



First International Conference on *Crop Wild Relative Conservation and Use*

Incorporating the PGR Forum Final Dissemination Conference

14-17 September 2005, Agrigento, Sicily, Italy

BOOK OF ABSTRACTS



UNIVERSITY OF
BIRMINGHAM



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Book of abstracts

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Preface

Crop wild relatives (CWR) are an under-conserved and under-utilised plant genetic resource. However, in recent years their value has been better appreciated, which has led to a re-evaluation of CWR conservation and use. CWR can be broadly defined as taxa related to species of direct socio-economic importance, including food, fodder and forage crops, medicinal plants, condiments, ornamental and forestry species, as well as plants used for industrial purposes, such as oils and fibres. It has been known for thousands of years that CWR germplasm (genetic material) can be used by humankind to improve the quality and yield of crops. For millennia, farmers have undertaken selection while growing their crops, in some cases after natural introgression with CWR has taken place; more recently, plant breeders have utilised CWR genes to improve crops for resistance to pests and diseases, and abiotic stresses such as drought and salinity. Other uses include increased protein and vitamin content, and the improvement of medicinal plants and pharmaceuticals. With increasing genetic uniformity of modern crops, and associated vulnerability to new strains of pests and diseases it is widely recognized that CWR are vital for improving agricultural production, increasing food security, and sustaining the environment.

In addition to their use as gene donors for crops, CWR species are also important sources of nutrition to many people who harvest plants directly from the wild or cultivate them on a small scale. These wild harvested species, minor crops and under-utilised species are critical to the livelihoods of many rural people and have the potential to contribute to food security, nutrition and stronger rural economies.

CWR are also essential components of natural and semi-natural habitats, as well as agricultural systems, and are critical for maintaining ecosystem health. However, many CWR species are under threat from habitat alteration and loss, changes in agricultural practices, genetic erosion and genetic pollution. Many CWR also have limited distributions and habitat niches. A unique threat to CWR is that many taxa are weedy and associated with traditional farming practices and cultivation of local varieties (landraces). With the increase in industrial farming and cultivation of high yielding varieties, associated CWR diversity is threatened, resulting in loss of genetic diversity and potential local extinction. A further hidden threat to CWR is that many of the less common species are overlooked in conservation planning. Without active management, these taxa are also at risk.

Until fairly recently, CWR conservation and use has received relatively little systematic attention, both within Europe and globally. However, in Europe and the Mediterranean region alone, 77% of the flora consists of CWR and other utilised species, as well as the crops themselves; in other words, more than three-quarters of the plant species in the region have a current or potential direct use to humankind. Now at national and international level there are several initiatives and activities to conserve CWR, but methods and approaches to their conservation *in situ*, and even *ex situ*, remain subject to debate and are practically untested. The European Community funded project, PGR Forum (European Crop Wild Relative Diversity Assessment and Conservation Forum) was the first major international project addressing the conservation and use of CWR. The project has involved 23 partners from 21 countries: Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Romania, Russia, and the United Kingdom, with the addition of partners representing IUCN -The World Conservation Union and the International Plant Genetic Resources Institute (IPGRI).

PGR Forum has created a Crop Wild Relative Information System (CWRIS), incorporating the PGR Forum CWR Catalogue for Europe and the Mediterranean, and standards for management and exchange formats for CWR conservation and use data. PGR Forum has also developed methodologies and approaches to the conservation of CWR by establishing methodologies for generating regional and national inventories and how to determine conservation priorities, protocols for genetic conservation gap analysis and threat assessment, best practice in the management and monitoring of CWR populations, and ways of assessing genetic erosion and genetic pollution of CWR.

The First International Conference on Crop Wild Relative Conservation and Use provides a platform to showcase the products of PGR Forum; it also brings together the international PGR community to debate and share knowledge about CWR and the many programmes that are committed to conserving these vital resources around the world. The Conference is a landmark in PGR conservation, highlighting CWR as a critical but neglected resource, and sets the scene for future international conferences and initiatives focused on CWR conservation and use. The specific aims of the Conference are to: promote the importance of wild plant species of socio-economic value to the international community; review the

establishment of CWR inventories and establish a baseline for their conservation assessment; assess procedures for establishing conservation priorities for CWR; review the current status of information access and management for CWR; evaluate methodologies for *in situ* and *ex situ* CWR conservation; and explore ways of strengthening CWR conservation and use through international and inter-agency collaboration.

The Conference has been organised by the University of Birmingham, UK, International Plant Genetic Resources Institute, Istituto Sperimentale per la Frutticoltura di Roma, Italy and the Agricultural Extension Service of the Regional Administration of Agrigento, Italy. The Conference organisers wish to gratefully acknowledge the financial support of the European Community, via the Fifth Framework Programme for Energy, Environment and Sustainable Development, and the Agricultural Development Service, Regional Government of Sicily, Palermo, Italy. The organisers are also grateful to the Parco dei Templi, Municipality of Palma, Agrigento Wine Association and Agrigento Tourist Service for generously providing their services in support of the Conference.

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Contents

| | Page |
|--|-------------|
| Preface | i |
| Session 1: CWR conservation and use: an overview | |
| – Oral abstracts..... | 1 |
| – Poster abstracts..... | 7 |
| Session 2: Establishing CWR inventories and conservation priorities | |
| – Oral abstracts..... | 11 |
| – Poster abstracts..... | 19 |
| Session 3: CWR threat and conservation assessment | |
| – Oral abstracts..... | 29 |
| – Poster abstracts..... | 35 |
| Session 4: Genetic erosion and genetic pollution of CWR | |
| – Oral abstracts..... | 39 |
| – Poster abstracts..... | 45 |
| Session 5: <i>In situ</i> management and monitoring for CWR | |
| – Oral abstracts..... | 51 |
| – Poster abstracts..... | 61 |
| Session 6: <i>Ex situ</i> conservation of CWR | |
| – Oral abstracts..... | 69 |
| – Poster abstracts..... | 75 |
| Session 7: CWR information management | |
| – Oral abstracts..... | 87 |
| Session 8: CWR as gene donors for crop improvement | |
| – Oral abstracts..... | 95 |
| – Poster abstracts..... | 101 |
| Session 9: Use of CWR and under-utilised species | |
| – Oral abstracts..... | 113 |
| – Poster abstracts..... | 119 |
| Index of authors | 127 |

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Session 1

CWR conservation and use: an overview

ORAL ABSTRACTS

Crop wild relative conservation and use: establishing the context

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The Convention on Biological Diversity, International Treaty on Plant Genetic Resources for Food and Agriculture and Global Strategy for Plant Conservation each recognise the requirement for more systematic conservation action and better assessment of the threats to biodiversity. More specifically, they require the conservation of and assessment of threat to agrobiodiversity, which includes crop wild relatives (CWR). CWR are identified as a critical component of biodiversity required for wealth creation, food security and environmental sustainability in the 21st century. CWR may be broadly defined as those wild species taxonomically related to plants of socio-economic importance, including crops, forestry, ornamental, aromatic and medicinal species, to which they may contribute genes via traditional breeding and biotechnology.

Surprisingly, considering their socio-economic importance, the conservation of, threat to and use of CWR taxa has not been systematically addressed. However, the need to meet these goals is now critical because of the widespread genetic erosion and even extinction that confronts CWR taxa. If the CBD 2010 Biodiversity Target (www.biodiv.org/2010-target) of a significant reduction in the current rate of loss of diversity is to be achieved for CWR taxa then there is a need to define, catalogue, assess the threats to and develop conservation protocols for CWR taxa.

Funded by the European Community Fifth Framework programme, the aim of the European Crop Wild Relative Diversity Assessment and Conservation Forum (PGR Forum) was to address these issues. Specifically, its objectives were to:

- bring together European conservationists to debate the assessment and conservation of CWR at both the species and component population levels;
- produce an assessment of baseline CWR biodiversity data, threat and conservation status;
- debate documentation methodologies, formulate *in situ* management regimes, and establish how to assess genetic erosion and genetic pollution for CWR taxa; and
- communicate the results to European stakeholders, policy makers and user groups as a means of facilitating efficient and effective CWR conservation and use.

This paper establishes the context for CWR conservation, provides a pragmatic definition of CWR, and an overview of the activities and achievements of PGR Forum. The need for a Global Strategy for CWR Conservation and Use to ensure that these vital resources are conserved and available for use is also highlighted.

Addressing the conservation and sustainable utilisation of CWR: the international policy context

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Wild relatives of crop plants, which include the progenitors of crops as well as other species more or less closely related to them, constitute an increasingly important resource for improving agricultural production and for maintaining sustainable agro-ecosystems. They have contributed many useful genes to crop plants, and modern varieties of most crops now contain genes from their wild relatives. Nonetheless, natural populations of many crop wild relatives are increasingly at risk, and are threatened by habitat loss through the destruction and degradation of natural environments or their conversion to other uses. When considering the conservation and sustainable utilisation of crop wild relatives, it is important to do so primarily within the parameters of *in situ* conservation, and through an ecosystem approach – crop wild relatives are most often used by local communities, and should be regarded as interacting with other biological situations (e.g. surrounding environment) but also factors such as policies, legislation and markets. The importance of the conservation and sustainable utilization of plant genetic resources including of crop wild relatives is recognized through a number of international instruments such as the FAO Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (GPA). This presentation will highlight some of the main international instruments of relevance to the conservation and sustainable utilization of crop wild relatives.

CWR conservation: European policy and information context

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A number of on-going processes and activities at EU and Pan-European level provide the opportunity to take into consideration the conservation of crop wild relatives. These range from protected areas at national and EU level (NATURA 2000 network), agri-environmental measures and rural development funds, identification of High Nature Value Farming Areas, development of biodiversity indicators including on genetic diversity. In addition specific initiatives on genetic resources take place as a contribution to global strategies. As a branch of the European Environment Agency, the European Topic Centre on Biological Diversity contributes to the overall mandate of this Community institution, i.e. *'to support sustainable development and to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policy making agents and the public'*. The presentation will show the link between information and policy action and reflect the need for coordination of data on CWR at a European scale for better consideration in decision making processes.

Plant genetic resources national programmes in Armenia: current state and prospects

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PGR conservation national programmes are considered in the republic to be a stable and long-term platform for the prevention of general processes of ongoing degradation of natural resources, loss of biodiversity and desertification, reliable conservation and sustainable use of plant genetic resources as well as for implementation of international agreements, such as the Global Plan of Action on Conservation and Sustainable Utilization of PGRFA and the relevant obligations of CBD, Framework Convention on Climate Change and Convention to Combat Desertification. Over a period passed after European Workshop on National PGR Programmes (2003, Alnarp) the main attention has been paid to forest genetic resources conservation and rehabilitation, that has an exclusive strategic significance from environmental and social-economic points of view. In 2004 National Forest Policy and Strategy was developed and approved by the government of Armenia. The next step is development of National Forest Programme, which is aimed at the restoration of deteriorated forest ecosystems, emphasizing the conservation of forest resources for present and future generations. Draft National Forest Programme has been prepared and submitted to the relevant ministries for consideration. Another document, which is at present in process of development, is National Programme for Plant Genetic Resources for Food and Agriculture. Draft PGRFA National Programme identifies national partners, priority activities in the area of *ex situ* (gene bank establishing, regenerating threatened accessions, collection) and *in situ* (surveying and inventorying, supporting on-farm management, etc.) conservation, effective use in breeding and farm practice, education and training. National programme on PGRFA will be coordinated by the Ministry of Agriculture through the inter-ministerial National Agency on PGRFA of Armenia, which was established by the initiative of the Ministry of Agriculture at the beginning of 2005 with the purpose of better coordination of PGR conservation, study and usage activities, elaboration of national programmes and strategies.

Session 1

CWR conservation and use: an overview

POSTER ABSTRACTS

The Italian national program to implement the International FAO Treaty on plant genetic resources for food and agriculture

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The International Treaty on Plant Genetic Resource, recently adopted by the FAO, has the aim to preserve the genetics resources for the future generations and to use in sustainable way the plant genetic resources for food and agriculture, and in addition, to promote the equitable share of the benefits deriving from their use. The Italian Government ratified the Treaty on the year 2004 (law n. 101 issued on April 6), and through the MiPAF (Ministry of Agriculture and Forestry Policies) entrusted the CRA (Council for Agricultural Research) of the duty to implement the needed actions.. The Istituto Sperimentale per la Frutticoltura of Rome, belonging to CRA, was appointed as the coordinating institute of the national project which involves the activity of 16 research institutes (Agronomy of Bari, Citrus of Acireale, Cereals of Rome, Fodder crops of Lodi, Industrial crops of Bologna, Flower crops of S. Remo, Fruit crops of Rome, Olive crops of Cosenza, Olive oil technology of Pescara, Viticulture of Conegliano Veneto, Vegetables of Pontecagnano, Tabacco of Scafati, Sylviculture of Arezzo, Forest settlement of Trento, Zoology of Florence, CNR Plant genetics of Bari).

The main actions to be carried out by the project are the inventory of the plant genetic resources for food and agriculture and their potential uses, the evaluation of the risk of genetic erosion, the development of an *ex situ* collection network. These actions will be carried on the plants of the list reported into the annex 1 of the FAO Treaty and to other plants currently not included, that are important for the strategic national policy, and possibly, included in the future in the mentioned Annex 1.

As first step of the project, the expected results are:

- the maintenance of the existing agricultural biodiversity and the preservation of the autochthonous species by improving *ex situ* collections
- the set-up of a data base of informations available for users (national and international research institutes, farmers, citizens)
- the supply to the users of propagating material of the available accessions
- the promotion of cooperation activities among the involved research institutes and farmers and/or local organizations aimed to establish of *in situ* collections, and the promotion of actions able to exploit the endangered plants through the recovery of traditional uses (food, tools, etc).

Session 2

Establishing CWR inventories and conservation priorities

ORAL ABSTRACTS

Creating a regional catalogue of crop taxa and their wild relatives: a methodology illustrated for Europe and the Mediterranean

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Europe and the Mediterranean is an important centre for the diversity of crops and their wild relatives. Major crops such as oats (*Avena sativa*), sugar beet (*Beta vulgaris*), apple (*Malus domestica*), annual meadow grass (*Festuca pratensis*), and white clover (*Trifolium repens*), have wild relatives in the region. Many minor crops have also been developed and domesticated in the region; such as arnica (*Arnica montana*), asparagus (*Asparagus officinalis*), lettuce (*Lactuca sativa*), and sage (*Salvia officinalis*). These crop and crop wild relative species are a major socio-economic resource, as well forming a cornerstone of agro-biodiversity for the region. Although it is acknowledged that populations of these species are under threat from factors such as habitat alteration and loss, their conservation has historically received relatively little systematic attention.

Establishing an inventory of a region that can form the basis for future monitoring is the first step in the conservation and effective use of these vital resources. Baseline data provide the foundations critical for biodiversity assessment, as required by the 2010 Biodiversity Targets, Global Strategy for Plant Conservation, European Plant Conservation Strategy and International Treaty on Plant Genetic Resources for Food and Agriculture. Taxon inventories provide the essential building blocks for the collation of information on *in situ* and *ex situ* conservation status, and on their current and potential uses as novel crops or gene donors.

This paper presents a methodology for establishing a regional catalogue of crops and their wild relatives. The PGR Forum CWR Catalogue for Europe and the Mediterranean, which is presented here, was primarily derived via two major databases: Euro+Med PlantBase (www.euromed.org.uk) and Mansfeld's World Database of Agricultural and Horticultural Crops (<http://mansfeld.ipk-gatersleben.de>), with the addition of data from other sources for forestry, ornamental, medicinal and aromatic groups. The catalogue forms the basis of the PGR Forum Crop Wild Relative Information System (CWRIS) which provides access to CWR data to a broad user community, including plant breeders, protected area managers, policy-makers, conservationists, taxonomists and the wider public.

In addition to providing the backbone to the CWRIS, the Catalogue reveals some interesting statistics about the number of crop and CWR taxa in the region, and how many are native, endemic, or introduced. For instance, results show that approximately 77% of the Euro-Mediterranean flora consists of crop wild relatives and other utilised species, as well as the crops themselves; in other words, at least three-quarters of the plant species in the region have a current or potential direct use to humankind. The data have also been analysed to indicate geographical areas of high CWR species richness and diversity as an aid to conservation planning. Given access to the appropriate data sources, the methodology presented in this paper can easily be adapted to create a CWR catalogue for any region or country in the world.

Establishing conservation priorities for crop wild relatives

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In this talk we raise the question of why there is a need to establish conservation priorities for crop wild relatives (CWR), suggest how taxa may be prioritised, ask what problems may be encountered and propose possible solutions.

Key PGR Forum objectives were to produce an assessment of baseline biodiversity data, threat and conservation status for crop wild relatives, and to establish a means of assessing genetic erosion and genetic pollution as an aid to their *in situ* conservation. A necessary first step was to produce a catalogue of crops and their wild relatives for Europe and the Mediterranean. This catalogue contains 23,818 species, which is 77% of the Euro-Mediterranean flora, and a larger number than was initially predicted. With this relatively large number of taxa and limited conservation resources, the objectives of CWR conservation cannot be fully addressed without prioritisation of taxa. Also many of this large number of taxa do not require immediate conservation action, while others may be less important as genetic resources in the region. Those that may require some form of action must be prioritised as it will be impossible to develop comprehensive conservation action plans for all species.

Opinions vary as to how this prioritisation should be undertaken. It is inevitable that prioritisation will differ according to needs within Europe, the Mediterranean (or any other region of the world), and the requirements of individual countries within these regions, or even different agencies within individual countries. Biodiversity conservationists may have opposing views to plant breeders, and the views of a forester are likely to differ from those of a horticulturist. There is some consensus for prioritisation on economic value, but how should such a prioritisation be undertaken? There is also some consensus for prioritisation on threat status, but data are not available for all taxa.

So, how can we establish conservation priorities for the CWR of Europe and the Mediterranean, and can this methodology be applied in any region of the world? Firstly, data for all CWR taxa must be available for any prioritising criterion used. This can be a problem when considering both economic value and threat status. Secondly, algorithms that employ combinations of several criteria give different results. A simple approach to overcome both of these problems involves using 'number of countries in which a taxon is recorded as present' as a proxy indicator of endemism and therefore threat, together with a simple assessment of relative use value reached by consensus among a sample of the PGR community. Full data sets for both of these criteria are already available for Europe and the Mediterranean and a prioritised CWR catalogue can be produced immediately.

This will then facilitate further in-depth studies and more intensive focus upon the CWR taxa in greatest need of conservation evaluation and action, including threat assessment, population monitoring and establishment of reserves. The methodology proposed in this paper can be applied in any other region of the world.

Construction and application of a national inventory of crop wild relatives: a methodological case study for the United Kingdom

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Crop wild relatives (CWR) are identified as a critical component of plant biodiversity required for food security and agricultural and environmental sustainability in the 21st century. A necessary first step in the conservation of CWR is the establishment of national CWR inventories. This paper reports a methodology for establishing a national CWR inventory using the recent creation of a CWR inventory of the UK as an example and suggests how this inventory might be used for CWR conservation and use.

The methodology consists of: (1) Creation of a checklist filtered from the PGR Forum Catalogue of CWR for Europe and the Mediterranean which resulted in a CWR inventory of 1,955 species for Great Britain. This was checked for taxa missing for Northern Ireland in order to create a National Inventory for the political unit UK. The inventory was harmonized with UK floristic data. (2) Economic importance of the crop was taken as the major criterion to establish conservation priorities and national economic statistics were collated to facilitate prioritisation. (3) The next step was to analyse the economically most important taxa for ecogeographic distribution and genetic diversity. (4) Based on the recent UK threat assessment eighty CWR taxa were identified, which were both threatened and related to important UK crops. Of these, 14 were related to major food crops, 10 to fodder/forage crops and 58 to major ornamental plants or trees. (5) Gap analysis was undertaken to establish which of the threatened priority CWR occur within existing protected areas and which are covered by conservation action. (6) Based on the gap analysis, Key National CWR Sites will be designated.

In the context of the Global Strategy for Plant Conservation and in response to the CBD 2010 Biodiversity Target of a significant reduction in the current rate of loss of diversity, this goal can be partially achieved for CWR through the creation and application of national CWR inventories.

CWR *in situ* conservation strategy for Russia

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Targeted collecting and safe conservation of agrobiodiversity, especially in the centers of origin and richest diversity of plant genetic resources, may be regarded as a pledge of national food security. The increasing threat of genetic erosion in plants, caused by negative anthropogenic effect and global climatic changes, calls for a vital need to develop a complementary (*ex situ/in situ*) strategy of agrobiodiversity, first of all – crop wild relatives (CWR), conservation. After the adoption of the Convention on Biological Diversity, *in situ* conservation of agrobiodiversity has become a problem of topmost priority. For many decades the Vavilov Institute has been collecting and studying plant genetic resources in different regions of the world and securing their safe conservation both in the genebank and within natural ecotopes. At present the Institute is working out an integrated strategy of *in situ* conservation of cultivated plants and their wild relatives in Russia. Major elements of this strategy are: selection of priority objects for conservation, using the principle of inequivalence of plant species according to various parameters; selection of areas for *in situ* conservation; development of guidelines on monitoring and management for different objects including specific measures to reintroduce separate taxa and taking into account socioeconomic features (such as basic aspects of the work with local communities in raising their awareness of the need to exercise sparing approach to utilization of traditional natural plant resources). Development of specific conservation efforts should be preceded by a detailed study of conservation objects as well as their morphological, ecological, taxonomic, geographic and other features. Research materials include the seed and herbarium collections of VIR and other national institutes, archives of collecting missions conducted in different years over the ex-Soviet territories, publications, etc. Technology-based approaches are very important for the development of the *in situ* PGR conservation strategy. Most important research tools are the database “Wild Relatives of Cultivated Plants in Russia”, which consists of different kinds of information including indigenous knowledge, database “Vascular Plants of Russia’s Natural Reserves” and GIS maps of plant species’ distribution throughout the former USSR. The strategy can be used as a model for different countries and separate territories.

