

COUNTRY REPORT ON THE STATE OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

THE REPUBLIC OF MACEDONIA



Note by FAO

This Country Report has been prepared by the national authorities in the context of the preparatory process for the Second Report on the State of World's Plant Genetic Resources for Food and Agriculture.

The Report is being made available by the Food and Agriculture Organization of the United Nations (FAO) as requested by the Commission on Genetic Resources for Food and Agriculture. However, the report is solely the responsibility of the national authorities. The information in this report has not been verified by FAO, and the opinions expressed do not necessarily represent the views or policy of FAO.

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned. The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

CONTENTS

CHAPTER 1		
THE STATE OF DIVERSITY		5
CHAPTER 2		
<i>IN SITU</i> CONSERVATION OF PGRFA		13
CHAPTER 3		
<i>EX SITU</i> CONSERVATION OF PGRFA		14
CHAPTER 4		
THE STATE OF USE		18
CHAPTER 5		
THE STATE OF NATIONAL PROGRAMS, TRAINING AND LEGISLATION		20
CHAPTER 6		
THE STATE OF REGIONAL AND INTERNATIONAL COLLABORATION		22
CHAPTER 7		
ACCESS TO PGRFA, SHARING BENEFITS OF THEIR USE AND FARMERS RIGHTS		23
CHAPTER 8		
CONTRIBUTION OF PGRFA TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT		24

THE STATE OF DIVERSITY



The natural advantages of Republic of Macedonia, such as fertile soil and favourable climate, facilitate the development of agriculture. In 2005, the surface of Macedonia's agricultural land amounted to 1.23 million ha or about 48% of the total land area, while forests covered an area of 947 653 ha or 37%.

In 2005 agricultural land includes 682 000 ha of pastures (or 55.5%) located mainly in the highlands, and 546 000 ha of cultivated land (or 44%) mainly concentrated in valleys. From the total cultivated land, 448 000 ha (82%) was arable land and gardens, 59 000 ha meadows (10%), 26 000 ha vineyards (5%) and 13 000 ha orchards (2.4%). Each year, one third of total arable land is estimated to be left fallow.

Cultivated land shows a decreasing trend from 633 000 ha in 1999 to 546 000 ha in 2005, mainly due to land abandonment (rural-to-urban population migration) and urban/industrial developments which occur at the expense of agricultural lands. The biggest drop is recorded in the use of ploughed land and gardens and orchards whereas there is land under meadows is slowly increasing. The abandoning of arable soil within rural areas is a result of population migrations. As a consequence, farming soil is being replaced for urban purposes (i.e. planned or not-planned buildings) and for other non-farming activities. These changes have all contributed to significant disturbances within the environment itself.

All crop categories faced decreasing trends in sown areas (therefore the share of meadows increased) over the observed period of time, especially evident for the cereals. In the last few years, the vegetable crops have stabilized descending development of the areas sown.

The vegetable sub-sector is the most important sub-sector of Macedonian agriculture. Over 740 000 tons of vegetables were produced in 2004 on a total area of approximately 60 000 hectares, out of which 260 ha were under heated glass house production, and the rest was cultivated under plastic tunnels or in open fields. The area sown with vegetables has been growing in recent years. Glasshouses cover 330 ha in total, in general built on plots of 1.50 ha each. There is huge concentration of 15 ha on average throughout the country. Plastic houses cover approximately 6 000 ha, mostly concentrated in Strumica, Gevgelija and Valandovo. The average plastic-house unit is 0.05 ha.

Currently, the most significant productions are those of tomatoes, peppers, cabbage, as well as cucumbers and potatoes. These crops are traditionally produced in the country, along with other garden vegetables such as potatoes, beans, onions, garlic, leek, green peas, string beans, cauliflower, lettuce, eggplants etc. Recently, the agricultural producers have introduced new types of non-traditional vegetables, like broccoli, Brussel sprouts, Chinese cabbage, asparagus and others.

Fruit orchards in Republic of Macedonia are mostly located from 300 to 800 m altitude, in west and South-West part of the country. They are represented with 2.7% of all agriculture-cultivated lands. Nearly 8.4 millions fruit trees, out of which about 7.6 millions fruit-bearing trees take an area of approx. 15 000 ha. In 2004 the total yield was approx. 150 000 tons. Out of total orchards, 84% are in the small farmer's sector. The average size of one orchard is approximately 3 ha. Almost two thirds of the fruit growers are part-time farmers. Unlike small orchards, the average area of orchards owned by agricultural companies is about 30 ha. Fruit producers, like the vegetable ones, are estimated to be several thousands, also in this case with the majority of them not being officially registered.

Apples as a fruits have dominant place in fruit production. As a main branch in fruit sector, apples are represented with more than 60% of fruit production. Essential regions for production of apples are located in lakes regions near Resen and Ohrid, on 700 m altitude over the sea level. In these regions about 70 000 tons apples are produced, of which most dominant are the following varieties: Idared, Jonathan, Golden and Red Delicious. Area under pears drastically decreased as a result of *Erwinia amylovora* to some 100 ha in total. Stone fruits (peaches, apricots, plums, cherries, sour cherries) comprise 36% of total fruit production. Dominant fruit is plum. Peaches and apricots are mainly cultivated in the central part of Macedonia (Rosoman). Production of cherries and sour cherries is mainly located in Tetovo region. Nuts (walnuts, almonds) in 2004 were represented with approx. 3% of total fruit production.

