Report of the IPGRI Workshop on Conservation and Use of Underutilized Mediterranean Species

UNDER UTILIZED MEDITER RANEAN SPECIES

March 28-30, 1994
At the Istituto Agronomico Mediterraneo of Valenzano, Bari, Italy

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International Plant Genetic Resources Institute
IPGRI

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Introduction

The Project on Underutilized Mediterranean Species

The Mediterranean basin, cradle of the Occidental Civilization, has a long history of agricultural exploitation of its endemic species. The region is home to a wealth of plant genetic diversity that has provided the benchwork to humankind for experimental plant domestication pursuits. Not less than 25 000 plant species are recorded from the Mediterranean. Such diversity has been utilized to obtain over time hundreds of crops which have been used extensively in the past or which are still popular today. For example, more than 500 crops are reported to be growing in Southern Italy alone, mostly of them being indigenous to the area.

It is estimated that not less than 364 crops have their primary or secondary centres of origin in the Mediterranean, such estimate not taking into account additional hundreds of useful species harvested directly from the wild and not yet domesticated.

In spite of such richness, however, economic considerations have led producers to focus only on a limited number of crops, to the detriment of numerous species which have important nutritional values and / or are potentially exploitable albeit with doubtful short-term economic returns. Current economic policies of the European Union stress the necessity of diversifying agricultural products, due to a generalized overproduction within the European countries. At the same time consumers are interested in diversifying their diet and look favorably to alternative crops that could bring more flavours to their table.

Furthermore, farmers from the Mediterranean region are in search of new sources of income to increase their reduced incomes.

There is no doubt that in order to promote the use of underutilized species of the Mediterranean only a major initiative, involving all countries of the region, could allow the potentials of these species to be fully assessed and exploited in a profitable way.

Another aspect of great concern along with the reduced utilization is the status of conservation of the underutilized species. Over the last 20 years the justified attention that has been directed toward the conservation of a few major crops has caused the neglect of the preservation of many more indigenous ones. Such a situation has led to the gradual loss of the genetic material and the tradition, both elements linked in the history of our civilization. As a matter of fact the availability of germplasm material of these neglected crops is indeed very scarce in national or international genebanks worldwide, when compared with what has been assembled so far for major crops.

In 1993 IPGRI initiated a new project on underutilized species of the Mediterranean. The project, sponsored by the Italian Government, through the Ministry of Foreign Affairs, aims at boosting the safeguarding of these species and encouraging their utilization. Utilization is, in fact, seen as an important component in a global strategy of conservation of plant genetic resources, as any initiative that raises awareness on crop potentials will be beneficial to preserve at the same time the genetic material that will be eventually used for its exploitation.

The project intends to achieve these goals through the pursuit of a number of well-defined objectives:

1. **rescue and preserve the genetic diversity of selected underutilized species**
2. **assess crop variability**
3. **establish and promote collaborative networks in the region**
4. **rescue local knowledge along with germplasm**
5. **promote on-farm conservation activities**
6. **develop a database for selected species.**

The Valenzano Workshop

The main goal of the UMS project fits within IPGRI's overall strategy which emphasizes the key role that international collaboration plays in the conservation and use of plant genetic resources worldwide. A way to strengthen such collaboration is to foster cooperation among various institutions engaged in this area and this can be achieved successfully by encouraging the establishment of crop networks. Networks promote direct contacts between scientists from different disciplines and countries who agree on doing something together. This working-together approach yields greater benefits than working in any other way.

A number of key resource persons selected from a wide representation of institutions belonging to both formal and informal sector were invited to participate in the meeting (see Appendix II). Their participation has been instrumental in laying down the foundation of the project. Some thematic papers dealing with the potential of the selected species were presented to introduce the species and stimulate the discussion. These contributions are presented here; the paper on rocket that was not ready at the time of printing this document will be included in the proceedings of the first meeting of the Rocket Genetic Resources Network which took place in November 1994.

After listening to the thematic presentations, participants met in four different Working Groups — rocket, obsolete wheat species, pistachio, medicinal and aromatic species — and discussed taxonomy, species distribution, status of conservation and degree of utilization of the genetic resources of these species. The core of the discussion of the Working Groups was, however, the identification of priorities on what needs to be done to strengthen the safeguarding and use of the selected species. The meeting also reached consensus for the establishment of four crop networks, which by relying on the active participation of partners from the region will work to meet the project's goals. The discussion and recommendations of the Working Groups are reported here.

The meeting was preceded by a preparatory study in which investigations were made on needs and priorities in the area of Underutilized Mediterranean species. Instrumental in that stage was the survey conducted through the use of a questionnaire despatched to research institutions and various organizations in the region. The questionnaire format and the results are given in Appendix IV.

Discussions and Recommendations of the Working Groups

Working Group on Obsolete Wheat Species

The working Group (WG) was composed of the following persons:

D'Antuono	Italy	Piergiovanni	Italy
Dalla Ragione	Italy	Stavroupoulos	Greece
Jaradat	IPGRI (Syria)	Vallega	Italy
Marconi	Italy	Vazzana	Italy
Perrino	Italy		

The WG elected Prof. D'Antuono as Chairperson and Dr. Jaradat as Rapporteur.

Taking into account that the interest of the project lies in einkorn, emmer and spelt, the WG suggested that the name of the network that it is intended to establish should be **Network on Obsolete Wheat Species**. Such a network will deal with the following cereals: *Triticum monococcum* L. (einkorn), *T. dicoccum* Schübler (emmer) and *T. spelta* L. (spelt).

The working group recognized that more basic research, collection and conservation are needed for *T. monococcum*. This species can be utilized directly, as a crop, or indirectly, as a source of novel genes to be transferred to the more widely grown Triticum species.

Triticum dicoccum and, to a lesser extent, *T. spelta*, are being more widely used than *T. monococcum*. There is a need, however, to boost their direct use, as well as research studies, particularly on their nutritional values.

All three species can be considered underutilized from both genetic and agronomic points of view.

Discussion

1. KNOWLEDGE OF THESE SPECIES

1.1 Taxonomy

All three species have been sufficiently described taxonomically. Their position within the wheat genepool seems clear. In the event that additional species from *Triticum* might be considered later on by the network it is important that their exact taxonomic position and relationship with the three selected species be well understood. The WG indicated that there is a need to inform the general public on the distinctions existing among the three selected species and their respective morphoagronomic characteristics and dietary values.

1.2 Existing genepool

Germplasm of these species has been collected and is being conserved in many genebanks around the world. However, most collections are old, and there might be a need for re-collecting germplasm. Data and information on these collections need to be compiled, collated and presented in a database format. The level of existing duplicates in germplasm collections needs to be assessed and the material involved properly identified.

The position of these species within the wheat genepool is well defined genetically. Gene transfers from these species are relatively easy and can be performed using well-established procedures.

1.3 Morphophysiological variability

It is postulated that among the three species, genetic variability increases with the ploidy level. Those traits that are of immediate practical importance in crop improvement programmes are disease and pest resistance and end-use quality factors. However, in order to exploit potential genetic variability, further information is needed in regard to the variability of these characters in the species.

1.4 Ecoregional distribution

The distribution of these species is well defined within and outside the Mediterranean basin, mainly on the European side. These species occupy niches in particularly traditional, resource-limited farming systems, and in mountainous areas, characterized by harsh growing conditions, where other wheat species do not grow well.

1.5 Threats to diversity

Due to the very nature of these species, and the type of agroecological niches they usually occupy, there is a strong indication that their on-farm genetic diversity is limited and declining with time. More information is needed on the genetic diversity of populations and on the biotic, abiotic and socioeconomic factors which contribute to their level of genetic diversity and decline. The WG feels that *T. monococcum* and *T. spelta* are under threat of genetic erosion more than *T. dicoccum*, and therefore they need to be collected / re-collected from areas of cultivation in order to capture the maximum amount of genetic diversity from those populations. The threat to the diversity of *T. dicoccum* in Italy could be generated by the uncontrolled introduction of "exotic" genetic material including that of *T. spelta* which can eventually end up mixed with local seeds of this species.

1.6 Marketed varieties

Few cultivars of *T. spelta* are registered in the EEC Crop Catalogue.

2. ORGANIZATIONAL ASPECTS

2.1 Groups involved in research

The Germplasm Institute (National Research Council) of Bari, Italy, in cooperation with farmers' associations, is working on the nutritional aspects of *T. dicoccum*. Some work has been done on the genetic diversity of *T. monococcum* and *T. dicoccum* at ICARDA and at the "Istituto Sperimentale per la Cerealicoltura", Italy. In addition to these activities there is the involvement of the Centro Ricerche e Sperimentazione per il Miglioramento Vegetale N. Strampelli (CERMIS) of Tolentino, Italy. This research centre is working on a number of projects dealing with germplasm evaluation, breeding and agronomic trials of einkorn, emmer and spelt.

There is a need to gather additional information on those groups / institutes around the Mediterranean which are currently working on these species.

2.2 Conservation activities

Some activities for the conservation of these species are going on, simply because research and conservation are linked. Farmers who cultivate these species are basically conserving, and most likely enhancing, their genetic diversity. However, the level of *ex situ*, and particularly on-farm, conservation activities is very limited. More cooperation between users and conservation agencies is needed.

3. CONSERVATION OF GENETIC DIVERSITY

3.1 How it is conserved
All species with orthodox seeds are being conserved in *ex situ* seed collections. On-farm conservation is being practised in a few restricted areas where farmers are cultivating landraces of these species.

3.2 Constraints
Several socioeconomic factors might be contributing to the loss of genetic diversity in these species. Strategies have to be outlined to strengthen on-farm conservation and to integrate it with *ex situ* activities. A consumer-driven strategy could be a viable option for this purpose. Lack of a strategy for on-farm conservation activities within the framework of sustainable agriculture systems was identified as a major constraint.

A more solid and well-defined linkage between research and conservation has to be worked out.

Profitability to farmers is a major constraint to its conservation and use.

3.3 Responsibility
The Germplasm Institute of Bari and ICARDA are centres that are well equipped with conservation facilities and are ready to accept the responsibility of being depository centres of the germplasm of these species. Other regional centres (e.g., the regional genebank in Toscana Region, Italy) are also ready to participate.

4. UTILIZATION OF GENETIC DIVERSITY

4.1 Potential / constraints
The following were those aspects indicated by the WG with good potential for the utilization of these species:

1. Suitability to low-input agricultural systems
2. Adaptation to marginal lands, scarce competition with other crops
3. Good competition with weeds present in the field
4. Potential for the development of new products (e.g., foods with high fibre content).

However, to fully exploit these potentials, systematic research has to be carried out on representative germplasm and within representative agroecological zones. Among the constraints the WG indicated the following:

1. Limited market size
2. Additional cost due to specialized processing
3. Plant height which leads to lodging
4. Fragility of the spikes which can cause loss of yield under certain environmental conditions
5. Limited availability of genotypes / seeds in the market to meet farmers' needs.

4.2 EEC contribution
Wherever appropriate, plans for direct, rather than indirect, compensation or support to farmers of these crops should be worked out based on the EEC regulation no. 2078/92. With this aim a number of initiatives were recommended by the WG:

1. Concentrate support efforts in a few — but selected — locations that represent crucial sites for conservation and utilization of genetic resources of these species
2. Promote on-farm conservation activities
3. Create links between conservation and utilization activities
4. Promote the commercialization of the end products.

4.3 Initiatives

Very few initiatives are actually being carried out. Among those that the WG is actually aware of are the following:

1. Studies on selection and adaptation of *T. monococcum* in marginal areas in Italy
2. Conservation activities carried out by "Regione Toscana" on-farm conservation of these species
3. Research activities being conducted by the International Wheat Genetic Resources Network (IWGRN)
4. Evaluation of agronomical and technological properties of *T. monococcum* germplasm accessions (Istituto Sperimentale per la Cerealicoltura, Rome, Italy)
5. Agronomic trials on *T. monococcum, T. dicoccum* and *T. spelta* aiming at improving morphoagronomic traits of these species, and understanding better the influence of fertilization and sowing density rates on their cultivation (Istituto Sperimentale per la Cerealicoltura, Foggia, Italy)
6. Investigation on the genetic diversity of *T. monococcum*, *T. dicoccum* and *T. spelta*, their agronomic performances and breeding aspects (CERMIS, Tolentino, Italy).

4.4 Commercial varieties

This point has been dealt with earlier on. The WG indicated that there are only a few spelt cultivars that are being commercialized. This material is particularly suited for northern European countries.

4.5 Evaluation / selection / breeding

A short-term objective is to utilize existing germplasm for the improvement of the end products. A long-term objective is to select and breed to improve yield potential, broaden species adaptation and improve nutritional and technological quality.

4.6 What we can do to bring researchers and users closer to each other

1. Inventory of institutions/organizations holding germplasm and information on the species
2. Use available means of communication to publicize this network and its objectives
3. Call on collaborating institutions to provide needed information on specific subjects on the species
4. Build up a database on the selected species.

4.7 Collaboration with the private sector

The private sector has been instrumental in promoting the cultivation and utilization of these species, and it is expected to be more involved in the future in providing feedback on consumer preferences and demands.

Establishment of the Network on Obsolete Wheat Species

Participants welcomed the proposal of establishing the network on obsolete wheat species. However, they expressed the need to broaden the participation by calling on additional partners from other Mediterranean countries.

Contacts will be made soon in this respect with the assistance of IPGRI project coordinator.

The following initiatives were indicated by the WG as having priority in the Agenda of the network:

1. Identify available germplasm held in major genebanks, e.g., ICARDA; Germplasm Institute of Bari; IPK, Germany; SDA; VIR, Leningrad, Russia; Kyoto, Japan; CIMMYT, Mexico; India; Ethiopia and Yugoslavia
2. Exchange of germplasm and information among interested participants of the network
3. Compile information on farmers, farmer organizations, etc. involved in cultivating these species; additional information should also be compiled on their interests and needs, and on the ecogeographical characteristics of areas of cultivation
4. Collect germplasm whenever and wherever possible, using recommended collection strategies to pay some attention to rare phenotypes
5. Publicize the network in regional newsletters (e.g., IPGRI/FAO Plant Genetic Resources Newsletter, WANA Newsletter, GRAIN, etc.)
6. Continue the characterization, evaluation and selection of germplasm, especially for nutritional and technological quality
   (Action: Germplasm Institute of Bari and University of Cambobasso).

Finally, members of the working group on Obsolete Wheat Species recommended the formulation of a Regional Project on "Obsolete Wheat Species" which should pursue the following objectives:

1. Promote the conservation and enhance the genetic diversity of landraces of these species
2. Promote research on, and development of, landraces of the selected species
3. Encourage farmers, NGOs, cooperatives, etc. to conserve and promote the utilization of landraces of these species
4. Develop new products and promote the use of health/specialty foods derived from these species.