CWR species in Finland: diversity, conservation, and taxa of special interest

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The vascular flora of Finland consists of about 3200 species, subspecies or variants, and a number of hybrids. A considerable proportion of these taxa are crop wild relatives (CWR) in the sense that at least one species of the same genus is known to have some socio-economic importance. Many of the wild taxa occurring in Finland have traditionally been used as food, primarily several *Vaccinium*, *Rubus*, *Ribes* and *Fragaria* species. A number of plant taxa have declined during recent decades, mainly due to intensive forest management, decrease in traditional agricultural habitats and increased construction activities, which have led to the fragmentation or even complete loss of suitable habitats. Among the vascular plants, the number of species classified as regionally extinct, critically endangered or endangered equals 90, of which 70% are considered to be CWR species (mainly ornamentals). The primary habitats of most declining CWR taxa are traditional agricultural habitats, such as grazing grounds, meadows and forest pastures. Other common habitats of the declining CWR plants include the sandy shores of the Baltic Sea, and moist and dry grass-herb forests. In this presentation on the CWR species in Finland, we will introduce the range, distribution and use of plant taxa possessing important socio-economic potential and pay special attention to the CWR taxa considered to be threatened to some degree.

A survey of the distribution of crop wild relatives in the Netherlands

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In November 2004 the latest version of the Standard List of the flora of the Netherlands 2003 has been published by Nationaal Herbarium Nederland and Stichting Floron. This list contains 1536 vascular plant species in 65 genera that comprise the Dutch wild flora. Some of the species on this list are, to a varying extent, related to cultivated crop species. Using different combinations of data sources three different lists with Crop Wild Relatives (CWR) species that occur in the Netherlands are presented in this paper. An extensive CWR-list for the Netherlands is obtained by the selection of species from the Standard List for which the genus name corresponds with the genus name of species that are included in the Mansfeld's World Database of Agricultural and Horticultural Crops. This list revealed that more than 80% of the species on the Standard List are selected as CWR. Another, more restricted, CWR-list is obtained by the selection of species from the Standard List for which the genus name is included in the Catalogue of the Wild Relatives of Cultivated Plants Native to Europe (Heywood and Zohary, 1995). This catalogue includes all species that are part of the European flora and that belong to the primary gene pool of cultivated crop species. This CWR-list included 324 species of the Standard List. A further restricted CWR-list with 102 species is obtained by the selection of species from the Standard List that are included in the catalogue. For the species on the three different CWR-lists the status of their distribution in the Netherlands over the last decades as well as measures for the conservation of these species will be discussed.

European forest genetic resources: status of current knowledge and conservation priorities

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Forest trees have two singularities: (1) the long life cycle and particular life history traits, and (2) the continuum of situations from "wild" to "domesticated" gene pools, sometimes within a single taxon. Therefore, conservation of forest genetic resources relies on both *in situ* and *ex situ* measures as well as sustainable forest management and protected areas. Forest trees include pioneer and climax species with various distribution patterns and ecological requirements, creating a need for different gene conservation strategies and methods. Research work based on experimental work and modelling in population genetics, genomics and ecology has increased our knowledge on the evolutionary processes that govern the genetic diversity and adaptability in trees. In particular, the importance of gene flow at various spatial scales, the high level of genetic diversity within populations, even for adaptive traits, the high phenotypic plasticity and the ability for rapid genetic changes have been stressed. A challenge for future research is to develop an integrative approach that combines different evolutionary processes, such as migration and adaptation, and predict response of forests to climate change. The European Forest Genetic Resources Programme (EUFORGEN) was launched in 1994 to implement Strasbourg Resolution S2 (Conservation of forest genetic resources) of the first Ministerial Conference on the Protection of Forests in Europe (MCPFE). The main outputs of EUFORGEN include pan-European strategies and technical guidelines for gene conservation of forest trees. Phase III (2005-2009) of the Programme focuses on promoting conservation and appropriate use of forest genetic resources as an integral part of sustainable forest management.

Using GIS models to identify the predictive potential suitable sites of wheat wild relatives in the Palestinian Authority areas

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The high rate of extinction of wheat wild relative species has promoted a call to the scientific community to make comprehensive assessment of status, causes and trend of biodiversity and recommended conservation strategies for proper management in the future. In this study the Diva-GIS software was used the BIOCLIM model (Bio-climatic analysis and prediction system) to generate a predictive map showing the potential geographical distribution range of wheat wild relatives, based on climatic features of the sampled data in the Palestinian Authority areas. Geographical Information System GIS modeling was used to identify areas climatically suitable to which the species of wild relatives of wheat can be conserved by using its current distribution and data on a range of environmental parameters. Annual mean temperature, maximum temperature of the warmest month, Minimum temperature of the coldest month, Annual precipitation, Precipitation of the wettest month, digital elevation model (DEM), species name and spatial location (Latitude and longitude of a set of localities) are the parameters used in the potential sites.

The predictive map shows six distinct regions where the selected species is predicted to be occurring by Diva-GIS: excellent, very high, high, medium, low and not suitable areas. The excellent areas for *Triticum dicoccoides* occur in the northern part of the West Bank in Jenin and eastern part of Nablus districts. Moreover the highest species richness was in Jerusalem district. *Aegilops geniculata*, *Aegilops peregrine* predication map suggested the northern part as the most suitable areas while the model suggest the Southern part of Hebron district as an excellent area for *Aegilops kotschyi*. Based on the above results proposed primary sites for conservation for important wheat wild relatives were proposed.

Session 2

Establishing CWR inventories and conservation priorities

POSTER ABSTRACTS

Genetic diversity and phylogeographic structure of the genus *Vitis*: implications for conservation

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Three hundred sixty grape accessions representing 44 taxa from both the Old and New World including the cultivated *V. vinifera* and its putative progenitor, *V. v. ssp. sylvestris*, and three taxa of *Muscadinia* were analyzed for genetic diversity and phylogeographic structure using 10 polymorphic microsatellite loci. The cluster analyses revealed several affinities roughly corresponding to the seven taxonomic series recognized based on morphological criterion within the American *Vitis* group. The series *Labruscae* appeared to be diverse with some of its members closely aligned with other series and some even with Chinese taxa. The cultivated grape and its putative progenitor *ssp. sylvestris* showed close relationship with the series *Labruscae*. Chinese group revealed significant genetic differentiation with as many as three major affinities and some of them showing strong relationships with many American taxa/series. The West Asian taxon, *V. Jacquemontii* showed relationship with Chinese taxa. The subgenus *Muscadinia* formed a distinct group basal to the subgenus *Vitis*. 2D projection of accessions along the first two principle axes revealed overlapping distribution of taxa. However, the taxa belonging to the series *Precosis* and the subgenus *Muscadinia* exhibited significant differentiation. The Chinese group exhibited a unique distribution partially diffusing into the territory of the New World taxa. The distance Wagner tree based on the Prevosti distance revealed two major affinities: (1) *Labruscae-Vulpinae-Precoces* affinity; (2) *Aestivales-Viniferae-Cinerascentes-Occidentales* along with the Asian group. Population substructure within most taxa was evident. Analysis of genetic differentiation revealed higher differentiation among taxa (~33%) than among the taxonomic series (~15%) in the genus *Vitis*. Local differentiation caused by small, fragmented, and isolated populations in which most taxa exists overlaid by sympatric distribution of many taxa connected through gene flow seems to have played a significant role in shaping the phylogeographic structure of the genus *Vitis*. Overall, the results suggest the existence of complex population subdivisions within and between taxa and taxonomic series of the genus *Vitis*. Based on the results, we present long-term strategies for effective conservation of genetic diversity within and between species of *Vitis*.

Collecting of wild species in the National park Muran Plain

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The exploration and collecting of plant genetic resources is the activity that is crucial for conservation of plant gene pool in Slovakia. In recent years the exploration, mapping and collection of wild species were conducted by several collecting expeditions. Last expedition was organised into National park Muran Plain at 2004. Muran Plain spread on Spis-Gemer carst territory and marginally interferes into areas Vepor and Stolick hills. Like a preserved natural area was region Muran Plain declared in 1977 and behind National park was her declaration 1 October 1997. Territory of National park Muran Plain has area (acreage) 20 318 ha and guard band (protective zone) 21 698 ha. Orthographically this plain stands in subprovince of The Inner West Carpathian Mountains. On the territory Muran Plain is recorded nearly 1150 taxon vascular plant, of them 97 are protected species, 35 endemic and sub-endemic and of them are 3 West Carpathian paleoendemics, also there are a few relict. From plants is rare appearance paleostenoendemic *Daphne arbuscula*, which growth generally on inaccessible chalky and dolomite walls and cliffs. From others here occurring *Pulsatilla subslavica*, *Campanula sibirica*, neoendemit *Soldanella carpatica*, relict *Dryas octopetala* etc. The aim of those expeditions was to gather seed material from wild species, mainly medical and aromatic plants and legumes from the meadows and pasture, in a region that is endangered by genetic erosion as a result of the development of agriculture and industrialization. GPS - geographical co-ordinates of the site and elevation of collecting were determined by means of geographical system "Garmin" and according to tourist map.)

Wild relatives for stone, pipe and nut fruits in Georgia

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Georgia is considered as one of the centres of origin. A lot of wild relatives of pipe and stone fruits and nuts have been grown spontaneously a long period of time almost all over Georgia from ancient times. According to Jukovski (1956) in Caucasus and especially Georgia are spread two wild species of apples: (*Malus Mill*): *M. orientalis* and *M. pumila*. In deep forests slopes of Caucasus is a very big diversity of varieties and subspecies of *M. orientalis*. Georgia is very rich with wild relatives for pears (*Pyrus communis*): there are found 11 wild species, among them *P. caucasica*, *P. balansae*, *P. ketzkhoveli*, *P. eldarica* and etc. These species are spread in both west and east part of Georgia. Five subspecies of quince (*Cydonia oblonga*) are spread in basically in Kakheti region (East Georgia). Broad spectrum of wild relatives *Prunus* species are found in Georgia, there are 6 species of plums (*Pr. domestica*), one subspecies of peaches (*Pr. persica*), one subspecies of apricots (*Pr. armeniaca*). *Amygdalus georgica* of almonds (*P. amygdalus*). Two wild species of cherry (*P. cerasus*), *P. avium* and *P. mahaleb* is found everywhere on the territory of Georgia in forests, they are reaches an altitude of 1800 m above sea level. It has a very interesting diversity of hazelnuts (*Corylus avellana*, *Corylus pontica* and *Corylus colurna*). Also there exists broad diversity of walnuts (*Juglans regia*).

Presenting materials are shown that Georgia has great potential for conservation wild species and its use for breeding purposes.

Improvement exploitation, and preservation of Sicilian plant genetic resources

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In the last decades, the reduction by human, of many natural ecosystems, rigid changes of the climate and the wide-spreading of races and cultivars with a restricted genetic basis, have determined a reduction of the bio-difference, caused by the extinction of several species and a strong reduction of intra-specific genetic variability. This has considerably reduced the adaptability of various species to the environmental conditions, to the new pathogens agents and diseases and to the global climatic differences. In the same period more interest has been shown for the preservation of the genetic resources belonging to various species of agronomic, forestry, zoo technical and microbial interest, with the purpose of preserving genes, genotypes and genetic pools potentially useful in productive processes either using traditional methods of genetic improvement or the most modern biotechnologies. Still today, however for many species used by man, there isn't a catalogue of the available genetic resources (data on genetic variability, distribution among the populations structure and organization within the populations etc.) in fact, just for few species, procedures for accurate preservation "*in situ*" or "*ex situ*" have been activated.

Taking into consideration such a situation the "Regione Siciliana" in recent years has started several projects aiming at tracing, preserving, multiplying, documenting and exploiting the germ plasma of cultivated species (varieties / races / ecotypes) and wild related species threatened by extinction or genetic erosion. Genetic erosion risk in natural populations is also being evaluated. The activity is mainly concentrated on exploitation of autochthonous genetic resources, trying to combine "*ex situ*" with "on farm" tracing and preservation for the cultivated species and "*in situ*" for wild ones. In Sicily, tracing, exploitation, preservation, and the setting-up of a germ-plasma bank has been started and partially carried out, especially as regards the following species: olive, vine, citrus, fruit-bearing, officinal, medicinal, cereals, leguminous, and vegetable plants.

The general objective of the activities in progress and of those which are being planned in cooperation with several scientific institutions, is to find, preserve and exploit "*in situ*" and "*ex situ*", autochthonous genetic resources which, at present, are under-utilized or threatened by erosion with interventions that can determine positive repercussions both for farmers and for small and medium size processing industries. To this regard, minor crops belong Pomes and Stone fruits, *Citrus*, shell-fruit, and other fruit bearing plants will be carefully evaluated by the Agriculture Extension Service (Servizio allo sviluppo) which already have a great experience in this field. The aim is the establishment of the 1st Catalogue of Sicilian Genetic Resources in cooperation with several scientific institutions involved in this project, within the next few years. In a second phase, cooperation with private enterprises will be necessary to realize small thematic collections enhancing the figure of the farmer as "guardian" and plant keeper of the originary patrimony.

CWR: grapevine, small and minor fruits in Georgia (The Caucasus)

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Cultivation of grapevine (*Vitis vinifera* L.) has ancient history in Georgia - it considered as one of centre of origin and domestication. In the Ampelography listed 525 autochthonous varieties. *V. silvestris* Beck., a wild ancestor of the cultural grapevine, still occurs in Georgia. Prof. R. Ramishvili investigated wildly growing grapevine on Georgia in XX centuries. He has prepared the map of spreading of wild grapevine; singled out 8 centres of concentration; collected 400 genotypes in collection and selected 20 forms with characteristic of ssp. *sativa* interesting for viticulture. Our institute renovate investigation and re-inventory of wildly growing grapevine of Georgia in the framework of the international project of IPGRI.

Widespread in forests of Georgia, cornel (*Cornus mas* L.) has three subspecies with red and yellow fruits. Population collect wild fruits. Simultaneously cultivated and different varieties exist in Georgia. Several species of *Rubus* spread on the Caucasus in wild conditions. Blackberry grows only in wild ecosystems and raspberry in culture too. Wild fruits utilises by Georgian kitchen. In forests of mountain regions grow several species of current (*Ribes* L.). Red current (*R. idaeus* L.) has been cultivated in Georgia since long time. Blueberry (*Vaccinium myrtillus* L.) grows only in wild ecosystems. Advanced breeding cultivars do not exist yet. In wild environments of Georgia grow and usable by population: gooseberries (*Grossularia* Mill.), strawberry (*Fragaria* L.), barberry (*Berberis*), wild rose (*Rosa canina* L.), hawthorn (*Crataegus* L.), persimmon (*Diospirus lotus* L.) and others. Wild grapevine, barberry and persimmon are bringing in the "Red book of Georgia" for *in situ* preservation. Biodiversity of wild grapevine (several forms only) are in *ex situ* conservation.

An overview on plant genetic resources in Albania, especially on crop wild relatives

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Although Albania is a relatively small country of 28,748 km², located in the western part of the Balkan peninsula on the eastern shores of Adriatic and Ionian seas, its territory is highly diversified. Its climate is characterized by a hot dry summer, strong sunshine, a generally mild winter and abundant rainfall. Thanks to these territory conditions, and corresponding to climatic variability, Albania is a rich country with a wide diversity of plant genetic resources. The fact that about 3,250 plant species are grown in Albania is very significant. In other words, there are 113 species per 1,000 km² surface. 157 of them are endemic species and subspecies. More than 300 species of them are aromatic and medicinal plants which are important economic natural source. 68 species are in danger to be lost. Early efforts about germplasm collection were reported on '30 years for wheat and maize cultivars collected by Professors Tashko and Vavako. But the first organized collecting missions seem to be "Balkan 1941-1942" by Hans Stubbe. An international cooperative project on plant genetic resources in Albania began in 1993. Collecting missions were undertaken and later, but there are not documented. More problematic is wild germplasm status. There was almost any organized collection mission for them. So, a Collection Germplasm Program financed by World Bank for three years, through Agriculture Services Project, is a powerful support, especially for aromatic/medicinal plants and wheat relatives. There were collected 348 samples of 11 aromatic/medicinal species and *Aegilops* sp. for two first years, organizing some collecting missions on 174 sites, belonging to 25 districts. There was good assistance from University of Bari, Italy. There are a lot of aromatic/medicinal species threatened to extinction due to the damage of their habitats. Another main cause of genetic erosion can be seen in the fast social and economic changes that are characterizing the country today. In our country these species are highly exploited by uncontrolled harvests which people carry out for own consume or to sell most of the production of those species in market. These harvests are completed without any efficient controls and biological planning, determining serious damages to natural populations of interested species. No National Program on Plant Genetic Resources has been planned, up to now.

Investigation on trees biodiversity, growing in the Templum Valley of Agrigento

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The archaeological and landscape park of the Templum Valley was established on November 2000 by the issue of a Regional law, and concern an area large 1300 hectares, from which 260 hectares are managed as public property while the residual land is still private. The Classic writers, attracted since the ancient time from the Templum hystory, described the richness of the Valley as area were growth vines, together with several trees of different species. The archaeological residual Templum continued to attract several travelling explorers, especially during the XVIII and XIX centuries that want "to touch" directly the beautiful spectacle described from the writers. It's a fact that the Templum Valley are representing a wonderful symbiosis between old hystory, in a fantastic frame where sea and sky, and local hospitality, made a special mixing of spiritual and material pleasure.

Although during the centuries the plants biodiversity was affected by the some negative human actions, in the area of the Templum Valley are remained a large number of plant samples that became completely integrated into the archaeological park as a single subject obtained by the synergism of the environment, the archaeology, the landscape and the local traditions. All those quality are synthesised in the Folkloristic Festival of "Mandorlo in fiore".

With the aim to study the natural plant patrimony growing in the Templum Valley and to facilitate in real time the plant technical maintenance, a preliminary investigation has been done in area of 260 hectares to list trees and shrubs growing in the park. The first step of the work was the acquisition of land registered and cartographic data and air-photos-frame. The second step consisted of the overlap of the data recorded in the land registering office and in the cartographic map, with the plant sites. The plants were distinguish as single tree or shrub or grouped population and botanically classified. Each of the identified individual (or population group) has been identified with identifying topographic coordinate, transcribed both in a geographic map and in a PC file. The identifying topographic coordinate take into account the land office data, also.

As conclusion of one year investigation, a total of 21.503 plants were monitored, from which: 8.471 almonds genotypes, 5444 olives trees, 145 pistachios trees, 40 carobs genotypes, 566 citrus trees, and a miscellaneous of 674 trees representing of different species. Beside that were found 1535 pear cactus, 414 ornamental species, 303 dwarfpalm and a surface of 5.14.23 vines.

The research must be considered as a preliminary contribution to the knowledge of the existing status of plant biodiversity growing in Templum Valley. Furthermore activities will have the aim to identify fully the other species and to prepare an itinerary plant map as part of archaeological itinerary.

Concept for establishing an inventory of CWR in Germany

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The wild flora in Germany shows approximately 4.500 taxa of ferns and flowering plants, of which ~ 3.600 are native plant species (incl. sub-species, apomicts, hybrids). Approximately 2.800 taxa are considered as crop wild relatives, incl. forest plants and ornamentals. *In situ* conservation and monitoring of CWR is part of the German national programme for PGR, which was established in August 2002. The realisation of this programme is supported by an advisory and coordination board and its working group on *in situ* PGR.

Regular surveys are carried out to record the wild flora on a grid basis, but the exact locations of populations of crop wild relatives are only known for very few species. Surveying gets more and more concentrated on the Natura 2000 network, but only 12 CWR species are listed in the Annex of the FFH directive. To what extent the habitats of the directive allow for conclusions on CWR has to be investigated. According to national law nature conservation is under the responsibilities of the 16 German Laender. For creating a national inventory (NI) on CWR it is therefore necessary to strengthen a cooperative approach. As a first step to build an NI, a catalogue of activities that deals with the recording of populations of CWR within the last 15 years is going to be compiled. Importance is set to document genetic studies. This catalogue shall provide a detailed overview of existing knowledge on the occurrence of CWR populations within and also outside of the network of protected areas and on the data that are available at the population and genetic levels. In parallel, a draft list of *in situ* descriptors was created, which builds the basic structure for the NI. Based on this concept a model project is intended that aims at (a) establishing an information flow from dispersed databases to the NI and (b) on promoting information on CWR to users like conservationists and plant breeders.

Conservation and utilization of officinal species germplasm in Sicily (Italy)

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For many vegetable species used by the man, a list of available genetic resources is missing (data about the genetic variability, the distribution of genetic variability in the populations, etc.). Several actions have been started up for not many vegetable species in order to obtain an accurate conservation *in situ* or/and *ex situ*. The aim of these actions is to collect, conserve, multiply, document and improve the germplasm of cultivated (varieties/ecotypes) and wild species that could be exposed to a risk of extinction or genetic erosion.

According to that, the Research Consortium for the Development of Innovative Agricultural and Environmental Systems (Co.Ri.S.S.I.A.) has begun a hard research activity about the valorization of autochthonous officinal genetic resources in order to improve their use in various sectors with agricultural, forestal, pharmacological, agro-industrial and environmental interests. During the research the exploration of Sicilian lands, the harvest and establishment of different living collections (oregano, rosemary and thyme species) were carried out. Because of the field investigations, several polymorphisms, existing inside the species, were determined.

Conservation priorities for crop wild relatives in Hungary

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According to floristical literature, the Hungarian flora has several crop wild relatives and species with potential for food and agricultural production. The natural flora of Hungary consists of 2161 vascular taxa, including 60 endemic and 2101 non-endemic species. Distribution of wild relatives by crop groups is the followings: forage legumes (41 %) with 92 taxa, grasses (28 %) with 62 taxa, vegetables (12 %) with 27 taxa, pulses (8 %) with 18 taxa, oil and fibre crops (6 %) with 13 taxa and cereals (5 %) with 11 taxa. The objectives of genetic conservation of crop wild relatives include the designation of priorities and proper methodology for effective conservation and monitoring the distribution and diversity of selected CWRs in Hungary. Collecting missions have focused on assessing samples from known and new habitats of rare and endangered crop wild relatives. It has been demonstrated that in the last decades certain natural populations of these taxa were severely affected by habitat disturbance and environmental stresses. Six species (*Aegilops cylindrica*, *Apium repens*, *Linum dolomiticum*, *Medicago rigidula*, *Onobrychis arenaria*, *Trifolium subterraneum*) were selected for detailed studies. The major aims of this study were to identify, collect and evaluate the occurrence and genetic diversity of these taxa within Hungary. Surveys were undertaken in collaboration with nature conservation experts of the Hungarian national parks.

