 26-28 June 2007, Olomouc, Czech Republic.

V. Cadot asked whether any other genebank would be interested in regenerating this material, after having checked the consent of the breeders for the availability of this material to third parties. She will circulate to CGN a list of available varieties, after verifying the status of breeders' rights (**by the end of February 2006**).

The Group agreed that every WG member should verify the situation of cultivars dropped from the respective national lists and try to make sure that these are not lost. Members will be asked to report on this issue during the **next WG meeting**.

The representative of Italy, A. Falavigna, agreed to send a list of Italian chicory cultivars that need multiplication to V. Cadot, who agreed to arrange for their regeneration.

V. Cadot (France) specified that the lettuce collection of the National Institute for Agronomical Research (Institut National de la Recherche Agronomique, INRA) includes 300 cultivars and these will be safely maintained by the curator, currently B. Maisonneuve, and may include some of the deleted varieties.

Collecting missions: needs and cooperation

The Group proposed to use part of the available funds for a Polish/Ukrainian joint collecting mission to Ukraine for exploration and collection of *Lactuca landraces*.

A detailed proposal for a collecting mission to be carried out in 2006 will be formulated by T. Kotlińska, in consultation with colleagues from the Ukrainian genebank, and will be submitted to the VEGMAP NCG for approval of the use of Network funds for this purpose.¹⁹

EU GENRES programme – Proposal on Leafy Vegetables

I. Boukema explained that the idea for a leafy vegetable project under the Council Regulation (EC) No 870-2004 emerged during the ad hoc Leafy Vegetables meeting in 2003 in Poland. At the beginning of 2004, partners and activities were identified, and in July 2004 a meeting was held at CGN to discuss the activities to be included in the proposal. Drafts were written during the end of 2004 and beginning of 2005. The official call came only in July 2005 and the formats in the beginning of August. The project was submitted before the deadline 30 September 2005.

The coordinator will be Chris Kik of CGN Wageningen, the Netherlands. There are 13 partners from nine EU countries and one country of the European Free Trade Association (EFTA), including genebanks, institutions and non-governmental organizations (CGN, WHRI, GEVES, IPK, Palacký University, NGB, INRA-Montfavet, Arche Noah, ProSpecieRara, the Union of Slovenian Organic Farmers' Associations (USOFA), HDRA, the University of Bologna (UNIBO) and the Associazione Italiana Sementi (AIS)). The crops included in the project are lettuce, spinach, chicory and the minor leafy vegetables lambs' lettuce and rocket. The activities are divided into the following workpackages: documentation, regeneration and characterization, evaluation for resistances and abiotic characters, evaluation for marketing, and use and coordination. In the project, the European databases for chicory and spinach will be developed and the ILDB updated. Characterization and evaluation data will be added to the databases. In all about 1100 accessions will be regenerated and characterized. About 700 accessions will be evaluated for disease resistance

¹⁹ Two collecting missions were organized in the end of 2006. See: Kotlińska T et al. 2008. Collection of vegetable crops, medicinal plants and their wild relatives in Ukraine. *Biodiversity Newsletter for Europe* 35:3.

and quality characters and about 180 evaluated for characters such as field performance, appearance acceptability and taste.

The project will speed up the activities of the Leafy Vegetables WG and stimulate the use of the collections of these vegetables. WG members not included in the project can be invited to some of the meetings. It is expected that the decision on funding will be taken in January or February 2006.²⁰

Research projects and meetings, past and future

LacNatRes (Genetic Diversity of Wild Crop Relatives)

(full paper in Part II, pp. 41-43)

R. van Treuren reported that between 2000 and 2004 a research project entitled "Genetic Diversity of Wild Crop Relatives: Exploitation and Efficiency of *ex situ* Conservation of Natural Resources of Wild *Lactuca* Species" (acronym: LacNatRes) was carried out under the coordination of CGN, the Netherlands, and funded through the Fifth EU Framework Programme.

A component of this project was the inventory of lettuce wild crop relatives' accessions, whereby about 2000 accessions' data were included in the International *Lactuca* Database. The project also verified the level of accessibility of this material to the user community, the degree of redundancy within this material, the distribution of naturally occurring genetic diversity represented in the collections, and considered the possibilities for optimizing exploitation and improving conservation practices.

Overall, the project was considered very successful, but the decision taken by the EC to merge this project with a large bioinformatics one (GENE-MINE) did not improve efficiency, but rather created management difficulties due to the larger size of the project. Also the frequent unavailability of EC officers who should have been reference points for the project was deplored, as well as the long delays in the receipt of payments from the EC.

EUCARPIA 2007, Warwick HRI, UK

D. Astley gave information about the EUCARPIA Leafy Vegetables 2007 meeting, which will be organized at the University of Warwick, United Kingdom. The responsible person is D. Pink from WHRI. In order not to focus too narrowly on lettuce, experts on other leafy vegetable crops are encouraged to join in, in order to widen the meeting's scope. All the members of the Leafy Vegetables WG will be included in the mailing list for the first announcement. Suggestions for speakers are welcome.

Future research directions in leafy vegetable crops in Europe

R. van Treuren suggested that members working on molecular aspects should put more effort into communicating with each other and exchanging information on the methodologies and markers used.

It was suggested that researchers should remain in close contact in order to, for example, use the same sets of primers and thus to ensure that they carry out comparable research.

²⁰ The project "Leafy vegetables germplasm, stimulating use" (Leafy Veg) was approved for funding support as a targeted action under AGRI GEN RES 870/2004 and will run from January 2007 until December 2010 (<http://documents.plant.wur.nl/cgn/pgr/leafyveg/default.htm>).

Cooperation between holding institutions and others (universities, research institutions, plant breeders, etc.)

I. Boukema reminded the Group that breeders would be interested in screening collections of spinach and they would also be willing to regenerate accessions.

A list of breeders available to multiply vegetable material is published on page 137 of the Skierniewice report.

It was also recommended that the chicory scientific community should increase international collaboration.

V. Cadot and A. Falavigna were invited by the Group to become promoters of collaborative activities on chicory genetic resources in Europe and they agreed to explore the possibilities.

Conclusions

Discussion of report and new workplan

A draft report was distributed to all the participants, discussed, and endorsed by the Group with minor modifications.

A new workplan was proposed, as follows:

Databases

- Improve the International *Lactuca* Database (update of passport data in 2006; inclusion of characterization data if the GENRES project is funded) (CGN, the Netherlands);
- Establish the ECP/GR Spinach database (enter passport data, with the help of EURISCO, complemented with requests for data to collection holders; inclusion of characterization data if the GENRES project is funded) (CGN, the Netherlands);
- Establish the ECP/GR Chicory database (enter passport data, with the help of EURISCO, complemented with requests for data to collection holders; inclusion of characterization data if the GENRES project is funded) (GEVES, Brion, France);
- Update of national databases (WG members to ensure that data from leafy vegetable collections are provided to their respective national inventories) (All WG members).

Safety-duplication

Improve the level of safety-duplication (All WG members should report on improvements at the **next meeting in 2007**) (All WG members).

Long-term storage

Improve storage conditions if necessary (All WG members should report on improvements at the **next meeting in 2007**) (All WG members).

Regeneration protocols for minor crops

Collect regeneration protocols for minor leafy vegetables (All WG members to send to the Chair information on the regeneration protocols used in their various collections). Minor leafy vegetables include, but are not limited to: *Asparagus*, *Diplotaxis*, *Eruca*, *Rheum*, *Valerianella* (**by the end of December 2005**) (All WG members).

Regeneration

Establish collaboration for regeneration.

V. Cadot (France) to circulate a list of lettuce and spinach varieties that need seed multiplication, seeking volunteers from other countries.

A. Falavigna to provide to V. Cadot a list of Italian chicory varieties in need of multiplication (**by the end of 2005**) and to provide the seeds in September 2006. V. Cadot to provide for their regeneration with the help of the French breeders (**by the end of 2007**) (*A. Falavigna and V. Cadot*).