Working Group on Rocket

The WG on rocket was composed of the following participants:

Bianco	Italy	Pignone	Italy
Frison	Italy (IPGRI)	Pimpini	Italy
Laghetti	Italy	Stavroulakis	Greece
Noto	Italy	Yaniv	Israel

The WG elected Prof. Bianco as Chairperson and Prof. Yaniv as Rapporteur of the meeting, Frison being Co-rapporteur. It was agreed to follow the discussion by going through the points included in the IPGRI suggested guidelines discussion paper.

1. KNOWLEDGE OF THE CROP

The WG agreed that the species of interest include both the genepool of the genus *Eruca* and *Diplotaxis* (with the exclusion of *D. erucoides* from the latter; *D. erucoides* is in fact scarcely used as food in the Mediterranean). Therefore, the species of interest for the WG would be the following:

Eruca sativa
Diplotaxis muralis
Diplotaxis tenuifolia

E. sativa is present in both wild and cultivated forms; *D. muralis* is known as a wild taxon and *D. tenuifolia*, while being common in the wild, is reported to also have some semidomesticated types which seem to have been produced recently in Southern Italy.

Assembling representative samples of the diversity present in the Mediterranean was identified as a top priority. The development of a descriptor list was also identified as a priority. The WG indicated the necessity to define standards for the identification of the different species. The analyses of karyotypes was suggested as one of those activities that also would provide important information for a better understanding of the genetic diversity in *Eruca* and *Diplotaxis* genepools. Molecular markers and isoenzymes were also indicated as useful tools for evaluating these species' variability.

The Mediterranean region is the centre of origin and diversity of rocket genepool and the material found in other countries has most likely originated in this area.

Only a few seed companies in Italy sell cultivated material (populations) of *E. sativa* and more recently also of *Diplotaxis* spp.

The WG reported the presence of a threat to the diversity of rocket in several countries, including Israel. It was recommended that this phenomenon should be properly assessed and each member of the network agreed to carry out an investigation to this regard in her/his own country.

2. ORGANIZATIONAL ASPECTS

A number of organizations working on rocket have been identified by the WG:

- The Extension Service of the "Regione Veneto", Italy
- Private farmers in Puglia and Sicily, Italy
- The Institute of Industrial Horticulture, National Research Council, Bari, Italy
- The Germplasm Institute, Bari, Italy

- The Volcani Centre, Dept. of Introduction, Bet Dagan, Israel.

It was agreed that investigations should be carried out to identify other partners, expecially in Spain, Egypt and Turkey. The Germplasm Institute of Bari and the Volcani Centre of Bet Dagan are the only organizations that have been identified as holders of the germplasm of these species.

3. CONSERVATION OF THE GENEPOOL

The conservation of the genepool can be carried out *ex situ* in seed genebanks. No particular problem was identified for this type of conservation. The WG agreed that material collected in the various countries should be conserved in the genebank of Bari and also in the genebanks of those countries where it was gathered.

Safety duplicates of the entire collection will be sent to Prof. Gomez Campo of the University of Madrid, Spain. Prof. Campo is the curator of an interesting *Brassica* germplasm collection; he will be shortly contacted by Padulosi to this aim.

The role of *in situ* conservation was also recognized to be of importance, especially for *Diplotaxis.* The potential role of NGOs in the conservation and use of these species should be investigated.

4. UTILIZATION OF THE CROP GENETIC DIVERSITY

The different species belonging to the *Eruca* and *Diplotaxis* genepools are used for different purposes, including the following:

- fresh leaves
- frozen leaves
- seed production
- oil production (used for industrial purposes, plastics, lubricant of airplane engines)
- biological activities (insecticide, nematocide, seed germination inhibitor, etc.)
- mustard production
- bioassays.

Some constraints to their use have been identified which include the following:

- poor seed germination
- early bolting
- susceptibility to diseases
- lack of information on post-harvest technology
- lack of information on nutritional values
- reduction in flavour when plants are grown in glasshouses.

It was agreed to investigate the existence of commercial varieties in other Mediterranean countries such as Egypt.

It was agreed that in order to stimulate the commercial exploitation of rocket, work should focus first on the evaluation of the available diversity within the Mediterranean and on the selection of material by looking at the different characteristics required for the crop’s various uses.

Development of Rocket Genetic Resources (GR) Network

All participants agreed on the establishment of a GR network on rocket with the following main objectives and proposed work plan.

1. OBJECTIVES

The main objective of the network is to study the rocket genepool and to conserve it for better use of its diversity for different purposes.

2. WORKPLAN

2.1 Exploration and collection

Assemble germplasm in the genebank of Bari during 1994. Samples of accessions will be requested from relevant genebanks and botanical gardens (Action: Pignone and Yaniv). Germplasm will be collected in the following areas:

- Basilicata and Sardinia Region, Italy (Action: Laghetti)
- Puglia Region, Italy (Action: Bianco)
- Sicily and Calabria Region, Italy (Action: Noto)
- Veneto Region, Italy (Action: Pimpini)
- Crete, Greece (Action: Stavroulakis)
- Israel (Action: Yaniv)
- Spain (Action: Ramirez).

The germplasm collectors should use collecting sheets that will be provided by Laghetti.

2.2 Descriptor list

Prof. Bianco will take the lead for the development of a descriptor list for rocket.

2.3 Regeneration

The germplasm assembled during 1994 will be regenerated by the Germplasm Institute in the spring of 1995, along with some preliminary evaluation. Samples will be distributed to the various partners to enable them to carry out further evaluation activities.

2.4 Evaluation

Field evaluation will be carried out in Puglia (Action: Bianco, Pignone) and in Veneto (Action: Pimpini, Experimental Regional centre "Po di Tramontana" and E.S.A.V.).

Chemical evaluation and study on biological activities will be carried in Israel at the Volcani Centre and in Crete at MAICh (Action: Yaniv, Stravoulakis).

Study on the adaptability to greenhouse cultivation will be carried out in Catania, Italy (Action: Noto).

Investigations on nutritional values and quality aspects will be carried out at the University of Campobasso (Action: Marconi).

2.5 Database

The Germplasm Institute of Bari will establish a database in order to include all the characterization and evaluation data assembled by the Network.

2.6 Evaluation activities at the molecular level

Evaluation of germplasm at the molecular level will be carried out at the Germplasm

Institute if manpower and resources are available. The possibility of placing a student of MAICh at IAM in Valenzano, Italy, will be investigated. Work on karyotype analyses will be initiated in Bari in the second half of 1994. The possibility of seeking IPGRI support for a fellowship to focus in this area of research will also be investigated.

2.7 Agronomic trials

A trial will be set up in the Veneto Region, Italy, to study the effects of different sowing dates and different rates of nitrogen applications on the production and quality of *Diplotaxis* spp.

3. FUTURE CONTACTS

The possibility of organizing a small meeting of the Network members at the Cruciferae workshop scheduled to take place in November 1994 in Lisbon will be investigated.

Working Group on Pistachio

The WG on pistachio was attended by the following persons:

Caruso	Italy	Monastra	Italy
Chaudier	France	Nicolas	France
Di Palma	Italy	Toll	Italy (IPGRI)
Khaldi	Tunisia	Martelli	Italy
Kunter	Turkey	Perna	Italy

The WG elected Prof. Monastra as Chairperson and Dr. Khaldi as Rapporteur, Ms. Toll being Co-rapporteur. The participants agreed on the establishment of a network on Pistachio Genetic Resources. Further discussion of the WG was held to identify objectives and a work plan for the Network.

Proposed Objectives and Activities of a Network on the Genetic Resources of Pistachio in the Mediterranean Region

Network Objectives

The WG identified a number of objectives to be pursued by the network within three different time frames:

1. SHORT-TERM OBJECTIVES

1. Development of a list of descriptors
1. Initial country survey and collection activities (by October 1994).

2. MEDIUM-TERM OBJECTIVES

The WG recommended the development of a project to undertake a number of activities such as:

- Establishment of regional collections
- Further collecting in Mediterranean countries
- Establishment of a central database
- Identification of genetic markers for *Pistacia*
- Guidelines for safe movement of germplasm.

3. LONG-TERM OBJECTIVES

The WG indicated those long-term activities that should be pursued by the network: the research on phenotypic traits (morphological, physiological and biological), influence on their expression made by the environment.

Work Plan

1. DEVELOPMENT OF A DESCRIPTOR FOR PISTACHIO

Participants stressed the need for a descriptor for pistachio as soon as possible since there is much confusion on its taxonomy; indeed, many synonyms are to be found within the *Pistacia* genus. The WG recommended the development of a standard descriptor for the different species. More specifically, the following suggestions were made:

1.1 *Pistacia vera*

There is a need to develop a descriptor list for male and female trees. Action proposed: to use the existing descriptors developed in Turkey and any other available material as a reference for its development. Initial compilation will be done by Caruso. IPGRI will assist in guidance on descriptor development.

1.2 Other wild *Pistacia* species of Mediterranean distribution

There is a need to develop a list of botanical characters that will discriminate between the different species (e.g., characters referring to flower, fruit, seed and leaf morphology). The following species should have a priority in this investigation: *P. atlantica, P. terebinthus, P. lentiscus, P. palestina, P. integerrima, P. chinensis, P. tsicudia.* Participants noted that some of these species names might be actually just synonyms (e.g., *P. khinjuk, P. chinensis, P. integerrima, P. terebinthus, P. palestina, P. sapota, P. tsicudia*).

Action: Caruso will develop a first list of characters and send this draft to all participants to ask for their comments/suggestions for its completion. Participants were encouraged to survey trees by September and provide data in October (including photocopies and photos of the material). This will greatly assist the process of assessing the genetic diversity of the material and will help in the production of the final descriptor list.

The Network participants indicated their availability for working closely toward the production of a comprehensive descriptor list.

2. ASSESSMENT AND DESCRIPTION OF THE GENETIC DIVERSITY IN PISTACHIO

The following points were given priority by the participants:

2.1 Survey and preliminary collection of wild material and old cultivated varieties of *P. vera* in each country

French participants stressed the importance of paying particular attention to the *P. vera* types called "Provence" distributed in southern France which are seriously in danger of genetic erosion thus requiring urgent germplasm rescuing intervention. The WG stressed the importance of gathering, along with germplasm material, information on the use of the different species made by the local populations (e.g., in *Pistacia* the leaves are used as a source of forage and tannins; the pericarp is used for the preparation of essential oils; embryos are used for food preparations and as antioxidants) and potential of the local varieties of *P. vera.*

2.2 Characterization of germplasm material using descriptor lists

2.3 Establishment of collections at national level and duplications in regional Mediterranean field genebanks. Identification of possible *in situ* conservation sites

2.4 Definition of priorities for further collecting and conservation activities

3. CONSERVATION AND EXCHANGE OF GERMPLASM

3.1 Establishment of field genebanks in the Mediterranean region

For secure duplications and for carrying out effective evaluation activities of genetic diversity, it is proposed to establish regional collections in the Mediterranean region. To this end, Italy offered to maintain regional collections at Palermo, Rome and other sites; possibilities exist also in Turkey at Gaziantep, Saliurfa and Siirt.

3.2 Establishment of a central database

The Network will work on the establishment of a central database to store characterization and evaluation data (including molecular markers, disease resistance, etc.). IPGRI will assist in setting up the documentation system for carrying out this task.

3.3 Phytopathological aspects

Participants recommended the adoption of guidelines for the safe movement of germplasm material of *Pistacia.* There is a need for the identification of those diseases requiring control when exchange of germplasm is involved (both seeds and vegetative parts). The network will seek the assistance of IPGRI for the development of these guidelines.

3.4 Research activities

Two main areas of investigation were indicated by the WG as particularly important in *Pistacia* research:

1. Phylogenetic relationship within the *Pistacia* genepool: in this field of research both morphological and biochemical studies are recommended
2. Conservation methods: the *in vitro* method of conservation was suggested as an important area of investigation for getting more knowledge on improved methods of conservation that could be adopted for safeguarding *Pistacia* spp.

Establishment of Network on *Pistacia* Genetic Resources

1. ESTABLISHMENT OF THE NETWORK

Participants attending the WG session expressed their interest in establishing a network on *Pistacia* Genetic Resources. The network will operate within the broader framework of the **FAO** Inter-regional network on nut trees and the Pistacia subnetwork thereof. Several participants who are also active members of the FAO regional network showed their enthusiasm for the idea of having such an approach which represents an important element for strenghtening efforts spent on this crop in the region.

2. ADDITIONAL PARTICIPANTS

The WG indicated that there are a number of additional people actively working on pistachio who should be contacted to seek their participation (Action: Padulosi, Monastra); among them ACSAD would be an important network partner.

3. PRESENCE OF OTHER GROUPS INVOLVED IN WORK ON PISTACHIO

Other groups involved in work on pistachio and with which close consultations will be made for possible collaborations are the following:

- **WANANET** (West Asia & North Africa Fruit Tree Network)
- **ISHS** Nut Working Group (WG of the International Horticultural Society)
- **GREMPA**.

4. ISHS SYMPOSIUM: 20-24 SEPTEMBER 1995 IN ADANA, TURKEY

WG participants felt that this symposium could be an important occasion for the network for meeting again and to investigate the possibility of fostering further collaborations with the existing groups dealing with pistachio.

5. NETWORK COORDINATION

The participants elected the following persons to represent a "Noyeau" of resources that will follow up activities with the Project Coordinator (Padulosi): Monastra, Italy; Kunter, Turkey and Khaldi, Tunisia.

Working Group on Medicinal and Aromatic Plants (MAP)

The participants at the Workshop in Valenzano felt that it was more sensible to merge the WG on medicinal with that on condiment (aromatic) species.

The following persons participated in the MAP WG session:

Baricevic	Slovenia	Marzi	Italy
Ba_er	Turkey	Maruca	Italy
Basso	Italy	Padulosi	Italy (IPGRI)
Bezzi	Italy	Pasquier	France
Branca	Italy	Ramirez	Spain
Cerretelli	Italy	Redon	France
De Mastro	Italy	Rejdali	Morocco
Figliuolo	Italy	Skoula	Greece
Heller	Italy (IPGRI)	Telhada	Portugal
Manfredi	Italy		

The participants elected Prof. Ba_er as Chairperson and Dr. Bezzi as Rapporteur, De Mastro, Padulosi and Heller being Co-rapporteurs of the meeting. There was a general consensus among the participants that a clear distinction between medicinal and aromatic species cannot always be made since most officinal species are in fact used as both aromatic and medicinal purposes. However, for the sake of clarity it was decided to use the expression "medicinal and aromatic plants" (MAP) when referring to this group of species.

1. SELECTION OF SPECIES

A lengthy discussion was held for the selection of the species by bearing in mind those species suggested earlier by IPGRI. The criteria that the WG adopted for selection were:

- species with a wide Mediterranean distribution
- concerns for the genetic diversity of the species
- relevant economic impact for the species utilization
- relevant importance of the species in the Mediterranean culture.