Session 3

CWR threat and conservation assessment

ORAL ABSTRACTS

CWR threat and conservation assessment: overview

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A workshop was held under the auspices of the EC funded project, European Crop Wild Relative Diversity Assessment and Conservation Forum (PGR Forum) to look at the threats to European crop wild relatives (CWR) and how to assess their conservation status. The specific objectives of the workshop were to (i) assess the risk of extinction for selected European crop wild relatives, (ii) review the *in situ* and *ex situ* conservation status of the selected taxa, (iii) discuss methodology to conduct a gap analysis of conservation needs, and (iv) examine methods for producing a preliminary list of priority taxa for conservation action.

This paper presents the recommendations that were agreed at the workshop. These recommendations can be grouped under seven headings: (i) assessing the conservation status of CWR taxa (e.g., the compilation of a preliminary CWR Red List based on existing assessments at national, regional or global scales, and how to deal with 'recently' introduced taxa and 'casuals'); (ii) the identification of data gaps when doing assessments (e.g., the need for better distribution data at the appropriate scale, distribution data for infra-specific taxa, and the need to collect information on breeding and dispersal systems); (iii) what additional data sets would be useful for conservation planning (e.g., spatial data on threats, data on the location of protected areas, and information on existing legislation); (iv) how to set conservation priorities across Europe and within each European country (an approach to do this has been developed but requires testing); (v) *in situ* conservation planning (e.g., conducting a gap analysis using the MARXAN software), (vi) *ex situ* conservation planning (e.g., the proposed use of EURISCO data to conduct a gap analysis of European CWR in *ex situ* collections); and (vii) broader conservation planning (e.g., through raising awareness of CWR taxa and their incorporation in broader planning initiatives).

National approach for crop wild relative red listing: is it as difficult as we think?

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Crop wild relatives (CWR) have been identified as an important group of plant genetic resources for the 21st century. They include those species that are taxonomically related to socio-economic important crops to which they may contribute genes via traditional breeding and biotechnology. Their conservation and sustainable use is important for increasing crop production as well as for the maintenance of environmental stability.

However, this group of taxa is larger than had previously been appreciated. The PGR Forum CWR Catalogue for Europe and the Mediterranean contains 23,818 species (including crops), which is 77% of the Euro-Mediterranean flora. This means that with limited conservation resources it is necessary to prioritise taxa for immediate conservation action. One means of objectively establishing priorities is by determining the threat status. According to the Articles 6a and 7a of the CBD (1992), each ratifying country has the obligation to “identify the important biological diversity components” and to “develop national strategies, plans or programmes for the conservation and their sustainable use”. Moreover, Target 2 of the Global Strategy for Plant Conservation states that “a preliminary assessment of the conservation status of all known plant species, at national, regional and international levels” should be undertaken.

Threat assessment may be carried out in many different ways but in order for such assessment to be comparable it is preferable to employ a standardised system. Using the IUCN regional categories and criteria to assess CWR taxa at a national level provides a means of assessing genetic erosion and extinction risk and helps establish comparable conservation priorities. However, for individual countries, this task has not always been considered straightforward. In this paper the methodological stages involved in IUCN Red Listing of CWR, from data gathering to the application of assessment criteria, are presented in a systematic manner. The limitations of this approach are discussed and possible solutions suggested using specific national case studies.

Traditional farming systems in south-eastern Turkey: the imperative of *in situ* conservation of endangered wild annual *Cicer* species

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The area of the upper reaches of the Euphrates and Tigris rivers in south-eastern Turkey is now recognised as the core area where Near Eastern agriculture originated. Comparative genetic analyses (using both wild and domesticated forms) of wheat (diploid and tetraploid), lentil, chickpea, and pea suggest that many of the founder stocks of the Near Eastern crop plants are found in this area. Indeed the wild progenitor of domesticated chickpea *Cicer reticulatum* is a rare species reported only from this area. However, unlike wild wheats, lentil or pea that thrive in grasslands and open park forests of the region, two annual wild *Cicer* species (namely, *C. echinospermum*, and *C. bijugum*) grow in this area almost exclusively as weeds in traditional legume crops (lentil, bitter vetch, chickpea). This is probably due to their affinity to deep vertisols, which are suitable for traditional and mechanised farming. These two species are hardly known outside south-eastern Turkey and are therefore extremely important genetic resources for domesticated chickpea. While *C. reticulatum* is hardly encountered in arable lands, and therefore natural habitat protection may secure its future, the conversion of traditional systems in the region to modern irrigated farmland (e.g. for cotton growing and possible future application of organic farming) put these two species in great danger. This is because upon the introduction of herbicides or manual weeding, the two species will soon be extinct in the present centre of their distribution. It is proposed that international initiative should be taken to keep the traditional grain legume systems of south-eastern Turkey viable to save those important taxa but without compromising farmers' income and prospects for progress.

Ex situ conservation of crop wild relatives: representativeness and biases in genebank collections

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Ex situ collections of crop wild relatives aim to encompass most of the existing genetic diversity in wild populations. In order to achieve this, collections must ensure ecological or geographic representativeness of the accessions for a particular species throughout its distribution range. Thus, the evaluation of the representativeness of crop wild relative collections conserved in *ex situ* genebanks is priority to assess the quality of the collections and to design actions for the future. Gap Analysis, Geographical information system (GIS) and species distribution models are useful tools for studying genebank representativeness and collection biases. We used data from the Spanish central genebank (CRF-INIA) on *Lupinus* accessions collected in Spain to assess their representativeness and identify possible biases. Environmental and human-related georeferenced information was compiled in a GIS to perform spatial and statistical analyses. Our results provide CRF-INIA genebank with essential information about where and how to collect to improve the representation of existing collections.

Session 3

CWR threat and conservation assessment

POSTER ABSTRACTS

***Helichrysum arenarium* (L.) Moench conservation in Estonia**

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H. arenarium (*Asteraceae*), as protected species in Estonia, is included into category II and is placed in the Red Data Book. It grows on the northern border of its distribution area. Due to its weak competition ability, it grows in nature on extremely dry and relatively poor sandy podzols (mainly acidic, poor in nutrient elements but with the fast mineralisation of organic matter). Plant communities of habitats are also poor in species (mainly 12-25 dwarf-shrub and herb, 2-5 moss or lichen layer species). The number of habitats is diminished recently. The main reasons are: the changes in growth conditions (atmospheric and local pollution); the changes in plant communities due to natural development processes in communities (open sands and meadows are growing over, the thickening of former cut-over pine forests and young stands); the habitats destroying (mining of sand, mechanical forestry activities); the plant material use (medicinal drug, gardening and dry decoration material collecting). At same time, it is a well-known and widely used medicinal plant (as choleric, cholagogue, hepatoprotective etc.) in Estonia. Compound inflorescences are used as tea for treating gallbladder and liver disorders chronic diseases. The drug toxicity is low. Estonian law guarantees *in situ* conservation of *H. arenarium*. Its existing collection in the Institute of Pharmacy is one way of *ex situ* conservation of genetic diversity, and serves also as cultivation experiment. Some accessions from different habitats in nature as well in collection are characterised by morphological descriptors of vegetative and generative parts. The descriptors of accessions in natural habitats indicated fewer values in comparison with the same of collection plants. The diameter of compound inflorescence is sufficient for prognostication of drug production due to its strong correlation relations.

Session 4

Genetic erosion and genetic pollution of CWR

ORAL ABSTRACTS

Genetic erosion and genetic pollution of CWR: The PGR Forum perspective and achievements

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Genetic erosion and genetic pollution affect not only CWR but crops as well. While scientists have been aware of the causes and effects of genetic erosion for many decades, the identification of genetic pollution is a more recent concept and cause of concern. The European Crop Wild Relative Diversity Assessment and Conservation Forum (PGR Forum) elected, as one of the thematic backbones of the project, the discussion of how to assess genetic erosion and genetic pollution from conventionally and biotechnologically bred crops for European wild crop relative populations. This was the subject of a thematic workshop held with the objective to develop methodologies for the assessment and prediction of genetic erosion and genetic pollution, as they become an increasing risk to the *in situ* genetic conservation of European wild crop relatives. The Workshop held under the theme “Genetic erosion and pollution assessment methodologies” debated how genetic erosion and genetic pollution might be predicted and assessed, analysing existing methodologies and making recommendations on the more suitable ways forward. The methodologies developed to assess and predict genetic erosion and genetic pollution of European wild crop relatives contribute to the achievement of the objectives of the Key Action 2.2.3 - Assessing and Conserving Biodiversity, ensuring the conservation and promoting the sustainable utilisation of European socio-economically important species. The paper’s objective is to present and disseminate the outcome of the Workshop and its proposals.

Assessing the potential for ecological harm from gene flow to crop wild relatives

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Genetic exchange through introgressive hybridisation between crops and their wild relatives is not new and has occurred since the dawn of agriculture. However, interest in the phenomenon has increased dramatically with the widespread commercial release of Genetically Modified (GM) crops in many parts of the world. In this instance, attention has focussed on the possibility that a gene previously absent from the genus (i.e. the transgene) will enhance fitness of the wild relative and so cause ‘harmful’ ecological perturbations. Whilst there are certain features of some transgenes that do warrant special attention, in many ways the expansion of a successful crop from its native range provides similar scope for unwanted changes to previously allopatric crop wild relatives. The problem here is that the identity of the gene or genes that could lead to unwanted change are unknown, as is the nature of the change that could occur. Given the inevitability of gene flow between crop and most wild relatives in the context of sympatry, the challenge facing scientists is to specify which scenarios are most likely to occur and which of these will lead to ecological harm. In broad terms, unwanted change can be divided into *direct effects* on the wild relative itself and *indirect effects* to associated species that cohabit the community with the wild relative. Direct effects include scenarios such as extinction of the wild relative by genetic swamping, excessive genetic erosion (via genetic sweeps) leading to increased susceptibility to disease or abiotic stresses, or conversely, assimilation of traits that lead to enhanced invasiveness or weediness. The scope for indirect effect is rather more varied and ranges from population crashes or extinction of associates through to a radical change in community structure or function because of increased abundance of the relative. In this paper, I will describe the strategies available to assess risk for each of these categories of scenario and outline how to prioritise research effort to accommodate for the wide variety of potential outcomes.

Characterization of indigenous wild grapevine in France

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The indigenous wild grapevine, *Vitis vinifera* subsp. *silvestris*, is the ancestral form of *V. vinifera* subsp. *vinifera*, the cultivated grapevine. The latter is represented by 5 to 10 thousand cultivars in the world (called "cépages" in french), which produce wines, table grapes and raisins. The subspecies *silvestris* has never been domesticated and represents the only endemic taxon of *Vitaceae* family in Europe. The repartition of this subspecies extends from Portugal to Turkmenistan and from Rhine riversides to northern forests of Tunisia.

In this area, it is relatively frequent to find grapevine in natural environments, but they are generally old or recent cultivars that went back to wild status. These plants are capable of vegetative propagation. They can also cross with *V. v. silvestris* spontaneously. Consequently, different intermediary forms between wild and cultivated grapevines exist. The "real" *V. v. silvestris* are very rare, due to the strong genetic erosion during the last centuries. This taxon is not well-known and needs national updated surveys.

In 1999, we initiated an inventory and a characterization of wild grapevine in France. About 100 botanical stations and 300 individuals have been listed. The stations were characterized for their climates, soils, landscapes and vegetal associations. The number of plants, the inter-individual distance and the sex ratio were analysed for each station. The morphology of the individuals was studied, in relation with that of the cultivated and hybrid forms. Some biological characters of *V. v. silvestris* in natural environment were also assessed: development, vegetative propagation, phenology, fertility, pathogen susceptibility. This study confirms the scarcity of this subspecies and justifies its classification on the French National List of Protected Plants. The results contribute to enhance our knowledge of this botanical and viticultural heritages. They will allow us to reason about future prospecting and to consider concrete preservation.

Reciprocal introgression between wild and cultivated compartments of the peach palm (*Bactris gasipaes*, *Arecaceae*) in Western Ecuador

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Peach palm (*Bactris gasipaes* Kunth) is the only domesticated palm in the Neotropics. It is an important local food resource due to its very nutritious fruits. The human selection process, dating from pre-Columbian times, has been focused on fruit size, shape, color, starch/lipids ratio, and trunk spinelessness. Apart from this traditional use, modern cultures for the production of palm heart for canning and international exportation are developed in many Latin American countries. Plantations in western Ecuador have been established since a few decades, from seeds of Amazonian origin. Wild peach palms occur naturally near these plantations and are often conserved around the fields. To assess the genetic impact of this situation of sympatry, we undertook a population genetic analysis using 10 nuclear dinucleotide microsatellite loci and two chloroplastic (mono- and tetranucleotide) loci. We genotyped 80 wild and cultivated individuals from western Ecuador, and cultivated plants from Amazonia and Central America as reference populations. We detected high polymorphism in wild and cultivated samples and numerous presumably hybrid genotypes in both compartments. Hybrids were also characterized phenotypically by multivariate analysis of quantitative and qualitative fruit traits in wild and cultivated populations. The results clearly indicate ongoing introgression between the two compartments. As an introduced plant, the cultivated peach palm (*Bactris gasipaes* var. *gasipaes*) appears to local farmers as an entity totally distinct from the autochthonous wild peach palm (*Bactris gasipaes* var. *chichagui*). Preservation of the genetic integrity of wild peach palms is urgent, especially because of the unawareness of farmers of this on-going gene flow. Genetic pollution is a serious threat on wild populations already depleted by habitat reduction and fragmentation. The impact of introgression of the cultivated plants by wild individuals on the quality of the palm heart production still has to be assessed.

Impoverishment of the gene pool of the genus *Aegilops* L. in Armenia

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The territory of Armenia belongs to Western Asia Center of cultivated plants origin; many crop wild relatives, which are valuable material for genetic investigations and breeding, are still growing on the territory the republic. Increased interest to genus *Aegilops* L. is connected with the cytogenetic evidence concerning its role in the origin of tetraploid and hexaploid wheat (as source of B and D genomes). Species of goatgrass are a rich reservoir of genes for drought-stress tolerance adaptation to dry environments and stability against diseases as well. Nine *Aegilops* species with wide interspecific diversity have been discovered in Armenia: *A.cylindrica* Host, *A.tauschii* Coss.(*A. squarrosa* L.), *A.triuncialis* L., *A.triaristata* Willd., *A. crassa* Boiss. (*A. trivialis* Zhuk., [2n=42]), *A.biuncialis* Vis., *A.columnaris* Zhuk., *A.mutica* (Boiss.) Eig. /*Amblyopyrum muticum* Boiss./, *A. umbellulata* Zhuk.

As a result of increased urbanization and losses of habitat impoverishment of genetic potential of *Aegilops* is taking place. The results of the last field explorations showed that *A. crassa*, grown in the ravine of Razdan river now is under the threat of disappearance, only several plants can be met in this habitat. The only natural habitat of *A. mutica* near Erebuny state reserve at present is greatly shortened. The same situation is registered with *A. biuncialis*. So, having been under rapid genetic erosion these species have to be conserved both *ex situ* in seed collection and *in situ* in original habitat. With this purpose following activities are carried out at the Laboratory of Plant Genetic Resources within Armenian Agricultural Academy: collection missions conducting, definition of growing area, accessories evaluation (morphological, physiological, cytogenetic) and registration, storage, providing breeders with genetic material and evaluation data.

Session 4

Genetic erosion and genetic pollution of CWR

POSTER ABSTRACTS

The relationship between the agriculture modernization, and the fruit genetic erosion observed by analysing the plants offer from the nurseries catalogues

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The research is based on the hypothesis that:

- the survival of the fruit cultivars should be high as much more they are cultivated;
- the large cultivation coincide to the large nursery propagation of the cultivars, and these, as consequence, are regularly listed in the nursery catalogues;
- the cultivars missed from the nursery catalogues, could be probably lost or stored in some germplasm collection.

The third hypothesis, maybe, is realistic if referred to the first half of the XX° century when in Italy was not popular the establishment of germplasm collection; and the variety without any commercial perspective was easily considered “useless” and therefore abandoned. The policy to save the plant’s accession in the germplasm collection became more effective since the second half of the XX century, therefore for this period the cultivars not listed in the nursery catalogues, could not be necessarily considered lost.

The investigation was carried out by examining 122 nursery catalogues edited from the years 1897 to 2005 analysing almond, apple, apricot, cherry, peach, pear, plum, and quince fruits species. The examined catalogues were grouped in three periods: the first one from 1897 to 1932 including 33 nursery catalogues, the second one from 1933 to 1966 including 43 nursery catalogues, and the last group from 1967 to 2005 which included 46 nursery catalogues.

The criteria adopted to define the above years periods took in account the national laws issued to promote the improvement of the Italian agriculture. This policy started in 1933 (when was issued the Royal Decret n° 215 that funded the Integral Plan to Land Reclaimed) and was implemented by the “Piano Verde” laws, expired on 1966. These laws promoted significant change of the agriculture that moved from the land-owner old style management to the modern intensive farming. As consequence of these laws a dynamic expansion and reconversion of fruit plantation occurred. Who were the catalysers of this re-conversion? Of course the nurseries that started updating the propagated varieties but, at the same time, determined the abandon of several old fruit genotypes that, in many cases, were lost.

The genetic erosion has been quantified respecting the number of cultivars grouped in the first period, considered as 100%. The number of survived cultivars, recorded in the other two groups, has been calculated as relative percentage related to the first group. Results show that the survived cultivars are currently represented as follows: apricot and pear both 12%, apple, peach, plum and cherry ranged from 20% and 22%. Almond and quince, two species that practically resulted excluded from the fruitculture modernization, are those which have the higher surviving rate (25 and 28%, respectively). This observation is the evidence of the negative impact of the agriculture modernization on the genetic erosion.

These results could be useful to promote some project aimed the recovery the identified missed cultivars that, maybe, are kept in some germplasm collection or anonymously way stored, somewhere.

The importance of Sicilian phanerophytes as wild relatives of crop woody plants

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This study emphasizes the important and complex role played by Sicilian phanerophytes within agroforestry systems, as wild relatives of crop woody plants and to propose some suggestions for their conservation.

Many autochthonous woody Sicilian species, such as *Malus sylvestris*, *Prunus webbii* and all those entities (like *Pyrus pyraster*) included within *Pyrus communis*-cycle, are likely to be the ancestors of cultivated species and/or cultivars; several autochthonous woody species are often used within agroforestry systems (e.g. *Arbutus unedo*, *Pistacia lentiscus* and *P. terebinthus*, *Prunus mahaleb*, *Quercus suber*, etc.) and plenty of them have even been subject to human selective pressure (e.g. *Fraxinus angustifolia* and *F. ornus*, *Mespilus germanica*, *Myrtus communis*, *Olea europaea* var. *sylvestris*, *Vitis vinifera* L. subsp. *sylvestris*, etc.). Besides, many allochthonous species often used within agroforestry systems and sometimes escaped in the wild (e.g. *Castanea sativa*, *Ceratonia siliqua*, *Corylus avellana*, *Ficus carica*, *Olea europaea* var. *europaea*, *Opuntia ficus-indica*, *Prunus dulcis*, *Punica granatum*, *Rhus coriaria*, *Sorbus domestica*, etc.) have been subject to selection, too.

In the last years the above mentioned phanerophytes typical to the traditional tree culture experienced very fast genetic erosion, linked with the recent modification of agriculture techniques and policies. Against this process, protected areas seem to be the ideal place for plant resources *in situ* conservation; that is true especially for woody species.

On the conservation of the endangered European crab apple (*Malus sylvestris*): threats from hybridization with domesticated apple (*Malus × domestica*)

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The genetically endangered European crab apple (*Malus sylvestris*) is an endemic to Europe influenced severely by habitat modifications and potentially exposed to pronounced hybridization with cultivated relatives. The present study investigated the extent of hybridization between the wild species and its cultivated relative *Malus × domestica*. Crossability in genus *Malus* is known to be widespread and the present study proved this true also for the two species in question. A total of 178 wild individuals from four Danish populations were studied along with a reference sample of 29 old cultivars. Hybridization and genetic variation was studied using ten microsatellite marker loci. A morphological analysis was performed in order to 1) try to identify hybrids occurring in the wild and 2) test for correspondence between phenotype and genotype of the wild individuals studied.

Application of ordination and a model based cluster analysis to the molecular data, lead to two clusters consisting of wild and cultivated individuals respectively. This indicates that pronounced admixture between the two species is not present. At the population level, a high correspondence was found between geographic isolation from *M. × domestica* and genotypic and morphological indices of hybridization. As expected, isolated populations appeared less affected by hybridization than poorly isolated populations. Isolated 'pure' *M. sylvestris* populations could thus be identified indicating that genetic isolation of *in situ* protected populations is both possible and advisable. However, morphological and molecular evidence of hybridization was found to be divergent at the individual level. This is suggestive of some historical introgression into the *M. sylvestris* gene pool, and indicates that relying exclusively on either morphological or molecular characters as diagnostic markers in studies of hybridization between *M. × domestica* and *M. sylvestris* might lead to fallible results. Difference in flowering phenology was observed and could explain the low level of contemporary hybridization.