The bulk of the crops produced consist of commercial varieties, the major portion of which are imported from abroad, with a minor number of domestically developed varieties, mainly created by the Institute of Agriculture in Skopje. Small producers still grow local, varieties and indigenous species, especially in garden plant production. The number of varieties/species used in agricultural production within Macedonia is evidence of great biological diversity. Until 2002

there were 129 recognised domestic varieties and 2 205 imported varieties used domestically. A detailed review of the number of varieties by crop is presented in Table 1. In addition, for clear overview of diversity of PGRFA in Macedonia, fruit species in wild and domesticated forms used for food and rootstocks are given in Table 2, wild species found in natural meadows and pasture are given in Table 3 and medicinal and ornamental plants are given in Table 4.

1.1 Local landraces

Macedonia possesses significant crop diversity due to its favourable geographic location and climatic conditions. The diversity of a large portion of the local species has not been adversely affected because agricultural production is not intensive in many regions. In such areas, indigenous species and locally-bred varieties are grown, representing an important source of genetic material no longer appearing within the genotype of commercial species.

1.2 Wild relatives of crops

Most of the crops in Macedonia have wild relatives in close proximity to cultivated varieties. Such wild relatives are sometimes seen in the cereal grains (*Avena* spp., *Hordeum* spp. and *Triticum* spp.), and in some industrial crops (*Cannabis sativa* and *Papaver* spp.). In fruit production, wild relatives are used most often, both for food and as rootstocks. Some of them have been domesticated or cultivated. The diversity of these crops is large because small growers primarily use indigenous species. They continue to persist because they are actively collected and used directly for food or are processed into other products.

Fodder crops grown in Macedonia, mainly distributed within ploughed fields and meadows (natural or sown), were created by selection and cultivation of wild species. Some have been cultivated since long ago, and others began to be cultivated only recently. Because fruit and fodder crops appear far more often as wild or indigenous types, they are presented separately. During the period 1968-1971, indigenous and wild relatives were collected in Macedonia under an international project with the United States. The collected samples are still stored in the Germplasm Resources Information Network (GRIN) database, where they are available for exchange and reintroduction whenever Macedonia will be able to provide the proper conditions for their maintenance.

TABLE 1

List of recognized and approved varieties by Varietal Commission in Republic of Macedonia

No	Scientific name	Domestic recognized varieties	Foreign approved varieties	Domestic and domesticated foreign varieties
1	<i>Agropyron</i> Gaertn. spp.		4	
2	<i>Agrostis</i> sp.		3	1
3	<i>Allium cepa</i> L.	4	20	22
4	<i>Allium cepa</i> L. var. <i>viviparum</i> Proch.			1
5	<i>Allium fistulosum</i> var. <i>viviparum</i> Makino			1
6	<i>Allium porrum</i> L.	1	1	5
7	<i>Allium sativum</i> L.		2	16
8	<i>Alopecurus</i> sp.		2	
9	<i>Apium graveolens</i> L. var. <i>dulce</i> (Mill.)			3
10	<i>Apium graveolens</i> L. var. <i>rapaceum</i> (Mill. Gaud.)		3	3
11	<i>Apium graveolens</i> L. var. <i>secalinum</i> Alef.			1
12	<i>Arachis hypogaea</i> L.			2
13	<i>Armoratia rusticana</i> Ph. Gartn, B. Mey. et Scherb			1
14	<i>Arrhenatheum elatius</i> (L.) P. Beauv. ex J.S. et K.B. Presl.		3	1
15	<i>Asparagus officinalis</i> L.			3
16	<i>Astragalus cicer</i> L.		1	