Conservation

Verify the situation of cultivars dropped from the respective national lists and try to make sure that they are not lost. Members will be asked to report on this issue during the **next WG meeting, in 2007** (*All WG members*).

Documentation

Develop minimum descriptors for *Asparagus* (A. Falavigna) and *Valerianella* (V. Cadot and A. Lebeda).

A draft list of no more than 10-15 characterization descriptors will be drafted **before the end of 2005** and distributed to all WG members and to IPGRI for comments. The WG Chair will then make sure that a final list is endorsed by the Group **before the end of 2006** (*A. Falavigna, V. Cadot and A. Lebeda, the WG Chair and all WG members*).

Collecting missions

- Organize a joint Polish/Ukrainian collecting mission to Ukraine for exploration and collection of lettuce (proposal to be formulated by T. Kotlińska and to be submitted to the VEGMAP NCG for approval) (*T. Kotlińska*);
- Investigate the situation of *Lactuca* collections in other regions **by the end of November 2005** and recommend the establishment of appropriate collections (*ECP/GR Secretariat*).

Collaborative research

Explore existing possibilities for collaborative activities on chicory genetic resources in Europe (*A. Falavigna and V. Cadot*).

Funding

Explore opportunities to establish bilateral funding agreements (*All WG members*).

Election of the Chair and Vice-Chair

The Group asked I. Boukema if she would agree to be Chair and she accepted this role. She then offered the position of Vice-Chair to K. Karlová, who accepted some time after the meeting.

Concluding remarks

I. Boukema thanked A. Lebeda for all the work he has done in the last few years in support of the new Working Group on Leafy Vegetables, and especially for his initiative in proposing the establishment of the WG. She also suggested that A. Lebeda, although not a formal WG member, could be invited as an active observer to future meetings and therefore maintain an advisory role for the Group.

PART II. PRESENTED PAPERS

National reports

Status of leafy vegetable collections in Belgium – Update 2005	21
<i>Hervé De Clercq</i>	
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Overview of studies on wild crop relatives of lettuce carried out within the framework of the EU project GENE-MINE

Robbert van Treuren, Aleš Lebeda, Eva Křístková, Klaus Dehmer, Clemens C.M. van de Wiel, David Pink, Ivana Doležalová, Tatjana Sretenović Rajičić, Dave Astley, Nicola Spence and Theo J.L. van Hintum

Status of leafy vegetable collections in Belgium – Update 2005

Hervé De Clercq

ILVO-Plant Applied Genetics and Breeding, Melle, Belgium

National Botanic Garden of Belgium

Domein van Bouchout, 1860 Meise, Belgium

Director J. Rammeloo

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Web site: www.br.fgov.be

This institute has a genebank which holds the seeds of many species of wild plants, ornamentals and agricultural plants. For some species the staff carry out taxonomic research: for instance, there is a large collection of beans (*Phaseolus* spp.) which is used for this purpose. In leafy vegetables, the current living plant collection contains only one accession of each of the following species: *Lactuca serriola* L., *Lactuca virosa* L., *Cichorium intybus* L. and *Spinacia oleracea* L.

The Living Plant Collections Database (LIVCOL) is searchable online (<http://www.br.fgov.be/RESEARCH/COLLECTIONS/LIVING/LIVCOL/index.html>)

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In this botanical garden there is a small living collection of commercial varieties, maintained as teaching material.

ILVO-Plant Applied Genetics and Breeding

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The leafy vegetable collection contains only accessions of the genus *Cichorium*. The current working collection of seeds contains 50 accessions of *Cichorium intybus* L. var. *foliosum* Hegi, 50 accessions of *C. intybus* L. subsp. *sativum* (Bischoff) and 3 accessions of *C. endivia* L. cv. *crispum*.

UG Plantentuin

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In the genera *Lactuca*, *Spinacia* and *Cichorium* a small living collection of commercial varieties is maintained as teaching material.

Kruidtuin Leuven

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The living collection of the Kruidtuin Leuven currently contains one accession of each of the following: *Lactuca sativa* L., *Lactuca virosa* L., *Lactuca serriola* L. f. *serriola* and *Cichorium intybus* L. subsp. *sativum* (Bischoff); and some cultivars of *Cichorium intybus* L. var. *foliosum* ('Hegi', 'Zoom' and 'Middelvroeg Edellof') and *Spinacia oleracea* L. ('Nobel', 'Viking', 'Rico' and 'Viroflay').

vzw Brussels Grondwitloof

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This organization groups together a number of traditional witloof farmers near Brussels, producing witloof by the traditional outdoor method. The aim is to obtain a better remuneration for a traditionally grown crop by using a distinctive marketing policy. An application for an internationally recognized PGO label (Protected Geographic Origin) is under way.

This production area still works with old landraces of Brussels witloof. These landraces can be considered as an *in vivo* collection. But, in order to safeguard the maximum biodiversity, it would be advisable to collect some of the seeds into a long-term conservation store (-20°C). The first negotiations with the traditional witloof farmers have already been done. The organization of a seedbank collection of landraces for Brussels witloof will be carried out in cooperation with the institute ILVO-Plant Applied Genetics and Breeding.

Status of the national leafy vegetables collection in the Czech Republic

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Introduction

The Czech National Gene Bank has belonged to the Research Institute of Crop Production (RICP)²¹ in Prague-Ruzyne since 1994, but the collecting of vegetable genetic resources was already begun by about 1920 at the Moravian Institute of Agricultural Research in Brno and later on it continued at the Research Institute of Vegetable Growing and Breeding in Olomouc. Since 1994 when the Ministry of Agriculture of the Czech Republic accepted the "National programme of conservation and utilization of genetic resources of cultivated plants", RICP has been the national coordinator of this programme. It coordinates the activities of ten private and/or state institutions which conserve the genetic resources of all plant species cultivated in our climatic conditions. The collections of vegetables and medicinal, aromatic and spice plants are maintained in the Gene Bank in Olomouc, as a detached station of RICP. More than 10 000 accessions of about 430 botanical species are held in Olomouc (Dušek 2004) and the collection of leafy vegetables, with 1550 accessions, is the one of the largest crop groups.

Position of leafy vegetables in Czech agriculture

Cultivation of leafy vegetables has a long tradition in the Czech Republic. The lettuce (*Lactuca sativa* var. *capitata* L.) has been documented since the Middle Ages (Moravec et al. 1999) and it is still very popular up until now. Together with spinach (*Spinacia oleracea* L.), this species also has economic importance (Table 1).

Table 1. Production, market and consumption statistics for leafy vegetables in the Czech Republic, 1999-2004 (source: Buchtová 2004)

	Species	Year					
		1999	2000	2001	2002	2003	2004
Production area (ha)	<i>Lactuca sativa</i>	700	500	100	225	327	
	<i>Spinacia oleracea</i>	750	550	440	385	369	
Yield (t)	<i>Lactuca sativa</i>	8400	4500	4800	2200	2943	
	<i>Spinacia oleracea</i>	6750	3500	5280	2464	2363	
Average yield (t/ha)	<i>Lactuca sativa</i>	12.00	9.00				
	<i>Spinacia oleracea</i>	9.00	6.36	12.00			
Import (t)	<i>Lactuca sativa</i> var. <i>capitata</i>			3855	4935	5312	4891 [†]
	<i>Lactuca sativa</i> (other varieties)			221	242	369	417 [†]
	<i>Spinacia oleracea</i>			82	97	92	78 [†]
Export (t)	<i>Lactuca sativa</i> var. <i>capitata</i>			246	114	135	158 [†]
Consumption (kg/inhabitant)	<i>Lactuca sativa</i>	1.0	1.1	0.9	1.0	1.1*	
	<i>Spinacia oleracea</i>	0.7	0.7	0.7	0.7	0.7*	

* Estimation of the Czech Statistical Institute

[†] Period from 1 January–30 September 2004

²¹ As of 1 January 2007, RICP was renamed Crop Research Institute (CRI).