The species selected at the end of the discussion by the WG are the following:

Salvia officinalis *Salvia fruticosa* *Salvia sclarea*	These three species were selected for their economic importance as well as for their wide distribution in the Mediterranean region.
Thymbra capitata	Species selected for the concern of the status of its genetic erosion; the species whose area of distribution is limited to Spain is reported to be in fact under serious threat.
Origanum vulgare subsp. *hirtum* *Origanum onites*	Both species are extremely popular in the region and outside. The large

demand from the market for these species is met mainly with material from the wild: plants are often completely pulled out of the soil during collection which has led to drastic reductions in the distribution of the population of these endemic species. The effect of these practices in terms of genetic erosion, is, needless to say, very high.

Ocimum basilicum — This species was actually introduced in early times in the region probably from Asia. However, since the time of its introduction in the Mediterranean a great number of varieties have been selected by farmers. It is definitely one of the most representative condiment crops in the Mediterranean, an essential spice used in the preparation of many traditional foods in every part of the region.

Althaea officinalis — Among the medicinal species this a very famous one, largely used in pharmaceutical preparations. It is widely distributed in the region and there are signals of genetic erosion for its diversity.

Mandragora officinalis — Another popular medicinal plant in the Mediterranean region where it is widely distributed. WG indicated that genetic erosion is taking place on this species, particularly in Italy.

Discussion

Participants discussed what should be the best way to tackle the discussion and decided to adopt the following strategy:

1. Discuss by following the IPGRI discussion paper on the species *Salvia officinalis* (by doing so participants would gain a better understanding of the objectives of the project and gather more information for drawing up a work plan for the Network)

2. Concerning the remaining other species, because of the limited time available, participants felt that relevant information required to answer some specific questions will be provided later to the project coordinator who will collate them with the assistance of the steering committee in order to write up the final report of the meeting.

Salvia officinalis

1. KNOWLEDGE OF THE SPECIES

1.1 Taxonomy

The taxonomic information (genus, species, subspecies, authors) will be collated by referring to widely adopted floras and relevant taxonomic works.

1.2 Genepool(s)

The participants indicated three types of material in the constitution of the species genepool (this remark being valid for most of the other selected species):

- **Wild** (the most recurrent type of material)
- **Introduced/domesticated** to a certain degree (viz. landraces)
- **Cultivar** (cultivated types which have reached a higher degree of selection).

1.3 Morphophysiological variability

The high phenotypic variation that is noticed in this species (as well as in other selected species) suggests that there is a need for a closer examination of its genetic diversity.

1.4 Threats to its diversity

Participants expressed their strong concern about the genetic erosion that seems to affect this species (and also some of the other selected species). It was clear that the practice widely adopted in many countries of the region of gathering large amounts of material from the wild, will lead inevitably to a reduction in the diversity present in nature of these species. The WG stressed the importance of gathering additional information on this aspect and requested each participant to collect pertinent information on the status of each species in their respective country.

1.5 Ecoregional distribution

Information on this aspect needs to be gathered and provided to the project coordinator to complete the report.

1.6 Marketed varieties

As above.

2. ORGANIZATIONAL ASPECTS

Participants mentioned a list of names of groups/individuals involved in various works on these species. This information needs to be gathered and sent by the participants to Padulosi to complete the report.

3. CONSERVATION ACTIVITIES

Following are the names of those groups/individuals that participants indicated as being involved in conservation activities on *Salvia* and other MAP species.

COUNTRY	INSTITUTION / GROUP
Slovenia	University of Ljubljana (sometime later this year)
Turkey	Izmir genebank
Turkey	KUTAS (private firm; Ba_er will provide additional information on it)
Turkey	Aegean University (Faculty of Agric., att. Prof. Ceylano; Ba_er will enquire with Celano on their activities)
Italy	University of Bari (Prof. Marzi)
Italy	University of Basilicata (Dr. Figliulo)
Italy	University of Catania (Dip. of Horticulture)
Italy	Germplasm Institute of Bari
Greece	MAICh, Crete
Greece	National genebank
Greece	University of Thessalonikki
Greece	University of Athens
Portugal	University of Lisbon (AGRIMED project)
France	(need to gather more information)

Among International Institutions the following were mentioned:

BGI	Botanical Gardens International (need to gahter more information on their activities in this regard)
FAO	(need to enquire on existent activities)

3.1 Material conserved

Participants pointed out that in the identification of conservation approaches for MAP species it is necessary to take into account first of all the type of material to be safeguarded. In fact a different strategy has to be made according to whether the plants are wild or domesticated. The WG recommeded the following procedure:

- For material which is partially / fully domesticated it is recommended to collect the seeds and preserve them in *ex situ* genebanks
- For material which is wild, *in situ* conservation would be highly recommended in order to preserve intact the genetic structure of these populations.

3.2 Constraints to conservation

There was a general consensus that seeds of *Salvia* and of the other selected species are likely to be orthodox (i.e., do not encounter particular problems when stored at low temperatures). The WG recommended, however, that additional information be gathered on this important aspect.

3.2 Centre(s) prepared to accept the responsibility for the conservation of the diversity of these species

The following genebanks indicated their availability in this respect:

- Greek genebank (Thessalonikki, Greece)
- Turkish genebank (Menemen, Izmir, Turkey; need to contact them to reconfirm this. Action: Ba_er)
- Germplasm Institute Bari, Italy.

In case the network needs to contact other genebanks IPGRI will assist in this regard.

3.3 Farmers / Associations involved in conservation of these species

A number of names (among which are the Italian private firm SAIS of Cesena and INGEGNOLI of Milano) were suggested; however, more detailed information will be gathered by each participant and sent to IPGRI for collation in the report.

4. UTILIZATION OF THE SPECIES

4.1 Potential / constraints to cultivation

Apart from the economic potential there is evidence that the species could be an important alternative crop in marginal areas of the Mediterranean region (same could be said for the other selected species).

4.2 EEC regulation no. 2078/92

Participants noted that the project on underutilized species fits very well with the prerequisites of this EEC regulation. It is highly recommended therefore that future activities of the network dealing with cultivation (and thus with use of the species) and training should be submitted to the EEC for funding. Eventually other programmes from donor agencies should be also taken into consideration for seeking support to the network activities as appropriate.

4.3 Specific initiatives

The following initiatives were mentioned by the participants:

- Project of the former Italian Ministry of Agriculture entitled "Cultivation and improvement of medicinal and aromatic plants"
- EEC-supported project which has MAICh as one of the partners, entitled "Identification, preservation and cultivation of selected aromatic plants suitable for marginal lands of the Mediterranean region."

4.4 Commercial varieties

Information will be gathered by the participants for collation into the report.

4.5 Evaluation, selection and breeding

Participants noted that all three types of activities are important for stimulating the commercial exploitation of *Salvia officinalis*.

4.6 Collaboration between researchers and users

Participants agreed that this aspect is very important to pursue the objectives of the Network.

Farmers are in fact depositaries of valuable material and precious information that must not be lost. We definitely need to collaborate with them. How? The network will have to address this as a priority issue. It was also pointed out that communication is essential in order to foster collaboration; it was suggested that a good means for pursuing this objective (particularly among formal and informal sector) would be the distribution of a bulletin. All agreed that participation of farmers in the conservation of biodiversity is essential in order to achieve the goals set by the project.

Establishment of the Network on Medicinal/Aromatic Plants (MAP)

All participants of this WG expressed their interest in establishing and actively participating to a network on MAP. IPGRI will contact on behalf of the network those experts who were unable to attend the meeting in Valenzano and will query them on their willingness to join the MAP Network.

Objectives of the MAP Network

Participants identified the main objectives of the network as the following:

- Rescue and assess genetic diversity
- Promote collaborative effort in the Mediterranean region
- Rescue local knowledge along with germplasm
- Promote on-farm conservation activities
- Constitute databases for each of the selected species
- Promote awareness at the public and decision-making level on the importance of conserving underutilized species.

Network Working Plan

Following are the activities that the WG identified as a priority in the Agenda of the Network.

1. SURVEY OF MATERIAL

Before engaging in collecting activities the network should survey material already present in Mediterranean genebanks. This information will be gathered by each participant of the network in his/her respective country.

Along with this information, network members will gather additional information on each of the points listed in the discussion paper (taxonomy, genepool, species variability, threats of genetic erosion, ecoregional distribution, marketed varieties) that have been indicated as important for the better understanding of the selected species.

2. COLLECTING ACTIVITIES

The following institutions/groups gave their availability for collecting the species on behalf of the MAP Network:

- Germplasm Institute, Bari	Italy
- University of Catania, Catania	Italy
- University of Ljubljana, Ljubljana	Slovenia
- Greek National genebank, Crete	Greece
- University of Rabat, Rabat (funds need to be provided)	Morocco
- University of Basilicata, Potenza	Italy
- Mill la Forest Group	France
- Turkish genebank, Izmir	Turkey
- Braga genebank, Braga	Portugal
- Silviculture Institute, Trento (to send a duplication of its collection to Bari)	Italy

Collecting activities will have to be pursued by adopting a dual approach as mentioned earlier:

- material which is available at the domesticated/semi-domesticated level should be collected and preserved in genebanks as seed by following the conservation guidelines provided in the IPGRI conservation manuals

- wild material should be conserved *in situ* by protecting the natural habitat.

3. DOCUMENTATION

Documentation aspects will be done by adopting a computerized format that will be provided by the project coordinator (Padulosi). This information will be sent to a database manager (Maruca, Germplasm Institute of Bari) for collation and sharing with network members. The E-mail system is seen by the WG as a very efficient way to exchange information among network members. Unfortunately this facility is available only for some persons. The possibility of circulating via E-mail DBase-formatted data needs to be investigated.

4. BIOCHEMICAL EVALUATION

The various members that do already have active evaluation work going on MAP species gave their availability for analyzing material that could be possibly provided through the network (Ba_er in Turkey, MAICh in Greece and Telhada in Portugal). The University of Naples (Faculty of Agriculture, Portici, Italy) indicated its availability in the field of biochemical and molecular evaluation of medicinal species.

5. ELECTION OF A STEERING COMMITTEE

The following persons were elected as members of the steering committee set up for directing the course of actions of MAP Network:

C. Ba_er	Turkey
G. De Mastro	Italy
M. Skoula	Greece.

Thematic Presentations

Conservation and Utilization of Underutilized Mediterranean Medicinal and Aromatic Plants

K. Hüsnü Can Ba_er
Medicinal Plants Research Centre (TBAM), Anadolu University, Eski_ehir, Turkey

Medicinal and aromatic plants (MAP) have been used by humankind since time immemorial. They have been respected and blessed by people due to their healing and comforting properties, and the most favoured have survived until the present time. A survey made by the World Health Organization (WHO) put the number of medicinal plants used at 20 000. Further estimates increase the number to 75 000. However, the number of most widely used medicinal plants is estimated to be around 6500, of which only about 500 have been used and marketed in Europe.

It is interesting to know that over 40 medicinal and aromatic plants used in Anatolia (Eastern region of Turkey) during the Hittite period, 4000 years ago, are still used and traded in Turkey. This is significant from two points of view: firstly, medicinal properties of these plants are well established and they are regarded as reliable raw material to produce safe and effective medicines; and secondly, centuries of long collecting from the wild for commercial purposes have not, it seems, threatened their existence. It must also be asked why despite their reputed use, so few of them have been taken into cultivation.

According to the WHO survey, 80% of the world population depends upon medicinal plants for their preventive and healing properties. The figure increases up to 95% in some parts of Africa. This is because the majority of the world population dwells in developing countries and medicinal plants are cheaper and more widely available alternatives to modern medicines. In some major developing countries such as China and India, traditional medicine is strong, factory-made medicines are produced and a phyto-pharmaceutical industry exists. In most other developing countries a nonindividualistic approach is taken in the utilization of medicinal plants. Due to the unavailability of ready medicines, the healer has to prepare and prescribe his/her own remedy according to the patient's condition and requirement.

Even in industrialized countries, industrial production and use of phyto-pharmaceuticals has recently become a big business. The European market for phyto-pharmaceuticals was equivalent to USD 2.4 billion in 1991 which had a 3% share in the European Pharmaceutical Market. Annual growth of this sector is 5%. Germany had achieved the annual sales of USD 1.5 billion which is equivalent to 65% of the total European Union (EU) sales of phyto-pharmaceuticals, and of total pharmaceuticals sale in Germany that year.

The nonprescription drug (OTC) market, in which plant-based medicines play a major role, was in 1991 estimated at USD 8 billion in Europe and USD 25 billion worldwide, as against USD 10 billion for the production of pharmaceuticals.

Investigations conducted in Geneva, Switzerland, revealed that in 1990, based on figures obtained from 60 countries, the total import of medicinal plants was 1.5 million tonnes with an import value of over USD 1 billion.

World import value of plant saps and extract was USD 1.3 billion, based on figures from 47 countries in 1990. Total world import of essential oils in 1991 was around 10 000 tonnes correspondent to about USD 1 billion market value. The world production of essential oils is estimated at around 45 000 tonnes. Fifteen important oils account for 90% of the total production.

Research and development activities in this popular field are increasing at a rapid pace. However, since only about 10% of the plants of the world have been subjected to any degree of scientific research, we can regard the science of phytochemistry and pharmacology as still in its infancy. We all know that the biggest plant diversity and richness in genetic resources is in the Amazon Forest. Yet, we should also know that only about 1% of the flora of the Amazons has been chemically or pharmacologically investigated. The point can be further stressed if one takes into account the existence of chemotypes, especially in the case of aromatic plants. All these clearly show that in this world, we are in a treasure house the real value of which does not seem to be fully realized.

Medicinal and aromatic plants are not only used for producing medicines. They are also a source of raw materials for the isolation of extracts, active fractions, primary and secondary metabolites, enzymes, etc. Secondary metabolites and enzymes are especially low volume and highly priced products whose market value may sometimes reach thousands of dollars per unit gram.

Aromatic plants are sources of essential oils, aromatic extracts and aroma chemicals. These materials are utilized in the production of flavours and fragrances for use in pharmaceuticals, cosmetics, perfumes, food and other related chemicals industries. These industries are constantly searching for newer and better sources of aromatic chemicals and essential oils. The Mediterranean region is rich in aromatic plant species. There is a great opportunity for developing many underutilized aromatic plant species indigenous in this region to be used for either herbal teas, spices, condiments or as raw materials for essential oil, extract or aroma chemical production.

Labiatae family is particularly promising for agronomic and industrial exploitation. Exports of *Origanum* herb and oil from Turkey are increasing every year due to the ever-growing popularity in the old and new world markets of this plant.

A comprehensive screening programme for the complete essential oil analyses of the odoriferous plants of Turkey has been carried out for the last three years. Hundreds of essential oils have been investigated. The results have been communicated through international journals and symposia.

In Turkey, plants are generally collected from the wild and exported. Since post-harvest handling of such materials is not adequate in most cases, loss or wastage of this valuable material is not uncommon. It is strongly recommended that those species in greater demand undergo cultivation to counteract these losses.