Session 5

***In situ* management and monitoring for CWR**

ORAL ABSTRACTS

CWR *in situ* management and monitoring: the time has come

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Effective *in situ* conservation of crop wild relatives requires that the maximum genetic diversity of targeted species is adequately represented in a network of a minimum number of genetic reserves carefully selected within the species' distribution range. However, proper *in situ* conservation is not accomplished by simply selecting a number of populations of the target species and conferring them a protected status. Populations need to be assessed and actively managed in order to achieve clear, measurable conservation goals — thus, the importance of designing and establishing specific management plans for the CWR species of a region. Once a particular management regime is put into practice in a genetic reserve, it is essential to be able to assess whether the conservation goals are being properly met. This calls for the establishment of monitoring protocols specifically formulated for this purpose. The importance of *in situ* conservation of crop wild relatives and its contribution to the overall conservation of plant biodiversity and plant genetic resources has been clearly reflected in the global strategies signed by the international community. Basic knowledge on how to design and execute management and monitoring procedures is now being provided by the emerging discipline of conservation biology. In addition, an array of local, national, regional and international initiatives is being put forward in CWR *in situ* conservation providing invaluable experience in this field. So, the time has come to implement wide-scale initiatives for the *in situ* conservation of crop wild relatives. In an effort to make this come true from a European perspective, PGR Forum has discussed management and monitoring methodologies and has produced a set of guidelines oriented to promoting the efficient use of these methodologies.

Does agriculture conflict with *in situ* conservation? A case study on the use of wild relatives by yam farmers in Benin

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Agriculture is often seen as a major source of disturbance for wild relative populations. Actual genetic benefits of geneflows from the wild relatives to the cultivated crops have been debated. We present a case study on yam in Benin (West Africa). It provides an example of wild relative populations that interact with the cultivated pool through farmers' practices.

In Benin the wild relative species *Dioscorea abyssinica* and *D. praehensilis* are sympatric with the cultivated species *Dioscorea rotundata*. The latter species is vegetatively propagated by farmers whereas the two wild species reproduce sexually. We documented a particular farmers' practice, named 'ennoblement' (also called "domestication" by some authors). This practice allows the introduction of spontaneous yams, supposedly wild (*D. abyssinica* and *D. praehensilis*), in cultivated varieties. Farmers collect spontaneous yams, grow them in particular conditions, and may decide to integrate these plants into their local varieties according to their tuber morphology.

We conducted genetic studies to assess the genetic nature of spontaneous yams ennobled by farmers. Using microsatellite markers, we demonstrated that wild genotypes are actually integrated in the cultivated pool through ennoblement, as well as spontaneous hybrids between wild and cultivated plants. This study shows that, through ennoblement, farmers introduce products of sexual reproduction in the vegetatively-propagated cultivated pool.

These results suggest to set up *in situ* conservation plans for *D. abyssinica* and *D. praehensilis*. Such plans should not preclude the harvest of wild plants by farmers, in order to enable the ennoblement practice. In the other hand, only the maintenance of this practice will likely ensure the survival of wild populations. Indeed, if the relevant local knowledge were lost, wild population habitats would be threatened by agricultural pressure. This raises questions on the interactions between agricultural intensification, farmers traditional practices and *in situ* conservation of crop wild relatives.

Management plans for promoting *in situ* conservation of local agrobiodiversity in the West Asia centre of diversity

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The West Asia region contains one of the three major mega-centers of diversity for crop of global significance. Wild relatives of wheat, barley, lentil, chickpea, almond, pistachio, pear and many species of *Lathyrus*, *Medicago*, *Trifolium* and *Vicia* are still found under natural habitats in rangelands and forest ecosystems and in field edges. The remaining populations are highly threatened by over exploitation, mainly overgrazing and by natural habitats destruction for agricultural and urbanization purposes. These species constituting valuable gene pools for wealth creation, food security and environmental sustainability in the 21st century and need to be conserved both *ex situ* and *in situ*, but farmers and herders do not always realized this genetic value.

The Global Environment Facility funded West Asia Dryland Agrobiodiversity Project implemented in two target areas in four countries, Jordan, Lebanon, Palestine and Syria, has surveyed the distribution, the frequency and density of these species within selected monitoring areas over the period of 2000-2004 and has assessed the major factors of their degradation. Management plans were developed for selected sites to promote *in situ* conservation of these crop wild relative (CWR) species within their natural habitats. These plans are the first of its kind dealing with manage and the sustainable use of a designated site to conserve distinct CWR species of global important for food and agriculture.

Management plans include technological, institutional and policy options as well as alternative sources of income which will allow full participation of local communities in the conservation and management of local Agrobiodiversity. For some highly threatened species such as *Triticum* and *Lens*, protected areas are designated. A monitoring system should be conducted to assess the changes as well as the effectiveness of the management options on diversity of the target species.

Government and international support are needed to implement the proposed management plans if species of global importance are to be safeguarded to overcome environment challenges caused by climatic change and biotic stresses. This contribution will present the approach for the establishment of management plans and the examples developed within the Dryland Agrobiodiversity project in Palestine, Lebanon and Syria.

***In situ* conservation strategy for wild Lima bean (*Phaseolus lunatus* L.) populations in the Central Valley of Costa Rica: a case study of short-lived perennial plants with a mixed-mating system**

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In order to propose *in situ* conservation strategy for short-lived plants with a mixed mating-system, a case study was undertaken for the wild Lima bean (*Phaseolus lunatus* L.) populations distributed in several locations of the Central Valley of Costa Rica, a diversity centre for the Mesoamerican genepool of the species. Genetic structure, gene flow, soil seed bank and demography were investigated in representative populations of the Valley with a view to identify major factors influencing the dynamics of the wild populations and to develop an *in situ* conservation strategy. Results showed a predominantly self-pollinating system, a high interpopulation variability, a small effective neighbourhood size, heterogeneous gene flow values and presence of an important soil seed bank. At any given location, populations were subject to frequent extinction, recolonization, expansion and fragmentation. The establishment of a preliminary life cycle graph allowed identification of key factors in the survival and growth of the wild populations. It is suggested that the future of wild Lima bean conservation in the Central Valley of Costa Rica will rely on the design of synthetic populations implemented in protected areas and made with seeds of nearby populations collected in their origin sites. First trials were carried out on such populations to monitor their dynamics and to establish a careful management of the most representative wild Lima bean genepool in the Central Valley. The relevance of this study for *in situ* conservation of other species with similar breeding system and life cycle is discussed. Results from these investigations can be useful to implement an *in situ* conservation programme for crop wild relatives in regions characterized by a high genetic diversity of the target species but, at the same time, a strong pressure of disturbance factors, such as growing human demography, rapid change in land use and agricultural intensification.

Population performance of *Arnica montana* in different habitats in Lithuania

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Arnica montana L. is an important medicinal plant that has become quite rare and endangered in Europe. The decrease of its populations is mostly considered as a result of habitat loss and plant over-exploitation by collecting it for medicinal purposes. The aim of the current study is to estimate the present status of *A. montana* populations in different habitats and to envisage their further performance. The analysis of phytocenotic scale, population stage structure and morphological descriptions of plants were made at 34 localities in the south-eastern and eastern parts of Lithuania. Two different habitat types were distinguished within the distribution range of *A. montana*. The species occurs in the forest communities of *Cladonio-Pinetum* and *Peucedano-Pinetum*, and in a meadow community of *Polygalo-Nardetum strictae*. The forest habitats, where arnica occurs most commonly in Lithuania, are dissimilar to those described in the other parts of Europe. The analysis of population structure was based on the number of individuals in different ontogenetic stages of a life cycle. Within forest habitats the populations of arnica were characterized as 'normal' type and within the meadow one – as 'dynamic' type. The meadow populations were significantly over-represented by high density of immature and generative plants. Two types of populations differed from each other in total plant density either. In the meadow there was a significant increase in total density of individuals if compared to the forest habitats. The results of phenotypic investigations suggested the species is relatively homogenous within the corresponding vegetation type. In general, there appeared existing a strict linkage between habitat, vegetation and population types. It should be noted that the local populations of arnica does not yet face any evident threat.

A designated nature reserve for *in situ* conservation of the wild emmer wheat (*Triticum dicoccoides*) in northern Israel

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The discovery of the wild emmer wheat (*Triticum dicoccoides*; WEW), in the north of Israel by Aaronsohn in 1906, was a revolution in improvement of one of the three most important energy sources for the human diet. It is now well established that Neolithic agriculture developed in the Middle East depended primarily on the domestication and subsequent cultivation of WEW. Natural populations of WEW are confined to the Fertile Crescent. The species has its center of origin and diversity, and attains its widest morphological variation and ecological range in Israel, Jordan, Southern Syria and Lebanon. The rediscovery of the WEW evolved world wide research and development of new varieties. Continuous investigations have been carried out in Israel since 1908. With the remarkable revolution in biology and plant science, WEW research is undergoing a revival, which has attracted the attention of the scientific community, public institutions and government to the natural resources and indigenous plants in Israel and has raised the awareness to *in-situ* conservation of food progenitors.

Two International workshops carried out in Israel (1990, 1999) summarized the research and supported the idea that WEW harbours rich genetic resource polymorphism appropriate for wheat improvement. It was strongly recommended to establish nature reserves dedicated to WEW's *in situ* conservation.

A long range transect through the different populations have shown highest morphologic and genetic differentiations over very short distances in the Kibbutz Amiad area (East Galilee), on the karst limestone formation of the Eocene era, providing diverse microhabitats. Therefore the Israel Nature and Park Authority chose the Amiad region as a nature reserve dedicated to WEW's *in situ* conservation. A 380 ha area was allocated and the very long process of a nature reserve declaration is ongoing. The proposed nature reserve encompasses a rich species' grassland with ca 400 vascular plant species and an active management of cattle grazing. The Kibbutz was primarily opposed to declaration of the nature reserve, but then had to rescind the decision when realizing that development of the near-by town Zefat, was a greater threat than a nature reserve with grazing rights for their own herd ensured in the nature reserve regulations.

Three other near-by nature reserves, with similar habitats and with populations of WEW, have been located, encompassing an area of 1173 ha, one of which is the Rosh-Pina stream, where the WEW was first discovered by Aaronsohn.

Potential for integration of wild plants and landrace conservation within farming systems

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Spontaneous plants (including wild crop relatives) are commonly collected and used for food, medicinal or ornamental purposes in Italy. Their diffusion and use is linked to the habitat and cultural diversity which characterises Italy. All the same, landraces are still found and used throughout Italy. Just to mention some figures relative to edible plants, over forty wild species are reported to be commonly used in the Central and Southern part of the peninsula and over four hundred landraces were found in Central Italy during a ten-year period of collection missions. Most of these wild species and landraces are under threat due to habitat alteration and loss and changes in the social-economic context. In the context of conserving and using crop wild relatives, landraces which are cultivated where their relatives exist are of particular interest. Action to rescue and preserve this wealth of biological diversity is urgently needed. Examples are given from which the possibility of success and constrains to an active conservation are highlighted. A perspective for on-farm conservation of landraces in Italy seems to be, at least for part of the landraces still existing, the promotion of their use to obtain typical products. This can also be done in 'modern' farming systems. However, the major part of the landraces found are only grown for private consumption. These landraces appear severely endangered with the risk of extinction due to the advanced age of the farmers. Reinforcement of the links between the rural communities, their plant genetic resources and the pride of their heirloom, appears to be needed in order to stimulate and convince the younger generations to continue growing landraces. As for wild species, *in situ* conservation activities should mostly be based on recovering the traditional use of these plants in farm families as well as on recovering the traditional management of the territory. In addition, promotion of their use in local tourist circuits or markets could also serve the purpose, but great attention should be paid to the risk of overexploiting them, for which the possibility of cultivating them should be better explored.

Session 5

In situ management and monitoring for CWR

POSTER ABSTRACTS

Monitoring of fruit wild relatives in Albania

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During the years 1999-2005 the “Monitoring of fruit wild relatives in Albania” project was realized. Investigation, exploring, collection and conservation of fruit wild relatives have been the objectives of this project. The diversity of wild germoplasm is presented and it is related to geomorphology, climatic variability and history of our country. Organized expeditions carried out at the exploring and collecting of numerous wild relatives of stone and pome fruits, nuts, hazel, pomegranate, fig, grapevine, olive, and small fruits. Every zone of study *in situ* is described by topographical point of view, elevation, and type of spontaneous plants. It was made survey of the density for the number of plants that are explored and are described the morphological types of flowers, leaves, the size and colours of berries for explored plants.

A list of 62 candidates that concern 17 species considered as main for conservation have been collected and deposited in Fruit Trees Institute of Vlorë. There are characterized by minimal list descriptors. It appears essential to preserve this heritage that could be a source of diversification in the future.

Native litchi and their wild relatives-taxonomy gap, *in situ* conservation plan in Vietnam

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We are still long way from identifying, separating and giving names to native taro and wild relatives. This is a big gap in agro-ecosystem of Vietnam underpin decision making in conservation of biological diversity, sustainable use of its components and equitable sharing of the benefits derived from utilization of genetic resources. Taxonomy delivers stable classification and unequivocal names, both of which facilitate communication to conserve, manage or use biodiversity more efficiently. *In situ* techniques involve the maintenance of genetic diversity at the location where it is originated either in wild or in traditional farming systems. Recently, *in situ* conservation of wild crop relatives in their natural habitat and crop species in traditional farming systems, has become one of the important components of the National Programme. The highest priority have been given to globally significant species related to crops, which are in the primary gene pool of native litchi and wild relatives such as *Litchi chinensis* Sonn, *Nephelium lappaceum* L., *N. cuspidatum* Blume and many other subspecies, varieties does not yet have a scientific name in available documents bearing local names by farmers such as “*Qua Ke*”, “*Vai Guoc*”, or “*Mac Chia Ban*”, etc. In this paper, selection strategies of target species and gene management zones (GMZs); methodologies for litchi relatives conservation, management and monitoring plan for genetic diversity of target species in selected GMZs are discussed.

Temporal genetic variation in wild emmer wheat

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In situ conservation of wild crop relatives in their natural environment is one of the most efficient ways to secure the long term maintenance of their invaluable gene pools. Yet, while information on long-term variation, affected by yearly changes, is of prime importance, it has been considered only in few studies. The aim of the present study was therefore, to estimate the temporal genetic variation in a population of wild emmer wheat, *Triticum turgidum* ssp *dicoccoides* (2n=4x=28; genome BBAA), the progenitor of most domesticated tetraploid and hexaploid wheat. Single spikes were collected in 1988 and 2002 from plants in the same sampling points, from three sub-habitats in Ammiad conservation site, Eastern Galilee, Israel. Forty seeds from each sub-habitat (20 from 1998 and 20 from 2002) were planted in a nursery. From each plant DNA was extracted and analyzed by amplified fragment length polymorphism (AFLP). The results showed that, in addition to considerable genetic variation within and between sub-habitats, there were substantial differences in the genotypic constitution of the 1988 and 2002 plant collections. The temporal genetic variation was proportional to the within sub-habitat genetic variation. These results indicate that there might be great genetic differences in the population genetic structure in different years. In contrast to *ex-situ* conservation, *in situ* conservation is dynamic and secures the whole genetic diversity existing in the seed bank of the conserved population and hence, the safest and most efficient way to achieve the long-term maintenance of the largest possible genotypic diversity of the population.

Microsatellites as a model for decision making in *in situ* management of wild beets

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Wild beet population samples were collected from 15 well established populations on the Swedish west coast distributed from south to north. The collected leaf samples were subjected to microsatellite analysis in three loci. The data were analysed and an UPGMA dendrogram formed to give a survey of the distribution of the diversity among the populations.

This experiment can serve as a model for how molecular data may be used for designing an *in situ* management scheme in the southern Swedish provinces and throughout the whole Baltic Sea area.

Identification of valuable populations of the widely distributed crop wild relatives using *Rubus idaeus* L. as an example

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Many crop wild relatives are widely distributed species, and in this relation a question arises about selecting populations of special importance for conservation. Using *Rubus idaeus* L. as an example, we propose a complex selection of valuable wild populations for in situ conservation. Wild *Rubus* taxa are potential sources of new genetic material for cultivated raspberry breeding. Twelve raspberry populations in the Leningrad region have been evaluated. A decision about the necessity of conserving particular populations was made on the basis of a detailed analysis of such aspects as the presence of plants with useful traits for cultivated raspberry improvement, their genetic diversity, presence of botanical varieties, remoteness from cultivars and viability status.

To exclude the run-wild forms from the evaluation process, we tried to identify them applying a mathematical model developed by means of statusmetry. The constructed model is based on morphological features of leaves of primocanes and helps to distinguish the wild forms from the cultivated and run-wild ones. The diversity of wild raspberry populations was assessed by variation of seed storage proteins obtained by SDS-PAGE method. All studied populations showed polymorphism of the polypeptides banding patterns and differed by their quantitative ratios. The morphological features were subjected to the principal component analysis which confirmed the level of population diversity revealed by the seed proteins variation.

The results of viability status assessment for the chosen populations reflect the perspectives of their development and permit to determine the strategy and measures for optimal conservation.

***In situ* conservation in Peneda-Gerês National Park of Gerês lily (*Iris boissieri*), wild daffodil (*Narcissus pseudonarcissus* subsp. *nobilis*) and bastard balm (*Melittis melissophyllum*)**

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In the Peneda-Gerês National Park (Portugal), a project concerning *in situ* conservation with Gerês lily (*Iris boissieri*), wild daffodil (*Narcissus pseudonarcissus* subsp. *nobilis*) and bastard balm (*Melittis melissophyllum*) has begun in 2004. The first two plants are NW Iberian Peninsula endemics and wild relatives of ornamental iris and daffodils. The third plant is medicinal and probably threatened by the over-harvesting.

The project has two main goals. One is a better knowledge of the three plants ecology, conservation status and threats. The other is implementing conservations measures to maintain/increase population size and recover/increase species distribution areas. This project pretend also to apply knowledge from *ex situ* studies about vegetative and seeds propagation techniques developed since 2003.

A survey allowed to find 5 places with *Iris boissieri*, 3 with *Narcissus pseudonarcissus* subsp. *nobilis* and 21 with *Melittis melissophyllum*. In this first year, were evaluated 4 Gerês lily populations, 1 daffodil and 4 bastard balm. The *I. boissieri* and *M. melissophyllum* populations are small, ranging from two individuals to 146 individuals. They are also sparse, specially *I. boissieri* that the more densely population has 0,25 individuals/m². The *N. pseudonarcissus nobilis* population have 1703 bulb units and a relative low density of 3,12 bulb units/m². Possibly, the main threat to some *I. boissieri* populations is a weevil (*Mononychus punctumalbum*). Others threats may be herbivory and harvest. In *N. pseudonarcissus nobilis* populations the threats are the fire, the flowers cut, the collection and destruction of bulbs. The main threats in *M. melissophyllum* are the habitat degradation by fire and the over-harvesting.

A conservation measure that has been applied to small's populations is assisted propagation. Others conservations measures are fences, slashing and environmental education of the medicinal plants collectors, local population and visitors about the importance of plant resources conservation.

Conservation of wild grapevine genetic resources in Tunisia: Characterization by RAPD and SSR markers

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Wild grapevines are autochthonous liana which used to be frequent especially in alluvial and colluvial forests. Nowadays, they are still suffering from important erosion. Indeed, direct and indirect human impact on its habitat added by climatic constraints lead to its rarefaction and since 1980, the IUCN has added it to the list of endangered species. In Tunisia, wild grapes are also few. Indeed, they are available only in the North of the country (Zoghalmi et al. 2003).

The goals of this study were to (i) assess the genetic diversity within Tunisian wild grapes by means of RAPD and SSR markers (ii) valorise these genetic resources throughout comparison with a set of cultivated autochthonous varieties. The evaluation of genetic diversity by means of 54 RAPD markers allowed us to conclude that among this flora, polymorphism was less pronounced than within the cultivated varieties. Nevertheless, the use of 10 SSR markers has shown that the wild grapes were more diversified than the cultivated. Indeed, more alleles (103/84) and genotypes (175/159) were yielded. Among these markers, 31 alleles (30.09 %) were observed only in wild grapes and 11 (13.09 %) were observed only in cultivated. The presence of alleles specific to wild grapevine supports its originality as an independent source of genetic variation.

This study shows that genetic investigations should be a preliminary step in program of conservation of rare plant species.

Session 6

Ex situ conservation of CWR

ORAL SESSION

EURISCO a window on Europe's plant genetic diversity: Overview of European CWR collections

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Complementary conservation strategies couple the protection of wild plant populations and traditional crop varieties where they have evolved, with the collection and conservation of genetic diversity in genebanks. However, since the beginning of the modern conservation of plant genetic resources, less work on *in situ* than *ex situ* conservation has been made.

The information systems developed along the years to document *ex situ* conservation activities are well known and serve as a well established example to further develop and improve other documentation and information systems.

Providers and user often wondered how to make the plant genetic resources information data available and consequently where and how to look for it. In the present case the European *ex situ* community by contributing for the development of the so desired "one stop shop" contributed not only for the inventory of crops but also wild crop relatives material maintained *ex situ*. The development and establishment of the EURISCO Catalogue came to fulfill these and other purposes.

EURISCO is the first regional catalogue of Plant Genetic Resources. Is composed of, and updated with, data from the National Inventories (NI) of PGR accessions maintained *ex situ*. It currently contains passport information on over 926,000 accessions from 32 European countries on 1275 Genera, 7919 species and 926231 accessions.

EURISCO, at the present, holds passport data on 72% of the NI representing 50% of the institutions holding germplasm material identified as wild, wild natural and semi natural on a total of 727 genera, 2589 species and 36897 accessions.

EURISCO offers researchers, breeders and other users around the World a single entry-point to plant diversity held by the member countries of their *ex situ* collections. This represents around two million accessions across the continent, distributed in more than 500 European genebanks, roughly 15% of total worldwide holdings. Today, EURISCO is the "one stop shop" for the *ex situ* expert community in Europe.

Information on *ex situ* collections of plant genetic resources in Europe has reached a more advanced level of development and standardization. It is estimated that more than 2 million accessions are conserved and well documented in genebanks in Europe. Information on these valuable resources has been standardized in accordance to agreed international standards such as the FAO-IPGRI Multi-crop passport descriptors. These can be seen through a central web-based catalogue: EURISCO.

The EURISCO Catalogue could set out the model to meet the information needs of *in situ* conservation considering both what information is needed and how it can best be maintained and used.