The statistical data on *Lactuca sativa* var. *capitata* production, presented in Table 1, refer only to the official commercial production figures. Real lettuce needs are very often supplied from private hobby gardens. Recently not only butterhead lettuce but also other types of lettuce are becoming popular in the Czech Republic. Other leafy species have only a marginal importance but their genetic resources are also preserved to prevent the erosion of plant diversity.

The leafy vegetables collection, regeneration, storage and safety-duplication

A very detailed overview of the structure of leafy vegetables' genetic resources in the Czech Gene Bank was already reported by Křístková and Chytilová (2005). The current situation as regards status, regeneration and multiplication of these vegetables by the end of August 2005 is given in Table 2. Passport data of all accessions are available on the Web site (<http://genbank.vurv.cz/genetic/resources/default.htm>).

Table 2. Structure of the Czech national leafy vegetables collection and its regeneration

Species	No. of accessions	Regenerated (%)
<i>Lactuca</i> spp.	1435	65
<i>Cichorium endivia</i>	3	33
<i>Cichorium intybus</i>	18	11
<i>Cynara scolymus</i>	3	0
<i>Chrysanthemum coronarium</i>	1	100
<i>Eruca vesicaria</i> subsp. <i>sativa</i>	17	47
<i>Lepidium sativum</i>	1	100
<i>Spinacia oleracea</i>	17	100
<i>Asparagus officinalis</i>	11	100
<i>Rheum rhabarbarum</i>	28	100
<i>Tetragonia expanza</i>	15	100
<i>Valerianella locusta</i>	1	100
Total	1550	66

As is evident, the largest part of the collection is composed of the *Lactuca* species. This part of the collection consists of 831 *Lactuca sativa* L. accessions and 604 accessions of wild *Lactuca* species. The records of *L. sativa* accessions include mainly advanced cultivars but also landraces and breeding lines. Wild *Lactuca* species include 20 species of the *Lactuca* genus (*L. aculeata* Boiss. et Ky., *L. altaica* Fisch. et Mey., *L. angustana* All., *L. biennis* (Moench) Fernald, *L. canadensis* L., *L. capensis* Thunb., *L. dregeana* DC., *L. homblei* De Wild., *L. indica* L., *L. livida* Boiss. et Reut., *L. perennis* L., *L. quercina* L., *L. saligna* L., *L. serriola* L., *L. squarrosa* (Thunb.) Miq., *L. taraxacifolia* Chalk., *L. tatarica* (L.) C.A. Mey., *L. tenerrima* Pourr., *L. viminea* (L.) J. et C. Presl., *L. virosa* L.), interspecific hybrids of *L. serriola* and *L. sativa* and 4 genera related to the *Lactuca* genus (*Cicerbita alpina* (L.) Wallr., *Ixeris dentata* (Thunb.) Nakai, *Mycelis muralis* (L.) Dum., *Youngia denticulata* (Houtt.) Kitam.).

About 66% of the accessions have already been regenerated (Table 2). The regeneration and multiplication of the seeds is done according international standards and biological requirements of individual species are taken into account. *Lactuca sativa* accessions are regenerated in isolation cages (2.3 x 5.5 m), covered by glass or plastic net; wild species are regenerated as potted plants in the greenhouse. About 15–20 plants are used for the regeneration of each accession. The technical capacity for regeneration is about 100 accessions each year.

The seeds after regeneration are, according to international standards in both active and base collections, dried to 5–6% moisture content, placed in hermetically closed jars and stored at about -5°C and/or -18°C in the main store in the Gene Bank of RICP in Prague. A small

sample of seeds is also kept in Olomouc as a working collection. The most important accessions, consisting predominantly of Czech (Czechoslovak) original cultivars are also sent to the Gene Bank of the Research Institute for Plant Production (RIPP) in Piešťany (Slovak Republic), where, according to the agreement between representatives of the Czech Republic and Slovakia, the safety-duplicates are stored.

Enlarging the collection, characterization, evaluation and utilization

During the last 3 years the number of accessions has remained almost stable: only 11 new *Lactuca* accessions have been acquired. All old Czech lettuce cultivars available in the world's genebanks were already reintroduced to the collection during a previous period and collecting of wild *Lactuca* species has also almost stopped. There is no plan to enlarge the collection before the regeneration of all accessions is completed.

Basic morphological characterization and photo documentation of accessions are carried out either during their regeneration or in special trials under field conditions. National minimum lists of descriptors are used for characterization: *Lactuca sativa* – 47 descriptors (Křístková et al. 2005); wild *Lactuca* species – 88 descriptors (Doležalová et al. 2002); *Asparagus officinalis* – 18 descriptors; *Cichorium intybus* – 5 descriptors; *Cichorium endivia* – 6 descriptors; *Spinacia oleracea* – 7 descriptors (Chytilová et al. 2004); and *Rheum rhubarbarum* – 33 descriptors (Turečková et al. 2001).

In the period 2003–2005, 191 accessions were provided to users in the Czech Republic and also abroad.

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Current status of the *Lactuca* working collection of Palacký University in Olomouc, Czech Republic

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Introduction

The *Lactuca* germplasm collection located at the Department of Botany, Faculty of Science, Palacký University in Olomouc was formally established in 1995. However the first activities to be focused on the maintenance and utilization of wild lettuces as potential sources for commercial lettuce breeding were initiated in the 1970s by Prof. A. Lebeda at the Plant Breeding Station Smržice, Czechoslovakia (Lebeda and Křístková 1995; Lebeda 1996). Since its beginning the collection has not been included in the regular Czech national germplasm collection of the genus *Lactuca*. Rather, it has been used as a working collection for research, breeding and educational purposes within the framework of a programme on “Complex research on taxonomy and ecobiology of the genus *Lactuca*” (Lebeda et al. 1999). However, there is long-lasting cooperation with the Research Institute of Crop Production (RICP) in Prague–Ruzyne, and its Gene Bank station in Olomouc, mainly in research and collecting activities.

The working *Lactuca* collection

The status of the *Lactuca* working collection has changed compared to the situation in 2003 (Lebeda et al. 2005). The current data on the numbers of species and accessions are presented in Table 1.

Table 1. Number of *Lactuca* accessions and seed samples stored in the *Lactuca* working collection at the Department of Botany, Faculty of Science, Palacký University

Taxon	No. of accessions	No. of seed samples (not regenerated)
<i>L. aculeata</i> Boiss.	3	-
<i>L. altaica</i> Fisch. et C.A. Mey.	1	-
<i>L. biennis</i> (Moench) Fernald	1	-
<i>L. capensis</i> Thunb.	1	-
<i>L. canadensis</i> L.	4	10
<i>L. dregeana</i> DC.	4	-
<i>L. floridana</i> (L.) Gaertn.	-	1
<i>L. indica</i> L.	3	-
<i>L. ludoviciana</i> (Nutt.) Riddell	1	-
<i>L. perennis</i> L.	1	3
<i>L. quercina</i> L.	-	24
<i>L. saligna</i> L.	92	1
<i>L. sativa</i> L.	53	-
<i>L. serriola</i> L.	362	1314
<i>L. serriola</i> x <i>L. sativa</i>	3	-
<i>L. sibirica</i> (L.) Benth. ex Maxim	-	1
<i>L. taraxacifolia</i> Schum. et Thonn.	1	-
<i>L. tatarica</i> C.A. Mey.	1	-
<i>L. tenerrima</i> Pourr.	1	-
<i>L. viminea</i> (L.) J. et C. Presl.	3	20
<i>L. virosa</i> L.	16	7
<i>Lactuca</i> spp.	6	-
Total	557	1381

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The collection contains 557 germplasm accessions of 17 species originating from various ecogeographical areas of Europe, Asia, Africa, North America and Australia, hybrids of *L. serriola* × *L. sativa*, and undetermined *Lactuca* species. Within the collection there are 1381 seed samples representing nine species (Table 1). Part of the collection also includes a differential set for lettuce downy mildew (*Bremia lactucae*) identification, consisting of nearly 60 *L. sativa*, *L. serriola* and *L. saligna* accessions (genotypes).