It has been realized that out of 23 species comprising the 32 taxa of *Origanum* in Turkey, only five species are marketed. These are *Origanum onites, O. majorana, O. syriacum* var. *bevanii, O. vulgare* subsp. *hirtum* and *O. minutiflorum*, the latter being a species endemic only to Turkey. These species are annually exported in quantities exceeding 4000 tonnes. Except for *O. onites* (which is also known as Turkish oregano or Izmir oregano), the other species are collected and utilized under the generic name of oregano (kekik in Turkish).

O. majorana, a species of Turkish origin, is rich in essential oil (up to 8%), which contains carvacrol as a major constituent like the other Turkish oregano species of commercial importance. Therefore, it differs from the European or Northern African *O. majorana* which is known as majoram.

O. onites (*O. smyrneum*) is the most commonly known and collected oregano in Turkey. It contains up to 3% essential oil, rich in carvacrol. However, we have identified an *O. onites* chemotype containing up to ca. 5% oil rich in linalool (91%).

Such chemotype oils are becoming quite popular in the aroma-therapy trade. Growing chemotypes can be an interesting side activity for small farmers since the land required to cultivate these plants is not too large. Commercialization of such chemotypes can also help conservation efforts.

Another interesting finding was the occurrence of three chemotypes of *Thymus longicaulis* subsp. *longicaulis* in the same population growing in one square meter area. Each of these chemotypes was found to contain •-terpinyl acetate (80%) (which smells like lavender), geraniol (69%) (which smells like rose) and thymol (53%) (which smells like thyme).

Isolation of such chemotypes and their cultivation would result in crop diversification as a viable alternative to more traditional crops. These may also be considered as possible crops growing in marginal lands. I leave this point to the discretion of experts in this field. Some promising aromatic genera or species for the region are the following (this list could be easily expanded further and it is intended to be just an example):

Carvacrol/thymol-rich plants: among the Labiatae are *Origanum* spp. *Thymus* spp, *Thymbra* spp., *Coridothymus* spp., and *Satureja* spp.; among the Umbelliferae is *Trachyspermum copticum* (introduced species).

1.8-cineole rich plants: *Laurus nobilis* (Lauraceae); *Rosmarinus officinalis, Dorystoechas hastata, Salvia* spp. (Labiatae); *Myrthus communis, Eucalyptus* (introduced) (Myrtaceae); Achillea (Compositae).

Linalool-rich plants: *O. onites* (chemotype), *Nepeta italica, Ocimum basilicum, Mentha citrata* (introduced), *T. argaeus, S. sclarea* (Labiatae); *Coriandrum sativum* (Umbelliferae).

Camphor-rich plants: *Artemisia fragrance, Achillea wilhelmsii,* (Compositae), *Salvia* spp., *Lavandula stoechas* (Labiatae).

Pulegone-rich plants: *Ziziphora* spp., *Micromeria fruticosa, Calamintha nepeta, Cyclotrichium* spp., *Acinos suaveolens, Mentha pulegium* (Labiatae).

Anethol-rich plants: *Pimpinella* spp., *Foenolicum vulgare, Scaligera lazica* (Umbelliferae).

The following is a list of medicinal and aromatic plants growing in the Mediterranean region which may be considered in our discussions. The order does not indicate order of significance.

Mandragaora autunnalis (mandrake)
Laurus nobilis (bay laurel)
Salvia spp.
Origanum spp. (oregano)
Thymus spp. (thyme)
Rhus coriaria (sumach)
Laser trilobium
Atropa belladonna (belladon)
Hypericum perforatum (St. John's wort)
Tilia spp. (Linden)
Ruta chalepensis, R. montana (rue)
Several Labiatae plants as *Thymbra spicata, Coridothymus capitatus, Satureja* spp., *Sideritis* spp., *Melissa officinalis, Ziziphora* spp., *Cyclotrichium* spp., *Nepeta* spp., (catmint)
Rosmarinus officinalis (rosemary)
Myrtus communis (myrtle)
Liquidambar orientalis (levan storax tree)
Ruscus aculeatus
Glycirrhiza glabra (liquorice)
Gypsophila spp.
Capparis spinosa
Cedrus libani (taurus cedar), *Juniperus* spp., *Pinus* spp.
Carduus marianus
Scolymus hispanicus
Allium spp. (wild garlic)
Orchidaceae plants (terrestrial orchids) (salep)
Cynara scolymus
Valeriana spp.

Anadolu Botanic Garden, which is being established in Eski_ehir, Turkey, intends to realize *in situ* and *ex situ* conservation trials for MAP species. For *in situ* conservation, 15 reference areas have been identified around Eskisehir which will be protected and used as a germplasm supply for the botanic garden and also for other research purposes. Anadolu Botanic Garden will be mainly used to establish a living collection of steppe plants of Turkey.

A project for the collection of seeds of endemic plants of Turkey has been implemented by a group of Turkish botanists in Ankara. These seeds are deposited at the Turkish seed genebank in Menemen (Izmir) and are grown at Karaca Arboretum in Yalova, Istanbul. At Anadolu University research activities to analyze essential oils of aromatic plants are now about to start.

The Ministry of Agriculture of Turkey has been implementing a World Bank project to develop models for *in situ* conservation of several selected agricultural crops in their wild environment.

The Ministry of Forestry has initiated a project for the cultivation of medicinal, aromatic and bulbous plants in forest recreation areas for which Turkey has been divided into 25 study areas. Plants for cultivation in these areas were identified and some personnel were trained. But this initiative was later terminated without any reason given. This project intends to provide an alternative income source for forest villagers.

Some recommendations:

1. Floras of those regions which are centres of diversity of MAP species require good documentation and a mapping of the economic potential of MAP species. Crop production in these areas must be well managed in order to sustain yield, and scavenging should not be allowed.
2. Collectors and dealers of MAP from the wild flora should be certified and well trained
3. Cultivation of MAP should be encouraged. Incentives must be provided for the cultivation of chemotypes and rare MAP species.
4. Guidelines and manuals of "Good Collecting Practices" (GCP) for plants from the wild sources should be prepared.
5. While collecting plant materials, ethnobotanical data should also be gathered and documented before they are lost forever. It is our duty to utilize or otherwise pass these valuable information to future generations.

Some Issues on the Conservation and Use of Medicinal and Aromatic Plants (MAP)

G. Figliuolo
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1. Introduction

Today almost 60% of pharmaceutical drugs are either of natural origin or obtained through the use of natural material used for the synthesis of chemical products. Herbs and spices are used for culinary purposes in different forms, as dried materials (e.g. oregano), fresh plants (thyme, basil, etc.), frozen or as extracted aroma. Some species are also being widely used in aromatherapy and phytotherapy applications. The market for aromatherapy, culinary and environmentally safe pest control is growing constantly and the market frequently demands the planting of wild species for which no technical knowledge is available (Verlet 1990). Since labour is the major cost in the production of these plants, in Europe most medicinal and aromatic plants (MAP) are being imported from Eastern European and North African countries, where costs are much cheaper and the material is gathered mostly from the wild.

Extensive and unregulated harvests of wild genetic resources of MAP species from their natural habitats are the major cause of genetic erosion. However, cultivated varieties of MAP (varieties obtained after having carried out a substantial genetic improvement on the species) are scarcely available since crop breeding activities have been historically focused on primary food crops (staples). Thus MAP in the market are present mainly as either wild types (i.e. they are supplied directly from natural sources) or as partially domesticated material (landraces).

2. Conservation aspects

Aroma, flavour and other specific MAP traits of economical interest are generally the result of secondary metabolisms. Consequently, the principles and the practices governing the production of primary metabolites cannot be directly adapted to the production of secondary plant products. Studies on the biosynthesis of secondary products have shown that the chemical polymorphism is controlled by genetic factors (Crespo *et al.* 1991) and the accumulation and composition is modified by the influence of ecological factors (Bernath 1986). The developmental differentiation of biosynthetic pathways in the plant and the various environmental factors are responsible for the flexibility in the production of the secondary compounds. The level of build-up of secondary compounds in the organism may be modified by influencing the rate of expression of plant organs (e.g. flower/shoot ratio) which affect the dry matter production in the plant (Bernath 1986).

The results of a study conducted at over 500 sites distributed around the world have indicated the presence in MAP species of a much higher degree of tolerance to pH levels in soils than previously thought (De Baggio 1987a).

Reproduction in many species of the Labiatae family is often a rather complex system. Most species, although perennial, rely on insect pollination for ensuring their sexual reproduction.

For instance, in the genus *Thymus* some species exist only as female plants, and therefore must be propagated vegetatively. *Mentha* × *Piperita* is a sterile plant and cannot be obtained from seed, whereas *Origanum* and *Salvia* are perennial species which produce seed as well. Seed viability has been estimated to be close to 50% in *Thymus* and

Origanum and 60% for *Salvia* (De Baggio 1987b). Any preservation strategy on these species has to take into consideration these facts.

The successful conservation of the genepool of a species would be best achieved by protecting representative samples of genotypes and also the specific pollination system that is involved in the maintenance of the species, which may be achieved through *in situ* conservation approaches. However, on the other hand, the preservation of particular chemotypes and physiological races may be ensured only by vegetative and clonal propagation means.

3. Characterization

Characterization of MAP species requires a different approach than that usually adopted for other groups of crops. Classical characterization consisting of the scoring of major agrobotanical traits of the plant has revealed to be a rather insufficient tool for assessing the diversity of MAP species. The best way to study the variability of these species would be to accompany characterization of their morphological traits with an effective biochemical evaluation. For instance, it is known that the presence of flavonoid pigments is linked with colours of flowers and fruits, therefore the range of flavonoid composition is reflected in the variation of the colours of the plant's organs (Harborne 1980). A whole range of different investigations can be pursued for a better understanding of the genetic diversity of MAP species: among them are morphological characterization (for both qualitative and quantitative traits), biochemical evaluations (analyses of the various compounds viz. isozymes, essential oils and pigments), evaluation of the "chemosyndrome" (see later on in the text for a further explanation on this), evaluation at molecular level (RFLPs, RAPDs, mini and micro-satellites). All the different types of characterization and evaluation just mentioned play their role in providing valuable information on the diversity of the species, in regard to its taxonomy, phylogenetic relationship with closed taxa, gene-environment interactions or for gaining relevant information for the selection of core germplasm subsets of large genetic resources collections.

Morphological characters are widely used indeed for pursuing classification of plant taxa though they may not always be so useful for discriminating at intraspecific level. The evaluation of essential oils is very important for estimating the commercial value of the plant (Crespo *et al.* 1991), and variation found in these characters is even higher than what could be detected by just evaluating morphological traits. For such reasons a new term has been introduced, "physiological race", in order to stress the fact that compounds can be produced in very morphologically similar plants (Stapf 1906).

As stated by Bernath (1986) the "chemosyndrome" can be considered an "un-ambiguous constant spectre that reflects a special metabolic process of enzyme activity on specific substrates measurable in a given time." In more understandable words chemosyndrome is responsible for the "chemism", a genetically fixed biosynthetic pathway, occurring at a specific time in a theoretically infinite number of possibilities which is reflected in the "phenotypic" appearance of the plant. For MAP species the "chemosyndrome" character was used for taxonomic studies and to group different populations in a biochemical sense. Those populations, called "chemodemes" (Hegnauer 1978), are closely linked with cytological and ecogeographical factors. They are chemically characterized populations whose distribution is limited to narrow areas. Chemosyndrome analysis is useful for specific chemotypes; small population samples; and practical purposes, but it eventually becomes cumbersome and costly for large-scale characterization programmes.

A limit in chemism analyses is that such investigations are variable in relation to the sites where the plants are collected, to the stage of the growth cycle of the plant and to the time of collection. Another drawback is that identical substances found in different species might have developed through entirely different biosynthetic routes and thus, the process of developing the substance — and not the substance itself — has a chemotaxonomic value (Tétény 1986).

Biochemical markers like isozyme, molecular markers of DNA as RFLPs (Restriction Fragment Length Polymorphism) or RAPDs (Random Amplified Polymorphic DNA) and mini-satellite sequences also prove useful in characterizing genetic diversity of naturally occurring populations and germplasm collections (Gepts 1992). Techniques using molecular markers adopted to investigate both wild and cultivated species have the comparative advantage to allow the detection of the level of polymorphism (as they are free environmental influences) and contribute to a better understanding of a species molecular basis.

Ease of use and cost effectiveness, however, have to be taken into consideration when pursuing these investigations (RFLP are more costly than RAPDs and isozymes; isozymes and RAPDs are easier to run than RFLPs). With the aid of marker characters it is possible to calculate the "index of genetic diversity or similarity" and by a multivariate analyses approach to discriminate within and between groups and better define the genetic variation. For MAP species in particular, genotypic markers may be very useful in clonal identification, for fingerprinting of special chemotypes and chemo-cultivar analyses, to understand and define centres of diversity and areas where sampling plant material would yield most interesting genotypes. An integration of molecular together with chemical data is instrumental for a better understanding of evolution and genetic diversity of the species (Adams *et al.* 1993).

4. Conservation

The factors that are most relevant within the framework of germplasm conservation activities according to Frankel (1970) are the following: type of genepool, nature of material to be conserved, length of life cycle, mode of reproduction, size of the individuals, ecological status (wild, weedy or domesticated), time dimension (short, medium and long-term storage), and location of the storage. Cross-pollinated plants (such as the Labiatae) share genetic variation among individuals and not among lines as is the case for autogamous plants. Wild populations or locally domesticated/ semidomesticated populations (e.g. some forage plants) represent genepools in equilibrium adapted to local conditions (ecotypes). The genetic integrity of cross-pollinated populations is lost if plants are not grown in an environment similar to the site of their evolution. Factors such as selection pressure, unidirectional geneflow and environmental effects on the mating system could lead the population to a new genotypic structure with the fixation of some alleles and the loss of others (Perrino *et al.* 1981). Wild populations of MAP species are typically characterized by having a high degree of genetic variation, as a result of genetic recombination, geneflow and mutation processes.

Most material of *Thymus* spp., *Origanum* spp., *Salvia* spp., *Ocimum basilicum* L., etc. are in fact not cultivars but wild populations or semidomesticated chemotypes. The *in situ* conservation approach in natural or quasinatural environment ensures an effective safeguard of their genetic structure. Indeed this type of conservation ensures the genetic integrity and the "dynamic evolution" of plant communities. In such situations genotype-environment interactions and the natural gene flow within and between species is in place. A good understanding of the species taxonomy, of the genetic diversity within areas, of minimum viable population size, are among those facts that should be studied before pursuing an *in situ* conservation programme (Damania 1989). Within *in situ* conservation the access to conservation areas must be properly regulated and adequate guidelines must be established for the use of these resources. For medicinal plants it is important to precisely record the location of chemotypes with the highest precision (latitude and longitude may be not enough) in order to facilitate germplasm collection, especially if active compounds are site specific and the introduction and domestication of the species is not easy. *Ex situ* conservation should be recommended for those MAP species already domesticated/semidomesticated, and for those wild populations threatened by genetic erosion in their natural habitats. Semidomesticated and uncultivated plants may be found in man-made environments such as archeological sites, historical villages and gardens, such as those commonly found in the Mediterranean region.