No	Scientific name	Domestic recognized varieties	Foreign approved varieties	Domestic and domesticated foreign varieties
17	<i>Atriplex hortensis</i> L.			3
18	<i>Avena sativa</i> L.		23	3
19	<i>Beta vulgaris</i> L. subsp. <i>saccharifera</i> Lange		76	
20	<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i>			3
21	<i>Beta vulgaris</i> L. subsp. <i>vulgaris</i> subvar. <i>rubra</i> Alef. et Helm.		2	2
22	<i>Beta vulgaris</i> L. var. <i>crassa</i> Alef.		22	2
23	<i>Brassica napus</i> L. var. <i>biennis</i> Scuhbl. et Mart. Reichb.			1
24	<i>Brassica napus</i> L. var. <i>napobrassica</i> (L.) Rchb.			2
25	<i>Brassica napus</i> L. var. <i>napobrassica</i> (L.) Rehb.		3	
26	<i>Brassica napus</i> L. var. <i>oleifera</i> D.C.		22	1
27	<i>Brassica nigra</i> (L.) Koch.			1
28	<i>Brassica oleracea</i> L. convar. <i>acephala</i> (DC.) Alef. var. <i>planitolia</i> DC.			1
29	<i>Brassica oleracea</i> L. convar. <i>acephala</i> (DC.) Alef. var. <i>sabellica</i> L.			1
30	<i>Brassica oleracea</i> L. convar. <i>acephala</i> DC. var. <i>gongylodes</i>			9
31	<i>Brassica oleracea</i> L. convar. <i>botrytisycymosa</i> Duch.		2	1
32	<i>Brassica oleracea</i> L. convar. <i>oleracea</i> var. <i>gemmifera</i> DC.		9	3
33	<i>Brassica oleracea</i> L. var. <i>botrytis</i> (L.) Alef.		23	10
34	<i>Brassica oleracea</i> L. var. <i>sabauda</i> L.		2	9
35	<i>Brassica oleracea</i> L. var. <i>capitata</i> f. <i>alba</i> Duch, f. <i>rubra</i>		63	19
36	<i>Brassica pekinensis</i> (Lour.) Rupr.		2	1
37	<i>Brassica rapa</i> L. var. <i>oleifera</i> D.C.			1
38	<i>Brassica rapa</i> L. var. <i>rapifera</i> Metz.			2
39	<i>Bromus inermis</i> Leyss.			1
40	<i>Cannabis sativa</i> L.		4	2
41	<i>Capparis spinosa</i> L.			3
42	<i>Capsicum annum</i> L.	5	51	18
43	<i>Carthamus tinctorius</i> L.			1
44	<i>Cicer arietinum</i> L.			2
45	<i>Cichorium endivia</i> L.			17
46	<i>Cichorium inthybus</i> L. var. <i>foliosum</i> Bisch		3	
47	<i>Cichorium intybus</i> L.		2	1
48	<i>Citrullus vulgaris</i> L.		15	4
49	<i>Cucumis melo</i> L.		7	9
50	<i>Cucumis sativus</i> L.		45	14
51	<i>Cucumis sativus</i> L. var. <i>kornishon</i>		8	2
52	<i>Cucurbita ficifolia</i> Pangalo			1
53	<i>Cucurbita maxima</i> Duch.			3
54	<i>Cucurbita mixta</i> Duch.			1
55	<i>Cucurbita moschata</i> Duch.			1
56	<i>Cucurbita pepo</i> L. convar. <i>melo pepo</i> L. provar. <i>patissonina</i> Gred.		1	1
57	<i>Cucurbita pepo</i> L. var. <i>maxima</i> (Duchesne ex Lam.) Del.			1
58	<i>Cucurbita pepo</i> L. var. <i>oblonga</i> Willd.		5	13
59	<i>Cucurbita pepo</i> L. var. <i>oleifera</i> P.		4	
60	<i>Cynara cardunculus</i> L.			1



No	Scientific name	Domestic recognized varieties	Foreign approved varieties	Domestic and domesticated foreign varieties
61	<i>Cynara scolymus</i> L.			1
62	<i>Dactylis glomerata</i> L.		9	
63	<i>Daucus carota</i> L. subsp. <i>sativus</i> (Hoffm.) Hayek			2
64	<i>Daucus carota</i> L. subsp. <i>sativus</i> Hoffm.		19	13
65	<i>Fagopyrum esculentum</i> Moench.		2	1
66	<i>Festuca arundinacea</i> Schreb.	2	14	
67	<i>Festuca pratensis</i> Huds		5	3
68	<i>Festuca rubra</i> L.		10	
69	<i>Foeniculum vulgare</i> P. Mill. var. <i>dulce</i>			4
70	<i>Glycine hispida</i> (Moench) Max.		77	
71	<i>Gossypium hirsutum</i> L.	3	1	1
72	<i>Helianthus annuus</i> L.		39	2
73	<i>Helianthus tuberosus</i> L.		2	
74	<i>Helianthus tuberosus</i> L.			1
75	<i>Hibiscus esculentus</i> L.			2
76	<i>Hordeum vulgare</i> L. var. <i>distichon</i> Alef Jachmen	6	65	1
77	<i>Hordeum vulgare</i> L. var. <i>polystichon</i> Haller f.		24	1
78	<i>Humulus lupulus</i> L.		14	2
79	<i>Lactuca sativa</i> L.		25	23
80	<i>Lens esculenta</i> Moench.			3
81	<i>Lepidium sativum</i> L.			2
82	<i>Linum usitatissimum</i> L.		7	
83	<i>Lolium italicum</i> L.		16	
84	<i>Lotus corniculatus</i> L.		7	1
85	<i>Lotus perenne</i> L.		18	1
86	<i>Lupinus albus</i> L.		3	
87	<i>Lycopersicon lycopersicum</i> (L.) Karsten	4	76	18
88	<i>Medicago lupulina</i> L.		1	
89	<i>Medicago sativa</i> L. subsp. <i>sativa</i>	1	53	
90	<i>Melilotus albus</i> Desr.		1	
91	<i>Nicotiana tabacum</i> L.	29	23	17
92	<i>Onobrychis viciifolia</i> Scop.	1		
93	<i>Oryza sativa</i> L.	5	7	2
94	<i>Panicum miliaceum</i> L.		3	2
95	<i>Papaver somniferum</i> L.	2		2
96	<i>Pastinaca sativa</i> L.	1	2	1
97	<i>Petroselinum crispum</i> P. Mill.			5
98	<i>Phaseolus vulgaris</i> L.		21	8
99	<i>Phaseolus vulgaris</i> L. var. <i>communis</i>		8	2
100	<i>Phaseolus vulgaris</i> L. var. <i>nanus</i> (Jusl) Aschers f. <i>sine fibris</i>	2	40	3
101	<i>Phleum pretense</i> L.		9	1
102	<i>Pisum sativum</i> L. convar. <i>axiphium</i> Alef. Mend C.O. Lehk.			2
103	<i>Pisum sativum</i> L. subsp. <i>arvense</i> Poir.		8	
104	<i>Pisum sativum</i> L. subsp. <i>sativum</i> (<i>partim</i>)		54	8
105	<i>Poa pratensis</i> L.		6	1