***Ex situ* conservation of wild species: the botanic garden perspective**

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Botanic gardens have an important technical role to play in the *ex situ* conservation of wild plant species. Botanic gardens possess both information and skills with application to conservation, and these may be delivered directly, as services to conservation practitioners, or through training in appropriate techniques. The provenance data that botanic gardens hold in their living collections and herbaria are a primary source of information about wild plant localities, conservation status, phenology and appearance. These data can be used in prioritising, targeting and finding wild species. Once a wild plant has been located, botanic garden staff have the experience and skills necessary to enable efficient collection and processing of seed and/or living plants. In many cases BG staff will also have the relevant skills to germinate and propagate wild plants, and ensure the successful establishment of *ex situ* collections. For BGs with seed banks, short to long term seed storage is a service that can be provided, and for those with molecular laboratories, conservation genetics services may be offered. Many BGs are also able to provide training in *ex situ* conservation techniques. Case studies are presented incorporating all of the above, and suggestions are made as to how BGs might become more proactive in *ex situ* conservation.

Conservation of Spanish wild oats: *Avena canariensis*, *A. prostrata* and *A. murphyi*

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The Western Mediterranean has been suggested as the center of origin for some tetraploids and hexaploids oats as the most biological species of the genus *Avena* coexist in the area between Southern Spain, Western Algeria and the Canary Islands. Most of the species described in Spain are widely distributed in Europe and they present abundant populations; however, three of them are restricted to a few scarce populations in a limited area (*A. canariensis*, *A. prostrata* and *A. murphyi*). *Avena canariensis* and *A. murphyi* are included in the Spanish Redlist, and although *A. prostrata* is not mentioned, the ECP/GR *Avena* Working Group considered that it should possibly be a red list species.

In order to form an *ex situ* collection of these species, several expeditions have been carried out. The main characteristic of the collection is that a single panicle of each plant was collected and stored separately; when multiplication was required, one seed per plant was sown and the descendant seeds were again stored separately. In this way, and due to the high levels of self-fertilization in these species, the genetic structure of the sample is maintained unchanged. The genetic variability of the populations has been estimated using different kind of markers (isozymes, RAPDs and ISSRs), and several parameters were used to describe the level and structure of the genetic variation. The results show a substantial amount of genetic variation in the three species, in spite of the small number of populations analyzed and the reduced size sample in some of them. A significant fraction of the genetic variability of these species is due to population differentiation; therefore, further collections are suggested. Actions to develop *in situ* conservation programs have not yet been implemented, and these results may help to define which populations are critical in order preserve the maximum genetic variability in these species.

Analysis of wild *Lactuca* genebank accessions and implication on wild species conservation

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The *Lactuca* genus comprises numerous species among which lettuce *L. sativa* and its wild progenitor *L. serriola* are the most important, from the breeding and nutritional point. Wild relatives of *Lactuca sativa* are considered to be the source for the resistance genes and since there is the possibility of crosses between some *Lactuca* species, the importance of research on the genus and its interspecific relationships is quite. Here we present data of survey from 12 *Lactuca* species preserved *ex situ*, as many *Lactuca* accessions are collected and preserved in genebanks worldwide. Analyses have been performed with the use of AFLP, with three primer combinations, in order to study relationships between wild species and their conservation. Five species were studied as whole collections: all available genebank accessions of *L. aculeata*, *L. dentata*, *L. dregeana*, *L. livida*, *L. quercina* were included in our studies. We have confirmed the existence of a primary, secondary and tertiary gene pool for cultivated lettuce. Population genetics parameters have been calculated and analyses of intra and inter accession variability performed. Within some accessions, molecular findings showed that questions raised during morphological analyses towards species determination have been correct and some accessions are probably not properly labeled taxonomically. Many conclusions drawn from the *Lactuca* collections analysed here can be applied to wild species conservation in the genebanks in general and these items are discussed.

The role of botanic gardens in the conservation of CWR

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There are over 2,500 botanic gardens in existence worldwide. Collectively they contain over 6 million plant accessions and receive over 200 million visitors a year. Many botanic gardens are playing an active role in both the *in situ* and *ex situ* conservation of crop wild relatives. A number of botanic gardens hold extensive field collections of crop plants and their wild relatives, examples being the mango collection at Fairchild Botanic Garden, USA and the breadfruit collection at the National Tropical Botanic Garden, Hawaii. Many botanic gardens are also involved in projects focused on the sustainable utilisation of crop wild relatives, providing expertise in propagation and cultivation techniques and working with communities on the development of sustainable harvesting practices. As well as the conservation of valuable plant genetic resources, botanic gardens also play a major role in the collection and maintenance of indigenous knowledge related to crops and other useful plants, and in raising awareness of the importance of these plants. This paper provides an overview of the role of botanic gardens in the conservation of crop wild relatives as well giving details of the work of Botanic Gardens Conservation International (BGCI) in developing an on-line, searchable database of botanic garden plant collections. The paper also describes how the work in this area contributes to various targets of the Global Strategy for Plant Conservation, including Targets 8, 9, 13 and 14.

Session 6

Ex situ conservation of CWR

POSTER ABSTRACTS

Wheat wild relatives – A 25-year program of *ex situ* conservation

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Israel, which is located at the southern end of the "Fertile Crescent", is very rich in populations of wild ancestors and relatives of many cultivated crop species. Countrywide large scale urbanization, road construction, and use of herbicides endanger or even entirely destroy many of these wild populations. This process is not necessarily a danger to the existence of a species, but it causes drifts in its genetic constitution.

Facing this danger, a program of *ex situ* conservation of wild relatives of wheat was launched in 1980. Under its umbrella are six species: wild emmer, which belongs to the primary gene pool and five diploid *Aegilops* species (section *Sitopsis*) of the secondary gene pool. Systematic collections of a single spike samples were carried out in populations of each of the six species, using the transect method to ensure a random sampling of the variation present. The choice of populations aimed at covering the geographical distribution and all different habitats of each species. Each collected accession was propagated in a field nursery and subjected to tests of its response to fungal diseases of cultivated wheat. Many of the collected accessions showed a high degree of resistance to one or more of the pathogens tested. Repeated collections were carried out on the basis of the results of these evaluations. Each accession was harvested separately and stored in cold rooms of our seed bank. In all, 7226 accessions from 168 wild populations have been collected and studied so far.

In parallel to the collection and the study of the wild plant population, we have also studied their fungal pathogens in depth and thereby gained a good understanding of the nature of host-parasite interaction in the natural habitat.

A national Italian network to improve seed conservation of wild native species ('RIBES')

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At the beginning of April 2004 a group of approximately 20 Italian institutions interested in seed conservation of native wild species came together in Trento (NE Italy) to discuss the opportunity to team up to manage more efficiently, at national level, native seed conservation practice. Since then additional meetings took place in Rome, Milan and Pavia, giving the opportunity to discuss in detail and approve with a participative approach a consortium agreement, a charter, an action plan and various internal regulations. The acronym chosen, 'RIBES', stands for 'Rete Italiana Banche del germoplasma per la conservazione *Ex Situ* della flora spontanea italiana - The Italian Seed Bank Network for the *ex situ* conservation of the Italian native flora'. The network activities will focus on seed conservation of both endangered wild species that might be used for reintroduction and non endangered wild species that might be used for habitat restoration and land reclamation. These target species might well include CWR, though the network is not focused specifically on CWR. Nevertheless it aims to establish active links with the CWR conservation community in order to integrate possible overlapping areas of interest, producing mutual benefits. Members of the network are mainly university botanic gardens but also include local governmental agencies, national parks, no profit organizations and private companies. They represent most Italian regions and include key members that are already involved in other EU networks such as Ensconet and Genmedoc, providing in this way an active connection with the European context. This initiative can be considered an effective contribution to the regional and national implementation of the CBD-UNEP Global Strategy for Plant Conservation (in particular to targets iii, viii, xiv and xvi).

Conservation and characterization of *Myrtus communis* germplasm

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Myrtus communis L. is a shrub widespread throughout the Mediterranean Basin and the Middle East (one of the most important species of the maquis) and is grown for its ornamental value and the aromatic properties. Germplasm diversity within wild myrtle populations has not widely evaluated yet: the knowledge of such aspect is important not only from a botanical point of view or forest resource management, but also represents a basic step in developing breeding programmes or for selecting original plant material with improved ornamental traits. A collection of myrtle germplasm consisting of wild and cultivated plant material has been established in the recent years at the C.R.A. Experimental Institute for Floriculture (Sanremo, Italy). It consists of 45 genotypes coming from different regions of Italy (Liguria, Tuscany, Apulia, Campania, Sardinia, Sicily), 10 accessions of seed plant material obtained from Botanical Gardens of different countries around Mediterranean area (Spain, Portugal, France, Croatia, Greece, Israel) and 3 cultivars. Research activity performed on this plant material has regarded characterization of morphology, phenology, response to propagation *in vitro*, genetic relationships of the collected plant material by AFLP (Amplified Fragment Length Polymorphisms) markers. Data show a high intraspecific variability, especially among genotypes from Eastern and Western area of Mediterranean Basin, as demonstrated by AFLP analysis and by some morphological traits. The plants of the collection are maintained *in vivo* and, sometimes, *in vitro*; some genotypes (the most interesting for ornamental purposes) have been multiplied for cultivation use.

Tissue culture as a tool for *ex situ* conservation of wild pear: the role of the exogenous carbohydrates

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Tissue culture plays a critical role in *ex situ* conservation plant genotypes. Therefore, the development of reliable *in vitro* protocols is of great importance for conservation of plant species allowing to apply methods of slow growth storage at low temperature and of cryoconservation. Wild pear (*Pyrus pyraster* [L.] Burgsd.) plant family Rosaceae, is native to central, western and southern Europe and generally occurs in mixed hardwood forests, in hedges on farmland and in very extreme sites. It is very interesting for forestation and for the production of timber wood, highly valued on the market. Some studies regarding *in vitro* culture of this species have been performed.

In tissue culture type and concentration of sugars in the micropropagation medium affect quality and morphology of the explants and their survival to storage. The aim of the present research on wild pear was to optimise the quality of the *in vitro* grown material and the response to storage, evaluating the effect of different carbohydrates during the multiplication phase and the storage process at low temperature and in cryoconservation. A wild pear spontaneous seedling, collected by the Fruit Trees Research Institute of Rome, were established and propagated *in vitro*. Different carbohydrates (fructose, glucose, maltose or sucrose) were applied during the multiplication phase. The response was also studied at physiological and biochemical level by monitoring water, chlorophyll, carotenoids and phenol contents and pH and osmolarity in the culture medium. The type of sugar affected the multiplication rate and the physiological parameters. Sugars which gave the best response during the multiplication phase were used for storage experiments at various concentrations and the changes of the same physiological and biochemical parameters were investigated to evaluate effects on survival and on plant morphology and quality. Genetic stability of micropropagated and conserved material was also evaluated through DNA analysis.

Seed conservation studies in rare and threatened wild relatives of citrus in Australia

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The Australian species of the *Citrus* genus have edible fruits and are wild relatives of commercial citrus varieties. Australian *Citrus* species are a reservoir of genetic diversity with many traits not found in commercial varieties. These traits include: disease resistance, salt tolerance, dwarf habit and unique fruit characteristics. The two northern Queensland rainforest species, *Citrus inodora* and *Citrus garrawayi* are listed as vulnerable and rare respectively and are protected under the *Queensland Nature Conservation (Wildlife) Regulation 1994*. Long-term *ex situ* conservation of this novel and diverse germplasm is of significant interest for current and future breeding programs as well as *in situ* regeneration and restoration programs. Seed supply of *C. inodora* and *C. garrawayi* is limited and seed storage may not be orthodox. This paper reports on investigations of desiccation and low temperature tolerance of seed of *C. inodora* and *C. garrawayi*. Seed of both species showed some tolerance to desiccation and low temperatures with growth and acclimatization of plants post cryostorage achieved. This study demonstrates a potential *ex situ* storage technique for the valuable germplasm of Australia's northern *Citrus* species.

Crop Wild Relatives in the Dutch genebank: importance and use

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In the CGN collection the presence of wild relatives ranges from 0 to 87 percent depending on the crop. For potato this percentage is 87, for lettuce nearly 40 and for cucumber 0. For other crops this percentage is between 0 and 10. On average 13 percent of the CGN collection consists of crop wild relatives (CWR). However, these CWRs account for 25% of the distributed samples.

CGN actively expands the amount of crop wild relatives in its collection by organising or participating in collecting missions and sometimes via exchange with other collections. For regeneration and storage specific protocols are being used to guarantee an optimal conservation of the genetic diversity.

Although breeders would prefer to avoid the use of wild species in their breeding programs because of undesirable traits, this material is being requested increasingly. The reason is the ongoing search for new resistance genes e.g. for new strains of downy mildew in lettuce and spinach, for resistance to *Phytophthora*, nematodes, viruses and bacteria in Solanaceae. Wild species are also frequently used in molecular studies to determine phylogenetic relationships and the diversity within and between accessions. The use of wild species is stimulated by increasing the knowledge on the presence of important characters in this material by characterisation and evaluation programs.

The increasing requests for wild species illustrate the importance of this type of germplasm.

All available information on the CGN collection can be downloaded from CGN's homepage (www.cgn.wur.nl/pgr). All passport- and part of the evaluation data are on-line searchable.

Ex situ conservation of crop wild relatives in Hungary

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Ex situ conservation of plant genetic resources in Hungary started nearly fifty years ago. Since the foundation of the Institute for Agrobotany in 1959, the activities of the Institute have included the exploration, collection and *ex situ* conservation of wild relatives of crops grown in Hungary. The *ex situ* collections preserved in cold stores include 5369 accessions of wild relatives of crops (138 taxa) from which 1190 accessions collected from natural habitats in Hungary. Forage legumes (40 taxa) and grasses (48 taxa) represented by the highest number of samples. Several interesting ecotypes of forage species (*Trifolium pratense*, *Lotus corniculatus*, *Festuca pratensis*, *Poa pratensis*, *Lolium perenne*) have been collected from natural and semi-natural grasslands. Within the collections, there are 35 accessions belonging to 12 endangered species protected by law in Hungary. Distribution, geographic representation and possible utilization of the conserved taxa and accessions are summarized in the poster presentation.

Seed collections from nature for ex situ conservation

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The wild gene pools from which our crop plants were domesticated are no longer bottomless reservoirs from which plant explorers can make their introductions of breeding material. While unknown potentially useful species may still await discovery, exploratory seed collection for introduction of wild relatives of known crop plants has to be transformed into planned collection for conservation. Because of the shortage of unused ground area in regions of origin of crop plants, few land tracts can be set aside for *in situ* conservation of critical donor populations. Instead, a maximum of natural variation in disappearing populations has to be extracted for *ex situ* storage or maintenance. The seed bank or nursery can dictate some general collection rules, such as minimum sample sizes or the desirability of duplicate collections. However the main strategy for meaningful conservation has to be tailored to each donor population. This necessitates a prior acquaintance with the physical and genetic structure of that population, so that the disposition of sampling points can either encompass variables in topography, patchiness, specific neighbourhoods in which different genetic markers have been found, and more - or be random. There has to be some knowledge of patterns of gene flow, so that distances between sampling points can be pre-determined. Among other points for consideration are sampling patterns: transects vs. diffuse coverage of the area, collection from closely adjacent plants, repeat collections during different parts of the fruiting season or in different years, and separate maintenance vs. bulking of single-plant collections. The preparation of a detailed protocol for each collection should be a challenge for resident scientists and collectors rather than for visiting plant hunters.

Cryopreservation as a method of potato germplasm storage in gene bank

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Nowadays the interest in preventing the genetic diversity is increasing. It is related to the development of effective techniques of maintenance both wild and cultivated species. Many plant species are maintained in gene banks in the form of true seeds, but potato as other vegetatively propagated species need different ways of conservation. Such species are maintained in field or *in vitro* collections. These methods are complicated, time- and labour-consuming. Moreover risk of loss of the material is relatively high.

Alternative approach for field and *in vitro* collections of plant species is cryopreservation – storage of biological material in liquid nitrogen. This method can be carried out in a laboratory for *in vitro* culture with low additional cost. The aim of the study is application of cryopreservation as a standard method of potato germplasm storage in IHAR, Młochów Research Center gene bank. Shoot-tips, pollen and true seeds were used in experiments. Vitrification was chosen as a method of shoot-tips cryopreservation. This method guarantees higher regeneration of frozen shoot-tips than encapsulation-dehydration and droplet method. Depend on potato cultivar or clone, explant size and conditions of vitrification up to 90% of shoot-tips regenerated. Pollen and seeds were dried over silica gel before immersion in liquid nitrogen. Dependence of seeds and pollen viability on their genotype and time of drying was evaluated. Viability of seeds pollen depends on potato clone and time of dehydration. After optimal time of drying germination of seeds and pollen grains were not different from unfrozen control. Results of these experiments indicate that cryopreservation may be used as a method of potato germplasm storage in gene bank.

The CNR Gene Bank of Bari Activities in Crop Wild Relatives

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The Italian Gene Bank of the National Research Council (CNR) at Bari, started to collect crop wild relatives (CWR) in 1970, together with threatened crops. At the very beginning CWR did not receive much attention as it was later on and especially in collaboration with FAO, IPGRI, ICARDA, IPK (Germany), Institute of Agrobotany (Hungary), University of Tuscia (Italy), and others. Samples of the genetic material, gathered in all the Mediterranean countries, including Italy, Ethiopia, South Africa, Middle East, etc., were shared with national institutions and in some occasions were duplicated to IPK gene bank. The most important collected CWR concern species related to wheat, barley, oat, rye, pea, bean, cabbage, cowpea, lentil, sugar beet, meadow grass, white clover, lettuce, sage, crambe and several others.

CWR collected in more than 30 years are conserved *ex situ* at 0°C and 35% of R.H (short and medium term) and at -20°C (long term). A database of the collection by genera and species has been created.

Apart from the research carried out in other centers on the material provided to them, for which, unfortunately, there is no feedback, a lot of research has been carried out at Bari in collaboration with other Italian and foreign research centers.

From 1988 to 2000 the Italian Gene Bank of Bari coordinated a national project of CNR on plant, animal and microbial biodiversity, including wild species and CWR, with the aim to improve *in situ* and *ex situ* conservation and utilization of genetic resources. From 2002 to 2005, the Gene Bank, in collaboration with the Ministry of Environment, the Regional Council of Basilicata and the University of Bari, has also realized in Basilicata (at Policoro, PZ) a Thematic Center for the Safeguard and Protection of Mediterranean Plant Biodiversity, including endemic species and CWR. A detailed summary of data and other significant information concerning genera and specie of CWR collected, preserved and studied at the Bari Gene Bank for utilization will be shown at the conference with the poster presentation.

Studies on CWR at the Institute of Plant Genetics

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The Institute of Plant Genetics of the Italian National Research Council (IGV) has headquarters in Bari and research units in Firenze, Perugia, Naples and Palermo. One of the main interests of the IGV is collecting, storing, and utilising plant genetic resources (PGR). In the latest years activity on wild species has increased, particularly in wild crop relatives.

The IGV has carried out collecting missions in mainland Italy and in 47 Italian islands over 50. Samples of WCR were collected belonging to the genera *Beta*, *Linus*, *Aegilops*, *Daypyrum*, *Brassica*, *Cynara*, *Eruca*, etc. This material is presently under multiplication to obtain a quantity of seeds useful for conservation. Moreover, the IGV stores a collection of wild *Lycopersicon* species, from all over the world.

As regards the evaluation of these wild PGR, much activity has been devoted to the study of their genetic variability using various molecular (RAPD, ISSR, AFLP) and biochemical (isozymes, storage proteins) markers. Moreover for some segments (*Aegilops*, *Daypyrum*, *Vigna*, *Lens*) molecular cytogenetic studies were carried out.

The utilisation of wild PGR can be boosted by specific initiatives, like the participation to international networks (eg: IPGRI's Rocket Network) that has allowed a partial domestication of a wild species threatened of over-harvesting from the wild. Wild PGR are ideal candidates to provide useful genes to crops, like resistance to biotic stresses or qualitative traits. In one of the latest achievements, amphiploid *Aegilops*-wheat was produced and back-crossed to the wheat parent; in at least one case a recombinant line was obtained incorporating resistance to powdery mildew from *Ae. caudata* into durum wheat. Hybrids and amphyploids were also used to develop gene transfer models.

Genetic structure of island populations of wild cardoon [*Cynara cardunculus* L. var. *sylvestris* (Lamk) Fiori] detected by AFLPs and SSRs

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Wild cardoon [*Cynara cardunculus* L. var. *sylvestris* (Lamk) Fiori] is a non-domesticated robust perennial plant characterised by a rosette of large spiny leaves and branched flowering stems. It belongs to the family of *Asteraceae*, tribe *Cynareae* and is native to the Mediterranean basin, where it colonizes dry and undisturbed areas. Molecular, as well as cytogenetic and isozyme studies indicate that the species is the ancestor of the cultivated forms: globe artichoke (*C. cardunculus* var. *scolymus* L.) and cardoon [*C. cardunculus* var. *altilis* (DC)], since they are fully cross-compatible and their F₁ hybrids are fully fertile. Wild cardoon is potentially exploitable for the production of lignocellulosic biomass, oil from seeds, and biopharmaceuticals. The root contents include inulin, a known improver of human intestinal flora, while the leaves are a source of antioxidant compounds, such as luteolin and di-caffeoyl-quinic acids, which (i) protect proteins, lipids and DNA from oxidative damage caused by free radicals, (ii) inhibit cholesterol biosynthesis and contribute to the prevention of arteriosclerosis and other vascular disorders, (iii) inhibit HIV integrase, a key player in HIV replication and its insertion into host DNA and (iv) possess antibacterial activity. The genetic variation present at microsatellite (SSR) and amplified fragment length polymorphism (AFLP) loci has been assessed in seven Italian populations of wild cardoon, collected from Sicily and Sardinia. Thirty individuals, randomly sampled from each population were genotyped at five SSR loci and fingerprinted using seven AFLP primer combinations. Genetic distance estimates both within and between populations were consistent between the two marker systems. As a result of the geographical isolation, the Sardinian and Sicilian populations were clearly differentiated, forming two distinct gene-pools. Most of the genetic variation was partitioned within rather than between populations. The genetic distribution allows the design of rational sampling strategies to capture the genotypic range present.