Historically, botanical gardens were the first places devoted to the conservation of plant genetic resources, followed in more recent times by genebanks which have been established mainly for the conservation of those species used as a source of food. Botanical gardens are devoted to the conservation of single genotypes whereas genebanks have been established to conserve mainly the whole genepool of the species/crop. For perennials and vegetatively propagated plants like thyme, sage and oregano, another way of conserving the diversity of their chemotypes is represented by catalogue field and on-farm conservation initiatives. These activities are seen as complementary to those conservation practices in genebanks for the preservation of vegetative material and seeds. Marginal and agri-tourism farms, located in natural or quasinatural environments, may be useful structures for carrying out an effective conservation of "chemodemes" and "chemotypes".

The establishment of a Network of ecological representative farms committed in the conservation of those useful species used in their commercial activities could provide the safeguarding of the genetic diversity as well as the source of back-up collections of material conserved in *ex situ* genebanks. Material conserved by these *in situ* conservation methods may be useful for genetic studies and for defining core subset samples of large collections to store for basic research and breeding. As for other crop species, descriptor lists are a vital tool for MAP species enabling descriptive data to be standardized. Along with agrobotanical data, information on traditional use of these species also plays an important role in the better utilization of these resources.

5. Domestication

In order to successfully carry out the introduction of MAP species into cultivation both ecophysiological and ethnobotanical information must be assembled. The process of domestication of a MAP species or the cultivation of plants previously grown only in wild habitats requires the gathering of information from both native populations and from the experimental trials carried out on cultivated material. In order to be able to get the best of the secondary compound production in MAP species, a good knowledge of the genetic and environmental factors of the overall production system (the natural, quasinatural agricultural ecosystems) is necessary (Bernath 1986). It is important in MAP species to obtain a stable biosynthetic pathway for secondary compounds within populations.

Agro-technical interventions should try to meet the ecological and physiological requirements for achieving a better production of these compounds. Furthermore, within a domestication process of MAP species it is important that habitat characteristics of the cultivation site be maintained as much as possible similar to those of the collecting site in order to maintain composition and concentration of plant products close to those obtained in natural populations (Bernath 1986, 1990).

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Pistachio: an Introduction to its Genetic Diversity, Cultivation and Utilization

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1. The pistachio industry

The world production of pistachio nuts at present is estimated to be about 160 000 metric tonnes. The largest world producer of this crop is Iran which contributes 59% of the total production, followed by the USA (16%), Turkey (13%) and Syria (9%). The contribution of other minor producers like Greece, Italy and Tunisia is very limited. Countries where pistachio is also being cultivated include Algeria, Cyprus, Iraq, Morocco, Pakistan and Tunisia.

One of the most serious problems faced by the growers of this species is the phenomenon of alternation in fruit bearing. Such a problem, which is yet to be solved by crop improvement programmes, is present in all producer countries. The fluctuation in fruit production dictates production which differ markedly in each country (Table 1).

Table 1. Pistachio nut production in the world (× 1000 US tons) (source: California pistachio industry)

Year	Greece	Iran	Italy	Syria	Turkey	USA	Total
1976	2.09	47.30	0.22	4.07	2.20	0.00	55.80
1977	1.76	22.00	2.20	3.94	19.80	2.20	53.90
1978	1.65	66.00	0.22	7.59	5.50	1.21	82.17
1979	2.42	11.00	4.95	8.50	17.60	8.58	50.30
1980	2.77	27.53	0.22	5.50	7.70	13.50	57.29
1981	2.53	46.20	4.95	10.12	23.10	7.26	94.16
1982	1.76	25.30	0.22	8.80	12.10	21.67	69.83
1983	2.86	66.00	4.40	10.10	19.80	13.60	116.36
1984	2.31	77.00	0.22	11.88	13.20	31.50	136.11
1985	3.08	88.00	3.30	11.00	27.50	11.75	144.63
1986	2.50	66.00	0.22	12.50	13.50	27.50	122.22
1987	3.98	31.70	3.98	12.50	24.91	15.00	92.07
1988	2.99	81.50	0.27	17.84	14.95	42.30	159.85
1989	4.89	31.70	3.26	15.76	34.97	17.57	108.15
1990	2.62	90.60	0.27	19.93	13.95	54.27	181.64
1991	2.26	36.25	2.99	21.97	44.93	34.56	142.96
1992	2.99	99.65	0.27	23.82	19.93	66.36	213.02

The most common type of pistachio variety commercialized in the world is characterized by fruits bearing yellow seeds. A high proportion of these yellow seeds are found in the seed markets from Iran and the USA.

Green-seeded fruits are common in Turkey, Greece, Italy and Afghanistan and as a matter of fact this product is more important for the processing industry than the yellow type. However, marketing and economic gains of the green-seeded fruits are undermined by the intense lobbying for the yellow nuts.

The most important event in the pistachio industry over the last twenty years has been the addition of California producers to the world market. The pistachio industry in the USA took off in 1974-75, even though its first crop production was marketed in 1977. It is interesting to notice that the USA now ranks among the world's largest producers, second only to Iran. Iran, at the same time, continues to increase its production faster than ever: the goal being set by the Iranian Authorities is to reach a nut production in the near future of at least 100 000 tonnes / year.

2. Genetic diversity

Pistacia belongs to the Anacardiaceae family. The genus is widely represented in the Mediterranean region where not less than four species are growing both in the wild (*P. therebintus, P. atlantica, P. lentiscus*) and in cultivation (*P. vera*). *Pistacia vera* is, however, the only species of relevant economic importance.

Pistacia vera is a dioecious plant and is mainly wind pollinated. Compatibility is generally present among all species, therefore pollination and fertilization mechanisms within *P. vera* can be obtained by using this species in any sort of combination with other *Pistacia* species.

One important aspect in the crop physiology is the presence of a proterandry phenomenon in male varieties, which has an important influence in germplasm selection and management. Even though in each country several varieties are present as a result of the long selection process carried out by farmers over the years, out of these only a limited number of varieties can be considered to be of a high standard. Among those varieties the following can be mentioned: Ohadi, Montez and Bodami in Iran; Uzun, Kirmizi and Siist in Turkey; Aegina in Greece; Mateur in Tunisia and Algeria and Napoletana (Bianca) in Italy. The popular Kerman cultivar from the USA has been selected from material originating from the region of Kerman, Iran (Table 2).

Within the Mediterranean region several research activities are being undertaken on the varietal evaluation of pistachio varieties in different environments. Of notable interest is the variability present in varieties like Larnaka and Red Aleppo characterized by green seeds and low temperature requirements. These varieties are the object of investigation in several experimental stations in Southern Italy, Portugal, Spain and Tunisia. Other main research activities on pistachio are focussing on the selection of male varieties with the aim of selecting the best pollen donors.

In many countries the high specialization of pistachio cultivation in recent years has caused a narrowing of the genetic base of pistachio varieties. This alarming fact is reflected by the presence in many fields of very few cultivars, a clear sign that a strong genetic erosion is taking place on this crop. The most relevant example of this phenomenon is provided in the USA, the second largest world pistachio producer, where only one cultivar is being grown.

In consideration of these facts it is crucial that concerted action is taken as soon as possible to recover and conserve pistachio genetic diversity in the Mediterranean countries and the Near East. In Table 4 are listed the pistachio varieties conserved at the Capocotta Station of the Istituto Sperimentale per la Frutticoltura of Rome, Italy. At this site some 18 female and eight male varieties are being maintained as a whole in the field.

Table 2. Female pistachio varieties grown in different countries

Turkey	Iran	Syria	Italy (Sicily)	Cyprus	Tunisia	USA	Greece	Iraq
Kirmizi*	Ohadi	Ashouri	Napoletana	Larnaca	Sfax	Kerman	Aegina	Iraq-1
Uzun*	Montaz	(Red Aleppo)	Irabonella	Cyprus-D	Gafsa	Lassen		Iraq-2
Halebi*	Bademi	Red Oleimy	Bronte		El Guettar	Joely		
Degirmi*	Jawzi	White Oleimy	Sanguigna		Mateur	Damghan		
Cakmak	Kalleghouci	White Batoury	Cerasola			Kastel		
Sultani*	Akbari	Ajami	Silvana					
Keten gomlek*	Agah	Red Jalab	Nsolia					
Beyaz ben*	Noghli	Bundovky	Tariina					
Siirt*	Shah paesand	Marawahy	Serradi					
Antep	Vahidi	Lazwardy	Pilna-tone					
Kimzi ben	Sofidi		Cappuccia					
Sefid			Gialla					
Ohadi								
Memfaz								
Kelleusi								
Vahidi								
Badeni								

Table 3. Popular male varieties of pistachio with indication of their flowering behaviour (from Nadj-Hassan 1986; Crane and Maranto 1988; Avanzato *et al.* 1988)

Origin	Variety name	Flowering behaviour[1]	Blooming period (days)
Italy (Sicily)	Santagilisi	D	nn
Greece	Alpha	B	nn
	Beta	C	nn
	Gamma	D	nn
	Greco	B	12
USA	Peters (Kerman × Red Aleppo)	B	19
	Chico (introduced from Turkey)	nn	18
	Koz (introduced from Turkey)	A (not grown any longer)	nn
	Nazareth (introduced from Israel)	A	13
	Gazvin (introduced from Iran)	C	19
	O2-18 (introduced from Russia)	E	28
Israel	Ask	C	15
	Naz	B	19
	ENK	B	22
	502	C	19

[1] A = very early, B = early, C = medium, D = late, E= very late.

3. Cultivation aspects

3.1 Soil

The choice of soil is very important for ensuring good results in pistachio cultivation. In traditional agricultural systems, pistachio cultivations were realized by grafting wild trees indigenous to the area with vegetative parts taken from local cultivated material. Pistachio shows good adaptation to different soils, ranging from calcareous to volcanic.

For achieving an efficient pistachio cultivation, well-drained deep loamy soils are preferable.

3.2 Rootstock

The selection of rootstocks is a very important matter for the pistachio industry. Rootstocks are selected by taking into account a number of factors such as soil, salinity, temperature, drought and resistance to pests and diseases. The most widely used rootstocks include:

P. vera

These plants are usually obtained as seedlings. Growth is very slow and the plant is sensitive to nematodes. The nonproductive period is very long, and the plant requires 15 years to bear fruits. This rootstock is utilized in Afghanistan, Iran, Morocco, Syria and Tunisia.

P. terebithus

This species can grow in poor, rocky and stony soils. It is resistant to dry conditions and also to *Armillaria* fungi. This rootstock is being utilized in Italy, Syria, Tunisia and Turkey.

P. atlantica

It is one of the best rootstock for pistachio, characterized by a good resistance to nematodes. It is, however, sensitive to verticillium wilt. It is being utilized in the USA, Cyprus, Morocco and Tunisia.

P. integerrima

The species — actually considered as a clone of *P. khinjuk* — is resistant to verticillium wilt. It is being increasingly adopted in various countries. In California it is being utilized to replace dead trees. Other countries where this rootstock is also used are Iran and Turkey.

3.3 Irrigation

In most producer countries pistachio trees are commonly planted in dry stony soils, and nonirrigated lands. This is true particularly in the Mediterranean area where wild *Pistacia* species are a typical component of the indigenous Mediterranean Macchia vegetation. In California, pistachio is planted instead only in irrigated areas where different types of irrigation are being used, including the drip system.

Research experiments conducted on crop water requirements have pointed out that irrigation is an important factor for improving both the production and quality of fruit. Water supply is indeed very important for the crop: the period from May to September is crucial for the plant water requirements in every country.

3.4 Fertilization

In modern and rational pistachio orchards fertilization is an important factor needed for improving both production and quality. In standard soil conditions the amount of macroelements that are commonly used are 150 kg of N, 100 kg of P and 150 kg of K per ha. A well-balanced fertilization is reported to have a positive effect in reducing alternate fruit bearing in pistachio. In the United States and in Turkey the leaves routinely undergo biochemical analysis in order to identify the best levels of fertilization to be applied in the field.

3.5 Planting system and pruning

The importance of male trees in pistachio production is well understood and the most notable male varieties include ASK, ENK and Peters (Table 3). As a widely adopted rule, male and female pistachio trees are planted in the field with a ratio of about 1:7 or 1:8 in order to get a good fruiting set.

In the modern pistachio industry the vase planting system is the only one being practised. The distances between trees in the vase system usually is 4 by 7 or 6 by 6. It is important to maintain minimum distances between rows in order to allow the use of machinery for handling various cultivation practices including harvesting.

Pistachio is a resiniferous tree. This fact prevents severe pruning which is limited instead to the removal of dried branches only. Pruning is usually carried out soon after the harvest.

3.6 Harvest

Harvest time is determined by the colour change of the hulls from red to a dull colour plus hull cracking and splitting of the shell. The time for harvesting differs in each variety.

In Mediterranean and Middle East countries harvest is carried out manually, California being the only place where mechanical harvest is being used.

One of the most important problems in pistachio industry is the presence of toxins in the nuts, particularly in those produced in California. This problem is related to the quantity of water present in the seed and therefore it is important to ensure that fruits are well dried following harvest. For optimum storage the water content must not be higher than 5%.

3.7 Pests and diseases

The most important pests in pistachio are: *Chaetoptelius vestitus* and *Megastigmus pistachae*. Among diseases to be noted are: *Alternaria alternata, Pileolaria terebinthi, Rosellinia necatrix* and *Verticillium albo-atrum*.

Table 4. Varieties of pistachio conserved at the Capocotta germplasm field collection of the Istituto Sperimentale per la Frutticoltura of Rome, Italy

Female varieties	Male varieties
Achouri	Ask
Aegina	Chico
Baglio	Enk
Bianca	Greco
Bronte	MS (Siciliano 1)
Cersasuola	Naz
El Guettar	Spoto (Siciliano 2)
Irachena 3	502
Kerman	
Larnaka	
Mateur	
Nzolia	
Napoletana	
Rashti	
Red Aleppo	
Safeed	
Sfax	
Tignusa	

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Obsolete Wheats in Italy: an Overview on Cultivation, Use and Perspectives for their Conservation

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1. Introduction

Distribution and utilization of diploid (*Triticum monococcum* L.), tetraploid (*T. dicoccum* Schubler) and exaploid (*T. spelta* L.) hulled wheats in Italy have been the object of several research investigations.

Native populations of diploid einkorn and tetraploid emmer are still present, whereas spelt has been only recently introduced or, more likely, re-introduced since no local types of this species have been found up to now. Over the last few years, the establishment of a synergism between market demand, farmers' initiatives, better public awareness and scientists' work has determined an increase of interest in hulled wheats with the consequent expansion of emmer and spelt cultivations. This, however, also has raised questions concerning the most appropriate strategies for achieving a better valorization and conservation of the genetic resources of these crops. A brief review of the hulled wheats situation in Italy is presented in this contribution.