No	Scientific name	Domestic recognized varieties	Foreign approved varieties	Domestic and domesticated foreign varieties
106	<i>Portulaca oleracea</i> L. subsp. <i>sativa</i> Haw.			2
107	<i>Raphanus sativus</i> L. <i>oleiformis</i> Pers.		1	
108	<i>Raphanus sativus</i> L. var. <i>niger</i> Mil. S. Kerner			4
109	<i>Raphanus sativus</i> L. var. <i>radicola</i> DC.		6	7
110	<i>Rheum rhabarbarum</i> L.			2
111	<i>Ricinus communis</i> L.		1	
112	<i>Rumex acetosa</i> L.			1
113	<i>Rumex patientia</i> L.			1
114	<i>Scorzonera hispanica</i> L. convar. <i>edulis</i> Moench			1
115	<i>Secale cereale</i> L.	3	8	4
116	<i>Sesamum indicum</i> L.			2
117	<i>Setaria italika</i> L. P. Beauv			2
118	<i>Sinapis alba</i> L.		2	2
119	<i>Solanum melongena</i> L.		9	2
120	<i>Solanum tuberosum</i> L.		80	13
121	<i>Sorghum sudanense</i> (Piper) Stapf		3	1
122	<i>Sorghum vulgare</i> L.		9	
123	<i>Sorghum vulgare</i> Pers.		10	
124	<i>Spinacia oleracea</i> L.		14	4
125	<i>Taraxacum officinale</i> Wiggers			1
126	<i>Tetragonia tetragonioides</i> (Pall.) O.Kuntze			1
127	<i>Tragopogon porrifolius</i> L.			1
128	<i>Trifolium alexandrinum</i> Juslen		1	
129	<i>Trifolium hybridum</i> L.		1	
130	<i>Trifolium incarnatum</i> L.		1	1
131	<i>Trifolium pratense</i> L.		16	1
132	<i>Trifolium repens</i> L.		7	1
133	<i>Trifolium resupinatum</i> L.		1	
134	<i>Trifolium subterraneum</i> L.			1
135	X <i>Triticale</i>	3	6	
136	<i>Triticum aestivum</i> L.	22	300	1
137	<i>Triticum durum</i> Desf.	28	1	1
138	<i>Valerianella locusta</i> (L.) Laterr. em. Betcke			2
139	<i>Vicia faba</i> L.		5	2
140	<i>Vicia pannonica</i> Crantz		2	
141	<i>Vicia sativa</i> L.	3	3	
142	<i>Vicia sativa</i> L.			1
143	<i>Vicia villosa</i> Roth.		3	1
144	<i>Zea mays</i> L.	4	604	3
145	<i>Zea mays</i> L. subsp. <i>aorista</i> var. <i>oleifera</i>		7	
146	<i>Zea mays</i> L. subsp. <i>ceratina</i> Kulesch.		8	
147	<i>Zea mays</i> L. var. <i>everta</i> Sturt.		5	
148	<i>Zea mays</i> L. var. <i>saccharata</i> Sturt.		11	



TABLE 2

Fruit species in wild and domesticated forms used for food and rootstocks

1	<i>Amygdalus communis</i> L.	17	<i>Pistacia terebinthus</i> L.
2	<i>Castanea sativa</i> Mill.	18	<i>Poncirus trifoliata</i> (L.) Raf.
3	<i>Cornus mas</i> L.	19	<i>Prunus armeniaca</i> L.
4	<i>Corylus avellana</i> L.	20	<i>Prunus avium</i> L.
5	<i>Corylus colurna</i> L.,	21	<i>Prunus cerasifera</i> Ehrh.
6	<i>Crataegus oxycantha</i>	22	<i>Prunus insititia</i> (L.) Bonnier & Layens
7	<i>Cydonia oblonga</i> L.	23	<i>Prunus persica</i> L. Diva praska,
8	<i>Dyospiros lotus</i>	24	<i>Punica granatum</i> L.
9	<i>Dyospiros virginiana</i>	25	<i>Pyrus amygdaliformis</i> Vill.
10	<i>Ficus carica</i> L.	26	<i>Pyrus communis</i> L.
11	<i>Fragaria vesca</i> L.	27	<i>Rosa canina</i> L.
12	<i>Juglans regia</i> L.	28	<i>Rubus idaeus</i> L.
13	<i>Malus pumila</i> Mill.	29	<i>Rubus</i> spp.
14	<i>Malus silvestris</i> Miller	30	<i>Sorbus aucuparia</i> L.
15	<i>Mespilus germanica</i> L.	31	<i>Vaccinium myrtillus</i> L.
16	<i>Morus alba</i> L., <i>Morus nigra</i> L.	32	<i>Ziziphus jujuba</i> Mill.