Regeneration

Regeneration is carried out in an insect-free glasshouse under controlled conditions, following international standards for *Lactuca* genetic resources (van Hintum and Boukema 1999; Lebeda and Boukema 2005) and respects the regeneration protocols based on the biology of individual *Lactuca* species. Regeneration depends on the technical facilities which at present allow us to regenerate about 200 accessions per year. Approximately 45% of the accessions were regenerated during the period 1995-2005.

Characterization

Characterization and taxonomic verification of individual accessions during the vegetative period follow basic morphological descriptors (Doležalová et al. 2002a, 2003a). During the past ten years, about 50 % of the accessions were morphologically evaluated. The evaluation database of our working collection includes information on chromosome number, relative 2C nuclear DNA content, esterase zymograms and AFLP analysis of almost 100 accessions of wild species (Doležalová et al. 2002b, 2003b). Detailed characteristics of anatomical features of the accessions (Lebeda et al. 1999, 2001), including photographic documentation, are also available. The passport data of *Lactuca* accessions stored at the Department of Botany are fully computerized, but this is not the case for characterization and evaluation data which are only recorded in publications and in notebooks.

Collecting expeditions

The increasing interest in sampling, study of ecology and geographical distribution of wild *Lactuca* populations in the wild led to collecting missions, which have been organized each year. Since the last meeting of the ECPGR Working Group on Leafy Vegetables in Skierniewice in 2003 (Lebeda et al. 2005), almost 1300 seed samples have been newly collected. The *Lactuca* working collection has expanded with four new species: *L. floridana* (L.) Gaertn., *L. ludoviciana* (Nutt.) Riddell, *L. quercina* L. and *L. sibirica* (L.) Benth. ex Maxim. Apart from the Czech Republic and Europe, the collecting expeditions were also conducted in four states of the USA (California, Nevada, Oregon and Washington) and Canada.

Research activities

Current research is focused on wild *Lactuca* species occurring in their natural habitats as well as on genetic resources which are already being maintained in genebanks, and includes disciplines like taxonomy, morphology, anatomy, biochemical and molecular studies, ecobiology, plant pathology and genebanking methodology of the genus *Lactuca*. The list of scientific papers related to this topic, which have been published since 2003, is included after the list of bibliographical references at the end of this paper.

International cooperation

International cooperation which has been taking place for more than 20 years includes working with European and American partners and institutions involved in research on the genus *Lactuca* and *Lactuca* genetic resources (Lebeda et al. 2005). Within the past 3 years, intensive cooperation has been established with the Agricultural Institute of Slovenia

(Ljubljana) and the Institute of Evolution (Haifa, Israel). The cooperation network covers for example:

- taxonomic and morphological studies – Komenský University (Bratislava, Slovak Republic);
- geographical distribution and ecology – (United States Department of Agriculture/Agricultural Research Station (USDA/ARS), Salinas, Pullman, Ames, USA);
- establishment of nuclear DNA content (Institute of Evolution, Haifa, Israel);
- isozyme and AFLP variation – Agricultural Institute of Slovenia (Ljubljana, Slovenia) and Institute of Evolution (Haifa, Israel),
- research on *L. serriola* populations for downy mildew (*Bremia lactucae*) and powdery mildew resistance – Warwick HRI (Wellesbourne, UK) and Institute of Evolution (Haifa, Israel);
- genbanking management and utilization of germplasm in lettuce breeding – Centre for Genetic Resources (CGN), Plant Research International (PRI) and Wageningen University (WU) (Wageningen, the Netherlands), and Warwick HRI (Wellesbourne, UK).

One result of the broad international cooperation in the area of lettuce germplasm is the preparation of a book chapter entitled “Lettuce (Asteraceae; *Lactuca* spp.)” (Lebeda et al. 2007).

Future activities

Staff of the Department of Botany have recently been involved in various national and international research projects (e.g. *Variability of Components and Interactions in Plant Pathosystem and Impact of Environmental Factors on their Expression; National Programme of Conservation and Utilization of Genetic Resources of Plants and Microorganisms Important for Nutrition and Agriculture*). The two most important tasks for future research are considered to be the creation of the *Lactuca* working collection database to manage passport, characterization and evaluation data all of accessions stored, and our contributions to the activities of the ECPGR Working Group on Leafy Vegetables. The complex knowledge of *Lactuca* genetic resources obtained through our comprehensive research is an important key for their conservation and utilization, including the breeding of lettuce.

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Leafy vegetables genetic resources in Slovakia

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Leafy vegetables production in Slovakia

In Middle Europe, where Slovakia is situated, vegetables such as lettuce (in all its forms) and spinach are very popular.

The total vegetable area in Slovakia is approximately 34 600 ha.

Several varieties of spinach (Table 1) are sown, cultivated and harvested mechanically and immediately processed in the frozen food industry.

Heading lettuce (butterhead) varieties (Table 2) and var. *crispa* – ‘Salad Bowl’ (Table 3) and ‘Iceberg’ types of lettuce (Table 4) are grown under glass, plastics and in open fields. Large scale areas are planted by machine, small ones by hand. Harvesting in glasshouse conditions is done by small harvesting machines or by hand, the lettuce heads are carefully packaged in boxes and marketed as fresh vegetables, or sold as prepared salads or as ready-to-cook or as salad leaves in the case of spinach.

Recommended consumption of leafy vegetables is 3-4 kg inhabitant⁻¹ year⁻¹ but in reality the figures for amounts consumed are nearer to 0.7-0.9 kg per person. The numbers of recommended varieties for Slovakia and yield data are as follows:

Table 1. Data on spinach production in Slovakia, 2001-2005

<i>Spinacia oleracea</i> L. – spinach			
Year	No. of varieties	Area of cultivation (ha)	Yield (t/ha)
2001	13	99	7.03
2002	13	134.57	9.51
2003	13	149.61	7.19
2004	14	151	7.79
2005	11	147*	8.13*

* = estimates

Table 2. Data on conventional (butterhead) lettuce production in Slovakia, 2001-2005

<i>Lactuca sativa</i> L. var. <i>capitata</i> Alef. – lettuce							
Year	No. of varieties					Area of cultivation (ha)	Yield (t/ha)
	Forcing	Spring	Summer	Winter	Total		
2001	22	33	21	2	78	396	8.73
2002	25	38	20	2	85	329.54	5.53
2003	25	36	21	2	84	250	8.71
2004	23	38	19	2	82	357	7.78
2005	20	34	13	2	69	379*	7.9*
	including 2 spring	including 17 summer/autumn and 6 iceberg types	including 2 autumn and 2 iceberg types				

* = estimates

Table 3. Data on production of Salad Bowl type lettuce in Slovakia, 2001-2005

<i>Lactuca sativa</i> L. var. <i>crispa</i> – Salad Bowl	
Year	No. of varieties
2001	9
2002	9
2003	10
2004	8
2005	7

Table 4. Data on production of Iceberg type lettuce in Slovakia, 2001-2005

<i>Lactuca sativa</i> L. var. <i>capitata nidus jaggeri</i> Helm. – Iceberg lettuce		
Year	No. of varieties	Cultivars
2001	15	Court, Embrace, Lubo, Maximo, Miniko, Rocco, Santis, Tarzan, Delta, Iglo, Krystal, Marius, Pražan, Roxette, Saladin
2002	16	Court, Embrace, Maugli, Lubo, Maximo, Miniko, Rocco, Tarzan, Traper, Delta, Iglo, Krystal, Marius, Pražan, Roxette, Saladin
2003	12	Embrace, Maugli, Miniko, Rocco, Tarzan, Traper, Delta, Iglo, Lubo, Pražan, Roxette, Saladin
2004	9	Embrace, Maugli, Miniko, Rocco, Tarzan, Traper, Iglo, Lubo, Pražan
2005	7	Embrace, Maugli, Miniko, Tarzan, Traper, Lubo, Pražan

Other leafy vegetables are known and cultivated in some places on a small scale. They are listed in Table 5.