2. Hulled wheats in Italy: historical overview

A brief history can help in tracing the possible evolutionary lines of hulled wheats in Italy, although reliable information on the origin of the present native populations is still fundamentally lacking.

Commonly used names of hulled wheats in Italy do not help much in throwing light on their origin or in a better understanding of the links between present local populations and types cultivated in the past. The Italian word 'farro' derives from the latin root 'far'; such a name is perhaps the most extensively used term to indicate at the same time all the three species. 'Farro piccolo' (small farro), 'farro medio' (medium farro) and 'farro maggiore' (big farro) have been proposed as the correct common names for einkorn, emmer and spelt respectively (Perrino 1982). The name 'spelta' or 'speuta', however, is extensively used in southern Italy to indicate *T. dicoccum* and also *T. monococcum*; the use of 'speuta francese' (french spelt) for emmer and 'speuta italiana' (italian spelt) to indicate einkorn in the Apennines in Campania region (Perrino and Hammer 1984) could mean that those northern types of hulled wheats were introduced to southern latitudes at some time in the past. It is very likely that the name 'spelta', of northern origin, started to be used together with 'farro' to indicate both emmer and spelt as soon as the Roman influence was progressively replaced following the colonization by people of German origin and that its use has survived until present times.

Remains of *T. dicoccum* have been extensively found in prehistoric sites from northern Italy (Buschan 1895; Schultz 1913, reported in Acerbo 1934) to Sicily (Costantini 1981, 1989). *T. monococcum* seeds were also discovered in alpine sites (Buschan 1895, in Acerbo 1934) and in Sicily (Costantini 1981, 1989), whereas evidence of the presence of *T. spelta* in prehistoric ages is not available.

During Etruscan times, the distribution of emmer cultivation was substantially different and wider than it is nowadays, covering all the fertile coastal plains, lowlands and hilly areas of Tuscany and Latium, as indicated by the kernels gathered from many Etruscan archeological sites in Central Italy (Barker 1987; Costantini *et al.* 1987; Pohl 1987; Scheffer 1987). However, the finding of Tomba della Biga, at Monteleone di

Spoleto, in the highlands of Umbria, exactly coincides with a present site of emmer cultivation (see later on).

From the comprehensive documentation received from various Roman authors it can be deduced that emmer was a very important crop, representing a staple in the everyday diet. Such popularity lasted, however, until the early imperial times of the Roman Empire. Words connected to cereal trade, fiscal and religious practices contain the root ‘far’. Several varieties of emmer were cultivated, each one probably best suited to different areas, having specific names and differing for morphological characters such as spike shape, kernel colour and size, but also growth habit (e.g. the so called ‘three months’ types refer to the short-cycled spring emmer), are mentioned in several writings of that period. During the late imperial times, however, when agriculture was still flourishing, emmer already had been largely replaced by ‘siligo’, the modern bread wheat, which had the advantage of providing higher yields, bread of better quality, and being easier to process. The distribution area of emmer, already known for its wide adaptability, started in those times to be restricted to the less favourite sites in mountainous areas (Acerbo 1934). A change in emmer utilization was determined as a consequence of its more limited use for making bread, soups and gruels while at the same time its use in rituals and ceremonies increased. At a time when white bread from ‘siligo’ was increasingly becoming more popular among medium and higher class people emmer continued to be a food of the poorest (Salza Prina Ricotti 1987).

In contrast to *T. dicoccum*, information concerning the two other hulled wheats is instead very scarce. The presence of einkorn during Roman times is uncertain; a crop called ‘tife’ could be probably identified with *T. monococcum*. Hexaploid hulled wheats probably originated from central or northern Europe and were initially absent in Mediterranean Italy. The hulled wheat cultivated in Gallia (a Roman region corresponding to modern southern France and a part of northern Italy) was called ‘scandala’. The name ‘spelta’, of northern origin, started to be used only in the late imperial period to indicate, together with ‘scandala’, the hulled types imported from the north (Acerbo 1934).

The end of the Roman empire was characterized by a general decay of social conditions and a shift toward a self-sufficient, closed economy. Agricultural lowlands which yielded higher productions were being abandoned due to their vulnerability during social conflicts, and at the same time less demanding crops were preferred for agricultural systems in marginal areas. Although written documents are lacking, it seems that a decline of bread wheat cultivation occurred in favour of other cereals, among which emmer in central Italy and probably spelt in northern Italy played an important role. In those times, however, Italy was being divided among different powers and thus an independent evolution in the cultivation and use of these crops may have occurred in various regions of the country.

Evidence of the cultivation of hulled wheats in the Middle Ages is also reported, in spite of the scarce information available in literature for that period. A clear distinction between ‘spelta’ (*T. spelta*) and ‘farro’ (*T. dicoccum*) was made in that period (Crescenzi, date unknown, cited in Acerbo 1934). From the 16th century to the present time, the cultivation of hulled wheats has continued in several parts of Italy (Acerbo 1934), although probably with a trend of steady decline. Literature sources indicate that hulled wheats were still cultivated in this country in some valleys of the Apennines (Marro 1900) and in mountain areas of the provinces of Reggio Emilia (northern Apennines), L’Aquila and Campobasso (central Apennines), Potenza (southern Apennines) and Catania (Sicily) (Villavecchia 1911). Pantanelli (1955) reported that ‘spelta piccola’ was still under cultivation here and there in the Alps during the 1950s.

The present populations of emmer are distributed all along the Apennines from northern Tuscany (Garfagnana) down to Umbria (Valnerina and Monteleone di Spoleto), Latium, Molise, Campania and Basilicata regions, whereas *T. monococcum* has been found only in very restricted areas in the southern Apennines. In regard to hulled wheat distribution there is a lack of recent findings from the Alps and northern Apennines. For Sicily, furthermore, it is possible that accounts of the beginning of the century reporting the presence of these crops in the island might have mistakenly confused them with durum wheat landraces, locally known also as 'farro' (De Cillis 1927). As a matter of fact the cultivation of hulled wheat in Sicily has not been reported for a long time and in addition recent germplasm collecting missions (Hammer *et al.* 1986) did fail indeed to sample any germplasm material of the three species.

In conclusion, there are clear evidences that emmer and einkorn have been used in Italy since prehistoric times, and it is very likely that at least a part of present emmer populations could represent the direct descendant of the Etruscan and Roman 'farro'. Spelt was almost certainly present in Italy since the late Roman period, but today this crop seems to have been completely disappeared, at least from the Mediterranean part of the country.

3. The present situation of hulled wheats

Extensive information on the cultivation techniques and uses of emmer and einkorn has been reported in several papers (Perrino and Hammer 1982, 1984; D'Antuono 1989; D'Antuono and Lucidi 1989; Tallarico 1990; D'Antuono *et al.* 1993). Due to the limited importance of einkorn, the following refers mainly to emmer, unless otherwise stated.

At present, the cultivation of native hulled wheats is restricted to marginal mountain areas and, as a general rule, the crops are traditionally managed by means of typically low-input techniques. Organic manure is often the only fertilizer applied and the use of other chemicals, including herbicides, is virtually absent. However, the situation is rather different from site to site, depending on the utilization and the market of emmer. Indeed the knowledge on the various uses of the crop represents a crucial point for understanding its present situation and its future prospects. Grains of emmer have been and are still traditionally used to feed animals. In Garfagnana and in some parts of Central Italy, however, the use of emmer as human food has been more popular and it is still practised today. Furthermore, as a matter of fact, emmer cultivation has been drastically raised over the recent years in Garfagnana and other Italian localities in order to meet an increased market demand. Such hike in demand is certainly linked to the growing interest of people in unconventional foods, especially if produced by means of environment-friendly agricultural techniques.

Such expansion of the cultivation has determined an improvement of the agronomical production techniques especially with regard to mechanization (which has been introduced in all stages of the cropping cycle), crop rotations and grain processing. Moreover, in these areas a favourable place in rotation (e.g. following alfalfa) is often reserved for emmer. On the contrary, in many areas of the southern Apennines, emmer and einkorn are still used to feed animals and are linked to vanishing agriculture systems still practised there. The two species seem to exist there as mere relics of crops of the past, their cultivation being practised by old farmers in very traditional ways. In these areas, hence, the cultivation of these two species seems to have almost completely disappeared, and its possible resumption is unlikely to happen unless a change in their utilization takes place. In the surroundings of the city of Potenza, in Basilicata region, the cultivation of emmer to feed animals has been recorded to be practised with more modern techniques until a few years ago, the areas under cultivation amounting to a few tenths of hectares. In this case, however, its survival was clearly connected to the presence there of a closed rural economy in which seed exchange was still practised along with an appreciation for straw production (typical of emmer plants).

4. Morphological and biological characters

The native germplasm of emmer and einkorn has been recently characterized from several points of view (D'Antuono 1989; Castagna *et al.* 1992; D'Antuono and Pavoni 1993; Mariani *et al.* 1992; Castagna *et al.* 1993; Codianni *et al.* 1993; Castagna *et al.* 1994; D'Antuono and Pavoni, unpublished). Common characters for all types are the following: height (ranging from about 100 to 170 cm, depending on the genotype and, especially, on soil fertility), high sensitivity to lodging, high tillering capacity and fragility of the rachis (latter can determine high seed dispersal at ripeness in adverse conditions). Other observed traits include a lower susceptibility or a degree of resistance to some of the more widespread wheat diseases, such as mildew and rust, although this fact has been recorded only in open field and not specific trials.

The native italian populations of emmer can be clearly separated into winter types (needing a certain degree of vernalization) and alternative types (D'Antuono and Pavoni 1993). Winter emmer is spread all along the area previously indicated, from about 44 to 40 degrees latitude north, whereas the alternative types are limited to the central Apennines. The differences in growth habit correspond to differences in sowing dates, winter types being always sown in autumn and alternative types in spring. Alternative types are sometimes planted very late in plots where the growing of more profitable crops was prevented by accidental adverse weather conditions. It is interesting to note that in Umbria, where both types are present, spring types are indicated as 'farro' and winter types as 'spelta'.

Morphologically, winter types are characterized by larger plant parts: thicker culms and leaves, more robust spikes with a higher spikelet number, higher seed weight. Endosperm is mainly floury in winter and vitreous in spring emmer. Spring emmer showed an unconstancy of temperature summation between emergence and spike differentiation that was explained by a degree of sensitivity to photoperiod, whereas the development of winter emmer seem to be insensitive to daylength once the vernalization needs are satisfied.

Detailed analyses of the variability within types or within populations have not yet been carried out; however, some typical features have been observed and are summarized below.

The presence of long awns is typical of spring types, and this character has been observed to be fairly homogeneous. In winter emmer from Garfagnana, there is a wide range of variation for this character, with plants being long- or short-awned or even awnless. Two distinct populations from central Italy, respectively awnless and long awned, have been seen to be cultivated by the same farmer. All recorded emmer populations from southern Italy are long awned. This character is not much relevant from a taxonomic point of view; however, the population from Garfagnana is rather geographically isolated from all the others, and it is interesting to note the way the awned and awnless types of winter emmer meet in central Italy without mixing. Such an observation could be interpreted as an index of a polycentric origin of the Italian winter emmer.

Within the population, variability was observed in the shape of the spike and in the colour of awns, glumes, culms and seedling of spring emmer.

The percentage of plants regularly heading when sown in spring, higher in southern than in northern populations of winter emmer, suggests that selection for vernalization has been more severe in the northern populations.

In general, grain productivity of hulled wheats has been always lower than modern durum or bread wheat cultivars, ranging from 0.5 to 3.5 t/ha. The results of experiments on the complete collection of native Italian hulled wheats (D'Antuono and Pavoni, unpublished) are summarized in Table 1. Grain production decreases in the following order: durum wheat > emmer > einkorn. The trial on spelt was clearly not well suited to the environmental conditions. Total biomass was not substantially different between genotypes; as a consequence, harvest index of the hulled wheats was lower than in durum wheat, with values always lower than 30% in emmer and 20% in einkorn. Seed weight of winter emmer attained potential values of 50 mg/seed, whereas it hardly reached 35 mg and 30 mg in spring emmer and einkorn respectively. A peculiar feature of both winter and spring emmer was the very high level of intracrop competition. In fact, despite the very high tillering potential (up to 10 tillers/plant with population density of 300 plants/m^2), tiller mortality was extremely high and final number of spikes almost always lower than in durum wheat. Moreover, number of kernels/spikelet was significantly reduced as a function of spikelets/m^2. As a consequence, yield was always limited by the low number of kernels per unit area at harvest. It could be concluded that emmer genotypes appear to be scarcely adapted to self-crowding conditions.

Table 1. Morphoagronomic traits of native emmer and einkorn compared with durum wheat cv. 'Creso' and winter spelt cv. 'Algold Rotkorn' scored in experimental trials conducted in Italy

Genotype	Sowing	Biomass total	Grain (kg/ha)	Harvest index	Seed wt	Spikelets /spike	Kernels/s pike
Winter emmer	fall	9222	2493	27.3	46.2	18.0	1.46
	spring	6306	1184	18.7	34.4	18.6	1.03
Spring emmer	fall	8950	2090	23.5	33.7	13.9	1.31
	spring	7453	1862	25.1	33.6	13.5	1.58
Einkorn	fall	10007	1654	16.6	29.2	24.4	0.67
	spring	5811	949	16.2	27.9	20.8	0.79
Durum wheat	fall	9867	4080	41.4	51.3	15.7	1.75
	spring	5953	2651	44.6	38.6	13.5	2.08
Spelt	fall	8820	1581	18.0	42.9	17.0	1.32

From a qualitative point of view, systematic work on native emmer and einkorn is still lacking. Data on protein content are few and controversial (Tallarico 1990; Vallega 1992; D'Egidio *et al.* 1993; Galterio *et al.* 1993). Furthermore, technological analyses gave very poor values of main indices. These latter findings, however, are consistent with the very particular and crumbling texture of some of the products traditionally manufactured from the flour of emmer in some areas.

5. Future prospects for cultivation and conservation; Concluding remarks

The native populations of hulled wheats in Italy are represented mainly by emmer landraces. They certainly contain variability for several characters that is not yet completely known. The survival of this germplasm up to the present day represents a very interesting fact, from a historic and evolutionary point of view. However, even if the interest of these populations for breeding does not seem to be very high at this moment, their further conservation represents the only guarantee for their possible future exploitation.

The situation and uses of emmer seem to indicate that the best guarantee for *in situ* conservation of local types is profitability. As a matter of fact, the emmer populations of Garfagnana and Umbria are not threatened by extinction, whereas other populations might have disappeared already. Farmers of Garfagnana and Umbria up to now have been operating without public support, just by taking advantage of an increasing demand of ‘coming-from-the-past’ products. However, there is no doubt that the attachment of these farmers to their traditions also played an important role in the preservation of original emmer populations. In fact, the aptitude for emmer cultivation by these farmers made possible an improvement of cropping techniques within the limits allowed by the genetic characters of the available germplasm.