TABLE 3

Wild species found in natural meadows and pasture

1	<i>Achillea millefolium</i> L.	30	<i>Medicago lupulina</i> L.
2	<i>Agropyron cristatum</i> (L.) Geartner	31	<i>Medicago orbicularis</i> (L.) Bartal.
3	<i>Agrostis capillaris</i> L.	32	<i>Medicago sativa</i> L.
4	<i>Agrostis stolonifera</i> L.	33	<i>Melilotus albus</i> Desr.
5	<i>Alopecurus pratensis</i> L.	34	<i>Melilotus officinalis</i> (L.) Pallas
6	<i>Astragalus</i> spp.	35	<i>Nardus stricta</i> L.
7	<i>Beta vulgaris</i> L. var. <i>crassa</i> Alef.	36	<i>Onobrychis sativa</i> Lam.
8	<i>Brassica oleracea</i> L. var. <i>acephala</i> DC.	37	<i>Pisum sativum</i> L. var. <i>arvense</i> (L.) Poiret
9	<i>Brassica</i> spp.	38	<i>Plantago major</i> L., <i>P. media</i> L., <i>P. lanceolata</i> L.
10	<i>Bromus inermis</i> Leyss.	39	<i>Poa pratensis</i> L.
11	<i>Cynosurus cristatus</i> L.	40	<i>Poa trivialis</i> L.
12	<i>Dactylis glomerata</i> L.	41	<i>Rumex</i> spp.
13	<i>Dichanthium ischaemum</i> (L.) Roberty.	42	<i>Sanquisorba officinalis</i> L., <i>S. minor</i> Scop.
14	<i>Ervum ervilia</i> L.	43	<i>Taraxacum officinale</i> Wiggers
15	<i>Festuca arundinacea</i> Schreb.	44	<i>Trifolium alexandrinum</i> Juslen
16	<i>Festuca ovina</i> L.	45	<i>Trifolium fragiferum</i> L.
17	<i>Festuca paniculata</i> (L.) Schinz & Thell.	46	<i>Trifolium incarnatum</i> L.
18	<i>Festuca pratensis</i> Huds.	47	<i>Trifolium montanum</i> L.
19	<i>Festuca rubra</i> L.	48	<i>Trifolium patens</i> Schreb.
20	<i>Glycine hispida</i> (Moench.) Maxim	49	<i>Trifolium pratense</i> L.
21	<i>Helianthus tuberosus</i> L.	50	<i>Trifolium repens</i> L.
22	<i>Lathyrus sativus</i> L. S	51	<i>Trifolium resupinatum</i> L.
23	<i>Lotus corniculatus</i> L var. <i>tenuis</i> L.	52	<i>Trifolium subterraneum</i> L.
24	<i>Lotus corniculatus</i> L.	53	<i>Trisetum flavescens</i> (L.) P. Beauv.
25	<i>Lotus uliginosus</i> Schk.	54	<i>Vicia faba</i> L.
26	<i>Lupinus</i> spp.	55	<i>Vicia pannonica</i> Crantz.
27	<i>Malva verticillata</i> var. <i>crispa</i> L.	56	<i>Vicia sativa</i> L.
28	<i>Medicago arabica</i> (L.) Huds.	57	<i>Vicia villosa</i> Roth.
29	<i>Medicago falcata</i> L.	58	<i>Vigna unguiculata</i> (L.) Walpers.