Table 5. Other types of leafy vegetables grown in Slovakia

Genus and species	Common name
<i>Brassica pekinensis</i> var. <i>pekinensis</i> Rupr.	Pe-tsai
<i>Brassica chinensis</i> L. Jusl. var. <i>parachinensis</i>	Pak choi, choi sum, Chinese flowering cabbage
<i>Lepidium sativum</i> L.	Garden cress
<i>Lactuca sativa</i> subsp. <i>acephala</i> Alef.	Leaf lettuce
<i>Lactuca sativa</i> subsp. <i>secalina</i> Janchen	Leaf lettuce
<i>Lactuca sativa</i> subsp. <i>longifolia</i> Alef. syn. <i>romana</i> Gavs.	Romaine or Cos lettuce
<i>Cichorium intybus</i> L. subsp. <i>sativum</i> Janchen	Leaf chicory
<i>Cichorium endivia</i> L.	Endive
<i>Valerianella locusta</i> L. syn. <i>olifolia</i> L.	Lamb's lettuce, corn salad
<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i> convar. <i>vulgaris</i>	Beetroot
<i>Anethum graveolens</i>	Dill
<i>Apium graveolens</i> L. var. <i>dulce</i> (Mill.)	Celery
<i>Apium graveolens</i> L. var. <i>secalinum</i> Alef.	Celery
<i>Foeniculum vulgare</i> Mill. subsp. <i>dulce</i>	Fennel

The Research Institute of Vegetables (RIV) in Nové Zámky (Slovakia) deals with vegetable genetic resources mainly of the genera *Allium*, *Brassica*, *Capsicum*, *Citrullus*, *Cucumis*, *Daucus*, *Lycopersicon*, *Petroselinum* and *Pisum*, with ca. 600 accessions in the working collection, 107 in the base collection and 114 in the active collection. Most recently we have added leafy vegetables (17 accessions in the working collection).

SWOT Analysis of leafy vegetables in Slovak conditions

<p style="text-align: center;">Strengths</p> <p>Appropriate soil and cultivation conditions greenhouse, plastic house, open field Varieties available Strengthening organic and ecological production Strengthening export position</p>	<p style="text-align: center;">Weaknesses</p> <p>Additional energy requirement for under glass and plastic cultivation Technology discipline (GAP) Post harvest procedure and quality management (QMS) Skilled production staff for handling the produce</p>
<p style="text-align: center;">Opportunities</p> <p>Applying world knowledge to Slovakia Good agricultural practice (GAP) application Higher quality, higher income Increasing recommended home consumption from 0.7 to 3-4 kg inhabitant⁻¹ year⁻¹</p>	<p style="text-align: center;">Threats</p> <p>Spreading of infected soil and plant diseases Insufficient investment in the leafy vegetables sector</p>

Main tasks for breeding new varieties of leafy vegetables

It is important to note that of almost 100 *Lactuca* species only *Lactuca sativa* is commonly used around the world for breeding and production. Diseases such as *Bremia lactucae*, *Botrytis cinerea* and *Sclerotinia sclerotiorum* ought to be kept under control to give good quality, healthy market products. The working collection of RIV Nové Zámky consists of 17 lettuce accessions, which were collected for diversifying our prebreeding stage. Accessions are regenerated in small glasshouses and evaluation is done using the minimum descriptors for leafy vegetables (2004). After maintenance the working collection will be preserved as a genebank collection for the near future in the Genebank of the Research Institute of Plant Production, Piešťany. As researchers we accept as an important duty the need to look for international cooperation in order to develop our potential in this field of work.

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Leafy vegetables in the United Kingdom 2005

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There are a number of leafy vegetable crop collections in the United Kingdom with varying responsibilities as base and working collections. Each has a different mandate.

Warwick HRI Wellesbourne – The Genetic Resources Unit

Web site: <http://www2.warwick.ac.uk/fac/sci/whri/research/gru>

The Warwick HRI Genetic Resources Unit (HRIGRU) is active in the conservation of leafy vegetable crops, mainly lettuce, but also holds smaller collections of chicory, endive and spinach. HRIGRU has collaborated with the Centre for Genetic Resources, the Netherlands (CGN) over many years. In 1989, following discussions between HRIGRU, CGN and the International Board for Plant Genetic Resources (IBPGR, now Bioversity International), HRIGRU and CGN agreed to take on primary responsibility for specific crops, HRIGRU for carrot and CGN for lettuce. A decision was taken that all the HRIGRU *Lactuca* L. material would remain in the HRIGRU long-term seed store. CGN has access to all the passport data relating to the *Lactuca* collection and data relating to *Lactuca* accessions, classified as available, were included in the International *Lactuca* Database maintained at CGN. Work relating to the HRIGRU *Lactuca* collection has been limited to distribution of material to users, providing support for research programmes in the UK and regenerating material that originated in the UK. As a part of the HRIGRU-CGN agreement we store "black box" safety-duplicates for CGN on a quid pro quo basis. Duplicate seed samples of new HRIGRU accessions are despatched to CGN as soon as possible after receipt, but accessions in store are being despatched routinely as and when the resources permit. The percentage of the HRIGRU collection in safety-duplication with CGN varies between the taxa, but in general there is a significant requirement for HRIGRU to improve the safety-duplication of these collections. HRIGRU was involved in the EU GENE-MINE project which involved collecting seed samples of *Lactuca serriola* L. across the ecogeographical distribution of the taxon in the UK for analysis by project partners. From a UK perspective we need to collect more representative samples from wild populations of *L. virosa* and *L. saligna*.

HRIGRU maintains other collections of leafy vegetables including spinach, chicory and endive that are documented, conserved and distributed following standard HRIGRU protocols. The total of accessions for the various leafy vegetable taxa, an estimate of their availability and the extent of safety-duplication is given in Table 1. The availability of individual accessions is determined by seed numbers and/or percentage germination.

Information relating to the collections is mainly passport data (FAO/IPGRI *Multi-crop Passport Descriptors*) stored in MS Access.

Contact: Dave Astley (dave.astley@warwick.ac.uk).

Table 1. Warwick HRIGRU leafy vegetables collections

Genus/species	No. of accessions	No. available*	Safety-duplicated
Lactuca			
<i>aculeate</i>	1	N	0
<i>alpine</i>	1	N	0
<i>altaica</i> (x <i>sativa</i> cross?)	12	3	2
<i>biennis</i>	1		
<i>Canadensis</i>	1	N	0
<i>dentate</i>	1	N	0
<i>livida</i>	1	N	0
<i>perennis</i>	8	N	0
<i>quercina</i>	2	N	0
<i>sagittata</i>	3	N	0
<i>saligna</i>	24	8	7
<i>sativa</i>	1358	772	414
<i>sativa</i> var. <i>angustana</i>	8	4	4
<i>scariola</i>	3	N	0
<i>serriola</i>	119	27	30
<i>squarrosa</i>	1	N	0
<i>viminea</i>	3	3	2
<i>virosa</i>	25	18	12
Cichorium			
<i>endivia</i>	31	23	3
<i>intybus</i>	32	12	8
Spinacia			
<i>oleracea</i>	124	100	106
Other crops			
<i>Eruca sativa</i>	27	23	25
<i>Lepidium sativum</i>	68	36	30
<i>Barbarea taxa</i>	5	4	3
<i>Portulaca oleracea</i>	6	3	0
<i>Asparagus officinalis</i>	9	6	8
<i>Atriplex hortensis</i>	4	0	0
Total	1878		

* N = not available

Research

Current research utilising *Lactuca* genetic resources includes:

- Using the old variety 'Iceberg' (syn. 'Batavia blonde à bord rouge') as a source of quantitative resistance to *Bremia lactucae* Regel.
- Using the old variety 'Iceberg' as a parent in the construction of a genetic linkage map for lettuce and a mapping population of F6 and F7 recombinant inbred lines (the other parent is 'Saladin' – itself probably becoming a genetic resource accession!)
- Using the mapping population and the genetic linkage map to carry out a genetic analysis (quantitative trait loci, QTL analysis) of nitrate accumulation in lettuce.
- Using genetic resources of lettuce and *L. serriola* (24 accessions) to assess for variation in nitrate accumulation and assessment of both 'Iceberg' and 'Saladin' for postharvest discoloration in bagged salad packs.