The situation is rather different for new cultivations of hulled wheats which, pushed by the increased demand, were established outside the native areas. New farmers did not take too much care of the genetic material employed and a mixing of types of unknown origin and also of emmer with spelt occurred almost everywhere. In addition, the cultivation at a larger commercial scale emphasized the unfavourable, primitive characters of emmer, viz. height, lodging, kernel dispersal at ripeness, hulled kernels and low quality of the grain. To overcome these undesirable characters, hypotheses of emmer breeding initiatives have been thus proposed aiming to somehow run over again those steps that represented the milestones of the successful breeding of wheat.

What could then be the best strategy for emmer — or more in general for hulled wheats — in order to achieve their best conservation and utilization? There seem to be three major areas that should be tackled to meet this goal: encourage farmers' initiatives, influence the type of product demanded by the market, and increase public awareness on the potential of hulled wheat and the importance of safeguarding their genetic resources.

With respect to the first two points, historical evidence tells us that the use of emmer was already restricted to special purposes at the time of maximum welfare during Roman times, as better characters had been eventually found in bread wheat. Nowadays too the valorization of hulled wheats seems closely linked to specific market niches, where the image of the product plays a fundamental role for gaining greater popularity among the public. Farmers' initiatives that have resumed and enhanced the cultivation of native emmer have indeed operated in those niches. On the other hand, although there is no objection to breeding emmer for cultivation outside the native areas, that does not seem to represent a priority for public intervention. Yet conservation of native populations can guarantee the availability of a reservoir of characters of potential use for both direct breeding or for wheat improvement programmes.

An appropriate task for public research or extension services could be a more complete characterization of local types in order to extend the market of new uses and increase the public interest on the product. The contribution of scientists in raising public awareness on the importance of conserving the genetic resources of these species should stress the link existing between our crops, the conservation of the environment, as well as the conservation of our tradition and culture, all tightly bound together.

Doubts about a possible negative impact of actions directed toward on-farm conservation initiatives of obsolete types of our crops have been recently expressed for those areas, mainly marginal lands, in which self-sufficiency in food has not yet been attained (Jana 1993). To this criticism we could answer by saying that it is hard to imagine better ways, either by introducing new techniques or using modern cultivars, than that of using locally adapted types of primitive varieties to produce in the poor conditions of marginal agricultural lands.

Even if the strategies of conservation envisaged above probably could work in the end, a great contribution to save this heritage of culture and crops on a global scale is definitely achieved through the cooperation between countries, the free exchange of ideas, information and material.

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Appendices

Appendix I. Programme

28 March

8.00-9.00		Registration
9.00-9.30	Frison	Welcome address - introduction to IPGRI - the project on Underutilized Mediterranean crops
9.30-9.45	Lacirignola	Welcome address - introduction to IAM
9.45-10.15	Padulosi	Questionnaire results - selection of species
10.15-10.45		Coffee break
10.45-11.00	Perrino	The Mediterranean region: richness of a major centre of crop diversity

CROP PRESENTATIONS

A brief introduction to the diversity, distribution, uses and economic potential of the selected species addressed by some key speakers

11.00-11.20	D'Antuono	Einkorn
11.20-11.40	Bianco	Rocket
11.40-12.00	Monastra	Pistachio
12.00-12.20	Bezzi	Officinal species
12.20-14.00		Lunch
14.00-14.20	Baser	Medicinal species
14.20-15.10	Padulosi	What is expected from the Workshop: guidelines for discussion by the Working Groups
15.10-16.30		Visit to the Valenzano field station of the Germplasm Institute
16.30-17.30		Meeting of the crop working groups: Election of Chairpersons and Rapporteurs

29 March

MEETING OF THE CROP WORKING GROUPS

08.30-10.00	Meeting Session
10.00-10-15	Coffee break
10.15-12.30	Meeting Session
12.30-14.00	Lunch
14.00-15.30	Meeting Session
15.30-15.45	Coffee break
15.45-17.30	Meeting Session
17.30-18.00	Visit to IAM facilities
18.00	Return to Hotel
19.30	Dinner: Courtesy of the Germplasm Institute, Bari

30 March

PRESENTATION OF WORKING GROUP RECOMMENDATIONS

8.30-9.00	Einkorn
9.00-9.30	Rocket
9.30-10.00	Pistachio
10.00-10.15	Coffee break
10.15-10.45	Officinal species
10.45-11.15	Medicinal species
11.15-13.00	GENERAL DISCUSSION and WRAP-UP SESSION
13.00-15.00	Lunch
15.00-15.30	CONCLUDING REMARKS (Monti)

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Appendix III. Suggested Discussion Points

THE GOAL

" *Encourage, support and engage in activities to strengthen the* ***conservation*** *and* ***use*** *of plant genetic resources worldwide ...* "
(IPGRI's mission)

THE STRATEGY TO MEET THE GOAL

" *To strengthen and contribute to* ***international collaboration*** *in the conservation and use of plant genetic resources* "
(one of IPGRI's objectives in its strategy)

THE PROJECT WITHIN IPGRI's OVERALL MISSION

" *... IPGRI is engaged in focussing networking activities mainly on those genepools which, while not covered by a sister IARC, are nevertheless of* ***key actual*** *or* ***potential importance*** *to the agriculture or forestry of a particular region. Within this category are crops often referred to as "****under-utilized****", i.e. those which have the potential to contribute to sustainable production to a far greater extent than is realized at present ...* " (IPGRI's focus in Networking)

WHAT ARE THE PROJECT'S OBJECTIVES?

1. **RESCUE AND PRESERVE GENETIC DIVERSITY**
2. **ASSESS CROP VARIABILITY**
3. **PROMOTE COLLABORATIVE EFFORTS IN THE REGION THROUGH THE ESTABLISHMENT OF CROP NETWORKS**
4. **RESCUE LOCAL KNOWLEDGE ALONG WITH GERMPLASM**
5. **PROMOTE ON-FARM CONSERVATION ACTIVITIES**
6. **CONSTITUTE DATABASES FOR THE SELECTED SPECIES.**

WHAT THIS MEETING SHOULD COME UP WITH

1. To **DISCUSS** and **IDENTIFY** priorities on what needs to be done for boosting the safeguarding and use of the crops / groups of species selected

2. To **ESTABLISH** a number of crop-oriented networks on a number of selected underutilized species

3. To **IDENTIFY** those partners interested in taking part in the networks' initiatives

4. To **IDENTIFY** activities that can be pursued for fulfilling project's goals.

IDENTIFICATION OF NEEDS AND PRIORITIES

Given below are some suggested topics of discussion to enable the participants in identifying those areas of intervention in the field of crop conservation and use

1. WHERE DO WE STAND ON THE KNOWLEDGE OF THE CROP: how much do we know on

1.1 Its taxonomy
1.2 Its existing genepool(s)
1.3 Its morphophysiological variability
1.4 Threats to its diversity
1.5 Its ecoregional distribution
1.6 Its marketed varieties (if any)

2. ORGANIZATIONAL ASPECTS

2.1 Which groups are involved in research programs on the selected species

- Farmers associations (e.g. Cooperatives)
- NGOs
- Private groups
- National Research Centres (e.g. Botanical Gardens, Universities and other public Institutions)
- Institutes with international focus (e.g. Kew Gardens)
- Major international organizations (e.g. FAO, UNDP)
- CGIAR Centres

2.2 Are any of these groups engaged in conservation activities

3. CONSERVATION OF THE SPECIES' GENETIC DIVERSITY

3.1 Which is the part of the plant that is mainly used in germplasm conservation and which is the recommended type of conservation

ex situ: - seed conservation
- *in vitro* conservation (ovule, pollen, vegetative parts)
- field genebank

in situ: - habitat conservation
- on-farm conservation

3.2 Which are the constraints (if any) to its conservation

3.3 Which are the centres in the Mediterranean region that are prepared to accept the responsibility to be germplasm depositary for the species' diversity

3.4 Farmers / Cooperatives / Associations' initiatives in conservation.

4. UTILIZATION OF THE CROP'S GENETIC DIVERSITY

4.1 Major potential constraints in crop cultivation and uses

4.2 How can the EEC compensatory regulation to farmers (EEC regulation no. 2078/92, see provided documentation at registration desk) be used in order to stimulate cultivation and use of the selected species

4.3 Are there other any other specific initiatives (networks, projects), conservation or use-oriented, that this project could eventually link up with

4.4 What do we know of those commercial varieties available in the market (if any)

4.5 What is the potential of evaluation / selection / breeding work for stimulating the commercial exploitation of the crop

4.6 What can we do to bring researchers and users closer to each other (e.g. establish close collaboration with farmer cooperatives / NGOs / Extension Services involved in commercializing the crop)

4.7 What could be the role of the private sector in such a project.

WORKING TOGETHER

1. ADVANTAGES OF WORKING TOGETHER

Crop networks integrate germplasm collectors, curators, researchers, breeders and users into groups focused on individual crop genepools. Experience has shown that the network concept is successful in promoting collaboration, ensuring wider use of **underexploited collections** and providing good support to crop-improvement programs. A key factor in networking is that the-working-together approach yields greater benefits than working any other way. Yet the success of this *formula* lies in the fact that networks promote direct contacts between scientists from different countries who agree on doing something together.

2. THE ECP/GR PROGRAMME: AN EXAMPLE OF IPGRI's CLOSE INVOLVEMENT IN CROP NETWORKING ACTIVITIES

IPGRI launched a crop network programme in 1988. To date some 11 networks have been established with IPGRI support. An example of a very effective way of collaborating in partnership is provided by the ECP/GR (European Cooperative Programme for Crop Genetic Resources) which began in 1980 with the aims of facilitating interaction between countries and mobilizing new action on specific problems related to PGR aspects. Under this programme a number of crop-specific networks have been established, including those of *Allium, Avena, Prunus, Brassica* and *Vitis.*

ECP/GR has proved itself to be a valuable forum for the exchange of information and ideas within Europe. The programme over the course of its first four phases has greatly stimulated awareness among European countries of the benefits arising from collaborative activities on PGR.

3. THE DEVELOPMENT OF A CROP NETWORK

In order to achieve a successful network some basic steps have to be made:

- **identify clear objectives**

- **outline a specific work plan**
  the definition of a minimum plan of concrete actions is of paramount importance. Longer term projects might also be discussed and included in the recommendations: they will represent those activities that would eventually require more specific funding intervention for fulfilling their implementation.

- **define measurable outputs** ("who-does-what-where")

- work out an effective collaboration to implement a concrete exchange of germplasm and related information (passport/characterization/evaluation). Establish a standardized compatible data format for facilitate exchanges

- **identification of interested network partners**

- **identification of network members willing to accept** the responsibility for the conservation of the germplasm

- identification of network members willing to accept responsibility for the central database on the species. Databasing germplasm accessions is an essential way for network members to exchange information on the crop they are working on. A standardized database procedure will ensure that information can be accessed by all network members in the different countries of the region.

- **identification of network coordinators**

4. THE ROLE OF IPGRI IN NETWORKING ACTIVITIES

IPGRI support for the network is committed only for initial network meetings, whereupon the network is expected to become self-sustaining. IPGRI can assist networks members in the following areas:

- support for meetings and workshops
- close interaction with the network coordinators between meetings
- contribute to information gathering and distribution
- ensure complementarity with initiatives from other organizations
- assist in the development of crop databases
- assist in contacts with donor agencies
- assist with policy development and priority setting in the field of plant genetic resources (PGR)
- contribute to raising public awareness on the importance of PGR conservation
- promote scientific and technical advance in the area of PGR conservation.

WHAT ARE THE ELEMENTS OF SUCCESS FOR A NETWORK?

- **clear focus and direction**
- **an agreed programme of activities**
- **visible outputs**
- **an active and committed participation of members**

PRELIMINARY SELECTION OF SPECIES FOR PHASE II OF THE PROJECT

- **Pistachio** (*Pistacia* species)
- **Hulled wheats** (*Triticum monococcum, T. dicoccum* and *T. spelta*)
- **Rocket** (*Eruca sativa* and *Diplotaxis erucoides, D. muralis, D. tenuifolia*)
- **Medicinal species** (*Atropa belladonna, Althaea officinalis, Malva* and *Valeriana* spp.)
- **Condiment species** (thyme, basil, sage and oregano)

Appendix IV. Questionnaire on Underutilized Mediterranean Species

LETTER ACCOMPANYING THE QUESTIONNAIRE AND INTRODUCING THE PROJECT. DOCUMENT CIRCULATED TO MORE THAN 600 INSTITUTIONS AND ORGANIZATIONS OF THE 23 MEDITERRANEAN COUNTRIES CONTACTED

Dear Colleague,

The International Board of Plant Genetic Resources (IBPGR) is an autonomous international scientific organization under the aegis of the Consultative Group on International Agricultural Research (CGIAR). The mandate of IBPGR is to advance the conservation and use of plant genetic resources for the benefit of present and future generations.

IBPGR has recently initiated a project on "Conservation and Use of Genetic Resources of Under-utilized Mediterranean Species". The project sponsored by the Italian Government, is structured into two phases and intends to focus on those crops which could contribute to the diversification of agricultural production in a sustainable way.

In the first phase of the project a survey will be conducted to gather basic information on crop species which offer a potential economic impact in the sustainable production of food, feed, spices, medicinal plants and other products within the Mediterranean countries. The indications and data emerged from the survey will be discussed during a seminar to be held at the end of the first phase; at this meeting those crops which look most promising will be selected as candidates for the second phase. The objectives and activities of the latter will be also worked out and formulated in the first phase.

The second phase (providing that financial support for this part of the project will be available) is expected to study ways on how to improve the conservation, use and genetic enhancement of the germplasm of the selected species in view of the development of their economic potentialities.

An important aspect of this project will be the establishment of close interactions between institutions and organizations working on these species in the Mediterranean region.

As a first step I am writing this letter to seek your kind cooperation. Attached you will find a list of some crops that have been preliminarily identified. Please select 10 species from this list which you feel should be considered and/or suggest the name of those that are not listed here but which you think should be also included. I would appreciate if for each species selected you could make an assessment of their respective value by using the attached questionnaire and to briefly indicate the main causes that, according to you, are responsible for their under-utilization.

The items listed in the questionnaire are not meant to be exhaustive but they represent a tool to help you in assessing the species' potentials and its exploitation constraints while facilitating the job of compiling the contribution of different people. Please also indicate the species you are working on.

We will greatly appreciate also to have names and addresses of those people you are aware are involved in studying the species selected by you so that further contacts could be made with them.

Because of the urgency of having your comments as soon as possible we would be most grateful if you could despatch your reply by FAX, thus speeding-up the survey process.

Looking forward to receiving your views on this project, I remain,

Yours sincerely,
Stefano Padulosi
Project Coordinator

Evaluator's name	
Institution/ Organization	
Address	
Name of species actually working on	

Assign for each of the 5 aspects in each of the ten selected species a number from a scale of 1 to 5 (1=lowest priority, 5=highest priority): the assessment should be based on the credit you give to the species by valuing each of the areas of impact suggested in the questionnaire.