TABLE 4
Medicinal and ornamental plants

1	<i>Achillea millefolium complex</i>	76	<i>Fragaria vesca</i>	151	<i>Populus nigra</i>
2	<i>Aconitum divergens</i>	77	<i>Frangula</i> spp.	152	<i>Potentilla anserina</i>
3	<i>Acorus calamus</i>	78	<i>Fraxinus ornus</i>	153	<i>Potentilla erecta</i>
4	<i>Adonis vernalis</i>	79	<i>Fumaria officinalis</i>	154	<i>Primula veris</i>
5	<i>Aesculus hippocastanum</i>	80	<i>Galega officinalis</i>	155	<i>Prunus amygdalus</i>
6	<i>Agrimonia eupatoria</i>	81	<i>Galeopsis dubia</i>	156	<i>Prunus laurocerasus</i>
7	<i>Agropyrum repens</i>	82	<i>Galium verum</i>	157	<i>Prunus spinosa</i>
8	<i>Alchemilla vulgaris</i>	83	<i>Gentiana lutea</i>	158	<i>Prunus spinosa</i>
9	<i>Allium cepa</i>	84	<i>Gentiana punctata</i>	159	<i>Pulmonaria officinalis</i>
10	<i>Allium sativum</i>	85	<i>Geranium</i> spp.	160	<i>Punica granatum</i>
11	<i>Allium ursinum</i>	86	<i>Geum urbanum</i>	161	<i>Evernia prunastri</i>
12	<i>Althaea officinalis</i>	87	<i>Gymnadenia</i> spp	162	<i>Quercus</i> spp.
13	<i>Anacamptis rosea</i>	88	<i>Glaucium flavum</i>	163	<i>Raphanus sativus</i>
14	<i>Anacumphs</i> spp.	89	<i>Gleditchia triacanthos</i>	164	<i>Rhamnus catarica</i>
15	<i>Anethum graveolens</i>	90	<i>Glycyrrhiza glabra</i>	165	<i>Cotinus coggygria</i>
16	<i>Angelica archangelica</i>	91	<i>Gnaphalium uliginosum</i>	166	<i>Ribes</i> spp.
17	<i>Angelica panicii</i>	92	<i>Gypsophila paniculata</i>	167	<i>Ricinus communis</i>
18	<i>Apium graveolens</i>	93	<i>Hamamelis virginiana</i>	168	<i>Robinia pseudoacacia</i>
19	<i>Aquilegia vulgaris</i>	94	<i>Hedera helix</i>	169	<i>Rosa canina</i>
20	<i>Arbutus andrachne</i>	95	<i>Helleborus</i> sp.	170	<i>Rosmarinus officinalis</i>
21	<i>Arctium lappa</i>	96	<i>Helichrysum plicatum</i>	171	<i>Rubia peregrina</i>
22	<i>Arctostaphylos uva-ursi</i>	97	<i>Herniaria glabra</i>	172	<i>Rubus caesius</i>
23	<i>Aristolochia clematidis</i>	98	<i>Herniaria hirsuta</i>	173	<i>Rubus fruticosus agg.</i>
24	<i>Artemisia absintium</i>	99	<i>Humulus lupulus</i>	174	<i>Rubus ideaus</i>
25	<i>Artemisia vulgaris</i>	100	<i>Hyoscyamus niger</i>	175	<i>Rumex acetosa</i>
26	<i>Arum maculatum</i>	101	<i>Hypericum perforatum</i>	176	<i>Ruscus aculeatus</i> Bodlika
27	<i>Asparagus acutifolius</i>	102	<i>Hyssopus officinalis</i>	177	<i>Ruta graveolens</i>
28	<i>Asperula odorata</i>	103	<i>Inula helenium</i>	178	<i>Salix alba</i>
29	<i>Atropa belladonna</i>	104	<i>Iris germanic</i>	179	<i>Salvia officinalis</i>
30	<i>Avena sativa</i>	105	<i>Iris palida</i>	180	<i>Salvia sclarea</i>
31	<i>Bellis perennis P</i>	106	<i>Juglans regia</i>	181	<i>Sambucus nigra</i>
32	<i>Berberis vulgaris</i>	107	<i>Juniperus communi</i>	182	<i>Sanguisorba officinalis</i>
33	<i>Betula pendula</i>	108	<i>Juniperus oxycedrus</i>	183	<i>Saponaria officinalis</i>
34	<i>Borago officinalis</i>	109	<i>Lamium album</i>	184	<i>Satureja hortensis</i>
35	<i>Brassica alba</i>	110	<i>Lavandula</i> sp.	185	<i>Satureja montana</i>
36	<i>Brassica nigra</i>	111	<i>Leonorus cardiaca</i>	186	<i>Sempervivum</i> spp.
37	<i>Bryonia alba</i>	112	<i>Levisticum officinale</i>	187	<i>Sideritis raeseri</i>
38	<i>Calamintha grandiflora</i>	113	<i>Lilium</i> sp.	188	<i>Sideritis scardica</i>
39	<i>Calendula officinalis</i>	114	<i>Linaria vulgaris</i>	189	<i>Silybum marianum</i>
40	<i>Capsela bursa-pastoris</i>	115	<i>Lonicera xylosteum</i>	190	<i>Symphytum officinalis</i>
41	<i>Carlina acaulis</i>	116	<i>Loranthus europaeus</i>	191	<i>Solanum dulcamara</i>
42	<i>Castanea sativa</i>	117	<i>Malva sylvestris</i>	192	<i>Solanum nigrum</i>
43	<i>Celtis australis</i>	118	<i>Marrubium vulgare</i>	193	<i>Solidago virga aurea</i>
44	<i>Centaurium umbelatum</i>	119	<i>Melilotus officinalis</i>	194	<i>Sorbus aucuparia</i>
45	<i>Cetraria islandica</i>	120	<i>Melissa officinalis</i>	195	<i>Syringa vulgaris</i>
46	<i>Chamomilla recutita</i>	121	<i>Mentha</i> spp.	196	<i>Tamus communis</i>