The role of the Mediterranean species Botanic Garden (Agrigento district) played with the conservation and the valuation of the native botanic species

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At the Mediterranean species Botanic Garden of Agrigento, the collections of the wild and experimentally cultivated plants belonging to the Sicilian and in particular, the Agrigento district, flora of horticultural, fruitcultural and flowercultural interest, are present. From a scientific point of view, the collections represent a germoplasm bank and the best source from which it can be received the plantation material for technical interventation, vegetation restoring, etc. In order to preserve this great important genetic patrimony and to emphasize the activities relating to the eco-sustainable development, the Botanic Garden acts were referred to the introduction, propagation and autecological study of the wild endemic, rare and of particular agro-forestry interest species. From 2000 to date, the activities of Agrigento Mediterranean species Botanic garden dealt with:

- 1) collecting
 - the Olive-tree cultivar present in the Central-Southern coast, based on the high interesting role that oliveculture plays within the Sicilian economy;
 - the wild Sicilian *Limonium* species for the flowercultural interest and the environmental planning;
 - the wild edible plants, able to furnish high quality and innovative production suitable for the “Agriturismo” activity;
- 2) autecological study of pioneer species suitable for restoring vegetation cover as: *Lygeum spartum* L., *Salsola oppositifolia* Guss., *Suaeda vera* Försskal, *Pennisetum setaceum* (Försskal) Chiov., etc.;
- 3) restoring maquis vegetation aspects along the smooth sloped maritime cliffs;
- 4) the realization of a scientific biblioteque of bio-naturalistic and agronomic type, the herbarium collecting the Agrigento distinct flora and the Gardens web site;
- 5) the organization of refresher courses, conference and seminars based on emphasizing the botanic and agronomic patrimony;
- 6) the setting up of an audio-video room destined to environmental education applications for students.

Session 7

CWR information management

ORAL ABSTRACTS

***In situ* data management methodologies: an overview**

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The documentation of and information on Plant Genetic Resources is crucial for their conservation and use. As pointed out in the Global Plan of Action "... national programmes need to know what resources exist in their countries". And as plant occurrence is a spatial phenomenon it is also necessary to know where PGR exist.

Surveying has a long tradition and excellent tools like GIS exists to support the storage, retrieval and analysis of spatial data. To cope with the huge task of surveying many stakeholders have to pool together. And in addition to that the data needed to generate knowledge about *in situ* PGR – like the correlation between the landscape, spatial occurrence of crop wild relatives and their characteristics - come from different domains. Therefore it became obvious that a paradigm shift was necessary from providing theories for monolithic systems to theories for distributed information systems. With this came the need for specifications of information service interfaces accessible through the web. In the context of OGC and GBIF substantial progress is made to provide specifications, protocols and applications to facilitate data base interoperability. However the core problem is still semantic interoperability which assures that the content is understood in the same way within an interacting network of data providers. To tackle this formal ontologies for the PGR domain have to be developed.

While the access to *in situ* PGR data is getting easier, it is desirable that also the use of modeling tools will be enhanced and widespread. User friendly, Web-based services could help to bring modeling results closer to users like plant breeders and decision makers. It has also to be mentioned, that data quality is an issue and endeavour has to be made to use existing tools and the growing Spatial Data Infrastructure (SDI) to improve e.g. the site descriptors within passport data.

Last but not least it should be pointed out that *in situ* data management is a matter of organisation and decision making. As surveying is expensive it is hard even to create the baseline data not to mention the time series that are necessary for monitoring purposes. Therefore the focus should be set on building national inventories that support the respective programmes.

Creation and development of the PGR Forum CWR Information System (CWRIS)

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Effective and efficient information management is the crux of any conservation programme, and a vital component of current crop wild relative (CWR) conservation and use initiatives. Suitable standard descriptors and a management paradigm are required to manage CWR inventories, and to facilitate access to existing information on CWR taxon, site and population level data. To this end, the EC-funded project, European Crop Wild Relative Diversity Assessment and Conservation Forum (PGR Forum) has developed such standards and a paradigm, as well as implementing them in the Crop Wild Relative Information System (CWRIS), the first information management system specifically designed to facilitate CWR conservation and use.

CWRIS has two main dimensions: taxon information breadth is provided by the catalogue of crops and their wild relatives of Europe and the Mediterranean, while the CWR descriptors for conservation and use for individual CWR taxa provide taxon information depth. The Catalogue contains more than 23,000 species records and in excess of 243,000 records of taxon occurrences in 130 geographical units across the region. The CWR descriptors provide a comprehensive set of data standards that can be used to effectively manage genetic conservation of CWR taxa and their component populations. The descriptors provide the structure within which existing data can be accessed or mapped onto the data model, and novel data can be provided.

The two main components of the CWRIS are available as an online information management system (<http://www.pgrforum.org/cwrism.htm>). CWRIS 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. Specifically, it provides the opportunity for users to carry out taxon searches and to download a list of CWR taxa for geographical areas of interest. CWRIS also provides access to ancillary information on the taxa contained in the Catalogue via links to external online resources, such as Mansfeld's World Database of Agricultural and Horticultural Crops, GRIN Taxonomy, European Nature Information System (EUNIS), the IUCN Red List, and key publication search engines. The opportunity exists to link to any number of useful and relevant online information resources that will benefit the CWR conservation and user community.

The CWR descriptors have undergone an intensive process of standardisation, testing and refinement by CWR user groups, and a number of case study datasets have been collated for selected CWR taxa. The use and testing of CWRIS in this way is vital to steer further adjustments and development, which is ongoing. Perhaps not surprisingly, the case studies reveal that there is a lack of detailed information available at site and population level for many taxa, or that if it is available it is not in a format that can easily be translated into a standard data model. This emphasises further the need for a standard paradigm and data exchange formats to ease data sharing between all CWR conservation practitioners. An XML-schema has been written as part of our commitment to enabling access and sharing of CWR data.

The CWRIS is a major achievement and product of PGR Forum. There is however a need to continue to develop, refine and improve CWRIS, including expansion for provision of CWR datasets at national level. To this end, CWRIS will be managed and developed further after the end of the PGR Forum project by the International Plant Genetic Resources Institute (IPGRI) on behalf of the Secretariat for the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR), with the aim of making this vital data resource available to the wider conservation and use communities.

Crop wild relatives in the ECP/GR Central Crop Databases: a case study in *Beta* and *Avena*

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A large amount of information on gene bank accessions of crop wild relatives is available in the Central Crop Databases (CCDBs), which have been developed within the ECP/GR framework. This will be exemplified with the International Database for *Beta* (IDBB) and the European *Avena* Database (EADB). These databases are available online at <http://idbb.bafz.de> and <http://eadb.bafz.de>.

In the IDBB 3153 accessions have a sample status of wild, 161 of weedy. These belong to 12 species including three subspecies of *Beta vulgaris*. For 1990 of them collecting information is available on a location basis (total 1542 distinct locations in 25 countries), for 1848 with latitude and longitude given. For accessions of wild *Beta* 15061 observations are available on 76 evaluation and characterisation descriptors, including resistance to virus and fungus diseases and abiotic stress, mainly from the EU funded GENRES CT 95 42 project.

In the EADB 4492 accessions belong to 21 wild or weedy taxa (including *A. strigosa* and *A. maroccana*, which are partly cultivated on a low level). For 994 of them collecting information is available on a location basis (673 distinct locations in 43 countries), for 379 with geographical coordinates.

It is suggested to build on the CCDBs for further documentation of CWR wherever a crop specific approach seems appropriate. In other cases interfaces could be designed to more syn-ecologically targeted information systems. The access to data on CWR in the two databases will be shown. For the genus *Beta* the structure of evaluation and characterisation data within CWR will be discussed in comparison with cultivated material and in respect to the value for breeding. Documentation objects, which CWR share with other genetic resources and others, which are specific for them, will be discussed, and suggestions for further developing the CCDBs towards CWR and their management needs *in situ* will be given.

Crop wild relatives information: presenting a tool for its management and use

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This paper discusses an information management system developed as part of the GEF-supported project that aims to enhance conservation of crop wild relatives in Armenia, Bolivia, Madagascar, Sri Lanka and Uzbekistan. The project strategy is to maximize the use of existing resources and build capacity of countries to develop cost effective and sustainable conservation solutions. One of the major limitations for effective *in situ* conservation management of crop wild relatives is the lack of comprehensive information management tools to monitor and evaluate spatial and temporal information related to crop wild relatives. Relevant information is often available but it is highly fragmented and dispersed among national and international agencies. For optimal outcomes in conservation management planning and implementation, this information needs to be collated and made available and accessible from a single point. The project, therefore, will develop information management systems for crop wild relatives at international and national levels. At international level, a portal will provide access to international sources of information, and at country level, national crop wild relative information systems will bring together the data held by relevant national organizations and agencies such as herbaria and genebanks. Analysis of information will be used to establish the conservation status of species, determine the *in situ* and *ex situ* locations of crop wild relatives, formulate procedures for action, create systems to monitor conservation status and impact of conservation actions, and increase public awareness of the importance of crop wild relatives for conservation and use. IPGRI has developed a genetic resources information management tool for use at national level. This tool is targeted to the needs of users of information on crop wild relatives and integrates information on *in situ* and *ex situ* conservation. Importantly, it has inbuilt user-defined databases that allow users to modify databases to suit their needs.

Managing passport data associated with seed collections from wild populations: increasing potential for conservation and use of CWR in Israel

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Israel and its adjoining areas are located at the meeting point of four phytogeographical regions: Mediterranean, Irano-Turanian, Saharo-Arabian, and Sudanian. All the regions are represented in its rich flora of almost 3,000 species. Ten per cent of these species are related to Old World crop plants or are in folk use as medicinal or spice plants. Housing projects, road construction, industrial parks, and intensive farming impinge on this highly valuable plant genetic resource, which is becoming weedy and fragmented. Rescue by ex-situ conservation has become a necessity. In the 1990s, a list of some 200 species, considered as main candidates for conservation, was compiled by botanists of the local universities. Since then many of these taxa have been collected and deposited in the Israeli Gene Bank for Agricultural Crops. Emphasis is on garnering a maximum of genetic variation. So far, most of the collections were made in selected areas, in which the vegetation is most endangered. In a more recent approach, a few chosen species that warrant broad representation in the Gene Bank are collected throughout their distribution area in the country. For practical purposes we are compiling a database of background information on the distribution, reproductive biology, growth requirements, and uses in breeding of each candidate species. In the database for the individual collections, we have so far used the FAO/IPGRI Multi-crop Passport descriptors but augment them with data on the methods of sampling and fuller data on the provenance of each collection, such as the physical and phenotypic structure of the source population, other plant species associated with that population, and data on topography and soil. It is a challenge for us to preserve valuable gene combinations and to assure that the rich genetic diversity which abounds in our region is passed on to future generations.

Session 8

CWR as gene donors for crop improvement

ORAL ABSTRACTS

Using crop wild relatives for crop improvement: trends and perspectives

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The use of crop wild relative (CWR) genes to improve crop performance is well established with many important examples dating back more than 60 years. Considering the increased information on genes controlling useful traits in CWR, improved procedures for intercrossing species from different gene pools, advances in molecular methods for managing backcrossing programmes, and increased numbers of wild species accessions in gene banks, it is expected that the use of CWR in crop improvement programmes would be enhanced. However, there may be a difference between promise and the reality. In this paper, we review available information on the presence of genes from CWR in released varieties of 16 mandate crops of the CGIAR institutes, and some selected additional crops, focusing on the past 20 years- the period since the comprehensive review by Robert and Christine Prescott-Allen in 1986. It appears that, to date, there has not been a dramatic increase in the rate of release of varieties containing genes from crop wild relatives. While there continues to be a strong emphasis on using pest and disease resistance genes, a wider range of characteristics are being introduced than in the past. Those crops whose wild relatives have traditionally been used as sources of useful traits (e.g. wheat, tomato) continue to be most likely to include new genes from their wild relatives. The implications of these findings for the future conservation and use of crop wild relatives will be discussed.

The secondary gene pool of *Hordeum* as gene donor for crop improvement

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The wild species *H. bulbosum* L. is a potential resource of novel genes for barley improvement by introgression breeding. It represents the secondary gene pool of barley. *H. bulbosum* L. possesses numerous useful characters for breeding such as resistances to biotic and abiotic stresses. Using embryo-rescue technique, crossing barriers between *H. bulbosum* and *H. vulgare* have been overcome. A number of progenies were obtained from interspecific reciprocal crosses between a tetraploid *H. bulbosum* ($2n=4x=28$) accession and diploid ($2n=2x=14$) and tetraploid cultivars, respectively, of *H. vulgare* L. The number of F1 progenies depended on the genotype, the cross direction and the ploidy of the *H. vulgare* parents. The highest seed set was obtained with cv. 'Borwina' ($2n=2x=24$) as female parent. Barley anchor markers were used to verify the hybrid character of the interspecific F1 offspring. Using selfing, backcrossing, anther and microspore techniques diploid and tetraploid progeny were produced from interspecific hybrids. F1, F2 and BC1 plants were analysed for resistance to Barley yellow dwarf virus (BYDV), the soilborne mosaic virus complex (*Barley mild mosaic virus*, BaMMV, *Barley yellow mosaic virus*, BaYMV-1 and -2), leaf rust, powdery mildew and cereal cyst nematode (CCN) (*Heterodera avenae* Woll.). The results suggest that resistances to BYDV, leaf rust, and powdery mildew have been transferred into cultivated barley.

Exploitation of wild cereals for wheat improvement in the Institute for Cereal Crops Improvement

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The Institute for Cereal Crops Improvement is engaged in collection, conservation and evaluation of wild cereals and their exploitation for wheat improvement. Wild emmer wheat, *Triticum turgidum* ssp. *dicoccoides* and diploid *Aegilops* species of section Sitopsis were found as excellent sources of resistance to different diseases in wheat. The ease of gene transfer from these wild cereals into cultivated wheat depends on their relatedness to wheat.

The tetraploid wild emmer possesses the A and B genomes that are completely homologous to the A and B genomes of durum (tetraploid, genome BA) and bread (hexaploid, genome BAD) wheat. Therefore, normal pairing and recombination are expected between alien and the cultivated homologous chromosomes. Novel resistance to yellow rust is being transferred from wild emmer to wheat simply by crosses between them and backcrosses to the wheat cultivar accompanied with selection for resistance.

Aegilops speltoides (diploid, genome S) is an excellent source for resistance to leaf rust of wheat. Despite that S genome is closely related to B genome of wheat homoeologous chromosomes of these genomes do not pair and recombine normally. High pairing *Aegilops speltoides* type is used to encourage recombination between homoeologous chromosomes of *Ae. speltoides* and wheat. The wheat cultivar is used as a recurrent parent in subsequent backcrosses.

High pairing types are not available in *Ae. sharonensis* (diploid, genome S) which is another source of resistance to yellow rust. Therefore plants of this species are crossed with a wheat mutant that allows pairing between homoeologous chromosomes. Another possible obstacle in this cross is the presence of a gametocidal gene in *Ae. sharonensis* which ensures the inclusion of a specific alien chromosome in the wheat background in subsequent backcrosses. This problem is overcome by the use of an anti-gametocidal wheat mutant capable of counteracting the action of the gametocidal gene.

Using crop wild relatives as sources of useful genes

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Wild plant genetic resources (PGR), and particularly crop wild relatives, represent a source of useful germplasm for the present and future generations. In the past, the majority of the information on PGR was based on phenotype, geographic origin, social history, and parentage. In the last decades, advances in plant science and technology have provided new insights into the study of crop gene pools; in fact, techniques derived from plant genomics can address the weaknesses inherent non-molecular methods. The development of DNA markers and sequencing has provided new powerful ways of assessing genetic relationships and diversity, performing comparative linkage analysis, isolating useful genes from crop wild relatives, etc. Within this frame, some programs have been started at the Institute of Plant Genetics, in order to investigate the presence of gene variants in some crop gene pools, also in the view of isolating possible alleles that can be useful in plant breeding and/or in the development of new molecules. Examples are given on trypsin inhibitors isolated in the gene pool of lentil and in some cultivated and wild species of the Brassicaceae. Results indicate that in some crop wild relatives, a reasonable level of variation in active site region and/or in other important sites of the aminoacid sequence of these inhibitors can be observed. These findings might have important applications since these molecules are involved in plant disease resistance and/or can inhibit cancer cell development *in vitro*. Another project concerns the study of a gene family in *Cynara* involved in the synthesis of phenylpropanoids, which are attributed immunostimulating and antibacterial properties; in addition these molecules are reported to show anti-tumoral activity. These examples indicate that wild PGR may play an important role in developing new pharmaceutical or nutraceutical products. In this view, agricultural plants can be considered as not merely a source of food but also as bioreactors for strengthening the well-being of men.

Session 8

CWR as gene donors for crop improvement

POSTER ABSTRACTS

The contribution of C.R.A. – “Istituto Sperimentale per la Floricoltura” – Palermo section to the conservation and exploitation of the native germplasm: the wild species collections of the *Limonium* genus (Plumbaginaceae) present in Sicily

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During the last years, an increasing interest in native Mediterranean plants as ornamental and characterized by low cultivation costs, occurred in Italy. For a long time Palermo section of the “Istituto Sperimentale per la Floricoltura” has been interested in autochthonous germoplasm conservation and now, it is very experienced in exploitation of the native and threatened species for ornamental use. Thanks to the “Laboratorio di Biologia vegetale Applicata” of Palermo University, this material was collected, identified and preserved ex-situ. At present, in the Institute of flowerculture several botanical collections are present, but just the *Limonium* one in particular has to be remarked for richness in wild and endemic species; this collection consists of 30 distinct entities, of which 23 endemic to Sicily. A further genotype collection of single species (*L. virgatum*) showing a higher morpho-phenological variability was set up. The concerned testing grounds promoted to set a valuation to the single species properties as for ex-situ cultivation, and thanks to bio-reproductive and biological-qualitative observations, to specify 3 different species groups distinguished by ornamental use:

- 1) species group showing a high cut flower stems productivity; the ones characterized by a shorter stem length provide the cultivation of the bouquet stems;
- 2) the flower potted species group characterized by a stem length of 20 to 50 cm and by a nice architecture;
- 3) the flower-bed plant group, characterized by slow growth, nice stem architecture, evergreen habitus, not deciduous flower calyx and suitable to be put it in seaside villa gardens where a high colour effect is provided.

The tested different *L. virgatum* genotypes provided the cultivation of cut flower for high productivity of long stems, but in order to prevent the flattening, side supports are necessary. Finally it is clear that Sicilian wild germoplasm represents an important natural resource to be exploited and answering the purpose of the present flowerculture.

Commercial utilization of the widespread Cornelian cherry (*Cornus mas* L.) population in Slovakia

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Cornelian cherry (*Cornus mas* L.) belongs to naturally spread species in Europe. It grows up to altitudes of 1400 m above the sea level, and is not demanding for optimal growth conditions. Cornelian cherry tolerates temperatures up to – 40 °C, and is achieving the age of 100 – 300 years. It is highly tolerant against abiotic and biotic factors. Blooming time starts early in the spring with the high pollen production. Fruits are very valuable for further processing e.g. syrups, juices, jams and other traditional products. Ripening season starts from August to November. Fruits contain biological active substances, mainly vitamin C, flavonoids, saccharides, tannins and other metabolites interesting also for pharmaceutical and cosmetic utilization. Three varieties have been gained due to selection of the naturally occurring populations in the Slovak localities, but these varieties are cultivated just marginally. Cornelian cherry has a high potential to be utilized as species with valuable nutrient and biological properties, being suitable also for cultivation in monocultures. Therefore in our experimental study 250 ecotypes from the Gemer region in Slovakia have been evaluated for various characters. Fruit weight was in the range from 0.6 to 2.7 g, fruit length 13.2 – 20.1 mm, share of the flesh 77 – 86 %, vitamin C 17.7 – 38.6 mg/100g, total sugars 6.6 – 15.1 %, content of N 3200 – 6443 mg/kg, P 425 – 1275 mg/kg, K 7047 – 19460 mg/kg, Mg 298 – 1587 mg/kg. Significant variability was found also in the size, weight and shape of the stone, in the length, width and shape of leaves, in the length, width, weight and shape of flower buds and in other flower traits. Results confirmed possibilities of the detection as well as selection of genotypes for commercial usage. Large amount of experimental data in textual, numeral and image form are utilized for preparation of specialized database *CORNUS*database.

Conservation of *Limonium* species and their use in a breeding program

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The genus *Limonium* (fam. Plumbaginaceae) consists of about 300 species, well adapted to the Mediterranean environmental conditions, particularly to the southern regions of Italy where several wild species are endemics. *Limonium* is grown for use as a cut flower for both fresh and dry-flower arrangements.

An inventory of botanical species of *Limonium* has been established at the Experimental Institute for Floriculture since 1998 and a conservation program was started in 2004 (F.A.O. International Treaty on Phytogenetic Resources). The inventory includes the following species of *Limonium*: *artunsi* (1 accession), *fortunei* (3 accessions), *sinensis* (3 accessions), *tetragonum* (3 accessions), *aureum* (1 accession), *bellidifolium* (2 accessions), *caspia* (2 accessions), *otolepis* (3 accessions), *binervosum* (4 accessions), *deracifolium* (1 accession), *bonduelli* (1 accession), *sinuatum* (5 accessions), *dumosum* (1 accession), *tataricum* (3 accessions), *gmelinii* (5 accessions), *gougetianum* (1 accession), *puberulum* (1 accession), *latifolium* (5 accessions), *perezii* (4 accessions), *speciosus* (1 accession), *serotinum* (1 accession), *purpuratum* (1 accession), *peregrinum* (1 accession). Nineteen commercial varieties and 24 wild ecotypes are also included.