BOTANICAL NAME	COMMON NAME	ASPECTS					FACTORS RESPONSIBLE FOR ITS UNDERUTILIZATION
		1	2	3	4	5	

QUESTIONNAIRE

1. AVAILABILITY OF BOTH GENETIC MATERIAL AND INFORMATION

Work on the species could have a quick start thus granting hopefully an impact in relatively short time due to the availability of:

- herbaria collections
- germplasm collections
- information

2. GENETIC DIVERSITY

A considerable level of genetic diversity in terms of the species' qualitative and quantitative characters variability can grant better success in programs aiming to its genetic improvement.

3. SUCCESSFUL AGRICULTURAL ADOPTION AND TECHNICAL FEASIBILITY

Presence of some other agricultural or technical aspects that would made its adoption from growers as well as industrial sector more successful viz.:

- availability of technology for processing the crop
- fitting well into pre-existing cropping systems
- compatible with other land use
- availability of cultivation technology
- sp. rusticity
- attractive yield potential

4. WIDE ACCEPTANCE IN THE MEDITERRANEAN COUNTRIES

Being Mediterranean countries the targeted area for the cultivation of the to-be-selected species, its fitting in the traditional background of the region represent an important discriminating factor for its successful adoption. Among those factors contributing to its acceptance are:

- species with relatively large distribution
- widespread knowledge and use of the species across different ethnies
- absence of relevant cultivation constraints within the area

5. POTENTIAL ECONOMIC IMPACT

Among those factors that are most responsible for attracting the private sector into its economic exploitation thus contributing considerably in making the species a competitive cash crop are:

- attractive product marketing qualities (eg. taste, aroma, freshness, stability, slow perishability, easy processing,etc.)
- low production cost and attractive product price
- reliable information on market potentials

LIST OF SUGGESTED CROPS

	BOTANICAL NAME	COMMON NAME	MAJOR USE	FAMILY
FOOD CROPS				
1	*Allium* spp.	leek, onion, garlic	vegetable, spice	Apiaceae
2	*Apium graveolens*	celery	vegetable	Apiaceae
3	*Arbutus unedo*	strawberry tree	fruit	Ericaceae
4	*Armoracia rusticana*	horse radish	vegetable, spice	Brassicaceae
5	*Asparagus officinalis*	garden asparagus	vegetable	Liliaceae
6	*Avena* spp.	oats	grain	Gramineae
7	*Beta* spp.	beetroot, spinach beet	vegetable	Chenopodiaceae
8	*Borago officinalis*	borage	vegetable, medicinal	Boraginaceae
9	*Capparis sativa*	caper	vegetable	Capparidaceae
10	*Castanea sativa*	chestnut	fruit, wood	Fagaceae
11	*Ceratonia siliqua*	carob	fruit	Leguminosae
12	*Cicer aretinum*	chickpea	grain	Leguminosae
13	*Cichorium* spp.	chicory	vegetable, medicinal	Asteraceae
14	*Cornus mas*	cornelian cherry	fruit	Cornaceae
15	*Corylus avellana*	hazelnut	fruit	Corylaceae
16	*Crataegus azerolus*	azarole	fruit	Rosaceae
17	*Cydonia oblonga*	quince	fruit	Rosaceae
18	*Digitaria sanguinalis*	foxglove	vegetable	Gramineae
19	*Eruca sativa*	rocket	vegetable	Brassicaceae
20	*Ficus carica*	fig	fruit	Moraceae
21	*Foeniculum vulgare*	fennel	vegetable, spice	Apiaceae
22	*Junglands regia*	walnut	fruit, wood	Junglandaceae
23	*Lathyrus* spp.	chickling pea	fruit, forage	Leguminosae
24	*Lepidium sativum*	cress,pepper grass	vegetable	Brassicaceae
25	*Lotus edulis*	asparagus pea	vegetable	Leguminosae
26	*Lupinus* spp.	lupin	grain, forage	Leguminosae
27	*Malus* spp.	apple	fruit	Rosaceae
28	*Mespilus germanica*	medlar	fruit	Rosaceae
29	*Morus alba, M. nigra*	mulberry	fruit	Rosaceae
30	*Nasturtium officinale*	water cress	vegetable	Brassicaceae
31	*Olea europea*	olive	fruit, oil	Oleaceae
32	*Opuntia ficus-indica*	barbary fig	fruit	Cactaceae
33	*Phoenix dactilifera*	date palm	fruit	Palmae
34	*Pistacia vera*	pistachio	fruit	Anacardiaceae
35	*Prunus* spp.	almond, cherry, peach, apricot	fruit	Rosaceae
36	*Punica granatum*	pomegranate	fruit	Punicaceae
37	*Pyrus* spp.	pear	fruit	Rosaceae
38	*Raphanus sativus*	radish	vegetable	Brassicaceae
39	*Ribes uva-crispa*	gooseberry	fruit	Grossulariaceae
40	*Ribes nigrum*	blackberry	fruit	Grossulariaceae
41	*Rumex* spp.	sorrel	vegetable	Poligonaceae
42	*Sambucus nigra*	elder european	flower, fruit	Caprifoliaceae
43	*Triticum monococcum*	eikorn	grain	Gramineae
44	*Vaccinium vitis-idea*	cowberry	fruit	Ericaceae
45	*Vaccinium myrtillus*	blackberry	fruit	Ericaceae
46	*Valerianella locusta*	cornsalad	vegetable	Valerianaceae
47	*Vigna unguiculata*	cowpea	vegetable, grain	Leguminosae
48	*Ziziphus ziziphus*	jujubes	fruit	Rhamnaceae

	BOTANICAL NAME	COMMON NAME	MAJOR USE	FAMILY
CONDIMENT CROPS				
49	*Brassica juncea*	brown mustard	spice	Brassicaceae
50	*Cuminum cyminum*	cumin	spice	Apiaceae
51	*Mentha* spp.	mint	spice, medicinal	Labiatae
52	*Nigella sativa*	black cumin	spice	Ranunculaceae
53	*Ocimum basilicum*	basel	spice	Labiatae
54	*Origanum vulgare*	oregano	spice	Labiatae
55	*Rosmarinus officinalis*	rosemary	spice	Labiatae
56	*Ruta graveolensis*	herb of grace	spice	Rutaceae
57	*Salvia officinalis*	sage	spice, medicinal	Labiatae
58	*Sinapis alba*	white mustard	spice	Brassicaceae
59	*Thymus vulgaris*	garden thyme	spice	Labiatae
MEDICINAL AND INDUSTRIAL CROPS				
60	*Altea officinalis*	marsh mallow	medicinal	Malvaceae
61	*Argania spinosa*	argan	oil, resin	Sapotaceae
62	*Astragalus* spp.	goat's thorn	medicinal	Leguminosae
63	*Carthamus tinctorius*	safflower	colour	Compositae
64	*Chamamelum nobile*	roman chamomile	medicinal	Compositae
65	*Cistus ladanifer*	gumcistus	scent	Cistaceae
66	*Cistus creticus*	gumcistus	resin	Cistaceae
67	*Digitalis purpurea*	common foxglove	medicinal	Scrofulariaceae
68	*Glycyrrhiza glabra*	liquorice	flavour	Leguminosae
69	*Humulus lupulus*	hop	flavour	Cannabaceae
70	*Lavandula officinalis*	lavender	scent	Labiatae
71	*Linum usitatissimum*	flax	fibre	Linaceae
72	*Malva* spp.	mallow	medicinal	Malvaceae
73	*Matricaria recucita*	wild chamomile	medicinal	Asteraceae
74	*Quercus suber*	cork oak	wood	Fagaceae
75	*Rheum* spp.	rhubarb	medicinal	Poligonaceae
76	*Tilia* spp.	linden	medicinal, wood	Tiliaceae
FORAGE CROPS				
77	*Dactylis glomerata*	cock's foot	fodder, gardening	Gramineae
78	*Onobrychis* spp.	sainfoin	fodder	Leguminosae
79	*Trifolium alexandrinum*	berseem	fodder	Leguminosae
80	*Trigonella foenum-graecum*	fenugreek	fodder	Leguminosae
81	*Vicia narbonensis*	vetch	fodder	Leguminosae

NUMBER OF QUESTIONNAIRES MAILED AND REPLIES RECEIVED BY SEPTEMBER 1993

In the third column is listed the number of people contacted directly. As it shows, the questionnaire has been succesfully passed onto other persons upon receival, thus indicating the kindness in collaboration for the survey, also a certain interest on the subject among the contacted persons.

COUNTRY	MAILED	TOTAL REPLIES	PEOPLE DIRECTLY CONTACTED WHO HAVE REPLIED
ITALY	168	65	43
FRANCE	84	26	7
SPAIN	67	22	11
MOROCCO	33	2	1
ISRAEL	31	11	6
EGYPT	31	9	3
ALGERIA	30	3	2
SERBIA	27	5	1
TURKEY	21	14	2
TUNISIA	20	3	2
SYRIA	19	3	2
ROMANIA	16	0	0
PORTUGAL	16	4	2
GREECE	16	7	3
BULGARIA	15	9	2
CROATIA	12	0	0
SLOVENIA	8	4	0
ALBANIA	8	9	0
JORDAN	6	2	0
CYPRUS	6	4	4
LEBANON	6	0	0
MACEDONIA	2	1	1
LIBYA	1	0	0
TOTAL	**643**	**203**	**92**

It has to be noted that out of the 203 replies only 170 did in fact contain a partially or completely filled questionnaire. The information from the 170 replies has been compiled and a list of suggested species together with their respective score is given below. The score represents the number of persons that have replied indicating that particular species among those reputed to deserve priority attention. Species are artificially grouped by type of crop, though some of them may well fit under different categories.

FOOD CROPS

Name	Score	Name	Score
PRUNUS SPP.	42	LENS CULINARIS	6
FICUS CARICA	31	SAMBUCUS NIGRA	6
JUNGLANS REGIA	30	VICIA FABA	6
CICER ARIETINUM	29	ERUCA SATIVA	5
OLEA EUROPEA	28	PHOENOLICUM VULGARE	5
CASTANEA SATIVA	24	BRASSICA JUNCEA	4
PYRUS SPP.	22	BRASSICA NAPUS	4
VIGNA UNGUICULATA	22	NASTURTIUM OFFICINALIS	4
ARBUTUS UNEDO	21	RUBUS SPP.	4
MALUS SPP.	21	BRASSICA OLERACEA	3
PISTACIA VERA	20	RHAPHANUS SATIVUS	3
OBSOLETE WHEATS	20	SCOLYMUS HISPANICUS	3
MORUS SPP.	18	ATRIPLEX SPP.	2
ALLIUM SPP.	17	DIPLOTAXIS SPP.	2
CYDONIA OBLONGA	17	LOTUS EDULIS	2
CERATONIA SILIQUA	14	NIGELLA SATIVA	2
CICHORIUM SPP.	14	RIBES NIGRUM	2
OPUNTIA FICUS-INDICA	14	CHENOPODIUM ARVENSE	1
BETA SPP.	13	CRAMBE MARITIMA	1
CORYLUS AVELLANA	11	CYNARA CARDUNCULUS	1
MESPILUS GERMANICA	11	ERIOBOTRYA JAPONICA	1
PUNICA GRANATUM	10	LACTUCA SATIVA	1
CRATAEGUS AZEROLUS	8	LEPIDIUM SATIVUM	1
HORDEUM POLYSTICUM	8	PHOENIX DACTLYFERA	1
VACCINUM MYRTILLUS	8	PHONIUM SATIVUM	1
CORNUS MAS	7	PHYSALIS ALKECHENGI	1
SORBUS SPP.	7	RUMEX SPP.	1
ZIZIPHUS ZIZIPHUS	7	SECALE CEREALE	1
FAGOPYRON ESCULENTUM	6	VALERIANELLA LOCUSTA	1

CONDIMENT CROPS

Name	Score	Name	Score
ORIGANUM SPP.	23	SATUREJA HORTENSIS/CAPITAT.	2
SALVIA OFFICINALIS	19	ARMORACIA RUSTICANA	1
CAPPARIS SPINOSA	9	CORIANDER SPP.	1
OCIMUM BASILICUM	9	LAURUS NOBILIS	1
THYMUS SPP.	8	ONOPORDUM NERVOSUM	1
ROSMARINUM OFFICINALIS	7	PORTULACA OLERACEA	1
SINAPIS ALBA	5	SIDERITIS SYRIACA	1
CUMINUM CUMIN	3		

MEDICINAL CROPS

Name	Score	Name	Score
MENTHA SPP.	18	ATROPA BELLADONNA	1
MALVA SPP.	15	BRYONIA CRETICA	1
ASTRAGALUS OFFICINALIS	10	CALENDULA OFFICINALIS	1
ALTEA OFFICINALIS	8	GENTIANA LUTEA	1
BORAGO OFFICINALIS	8	HERACLEUM SIBIRICUM	1
MATRICARIA CHAMOMILA	7	MELISSA OFFICINALIS	1
DIGITALIS PURPUREA	5	MUSCARI COMOSUM	1
ARNICA MONTANA	3	RUTA GRAVEOLENS	1
VALERIANA OFFICINALIS	3	WITHANIA SOMNIFERA	1
TILIA SPP.	2		

INDUSTRIAL CROPS

Name	Score	Name	Score
GLYCIRRIZA GLABRA	15	CHARTAMUS TINCTORIUS	2
CHAMAEROPS HUMILIS	11	ABIES NUMIDICA	1
LINUM USITATISSIMUM	9	ACACIA SALIQUA	1
PINUS NIGRA	8	COLUTEA ATLANTICA	1
QUERCUS SPP.	8	HALOXYLON PERSICUM	1
FRAXINUS ANGUSTIFOLIUS	6	PIMPINELLA ANISUM	1
CISTUS SPP.	4	RHAMNUSA FRANGULA	1
LAVANDULA OFFICINALIS	4	RHUS CORIARIA	1
HUMULUS LUPULUS	3	SALIX SPP.	1
CEDRUS ATLANTICA	2	SALSOLA SPP.	1

FORAGE CROPS

Name	Score	Name	Score
DACTYLIS GLOMERATA	32	TRIFOLIUM SUBTERANNEUM	8
LUPINUS SPP.	30	PISUM ARVENSE	3
TRIFOLIUM ALEXANDRINUM	29	FESTUCA SPP.	2
LATHYRUS SPP.	28	MELILOTUS OFFICINALIS	2
VICIA SPP.	25	BROMUS SPP.	1
AVENA SPP.	23	CORONILLA SPP.	1
MEDICAGO SPP.	18	DASYPIRUM VILLOSUM	1
TRIGONELLA FENUM-GRAECUM	17	HEDISARUM CORONILLA	1
ONOBRYCHIS SPP.	14	ONONIS ARAGANONENSIS	1
LOLIUM SPP.	11	ORNITHOPUS SPP.	1
TRIFOLIUM PRATENSE	8	POA SPP.	1
TRIFOLIUM REPENS	8		