47	<i>Chelidonium majus</i>	122	<i>Menyanthes trifoliata</i>	197	<i>Taraxacum officinale</i>
48	<i>Chenopodium bonus-henricus</i>	123	<i>Morus alba</i>	198	<i>Taxus baccata</i>
49	<i>Chenopodium botrys</i>	124	<i>Morus nigra</i>	199	<i>Teucrium montanum</i>
50	<i>Cichorium intybus</i>	125	<i>Ocimum basilicum</i>	200	<i>Teucrium polium</i>
51	<i>Clematis vitalba</i>	126	<i>Olea europaea</i>	201	<i>Teucrium scordium</i>
52	<i>Cnicus benedictus</i>	127	<i>Ononis spinosa</i>	202	<i>Thymus</i> spp.
53	<i>Armoracia rusticana</i>	128	<i>Onopordon acanthium</i>	203	<i>Tilia cordata</i>
54	<i>Colchicum autumnale</i>	129	<i>Ophrys</i> spp.	204	<i>Tilia platyphyllos</i>
55	<i>Conium maculatum</i>	130	<i>Orchis</i> spp.	205	<i>Tribulis terrestris</i>
56	<i>Convallaria majalis</i>	131	<i>Origanum vulgare</i>	206	<i>Trigonella foenum graecum</i>
57	<i>Coriandrum sativum</i>	132	<i>Oxalis acetosela</i>	207	<i>Tropaeolum majus</i>
58	<i>Cornus sanguinea</i>	133	<i>Papaver rhoeas</i>	208	<i>Tussilago farfara</i>
59	<i>Corylus avellana</i>	134	<i>Papaver somniferum</i>	209	<i>Urtica dioica</i>
60	<i>Cotoneaster melanocarpa</i>	135	<i>Paris quadrifolia</i>	210	<i>Vaccinium myrtillus</i>
61	<i>Crataegus monogyna</i>	136	<i>Pastinaca sativa</i>	211	<i>Vaccinium uliginosum</i>
62	<i>Crataegus oxyacantha</i>	137	<i>Peonia mascula</i>	212	<i>Vaccinium vitis-idaea</i>
63	<i>Dactylorhiza</i> spp.	138	<i>Periploca greca</i>	213	<i>Valeriana officinalis</i>
64	<i>Datura stramonium</i>	139	<i>Petasites hybridus</i>	214	<i>Veratrum album</i>
65	<i>Daucus carota</i>	140	<i>Petroselinum sativum</i>	215	<i>Verbascum tapsiforme</i>
66	<i>Digitalis</i> spp.	141	<i>Physalis alkekengi</i>	216	<i>Verbena officinalis</i>
67	<i>Ecballium elaterium</i>	142	<i>Phytolacca americana</i>	217	<i>Veronica officinalis</i>
68	<i>Echium vulgare</i>	143	<i>Pimpinella anisum</i>	218	<i>Viburnum tinus</i>
69	<i>Ephedra</i> spp.	144	<i>Pinus sylvestris</i>	219	<i>Vinca minor</i>
70	<i>Equisetum arvense</i>	145	<i>Pinus</i> spp.	220	<i>Viola odorata</i>
71	<i>Erodium cicutarium</i>	146	<i>Plantago lanceolata</i>	221	<i>Viola tricolor</i>
72	<i>Eryngium campestre</i>	147	<i>Plantago major</i>	222	<i>Viscum album</i>
73	<i>Euphrasia officinalis</i>	148	<i>Polypodium vulgare</i>	223	<i>Zizyphus jujuba</i>
74	<i>Ficus carica</i>	149	<i>Polygonum aviculare</i>		
75	<i>Foeniculum vulgare</i>	150	<i>Polygonum hydropiper</i>		

CHAPTER 2

IN SITU CONSERVATION OF PGRFA

First attempts to conserve PGR *in situ* were undertaken in 2007 with the establishment of official collaboration for on-farm conservation of 12 pear landraces. Later on other fruit trees were conserved *in situ*. There are activities to organize on-farm and in garden conservation for some cereal and vegetable crops.



EX SITU CONSERVATION OF PGRFA

Some activities regarding *ex situ* conservation and utilization of plant genetic resources in Republic of Macedonia date from 30 years ago, mainly within international collaboration projects. Collections of commonly used agricultural species and wild relatives of crops included in breeding programmes were gathered during 70's and were conserved in Fort Collins, USA. At that time collections contained more than 2 000 accessions of different varieties and landraces of cereals, vegetables, legumes, and oil and fodder crops. Almost all of the collected accessions were transferred at newly established storage facilities in Belgrade gene bank. Other conservation activities were organized on Yugoslavian level, while all public institutions dealing with plant breeding were maintaining their own collection.

After Macedonian independence, 1991, the activities were reorganized at national level, with very limited support by the Government. Three research institutes: Institute of Agriculture, Skopje, Institute for Southern Crops, Strumica (today Faculty of Agriculture, Shtip) and Tobacco Institute, were equipped with cold chambers for medium-term storage. Fruit and *Vitis* collection was maintained by the Institute of Agriculture, Skopje. Seed collection was consisted mainly by domestic and foreign varieties and breeding lines. The accessions were not characterized and documented properly. Other institutions, such as Faculty of Agricultural Sciences and Food, Skopje, Faculty of Pharmacy, Skopje and Faculty of Natural Sciences, Skopje, were also participating in some of the activities.