Other than for conservation purposes, this germplasm has been utilised also for a breeding activity. The wild ecotypes, the botanical species and the commercial varieties were utilized in an incomplete diallelic cross design. The first inter- and intra-specific hybrids were obtained in 1999. A first group of selected progenies derives from crosses among *L. latifolium*, *L. gmelinii*, *L. caspia*, *L. bellidifolium*, *L. otolepis* and *L. serotinum*, a second group from crosses among *L. sinensis*, *L. fortunei*, *L. tetragonum* and *L. aureum*, a third group from the cross *L. bonduelli* x *L. sinuatum* and the last group from selected progenies of *L. tataricum*. These new varieties were propagated *in vitro* and, from 2001, were evaluated in open air and in greenhouses in Liguria, in Tuscany and in Sicily.

The collection and conservation of wild *Mangifera* species for the improvement of the commercial mango (*Mangifera indica* L.)

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The mango (*Mangifera Indica* L.) has become a major world export commodity over the last decade. The mango is grown as a subsistence and/or export commodity in nearly all countries of tropical and subtropical Africa, America, Asia and the Pacific, with exports primarily destined for Asia, Europe or North America. As the mango has increased in importance as an export commodity, the commercial industry has come to rely on a relative few cultivars that conform to the current demands of the export market. The result has been a narrowing of the genetic diversity and a growing concern about the loss of wild crop relatives and the threat of devastating diseases or pests. There are over 60 wild *Mangifera* species currently recognized in Southeast Asia, with many species locally rare and/or included on the IUCN Red List of Threatened Species [vulnerable (*M. pajang*, *M. zeylanica*), data deficient (*M. lalijiwa*, *M. odorata*) and extinct in the wild (*M. casturi*)]. These species are not well represented in genetic banks either within or outside of Southeast Asia. The current project has as its objective the identification, collection and propagation of *M. casturi*, *M. griffithii*, *M. lalijiwa*, *M. laurina*, *M. odorata*, *M. pentandra*, *M. pajang*, *M. zeylanica*, *M. foetida* and *M. caesia* for long term maintenance and use in a living gene bank. We have been unsuccessful in the establishment of *M. caesia*, *M. foetida* and *M. pajang* using current grafting techniques on *M. indica* rootstocks. All other species have been established and are currently undergoing DNA characterization and evaluation for use in breeding with *M. indica*. *M. casturi*, *M. griffithii*, *M. lalijewa*, *M. laurina*, *M. odorata* and *M. zeylanica* have shown the most horticultural potential for use with *M. indica*.

The wild olives of Sicily, their past and potential contribution to the improvement of the cultivated varieties

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Sicily island represents a reservoir of variability for the olive species due to the presence of numerous populations of wild relatives (*Olea europaea* subsp. *europaea*, var. *sylvestris*). In fact, it has been demonstrated that Sicily, for its position in the middle of the Mediterranean basin, has conserved numerous lineages of the oleasters which may play an important role to provide useful traits for the improvement of the olive cultivated varieties.

Different populations of oleasters have been collected and analysed by means of different genomic and cytoplasmic molecular markers, in order to verify their relationships with the cultivars of the island and to test their potential as source of alleles for adaptation to difficult environments and to control the architecture of the olive trees. To verify if cultivars sharing the same agro-ecological habitats and a high genetic relatedness may have originated with the gene contribution of local oleasters, the genetic structure of Sicilian olive tree populations was evaluated, by the use of AFLP and SSR markers. The clear distinction between oleasters and cultivars seems to demonstrate that cultivars did not develop from local oleasters, but were more likely introduced from foreign sources and propagated by grafting on local oleasters.

Canada yew (*Taxus canadensis* Marsh.) and taxanes: a perfect species for field production and improvement through genetic selection

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Canada yew (*Taxus canadensis* Marsh.) is a native coniferous shrub that grows in small colonies under the forest canopy in northeastern North America. Like all the other species of the genus *Taxus*, Canada yew contains taxanes, namely paclitaxel (PACLI) and its precursors 10-deacetylbaccatin III (10-DAB) and 13-acetyl-9-dihydrobaccatin III (DHB). These taxanes are extracted from biomass coming from natural stands and are used on the biopharmaceutical scene to develop anti-cancer and other drugs. Since little is known about variation in taxane concentration among populations and among trees within populations of Canada yew and among years, a study was undertaken to identify and describe the levels and patterns of variation.

In the fall of 2001, 50 individuals from three populations of the Charlevoix region, Quebec, Canada, were sampled. In 2002, on each site, 15 out of 50 individuals were randomly chosen and re-sampled. Each time, 10 three-year-old twigs were collected on each individual. The twigs of each individual were weighted dry after a drying process. Thirty grams of dried ground biomass per individual were used for the HPLC analysis.

For the individuals sampled in 2001, significant difference was revealed between populations for dry biomass, but not for PACLI, 10-DAB and DHB concentrations. Dry biomass was negatively correlated to taxanes. Taxane concentrations were positively intercorrelated in every comparison and varied greatly within populations. Some individuals presented eight times more PACLI than the others. We found some variation in taxane concentrations between 2001 and 2002. PACLI was higher in 2001 than in 2002 while the reverse was observed for DHB. However, partial correlation revealed that the individuals with a high content of taxanes in 2001 also had a high content in 2002. In conclusion, this would mean that opportunities for individual selection (high concentration of taxanes and above average biomass production), cloning and field production of Canada yew for taxane extraction are real.

Research on the volatile fraction in leaves of *Olea europaea* subsp. *oleaster* and *Olea europaea* subsp. *sativa*

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Olive (*Olea europaea* L.) is one of the oldest and most cultivated plants in the Mediterranean area. *Olea europaea* L. is divided in two subspecies: subsp. *europaea* or *sativa*, the cultivated olive tree and subsp. *sylvestris* or *oleaster*, the wild type. This last form is largely spread in Sicily, so to be a typical component of the natural landscape of the island. The juvenile seedlings of the cultivated olive varieties (called *olivaster*) are also present in the uncultivated areas.

A study on the composition of the volatile fraction extracted from the leaves of several Sicilian wild olive trees has been carried out, comparing the results with that ones obtained extracting the volatile compounds from the *sativa* subspecies. Extractions have been carried out by Clevanger apparatus and the volatile fraction have been analysed by GS and GS-MS. Differences among the components have been observed.

Collecting and evaluation of wild *Medicago* species

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Collecting and evaluation of alfalfa gene pool collections has started in Slovakia in 1961, especially from the aspect of their use in the breeding programmes. In the last decade we have concentrated our collecting activities especially at the territory of Slovakia with the aim to collect and maintain biological diversity of *Medicago* genus. In the Slovak territory the *Medicago* genus is represented mainly by species *M. falcata*, *M. lupulina*, *M. prostrata*, *M. rigidula*, *M. monspeliaca*, *M. minima* and *M. x varia*. *Medicago sativa* can be found sporadically in the communities of mesophyte non-inundated meadows in lowland up to submontane vegetation degrees. Several collecting expeditions have been undertaken also in some areas of Ukraine, Kazakhstan, Poland, Slovenia and Czech Republic. In course of all missions we have collected beside others 83 samples of *Medicago* species. Collected samples are registered in the database of collecting expeditions and after regeneration evaluated in the field conditions.

As a part of the study of genetic resources of alfalfa 12 *Medicago sativa* populations were evaluated on the experimental basis RIPP Piestany in the years 2003-2005. The experiment included wild populations originated from the Kazakhstan, Slovenia, Poland and Ukraine. The agronomic and selected biological and morphological traits of wild populations were evaluated and compared with registered varieties. The reached results showed the relatively high variability in all characteristics. The majority of wild populations were excellent in agronomic traits, mainly genotypes POLKIE99-2, SVNPIR101-207, SVNPIR101-101, KAZACH90-0225H and KAZACH90-0125H. The persistence and overall health state of the most populations was better as compared to control varieties. The results indicate that there is a potential for use of wild populations for breeding improvement of alfalfa.

Molecular and phytopathological characterization of natural populations of *Aegilops sharonensis* in Israel

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Aegilops sharonensis (section Sitopsis of the genus *Aegilops*), is a close relative of wheat and a potential donor of useful genes for wheat improvement. It is endemic to the coastal plain of Israel and South Lebanon, inhabiting sandy soils and stabilized dunes. Intensive urbanization and development in this region endanger the natural habitat of the species, and have caused already the loss of some populations.

About 2,000 accessions from 60 populations were collected from 30 locations along the coastal plain, and are maintained in the Lieberman Germplasm Bank in Tel-Aviv University. Molecular characterization of the populations has been carried out using AFLP markers. The southern populations were genetically distant from the northern populations. Morphological evidence for possible introgression from *Ae. longissima* in some populations was supported by molecular genotyping. Large frequency of resistance to yellow rust and leaf rust was found in some populations. Further investigations include a more extensive search for new populations in order to map the distribution area of this species, a detailed molecular characterization of selected large populations and the relation of genotypes to ecological factors.

Maintenance of and research on wild crop relatives at Department of Botany, Palacký University in Olomouc, Czech Republic

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Scientific activities developed by the Department of Botany are aimed at comprehensive studies of crop wild relatives. The collection of wild cucurbitaceous species includes 50 accessions of six genera. Research is focused at study of their morphological variation, interspecific hybridization, embryo-rescue and protoplast cultures, plant interactions with pathogens and pests. The collection of wild *Lactuca* species includes about 700 accessions of 17 wild species. The research is aimed at a study of eco-geography, biodiversity in natural habitats, collecting, studies of taxonomy, morphology, anatomy, karyology, molecular variation and interaction with lettuce downy and powdery mildews. The collection of the genus *Lycopersicon* with about 120 accessions of nine species is studied for response to tomato powdery mildew on the level of intact plants, leaf discs, cell structures and enzyme activities. The collection of the genus *Allium* includes about 500 populations representing various natural habitats of Europe. The research is aimed at a study of incidence, geography, ecology and reproductive biology of the polyploid complexes. A collection of 12 accessions of chive (*Allium schoenoprasum*), collected in natural habitats in Bohemia, and located in the botanical garden, is studied for morphological and karyological characters, and will be re-introduced to original habitats and offered for breeding purposes. All collections are used for educational purposes. Scientific results confirm a large variability within and among species, provide original information in botanic sciences, are essential for programs of plant protection and conservation, and should be explored in plant breeding.

RAPD and ISSR fingerprinting in cultivated chickpea [*Cicer arietinum* (L.)] and wild species

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Detection of phylogenetic relationships between chickpea cultivars and accessions of wild species *Cicer reticulatum* were investigated by using RAPD and ISSR markers. Nineteen cultivars of chickpea and five accessions of *C. reticulatum* were analyzed. On an average, 6 bands per primer were observed in RAPD analysis and 11 bands per primer in ISSR analysis. In RAPD, the wild accessions shared 77.8 % polymorphic bands with chickpea cultivars, whereas they shared 79.6 % polymorphic bands in ISSR analysis. In RAPD analysis 51.7 % and 50.5 % polymorphic bands were observed among wild accessions and chickpea cultivars, respectively. Similarly, 65.63 % and 56.25 % polymorphic bands were found in ISSR analysis. The dendrogram developed by pooling all the data of RAPD and ISSR analysis revealed that the wild accessions and the ICCV lines showed similar pattern with the dendrogram of RAPD analysis.

The present investigation demonstrates the potential of RAPD and ISSR fingerprinting in detecting polymorphism among chickpea cultivars and wild accessions. The ISSR analysis clearly indicated that even with six polymorphic primers, reliable estimation of genetic diversity could be obtained, while nearly 30 primers are required for RAPD. Moreover, RAPD can cause genotyping errors due to competition in the amplification of all RAPD fragments. The markers generated by ISSR and RAPD assays can provide practical information for the management of genetic resources. For the selection of good parental material in breeding programs the genetic data produced through ISSR can be used to correlate with the relationship measures based on pedigree data and morphological traits to minimize the individual inaccuracies in chickpea. Further, large amount of genetic variation which exists between chickpea cultivars and its wild accessions can be used efficiently for gene tagging and genome mapping of wild and cultivar crosses to introgress the disease and insect resistance into the cultivated genotypes.

Fingerprinting of Sicilian cherry germplasm with Simple Sequence Repeats and incompatibility (S) locus primers

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Sicily has distinctive germplasm of diploid sweet cherry (*P. avium*) and tetraploid sour cherry (*P. cerasus*). In addition to cultivars of both species there are many wild sour cherry genotypes. A survey using molecular markers has recently been conducted of 65 accessions of cherries selected from collections and farms or from the wild. A total of ten Simple Sequence Repeats (SSR) primer pairs as well as two primer pairs for the incompatibility (S) locus – amplifying across the first intron of the *S-RNase* and across the intron of the *SFB* genes – were used. The primers were combined in two multiplexes and fluorescent labelling allowed rapid throughput using an automated sequencer. Care was taken to reconcile the scoring with previous data sets to facilitate comparison with other work. The number of alleles per SSR locus ranged from 4 to 11 in *P. avium* and from 4 to 9 in *P. cerasus*. Homonyms and synonyms were detected in sweet cherry and the accessions were assigned to different incompatibility groups; a UPGMA dendrogram was constructed to explore relationships. This set of SSR primers distinguished 31 Sicilian sweet cherry accessions with unique fingerprints while nine accessions fell into four non-distinguishable groups. A low level of diversity was found among the 25 wild sour cherry genotypes; they may be closely related seedlings or derived from suckers. In future this approach could be used for comparing cultivars and wild populations of cherry, and of other *Prunus* species, and for establishing a database for breeding and conservation purposes.

Comparison of morphological characters in various accessions of *Solanum aethiopicum*

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Morphological variation was analyzed in 9 accessions of *Solanum aethiopicum* (GILO group) selected in south-western Nigeria. This plant, which is commonly called eggplant, is the third most important crop in the Solanaceae after potato and tomato. It is a delicacy in Nigeria and it is believed to be domesticated in Africa from its wild relatives, *S. anguivi* and *S. dasyphyllum*. Due to a wide range of fruit forms present within this species, the present study aims to understand the pattern of variability existing within the collection in south-western Nigeria. Variation was studied in 40 morphological characters from each of the nine populations. Some the characters include plant height at maturity, leaf size and shape and also floral characteristics, visual assessments of the growth habit and plant types were also investigated. Multivariate statistical analyses were used to group the populations according to their morphological similarities. Populations that clustered closely were very similar in their fruit characteristics while some were quite distinct from each other. The divergence within this group is to be exploited for the genetic improvement of the *Solanum aethiopicum* (gilo group).

Influence of water deficit on SOD and POD accumulation in wild and cultivated olive tree

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The research is aimed to analyze the effect of increasing water stress level on the rate of accumulation of the antioxidant enzyme systems SOD (superoxide dismutase) and POD (peroxidase) in leaf tissues. The wild olive (*Olea europaea* L. var. *oleaster*) was tested and compared to the cultivated olive (*Olea europaea* L. var. *sativa*) to assess the relationship between the two botanical forms of *Olea europaea* in their response to water deficit. The aim was also to acquire knowledge on the genetic resources of wild olive, growing in Sardinia within the Mediterranean maquis as one of the most widely spread wild relatives of cultivated plants. One-year-old seedlings of *oleaster* and young self-rooted plants of the traditional variety "Bosana", belonging to the germplasm of Sardinia, were submitted to three different levels of water stress from June to August 2002. Irrigated plants were used as control. The trials were carried out in climatic chamber and the plants were grown in pots. Predawn leaf water potential, the enzymatic activity of SOD and POD in leaf tissues were determined. The POD and SOD enzymatic activities were raising gradually as water stress increased in both olive types, while leaf water potential showed a similar trend. The activity of the antioxidant enzymes was stronger in wild than in cultivated olive plants. The results obtained in this trial clarified some aspects related to drought resistance responses of wild and cultivated olive tree. The observed capacity of activating anti-oxidant defenses indicates that the species *Olea europaea* has developed morphological and ecophysiological mechanisms of drought resistance.

Utilization of Wild Relatives for Commercial Profitability in Chickpea (*Cicer arietinum* L.)

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In all 32 annual and perennial wild relatives which have been reported in chickpea *Cicer arietinum* L., there are some reports available of useful genes donors among these wild relatives. Though there are some practical difficulties in utilizing all wild species through conventional breeding approaches due to the gene pool barriers, only limited species offer an opportunity for plant breeders. Due to these problems the commercial exploitation of desirable genes for crop improvement has not been taken up worldwide except for few cases.

The *Cicer reticulatum* for transferring desirable wild genes was utilized recently at Indian Agricultural Research Institute, New Delhi, India. This wild *C. reticulatum* was directly crossed with the well adapted cultivars of *C. reticulatum* because it falls in the category of primary gene pool. Single back cross with another well adapted cultivar was provided to get acceptable and possible gene pool. The rigorous multi trait single plant based selection was carried out in segregating populations (F2-F6) under moisture stress environments. Special emphasis was given for high biomass production, medium early maturity, high seed yield and resistance against soil borne diseases and moisture stress. From this program desi variety BG 1103 was released for commercial cultivation in Northern India in 2004. Variety BG 1103 significantly out yielded all the checks with a margin between 30-40%. It has shown resistance to *Fusarium* wilt, wet root rot, moisture stress and tolerance to low and high temperatures under multi location testing at different locations. Considering these investigations, it is concluded that the utilization of crop wild relatives in chickpea provide an excellent opportunity for population improvement.

Session 9

Use of CWR and under-utilised species

ORAL ABSTRACTS

The use and economic potential of wild species: an overview

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While only 20–30 plant species make up the staples that supply most of human nutrition, in communities across the world, a combination of wild, semi-domesticated species and minor crops provide variety to the table in the form of vegetables, fruits, herbs and spices as well as vitamins and micronutrients while others are the source of oils, fibres, fuels, intoxicants, ornament and medicines. These range from locally consumed species such leaf greens and wild fruits to economically important non-timber forest products obtained by extractivism such palm hearts, Brazil nuts and rubber and the trade, most of it uncontrolled and much of it illegal, in ornamentals including cycads, orchids, cacti and succulents and bulbs. The total number of wild species involved may be as high as 100 000 and an overview will be given of the main ways in which these plants are used in different farming systems and the contributions they make to rural households. Issues that will be addressed include the wild species/domestication interface, overexploitation, community rights and the role of women. It will be emphasized how remarkably little is known about the extent of the use of wild species, their availability and the contribution they make to the local economy. Even less is known about their genetic diversity and conservation status. The reasons for this neglect are explored, including social, economic, legal and institutional factors. These include attitudes of policymakers, economists, agricultural extensionists and the development community, the intensification of agriculture, the lack of organized markets and the lack of indicators to measure wild plant use and the non-availability of data in recorded trade statistics. Proposals will be made that address the economic, social, developmental, technical and policy challenges involved in improving the exploitation of economically important wild species and an outline plan of action proposed for their more effective use.

Minor crops and underutilized species: lessons and prospects

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Unlike for underutilized species, examples of categorization of minor crops, specialty crops of high monetary value and cultivated usually in small acreage, do exist. Understanding what these crops really are has proven easier than for underutilized species, whose characterization has raised often controversy among experts. Despite this, research on underutilized species, has been evolving over the years. Much of the work in the 80s and 90s was directed towards a better knowledge of the distribution and use of such species, improvement of description, variety selection, assessment of their biological, cultivation and conservation needs. Today, a review of such efforts reveals some progress in securing diversity and associated traditional knowledge, in linking actors along the production-to-consumption chain, developing cultivation practices and tools for decision making by communities, strengthening capacities of user communities and raising awareness at local, national and international levels. Experiences insofar and emerging socio-economic trends are calling for further attention on research areas not adequately covered in the past, where more incisive interventions are needed to yield a sustainable impact on the poor. These interventions include greater efforts to improve access of producers to local and export markets, strengthening demand, reverse of the often negative image attached to these species, broadening assessment of nutritional benefits, enhancement of role of women, maintenance of diversity in production systems, sustained capacity building of stakeholders on economics, marketing and nutritional aspects. Limited availability of germplasm of minor crops and underutilized species in *ex situ* collections remains an important issue to tackle along with the unprecedented fast eroding of associated traditional knowledge. Within the international scenario, actors such as the German-supported Global Facilitation Unit for Underutilized Species, provide opportunities for strategic synergism among all national and international players involved in this field.

Conservation and use of medicinal plants in Sri Lanka

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Medicinal plants occupied a pre-eminent place in indigenous medicine in Sri Lanka over thousands of years and the development of systematic pharmacopoeias dates back to 3000 BC. The recorded number of medicinal plants in the country exceeds 1400 of which 12% are endemic. Around 70 % of the population in Sri Lanka continues to depend on traditional medicine for primary healthcare. Among the native flora of the country over 500 species are highly used in traditional medicine. The island is a rich reserve of traditional knowledge on diversity and therapeutic value of medicinal plants. There are over 10,000 practitioners of traditional medicine scattered all over the country who use medicinal plants extensively for their preparations. Usually the local requirements of herbs are either extracted from the wild (over 80%) or collected from home gardens. Of all the medicinal plants used in Sri Lanka 79 species are threatened. The traditional knowledge associated with medicinal plants is also at a high risk of being lost. *Ex situ* and *in situ* conservation are successfully carried out in several areas in the island. Home gardens can be considered as a good model for *ex situ* conservation. Commercial cultivation is also prevalent in several locations in the country. Major issues confronted with the conservation of medicinal plants in Sri Lanka are increased habitat destruction, aggressive and unsustainable harvesting from the wild, biopiracy and other human induced factors such as waste disposal, pollution and urbanization. Information generated for effective conservation strategies are limited. Dearth of knowledge and skills on ethnobotany and taxonomy has also hindered effective conservation strategies. Therefore a successful national strategy for the conservation and sustainable use of medicinal plants is important. And also Sri Lanka needs a national policy on access to genetic resources and benefit sharing when considering the pharmaceutical prospecting of medicinal plants.

Use of wild plant species: the market perspective

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Consumers are increasingly interested in the provenance of the goods they are purchasing. We retail herbs and essential oils from around the world for medicinal use and also use them as ingredients in our toiletries range that we manufacture ourselves. As a Director of an ethically oriented company we receive many enquiries about the sustainability of the products that we supply. We have a policy of supplying no GMO ingredients, no animal testing (with a fixed cut off date) and offering certified organic products where available. We are currently working on a policy to ensure that wild crafted products are sustainably managed. Rather than waiting for ingredients to be made available we frequently work directly with growers, suppliers and manufacturers to find ways of developing products suitable to our requirements.