Contact: David Pink (david.pink@warwick.ac.uk).

Science and Advice for Scottish Agriculture (SASA), Edinburgh

Web site: <http://www.sasa.gov.uk/>

SASA stores seed collections of cultivars for UK Distinctness, Uniformity and Stability testing and for post-control checks of seed in commerce. The following leafy vegetable collections are maintained (Table 2):

Table 2. SASA leafy vegetables collections

Crop	No. of accessions
Lettuce	821
Spinach beet	41
Spinach	9
Endive	3
Total	874

Information relating to the collections is mostly passport, administrative and characterization data stored in MS Access. Morphological descriptions are available for some, but not all, of the accessions in these collections. Seed is only available to testing and for the certifying authorities. All accessions are safety-duplicated at a different location at the SASA site.

Contact: Niall Green (niall.green@sasa.gsi.gov.uk).

Garden Organic – Heritage Seed Library

Web site: <http://www.gardenorganic.org.uk/>

Garden Organic, formerly known as the Henry Doubleday Research Association (HDRA) at Ryton-on-Dunsmore, Coventry, is home to the Heritage Seed Library (HSL) which is custodian to a living collection of “heritage” vegetable varieties that are no longer available commercially. Seed is distributed to HSL members who are amateur gardeners. They save seed, retain some for their own use and return the rest to the collection. Many of the accessions are also held in long-term storage at Warwick HRIGRU. Over 800 vegetable varieties are conserved in this way.

A summary of leafy vegetable varieties held in the HSL collection is given in Table 3.

Table 3. HSL leafy vegetables collections

Crop type	No. of varieties
Chard	1
Chicory	3
Cress	1
Lettuce	30
Sorrel	1
Spinach	1
Total	37

New accessions are added from time to time and some are lost. Numbers fluctuate and are given as guidance only.

Contact: Sandra Slack (sslack@hdra.org.uk).

Royal Horticultural Society (RHS)

Web site: <http://www.rhs.org.uk>

The RHS maintains the UK national collection of rhubarb varieties plus some accessions of *Rheum* spp. at its garden at Harlow Carr, Yorkshire. The collection of over 130 accessions includes wild Asian species, medicinal and decorative species like *Rheum palmatum* and Victorian culinary favourites like ‘Prince Albert’ and ‘Victoria’. It also includes newer introductions, such as those bred at Stockbridge House research station near Selby,

Yorkshire. The National Rhubarb Collection will conserve a part of the West Riding of Yorkshire's vanishing heritage.

Royal Botanic Gardens, Kew – Millennium Seed Bank Project (MSB)

Web site: <http://www.kew.org/msbp/index.htm>

The UK Flora Programme of the MSB Project has already collected seed from around 90% of the UK's native higher plants including the wild relatives of leafy vegetable crops. This is the first time that any country has underpinned the conservation of its wild flora in this way. Valuable assistance with the collection of the UK flora has been given by a number of national organizations.

Overview of studies on wild crop relatives of lettuce carried out within the framework of the EU project GENE-MINE

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Introduction

Industrial organizations and research institutes working in the field of plant breeding and plant sciences rely to a large extent on genebanks for access to relevant plant germplasm. Genebanks are publicly funded institutions that serve two important needs: 1) availability of genetic resources for present-day exploitation, and 2) conservation of genetic diversity for future generations of mankind. Genebanks aim to constitute collections that represent as wide as possible genetic diversity of the crop with a minimum of redundant germplasm. Populations of wild species are generally considered rich sources of genetic variation. Nevertheless, due to various practical difficulties in the handling of wild material in *ex situ* conservation management (e.g. resulting from seed dormancy, seed shattering, unsynchronized development, etc.), only about 15% of the current genebank holdings consists of crop-related wild species. However, access to genetic diversity present in wild species is becoming increasingly important, driven particularly by the need for novel resistance characters. This need is increasing as a result of pathogen adaptation which is breaking resistances, but also as a result of the increased public aversion to, and governmental legislation concerning, the use of pesticides in European Union countries. The development of techniques to facilitate the transfer of genes across related species, such as embryo rescue, chromosome doubling, *in vitro* culture and marker-assisted selection has contributed to the interest in crop-related wild species. Therefore, to meet the needs of society, it is an important challenge for genebanks to improve substantially the access to genetic resources of wild crop relatives.

For wild relatives of lettuce, Europe is regarded as an important distribution area, harbouring species of both the primary, secondary and tertiary gene pools. Lettuce is a typical example of a crop in which plant breeding for pathogen resistance predominantly relies on wild materials. Currently, there is an urgent need to improve the resistance to downy mildew and the lettuce mosaic virus (LMV) in order to sustain the position of lettuce as a major food source in the European Union. Investigation of the major lettuce collections

has revealed that on a global scale approximately 9% of the material conserved in genebanks is wild. This under-representation of wild materials is expected to be even more severe because a substantial degree of duplication can be expected, based on historical data on the accessions.

In 1999 a research proposal entitled “Genetic Diversity of Wild Crop Relatives: Exploitation and Efficiency of *ex situ* Conservation of Natural Resources of Wild *Lactuca* Species” (abbreviated title: LacNatRes) was submitted by the Centre for Genetic Resources, the Netherlands, to the fifth EU Framework Programme, “Quality of Life and Management of Living Resources”. Objectives of this project were 1) promotion of the exploitation of the natural occurring diversity of wild crop relatives to end-users, and 2) improvement of the efficiency of genetic resources management of wild crop-related species.

To achieve these objectives, the project included the following components:

1. Inventory of all wild crop relatives of cultivated lettuce that are currently conserved in genebanks worldwide;
2. Determination of the accessibility of this material;
3. Assessment of the degree of redundancy within this material;
4. Determination of the distribution of the natural occurring genetic diversity and analysis of the representation in *ex situ* collections; and
5. Optimization of exploitation possibilities and improvement of conservation practices.

The project consortium consisted of:

1. the Centre for Genetic Resources, the Netherlands (CGN),
2. Palacký University Olomouc, Czech Republic
3. the Research Institute of Crop Production Prague-Ruzyne (RICP)²³, Czech Republic
4. the Institute of Plant Genetics and Crop Plant Research (IPK)²⁴, Germany
5. Plant Research International B.V., the Netherlands, and
6. Warwick Horticulture Research International, United Kingdom.

LacNatRes, as well as a bioinformatics project proposal called GENE-MINE, were granted by the EU. It was decided by the EU that LacNatRes had to be merged with GENE-MINE and to be continued under the name of the latter project. GENE-MINE (<http://www.gene-mine.org/>) started in January 2001 and finished in June 2004. We briefly report here on the studies carried out within the framework of LacNatRes.