In this paper I would like to explore how we establish that the materials we use are appropriately sourced; and how we present that information to our customers.

Specific areas to examine will include:

- Working with NGOs (we have developed links with WWF, Soil Association and places such as Kew and Eden Project).
- Developing relationships with primary producers
- Writing a company sustainability policy
- Developing a wild crafting audit of suppliers
- Sourcing from around the world
- Fair trade – is this related to conservation?
- Introducing new materials (e.g. we have established a market for Seje Oil, a fair-traded Columbian Rainforest Project)
- The impact of the new EC Directive in Traditional Herbal Medicinal Products on the demand for plant material

One of the main areas of difficulty we have experienced is how to establish accurate information about the conservation status of certain plants. There are pressures from some organisations for us to stop selling a number of plants, for example golden seal (*Hydrastis canadensis* L.), sandalwood (*Santalum album* L.) and Atlas cedar (*Cedrus atlantica* (Endl.) G. Manetti ex Carrière) that need to be balanced with encouraging more environmentally sensitive projects that support local economies. I will use cedar and sandalwood as specific examples of how as a company we have responded to a variety of pressures from campaigning organisations, commercial demands, media and customers.

Session 9

Use of CWR and under-utilised species

POSTER ABSTRACTS

Evaluation of underutilized *Solanum americanum* lines

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Solanum americanum is an important medicinal vegetable popularly known to traditional farmers because of its tremendous uses. It can be grown for fresh and soup consumption. Productivity of *Solanum americanum* is very low compared with its high value. There is need to popularize and improve the crop.

Ten *Solanum americanum* lines were evaluated. The experiment was laid out in a randomized complete block design with three replicates. Observations were made on five plants chosen randomly for plant height, number of inflorescence, internode length, fruit number, fruit weight, seed weight. The results showed that *Solanum americanum* was early flowering about thirty five days after sowing to 50% flowering. Plant vigour was however weak with small size leaves, prolific flowering. Leaves and branches were produced from the nodes.

Extraction of mulberry flavonoids for industrial and pharmacological use

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Mulberry tree, a plant of the family of *Moraceae* and genus *Morus*, has been widely cultivated to feed silkworm for the production of silk. Until the past century, in Italy the mulberry cultivation was ruled by regulations which forbade to cut down this plant. But, after the coming in the market of the synthetic textile fibres, the silk production diminished and so the cultivation of mulberry was almost forgotten. At present, it can be found as an ornamental or wild plant in marginal areas. Nevertheless, other utilizations, beyond silkworm feeding, are possible for mulberry. For example, leaves could be used for the preparation of protein concentrates for animal or human nutrition and for extracting compounds with either pharmaceutical activity or textile fibres colouring ability.

This paper describes experiments carried out for the extraction of flavonoids from mulberry, the major responsible compounds for the claimed therapeutic benefits ascribed to mulberry in the folk medicine, in order to study if the recovery of such substances, together with other products, can make suitable the growing, management and processing of mulberry and so allow the conservation of this historical plant.

Diversity of wild and domesticated *Arracacia* species in Peru, as a unique reservoir to improve arracacha, one of the most promising Andean root and tuber crops

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In order to promote under-utilized species in Andean regions, a study was conducted to clarify the genetic diversity, the taxonomic status and the geographical distribution of Peruvian *Arracacia* species, including wild and cultivated populations. The principal objective is to valorise the genetic resources of the only domesticated species of the genus *A. xanthorrhiza*, commonly known as arracacha, a promising Andean root crop in marginalized highland regions. Phyletic relationships between *Arracacia* species were investigated in several accessions covering different taxa: mainly *A. elata*, *A. equatorialis*, *A. incisa*, *A. xanthorrhiza* and *Neonelsonia acuminata*. Study of morphological and molecular markers, under both *in situ* and *ex situ* conditions, showed a higher genetic difference at between species level than at within species and populations levels. Accessions considered previously as *A. equatorialis* were regrouped with populations of *A. xanthorrhiza*. These comparisons and multivariate analysis resulted in the selection of discriminatory characters to identify the three *Arracacia* Peruvian species: *A. elata*, *A. incisa*, *A. xanthorrhiza*. *A. xanthorrhiza* included the cultivated form and the wild forms monocarpic and polycarpic. The polycarpic form appeared to be the most closely related to the cultivated arracacha. On the other hand, the wild taxon *A. incisa* was closely related to *A. xanthorrhiza* wild forms. Morphological and molecular characterization resulted in the identification of morphotypes and duplications within germplasm collections. The same chromosome number was determined for the three analysed species *A. elata*, *A. incisa*, *A. xanthorrhiza*, identifying the *Arracacia* genus as tetraploid, with $2n = 44$ chromosomes. *Arracacia* species in Peru have a wide geographical and ecological distribution, covering both dry and humid zones of different altitudes (from 700 to 4,050 masl). Such information is useful to establish *in situ* and *ex situ* management of germplasm and to identify the most interesting ecological and agronomical areas for the cultivation of arracacha.

A methodology for conservation and sustainable use of the neglected/under-utilized tree species: *Q. ilex* subsp. *rotundifolia* (Lam) O. Schwarz

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Holm oak (*Q. ilex* subsp. *rotundifolia* (Lam) O. Schwarz) and cork oak (*Q. suber* L.) are keystone species of traditional Mediterranean silvi-agroecosystems known as *dehesas* in Spain and *montados* in Portugal. These cover an area of about 10 million ha in the Iberian Peninsula, occupying critical areas in terms of soil and water resources. Both species have multiple uses such as fodder for livestock, firewood as well as cork in the case of *Q. suber* L. In addition, they prevent desertification and erosion of the soil and provide shelter for wildlife.

Dramatic changes in landscape structure and function have occurred in their native ranges in the past century. The reasons include: deforestation, unfavourable climatic factors, pests and diseases, and overgrazing. However, these traditional ecosystems have become valued at national and international policy-making levels for their agronomic and ecological importance, biodiversity, and potential for tourism. Nevertheless, an effective link between conservation and sustainable use is still lacking.

In the present work, a methodology aiming at the rehabilitation of *montados* through reforestation using selected holm oak trees for important agronomic traits is proposed for Portugal. The methodology has two components: determining the distribution of genetic diversity and identification of associations between molecular markers and “oil content” of the acorns. Assessment of genetic diversity will provide guidelines on decision making concerning conservation, particularly the adequate location of on-farm reserves, the number of locations that could be collected for *ex-situ* conservation, as well as the number and location of mother plants used for regeneration. Identification of associations between molecular markers and the agronomic trait “oil content” study will allow selection of the best trees for reintroduction and new planting.

Increasing the attractiveness of the crop to land owners and farmers by crop genetic improvement through selection could lead to long-term sustainability and conservation of *dehesas* and *montados* habitats avoiding loss of associated biodiversity.

Identification and bio-agronomical study of seven biotypes of azarole (*Crataegus azarolus* L.)

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Small fruits, although scarcely spread as commercial orchards, are achieving new interests for their different potential uses. The yield of these fruits is not the only interesting aspect, but their use as ornamentals, their content of chemical substances for pharmacological applications, their possible implementation of marginal areas, are also worthy to be considered. Among the small fruits, *Crataegus* is one of the most spread genus in the self vegetation because of its high tolerance to dry soils and cold winters. Azarole (*Crataegus azarolus* L.) has never been cultivated in commercial orchards, and as a consequence, its taxonomical and genetic characteristics have been poorly investigated. The Department of Plant Production Science of Bari University has surveyed the area of the Bari province to identify biotypes of azarole to be grafted and cultivated at the Agricultural Experimental Station belonging to the University of Bari. The biological and pomological characteristics of the most promising biotypes for their possible use and valorization have been also described.

Genetic variation in and between wild populations of *Origanum syriacum* in Israel

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The dwarf shrub *Origanum syriacum* L. (Lamiaceae), (syn. *Majorana syriaca* L.) grows on rocky soils over a large area in the Eastern Mediterranean region. This is the biblical hyssop, which is nowadays almost exclusively harvested from the wild. Its main use is as an ingredient of the spice *za'atar*, a similar spice to oregano and thyme, and as a folk medicine to combat several health disorders. Our goals are to learn about the biodiversity of *Origanum syriacum* and to utilize it as a cultivation resource. In an attempt to identify genetic variation that correlates with oil content and plant morphology, a survey on different geographical populations was performed. Twelve populations were selected according to their different habitats with varying amplitude range of climates, soil, elevation and temperatures. The plants were screened by gas chromatography / mass spectrometry (GCMS) for the content and composition of the volatile oils, as well as for AFLP variation and differences in foliage morphology. Data obtained from this survey may contribute to cultivation programs and will serve as a database of breeding resources for a high quality crop.

Diversity of under-utilized fruit species in West Bengal

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There is a large diversity of less known fruits in West Bengal. Many of these fruits crops are interwoven with the rituals and cultural heritage of local people. Among the less known and underutilized fruit crops are star apple (*Syzygium javanica*), a wax-white thirst quenching fruit available during summer months. Rose apple (*Syzygium jambos*) is another important less known fruit, having fragrance of rose flowers at ripening. Other promising fruit species in the genus *Syzygium* are jalpai (*Syzygium malaccense*), Black jamun (*Syzygium cumini*) etc. Both sweet and sour fruit of hog plum (*Spondias mangifera*) are available as fence side trees in scattered way. The water bodies available in the state could be exploited by growing the aquatic fruit i.e. water chesnut (*Trapa bispinosa*, *T. quadrispinosa*) for supporting the livelihood of the rural people which are now being grown in a limited scale. The many other less known fruit crops like bakul (*Mimusopos elengi*), barhal (*Artocarpus lakoocha*), madhuphal (*Salacina chinensis*), penoil (*Flacourita ramontchi*), kujithekera (*Garcinia cowa*), star gooseberry (*Phyllanthus acidus*), cape gooseberry (*Phyllanthus peruviana*) etc. grown in scattered way could be better exploited for nutritional security of the rural mass. The wild relatives of the fruits also hold importance in crop improvement as a source of resistance to biotic and abiotic stresses.

Establishment of a collection of *Salvia* with multipurpose potentialities

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The genus *Salvia* includes more than 900 species spread out all over the world. Some of them are known for the aromatic properties, some for the medicinal and cosmetic potential, some of them are used for gardening and ornamental pot plant production. In the frame of an international project on the development of potentialities of this genus, a great number of species and cultivars were collected, propagated and evaluated at the C.R.A. Experimental Institute for Floriculture. More than 150 accessions were obtained from botanical gardens, private collections and seed companies as seeds or plantlets. In vivo propagation (seed germination and rooting of cuttings) of 50 accessions was tested. The plant material was then observed and evaluated for the morphological traits (plant habitus and texture, colour and shape of leaves and flowers) and phenology (time and duration of flowering) in order to evidence plant material particularly interesting for the ornamental market. After preliminary tests on the presence of essential oils and new natural substances, some species were multiplied *in vivo* and transferred in open field to evaluate their growth performances and the possibility of adaptation to the mediterranean climate. The production of biomass was pursued to allow phytochemical extractions of a large quantity of specific substances in order to perform biological tests. *In vitro* multiplication protocols were established for about 25 species with the aim of enhancing germplasm preservation and also to propagate recalcitrant accessions; all the phases (explant sterilization, multiplication through axillary buds induction, rooting and acclimatization) were evaluated.

Domestication and field management trials of *Cicerbita alpina* (L.) Wallr.

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Cicerbita alpina (L.) Wallr. (English: Alpine-sow-thistle), is a perennial plant belonging to the *Compositae* family, spread in all the Alpine arc between 1,000-2,000 m a.s.l. and in Italy present in the northern part of the Apeninnes too. Alpine-sow-thistle shoots, collected at the beginning of the vegetative season, boiled and seasoned with olive oil or tomato sauce may be used for alimentary purposes and in different Alpine regions are considered a delicacy. To meet needs and traditional habits of mountain areas, where *C. alpina* shoots have always been collected for domestic use, legislative measures regulating its harvest have been issued. In Trento Province they allow collecting 2 kg of *C.* fresh shoots per person daily, while in Friuli Venezia Giulia the maximum quantity allowed is 1 kg. Both administrations provide also penalties for trespassers. Veneto region has submitted a bill to allow harvesting 1 kg of shoots daily. Nevertheless as time goes by, eating Alpine-sow-thistle has become more and more popular and its use from domestic tables has passed to restaurants and it's also possible to find it in various culinary preparations in specialised shops. So these vegetables are more and more at risk of over-exploitation. In order to exploit these alimentary properties without negatively touching upon its natural diffusion, it would be advisable to go from wild collecting to proper cultivation. Concerning this change, within a project financed by the Province of Trento, the CRA-ISAFA has started to harvest seed of *C. alpina* in different areas of Trentino, has solved the seed dormancy problem and has achieved its micropropagation techniques. In the meanwhile vigor and productivity of various seed-borne accessions and effects on plant productivity of different dates (years) of shoots harvest are compared in experimental trials.

Index of authors

| | | | |
|----------------------|-------------|----------------------|------------------------|
| Abbo | 33 | Chessa | 112 |
| Acquadro | 84 | Chkhartishvili | 24 |
| Adetula | 121 | Çiçi | 63 |
| Agami | 93, 109 | Clarke | 111 |
| Agbangla | 54 | Coart | 49 |
| Aiello | 126 | Codd | 15 |
| Al-Atawneh | 55 | Collette | 4 |
| Allahham | 18 | Collin | 17 |
| Amri | 55 | Comino | 84 |
| Andreoni | 121 | Correia | 123 |
| Anikster | 64, 77, 109 | Couvreur | 43 |
| Aprile | 103 | Cultrera | 107 |
| Aradhya | 21 | Curtis | 117 |
| Arslan | 64 | Cuyper | 17 |
| Ashmore | 79 | Dafgård | 64 |
| Asmussen | 49 | Daïnou | 54 |
| Assi | 55 | Damiano | 78 |
| Avagyan | 5, 44 | Dangl | 21 |
| Avanzato | 9, 47 | Daoust | 107 |
| Avetisyan | 5 | Das | 125 |
| Azzu | 4 | Degreef | 56 |
| Baco | 54 | Dehmer | 73 |
| Baldoni | 107 | Deshmukh | 110 |
| Barbera | 48 | Di Marco | 108 |
| Barone | 26 | Dias | 41 |
| Baudoin | 56, 122 | Dinh | 63 |
| Bedini | 77 | Dishnica | 25 |
| Benchacho | 72 | Doležalová | 109 |
| Benedikova | 22 | Dooijeweert | 79 |
| Ben-Yehuda | 98, 109 | Draper | 33 |
| Bettencourt | 41 | Drew | 79 |
| Bianchini | 105 | Drobna | 108 |
| Blas Sevillano | 122 | Duchoslav | 109 |
| Bobokashvili | 22 | Dudai | 124 |
| Bonomi | 77 | Dulloo | 92 |
| Bordenave | 42 | Durah | 92 |
| Bošković | 111 | Dzeria | 22 |
| Boukema | 79 | Ezrati | 109 |
| Bourse | 42 | Fady | 17 |
| Boursiquot | 42 | Feldman | 64 |
| Branca | 59 | Ferraj | 63 |
| Brindza, J. | 104 | Fideghelli | 9 |
| Brindza, P. | 104 | Flath | 97 |
| Bronner | 42 | Ford-Lloyd | 3, 13, 14, 15, 41, 123 |
| Bruna | 78 | Frattarelli | 78 |
| Burchi | 105 | Frese | 91 |
| Caboni | 78 | Fusani | 126 |
| Cammalleri | 28 | Gaeta | 28 |
| Campbell | 106 | Gaiji | 92 |
| Can | 33 | Galili | 124 |
| Capponi | 125 | Gallotta | 124 |
| Carbonneau | 42 | García | 72 |
| Çarka | 63 | Germanà | 107, 108 |
| Cartabellotta | 23 | Germeier | 91 |
| Caruso | 111 | Ghislain | 122 |
| Cataldo | 82 | Ghorbel | 67 |
| Cervelli | 78, 125 | Giorgio | 124 |

| | | | |
|-----------------------|-------------------|-----------------------------------|--------------------------------|
| Giovannini..... | 125 | Losciale..... | 124 |
| Gogishvili..... | 24 | Ludeña..... | 43 |
| Große..... | 97 | Luhua..... | 124 |
| Guarino..... | 56 | Maghradze..... | 24 |
| Habekuß..... | 97 | Magos Brehm..... | 15, 32 |
| Hadas..... | 93, 124 | Malice..... | 122 |
| Hajjar..... | 97 | Mallardi..... | 82 |
| Hamilton..... | 79 | Manisterski..... | 77, 98, 109 |
| Hammer..... | 82 | Marchese..... | 111 |
| Harutyunyan..... | 44 | Martins-Loução ² | 32 |
| Hasan..... | 125 | Maruca..... | 82 |
| Hasasneh..... | 18 | Mascarello..... | 125 |
| Hauptvogel..... | 22, 108 | Mauromicale..... | 84 |
| Havránek..... | 109 | Maxted..... | 3, 13, 14, 15, 32, 55, 90, 123 |
| Helenius..... | 16 | Mercatelli..... | 105 |
| Heywood..... | 115 | Mercuri..... | 78, 105 |
| Hilton-Taylor..... | 31 | Mieslerová..... | 109 |
| Hoa..... | 63 | Millet..... | 64, 98, 109 |
| Hodgkin..... | 92, 97 | Mitchell..... | 32 |
| Hoekstra..... | 17, 79 | Mliki..... | 67 |
| Hoeschle-Zeledon..... | 115 | Monti..... | 83 |
| Holly..... | 28, 80 | Moore..... | 90 |
| Horovitz..... | 80, 93 | Motisi..... | 111 |
| Horváth..... | 28, 80 | Negri..... | 59 |
| Hovhannisyan..... | 44 | Nieddu..... | 112 |
| Hyso..... | 25 | Oboh..... | 111 |
| Iriondo..... | 33, 53, 90 | Odé..... | 17 |
| Izzo..... | 9 | Olrik..... | 49 |
| Jury..... | 13 | Onejeme..... | 111 |
| Kaplan..... | 58 | Ouédraogo..... | 56 |
| Kariyawasam..... | 116 | Ozaslan..... | 33 |
| Kell..... | 3, 13, 14, 15, 90 | Ozlem..... | 64 |
| Kjær..... | 49 | Padulosi..... | 115 |
| Knüpfner..... | 13 | Palazzolo..... | 108 |
| Korpelainen..... | 16 | Palombi..... | 78 |
| Koskela..... | 17 | Panguluri..... | 110 |
| Křístková..... | 109 | Parra-Quijano..... | 33 |
| Kroitor..... | 124 | Pasta..... | 48 |
| Kryszczuk..... | 81 | Pendinen..... | 97 |
| Kumar..... | 110 | Pérez de la Vega..... | 72 |
| Kvaliashvili..... | 22 | Perrino..... | 82 |
| La Bella..... | 28 | Pham..... | 43, 54 |
| La Mantia..... | 48, 85, 103 | Pignone..... | 83, 99 |
| Labokas..... | 57 | Pihlik..... | 37 |
| Lacombe..... | 42, 67 | Pintaud..... | 43 |
| Lafiandra..... | 82 | Pohjamo..... | 16 |
| Lane..... | 92 | Porceddu..... | 107 |
| Lanteri..... | 84 | Portis..... | 84 |
| Lara..... | 43 | Poulsen..... | 64 |
| Larsen..... | 49 | Principato..... | 125 |
| Laucou..... | 67 | Prins..... | 21 |
| Lebeda, A..... | 109 | Radušienė..... | 57 |
| Lefèvre..... | 17 | Raimondo..... | 111 |
| Leite..... | 66 | Raparelli..... | 47 |
| Leto..... | 28 | Ratnayake..... | 116 |
| Lev-Yadun..... | 33 | Ricciolini..... | 107 |
| Licata..... | 28 | Richard..... | 4 |
| Linga..... | 110 | Rocha..... | 56 |
| Liotta..... | 26 | Roscher..... | 27, 89 |
| Longe..... | 111 | Rossi..... | 77 |

| | | | |
|------------------------|---------|------------------------|---------|
| Ruffoni | 78, 125 | Takaluoma..... | 16 |
| Ruge-Wehling | 97 | Tchiphashvili..... | 24 |
| Ryabova | 65 | Terzi | 82 |
| Sáenz de Miera..... | 72 | This | 42, 67 |
| Saiano | 108 | Thormann | 92 |
| Salillari..... | 25 | Tiago | 66 |
| Sarli | 82 | Tobutt | 111 |
| Satta | 112 | Tomaselli..... | 82 |
| Scarascia I..... | 82 | Torres..... | 33 |
| Scarascia M..... | 82 | Tostain | 54 |
| Scarcelli..... | 54 | Tóth..... | 104 |
| Scartezzini | 126 | Toussaint..... | 56, 122 |
| Schiva..... | 105 | Turok | 17 |
| Scholten..... | 15, 90 | Tuttolomondo | 28 |
| Scholz..... | 97 | Usha Rani..... | 110 |
| Sciarratta | 26 | Varès | 42 |
| Sharrock | 73 | Vecchi | 42 |
| Shmueli..... | 124 | Veller | 17 |
| Silva..... | 66 | Vences | 72 |
| Simon | 21 | Vender..... | 126 |
| Sirois | 107 | Voci | 25 |
| Sirota | 124 | Vondráková | 109 |
| Smekalova | 16 | Vörösváry | 28, 80 |
| Smith | 72 | Vorpsi | 63 |
| Sonnante | 99 | Wehling | 97 |
| Sortino, M | 85 | Wilkinson | 41 |
| Sortino, S..... | 85 | Wühlisch..... | 17 |
| Spartà..... | 23 | Wyse-Jackson | 73 |
| Sretenovic Rajic | 73 | Yadav, S.S. | 112 |
| Stehlíkova | 104 | Zimnoch-Guzowska | 81 |
| Stover | 21 | Zoghlami..... | 67 |
| Syde | 64 | Zoro Bi..... | 56 |



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