Brief summary of project results

An inventory was made of all wild crop relatives of cultivated lettuce currently conserved worldwide, which revealed a total number of about 2000 accessions. Passport data of these accessions were collected and included in the International *Lactuca* Database (ILDB). The accessibility of this material to the user community was investigated by sending a questionnaire to all major genebanks having wild *Lactuca* in their collections, followed by verification of the results by actually requesting seed material. Results of the questionnaire indicated that everything was available to everybody within three weeks. However, out of the 125 accessions requested, only about 78% was received. Because of the methodology used in requesting seed material, this figure was considered an upper limit. Thus, only (a limited) part of the wild *Lactuca* accessions appeared to be available for distribution. Based on passport data, 1063 accessions were considered unique, whereas 405 potential duplication groups were identified that collectively contained 1016 accessions. Using a selection of 95 accessions, a combination of morphological and amplified fragment length polymorphism

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²⁴ Now Leibniz Institute of Plant Genetics and Crop Plant Research

(AFLP) analysis revealed that 37 accessions (39%) were taxonomically described incorrectly and that 18 accessions (19%) were redundant. Thus, a substantial part of the wild *Lactuca* accessions was misclassified, while a considerable level of duplication also existed. Screening of the world literature identified 98 wild *Lactuca* species of which only 27 are represented in the ILDB. Distribution areas of the species also displayed a skewed representation in the ILDB and revealed potential target areas for future collection missions. Fifty populations of *Lactuca serriola*, representing an important species of the primary gene pool, were sampled along an east-west transect in Europe. A total of about 800 samples were screened for morphological and molecular diversity (AFLP, simple sequence repeat (SSR) and nucleotide binding site-directed profiling (NBS-DP)) as well as for variation in disease resistance characters (downy mildew and LMV). These analyses revealed substantial levels of variation both within and between populations, except for the UK where the samples appeared to be rather uniform. A high diversity of resistance phenotypes against downy mildew was observed, while novel reaction patterns against LMV were also detected. The wealth of data obtained from the collected *L. serriola* samples are still being analyzed, but preliminary results suggested the presence of unexplored diversity. After completion of the analyses, results from the various characterization methods will be integrated, followed by examination of the representation of diversity in *ex situ* collections. Finally, implications of the project for the exploitation possibilities and conservation practices for wild *Lactuca* species will be evaluated. Publications related to the project are presented below, while six additional papers are scheduled.

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Appendix I. Safety-duplication status of leafy vegetables

(for list of acronyms, see Appendix V, pp. 52-53)

Country	Institute	Storage conditions Temperature for duplicates	Already arranged	Institute	Offering to host
Bulgaria	IPGR	-18°C	Not yet		
Czech Republic	RICP	-20°C	YES	RIPP Piešťany	Limited
France	GEVES	-18°C	YES	SNES	Limited at GEVES, Brion
Germany	IPK	-15°C			
Hungary	RCA	-20°C at NBC		TABI Tápiószele	YES
The Netherlands	CGN	-20°C	YES	WHRI	YES
Nordic Countries	NGB	-4°C	YES		YES
Poland	RIVC	-18°C at IHAR	Not yet		YES
Portugal	BPGV	-20°C			
Russian Federation	VIR	-10°C	Not yet		NO
Slovakia	RIV		Not yet	RIPP Piešťany	Limited
Slovenia	AIS		Not yet		Limited
Spain	COMAV-UPV	-3°C	YES	BGHZ and CRF	NO
	BGHZ	-18°C	YES	UPV and CRF	-
United Kingdom	WHRI	-20°C	YES	CGN	YES

Appendix II. Leafy Vegetables: status of characterization and regeneration

(for list of acronyms, see Appendix V, pp. 52-53)

Percentage of accessions that have been characterized

Country	Institute	Lettuce (%)	Spinach (%)	Cichorium (%)	Others (%)
Bulgaria	IPGR	30	30	40	(-)
Czech Republic	RICP	65	100	15	90
France	GEVES	60	75	80	tbc
Germany	IPK	80	80	95	tbc
Hungary	RCA	90	40	100	30
The Netherlands	CGN	95	95	(-)	(-)
Nordic countries	NGB	50	10	tbc	tbc
Poland	RIVC	15	0	0	20
Russian Federation	VIR	95	90	90	tbc
Slovakia	RIV	10	(-)	(-)	(-)
Slovenia	AIS	50	(-)	(-)	(-)
Spain	COMAV-UPV	55	15	tbc	tbc
UK	WHRI	10	0	0	0

(-) = no collection present

tbc = to be confirmed

Percentage of accessions that have been regenerated

Country	Institute	Lettuce (%)	Spinach (%)	Cichorium (%)	Others (%)
Bulgaria	IPGR	40	70	50	(-)
Czech Republic	RICP	65	100	15	90
France	GEVES	(*)	(*)	95	(*)
Germany	IPK	80	80	90	tbc
Hungary	RCA	90	40	100	30
The Netherlands	CGN	95	95	(-)	(-)
Nordic countries	NGB	100	100	100	tbc
Poland	RIVC	15	0	0	20
Russian Federation	VIR	90	90	90	tbc
Slovakia	RIV	50	(-)	(-)	(-)
Slovenia	AIS	70	(-)	(-)	(-)
Spain	COMAV UPV	55	20	60	tbc
UK	WHRI	55	80	65	75

(-) = no collection present

(*) = regeneration is not carried out, since there is no network on lettuce and spinach in France

tbc = to be confirmed

Appendix III. Leafy Vegetables. Regeneration protocols: number of plants per accession, isolation, pollinators

(for list of acronyms, see Appendix V, pp. 52-53)

Country	Institute	Lettuce	Spinach	<i>Cichorium</i>
Bulgaria	IPGR	40-60 plants/accession isolation in the field and 20-30 plants/accession Isolation in greenhouse	100-120 plants/accession isolated in the field	30-50 plants/accession isolation in the field
Czech Republic	RICP	- cultivated: 15-18 plants/accession in isolation cages. - wild: 16-20 plants/accession in greenhouse	40 plants/accession in isolation cages with pollen-proof plastic gauze	(-)
France	GEVES			cross-pollinated species: 60 plants/accession; insect-proof cages; bees or flies
Germany	IPK	20 plants/accession in the field	100 to 150 plants per accession isolated in the field	24 plants per accession isolated in the field or greenhouse
Hungary	RCA	24 plant/accession, in open field; no isolation	36 plants/accession, in the field and backyards, isolation in space	18 plants/ accessions, in experimental fields isolation in space
The Netherlands	CGN	- cultivated: 8 (homogeneous) or 16 (heterogeneous) plants/accession; heading types: GA3 20 ppm; no isolation. - wild: 16-24 plants/accession; vernalization; no isolation; panicles held in perforated plastic bags. - cross-breeding species: isolation cages with blowflies	50-80 plants/accession; distance isolation in glasshouses; wind	(-)
Nordic countries	NGB	50-100 plants/accession in glasshouse	50-100 plants/accession in isolated cages	
Poland	RIVC	30-50 plants/accession in glasshouse in isolation cages	No regeneration carried out	No regeneration carried out
Russian Federation	VIR	15 plants/accession - cultivated: no isolation - wild: in isolation cages	30-40 plants/accession in isolation cages wind	about 30 plants/accession 50% acc. in isolation cages 50% acc. in isolation plots pollinated by bees and flies
Slovakia	RIV	20 plants/accession in small glass houses	(-)	(-)
Slovenia	AIS	14-20 plants under isolation nets in the field	(-)	(-)
Spain	COMAV-UPV	Cultivated: 15-20 plants/accession	40-50 plants/accession in isolated fields	(-)
UK	WHRI	- cultivated: 20 plants/accession in glasshouse with cooling; no isolation; - wild: panicles held in perforated plastic bags	80 plants/accession in isolation under glasshouse conditions	40 plants/accession in insect-proof cages pollinated by blow flies

(-) = no collection present

Appendix IV. Agenda

First Meeting of the ECP/GR Working Group on Leafy Vegetables 13-14 October 2005, Olomouc, Czech Republic

Thursday 13 October 2005

1. Introduction (8.30-10.30)

- Welcome address (*A. Lebeda*)
- Organization remarks (*A. Lebeda and K. Dušek*)
- Self-introductions by the participants
- Brief description of the national leafy vegetable collections by the participants (*ca. 5 minutes per country*)

Coffee break (10.30-11.00)

2. ECP/GR (11.00–11.45)

- ECP/GR: Briefing on ECP/GR – Phase VII (*L. Maggioni*)
- AEGIS: A European Genebank Integration System, and consequences for the Leafy Vegetables Working Group (*L. Maggioni*)
- EURISCO: Status of the European Catalogue and update on documentation projects (*L. Maggioni*)

3. The ECP/GR Leafy Vegetables Working Group (11.45–12.30)

- Conclusions and Workplan of the *ad hoc* meeting on Leafy Vegetables, Skierniewice 2003 (*A. Lebeda, I.W. Boukema*)
- Establishment of a formal Working Group on Leafy Vegetables (Application letter October 2003 for the Steering Committee, conclusions of the SC) (*A. Lebeda, L. Maggioni*)

Lunch (12.30-14.00)

4. Reviewing the achievements and workplan of the LVW from 2003 (14.00–15.30)

(see Report of a Vegetables Network, Joint meeting with an ad hoc group on Leafy Vegetables, 22-24 May 2003, Skierniewice, Poland – Discussion and workplan, pp. 83-85)

4.1. International Leafy Vegetables Databases (progress and recent status)

- International *Lactuca* Database (ILDB) (*I.W. Boukema*)
- European Database for Spinach (*I.W. Boukema*)
- European *Cichorium* Database (*C. Cadot*)

4.2. Characterization and evaluation

- Status of characterization (Appendix II)
- Minimum descriptors for leafy vegetable crops

4.3. Regeneration

- Status of regeneration (Appendix II)
- Regeneration protocols (Appendix III)

4.4. Storage of safety-duplicates

- Status of safety-duplication and review of storage conditions (Appendix I)

4.5. Duplicates

- Detection of the most original samples (MOS) for wild *Lactuca* species (*I.W. Boukema*)

Coffee break (15.30-16.00)

5. Other items on the leafy vegetable collections (16.00–16.30)

- Identification of gaps in the leafy vegetable collections
- Collecting missions: needs and cooperation

6. EU GENRES programme (16.30–17.00)

Proposal on Leafy Vegetables (*I.W. Boukema*)

7. Research projects and meetings, past and future (17.00–18.00)

7.1. GENE-MINE (*R. van Treuren, A. Lebeda*)

7.2. EUCARPIA 2007, Warwick HRI, UK (*D.A.C. Pink*)

7.3. Future research directions in leafy vegetable crops in Europe

7.4. Cooperation between holding institutions and others (universities, research institutions, plant breeders, etc.)

Evening (social programme, 18.30-21.00)

Friday 14 October 2005

Drafting of the report (responsible persons) (9.00-13.00)

Excursion (rest of the group) (8.30-13.00)

Lunch (13.30-15.00)

Conclusions (15.00-16.30)

- Discussion of report and new workplan
- Election of the Chair and Vice-Chair
- Future contacts and activities inside and outside of the Leafy Vegetables Working Group
- Concluding remarks

Farewell dinner in Ústín (village near Olomouc) (17.30-20.30)

Appendix V. Acronyms and abbreviations

AFLP	Amplified fragment length polymorphism
AIS	Associazione Italiana Sementi (Italian Seed Trade Association), Bologna, Italy
AIS	Agricultural Institute of Slovenia, Ljubljana, Slovenia
ARSIA	Agenzia Regionale per lo Sviluppo e l'Innovazione nel Settore Agricolo-forestale (Regional Agency for the Development and Innovation in Agriculture and Forestry), Firenze, Italy
BGHZ	Banco de Germoplasma Hortícola de Zaragoza (Zaragoza Germplasm Bank), Spain
BPGV	Banco Português de Germoplasma Vegetal (Portuguese Plant Germplasm Bank), Braga, Portugal
Bras-EDB	<i>Brassica</i> European Database
BRG	Bureau des Ressources Génétiques (Genetic Resources Board), Paris, France
CCDB	Central Crop Database
CGN	Centre for Genetic Resources, the Netherlands, Wageningen
COMAV	Centro de Conservación y Mejora de la Agrodiversidad Valenciana (Institute for Conservation and Improvement of Valencian Agrodiversity), Valencia, Spain
CRA	Consiglio per le Ricerche Agricole (Agricultural Research Council), Italy (<i>now Consiglio per la Ricerca e la sperimentazione in Agricoltura</i>)
CRF	Centro de Recursos Fitogenéticos (Centre for Plant Genetic Resources), Spain
CRI	Crop Research Institute, Prague-Ruzyne, Czech Republic
CRRG	Centre Régional de Ressources Génétiques Nord Pas-de-Calais (Regional Centre for Genetic Resources of Nord Pas-de-Calais), France
CWR	Crop Wild Relative
CWRIS	Crop Wild Relative Information System
DvP-CLO	Departement voor Plantengenetica en –veredeling - Centrum voor Landbouwkundig Onderzoek (Department of Plant Genetics and Breeding - Agricultural Research Centre), Melle, Belgium (<i>now ILVO-Plant Applied Genetics and Breeding</i>)
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks (<i>now European Cooperative Programme for Plant Genetic Resources, ECPGR</i>)
EFTA	European Free Trade Association
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding
EURISCO	European Plant Genetic Resources Search Catalogue
FNPE	Fédération Nationale des Producteurs d'Endives (National Federation of Chicory Producers), France
GEVES	Groupe d'Etude et de contrôle des Variétés et des Semences (Group for the Study and Monitoring of Varieties and Seeds), France
HDRA	Henry Doubleday Research Association, Ryton-on-Dunsmore, United Kingdom (<i>now Garden Organic</i>)
IHAR	Instytut Hodowli i Aklimatyzacji Roślin (Plant Breeding and Acclimatization Institute), Radzików, Poland
ILDB	International <i>Lactuca</i> Database

ILVO	Instituut voor Landbouw- en Visserijonderzoek (Institute for Agricultural and Fisheries Research), Belgium
INH	Institut National d'Horticulture (National Institute of Horticulture), Angers, France
INRA	Institut National de la Recherche Agronomique (National Institute for Agronomical Research), France
IPGR	Institute for Plant Genetic Resources "K. Malkov", Sadovo, Plovdiv, Bulgaria
IPK	Institut für Pflanzengenetik und Kulturpflanzenforschung (Institute for Plant Genetics and Crop Plant Research), Gatersleben, Germany (<i>now Leibniz-Institut für Pflanzengenetik und Kulturpflanzenforschung</i>)
LMV	Lettuce mosaic virus
MOS	Most original sample
NBC	National Base Collection, Tápiószele, Hungary
NGB	Nordic Gene Bank, Alnarp, Sweden (<i>now Nordic Genetic Resource Center, NordGen</i>)
PRI	Plant Research International, Wageningen, The Netherlands
QTL	Quantitative trait loci
RCA	Research Centre for Agrobotany, Tápiószele, Hungary
RHS	Royal Horticultural Society, United Kingdom
RICP	Research Institute of Crop Production, Prague-Ruzyne, Czech Republic (<i>now Crop Research Institute, CRI</i>)
RIPP	Research Institute of Plant Production, Piešťany, Slovakia
RIV	Research Institute for Vegetables, Nové Zámky, Slovakia
RIVC	Research Institute for Vegetable Crops, Skierniewice, Poland
SASA	Scottish Agricultural Science Agency, Edinburgh, United Kingdom (<i>now Science and Advice for Scottish Agriculture</i>)
SGGW	Szkoła Główna Gospodarstwa Wiejskiego (Warsaw Agricultural University), Warsaw, Poland
SNES	Station Nationale d'Essais de Semences (National Seed Testing Station), Angers, France
SRGB	Slovenska Rastlinska Genska Banka (Slovenian Plant Gene Bank)
TABI	Institute for Agrobotany, Tápiószele, Hungary (<i>now Research Centre for Agrobotany</i>)
UDS	Ustymivka Experimental Station of Plant Production, Ustymivka, Ukraine
UPOV	Union internationale pour la protection des obtentions végétales (International Union for the Protection of New Varieties of Plants), Geneva, Switzerland
UPV	Universidad Politécnica de Valencia (Polytechnic University of Valencia), Spain
USDA/ARS	United States Department of Agriculture/Agricultural Research Station, USA
VIR	N.I. Vavilov Research Institute of Plant Industry, St. Petersburg, Russian Federation
WHRI	Warwick Horticulture Research International, Wellesbourne, United Kingdom
WU	Wageningen University, The Netherlands

Appendix VI. List of Participants

N.B. Contact details updated at time of publication. The composition of the Working Group is subject to changes, and is constantly updated on the Working Group's Web page (http://www.bioversityinternational.org/networks/ecpgr/contacts/ecpgr_wglv.asp).

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