This situation was changed in 2004 with the initiation of the SEEDNet project (<http://www-seednet.cbm.slu.se>), financed by Sida. Since 2004 until present many activities for conservation of PGRFA were carried out in Macedonia.

The Institute of Agriculture, Skopje, was appointed as a national genebank responsible for maintenance of all collections. Storage facilities were established at the end of 2003 and were operative in 2004. Total storage capacity of the long-term storage chamber is 10 000 seed accessions, consisting of 30 vertical freezers (-18°C to -20°C). These capacity is fully sufficient for the activities planned in the next 5 years. Genebank was also equipped for preparation of seeds before storing. An inventory of the old collections was undertaken where priority was given on domestic breeding material and landraces. As germination percentage of those accessions was in general very low, almost all accessions decided to be conserved were regenerated. In the meanwhile many collection missions were organized for collection of landraces, wild species and MAPs.

Vegetative propagated species are stored in a form of field collections on several experimental fields of the Institute of Agriculture in Skopje. Some of the medicinal and aromatic plants are planted at the Botanical garden at the Faculty of Natural Sciences.

All accessions that are currently stored at the genebank are characterized and documented according to genebank standards. Each accession is packed to satisfy the needs of active, base, safety duplicate and distribution collection. There is an agreement all safety duplicates to be send in Svalbard Global Seed Vault (SGSV).

Six working groups were established at the beginning of the project (cereals WG, vegetables WG, forage WG, industrial crops WG, fruit and *Vitis* WG and MAPs WG). They are organized and active both on national and on regional level. During 2008, documentation WG was established as well. Within the first three years of the project lot of activities were performed for raising scientific, governmental and public awareness.

Within this project, human capacities for conservation of PGR were upgraded through various trainings and workshops, organized by NGB, CBM, or by various education and research institutions in the countries participating in SEEDNet. Macedonia is leading country in the conservation activities since the beginning of the project, so many of these trainings and meetings were organized in the Institute of Agriculture in Skopje.

Unfortunately, Macedonia is the only country participating in this network, that hasn't any significant support by the Government. The activities are realized with participation of the Institute's own resources, only. In 2008 an officer for genebank activities is appointed at the Directorate for Seed and Seed Material, under the Ministry of Agriculture, Forestry and Water Economy.

Having in mind that Macedonia has not created official national program for conservation and utilization of PGRFA, scientists that are working in this program have prepared some documents, providing the directions and bodies involved in the issue. Generally, coordination of conservation activities is provided by the National

Coordination Board of PGR, composed of curators, representatives of all stakeholders, NGO's and government, while the technical activities are coordinated by a genebank manager.

Detailed survey of genebank collection by group of crops is given in Table 5, and by crops is given in Table 6. The largest number (601 or 33.63%) of accessions belongs to cereals, than of fruits (563 or 31.51%), *Vitis* (410 or 22.94%), vegetables (84 or 4.70%), grasses (41 or 2.29%), legumes (39 or 2.18%), MAP's (25 or 1.40%) and oil crops (24 or 1.34%). In total 1787 accessions are conserved by the gene bank, up to 30. September 2008, out of which 814 (45.55%) belong to the seed collection and the rest 973 (54.45%) belong to the field collection.

TABLE 5
Survey of *ex situ* collections by group of crops

Crop	No.	Breeding material	Advanced lines	Landraces	Wild relatives	Unknown	%
Cereals	601	384	62	6			33.63
Vegetables	84			60		24	4.70
Oil crops	24			24			1.34
Legumes	39		7		32		2.18
Grasses	41		1		40		2.29
Fruits	563	24	453	72		14	31.51
Vitis	410	23	100	287			22.94
MAP's	25				25		1.40

TABLE 6
Survey of *ex situ* collections by crops

Botanical name	Crop	Total no.	Breeding material	Advanced lines	Landraces	Wild relatives	Unknown	%
Cereals								
<i>T.aestivum</i>	Wheat	51	51					8.49
<i>T.durum</i>	Hard wheat	68	54	14				11.31
<i>Z. mays</i>	Maize	82	82					13.64
<i>O. sativa</i>	Rice	399	197	48	5			66.39
<i>A.sativa</i>	Oat	1			1			0.17
Total		601						
Vegetables								
<i>L.esculentum</i>	Tomato	27			15		12	32.14
<i>C.annuum</i>	Pepper	57			45		12	67.86
Total		84						
Oil crops								
<i>S.indicum</i>	Sesame	10			10			41.67
<i>A.hypogaea</i>	Groundnut	14			14			58.33
Total		24						
Legumes								
<i>V.sativa</i>	Common vetch	3		2		1		7.69
<i>V.ervilia</i>	Ervil	1				1		2.56
<i>O.vicifolia</i>	Sainfoin	1		1				2.56
<i>T.repens</i>	White clover	1		1				2.56
<i>T.pratense</i>	Red clover	24		1		23		61.54
<i>P.sativum</i>	Field pea	1		1				2.56
<i>M.sativa</i>	alfalfa	1		1				2.56
<i>C.arietinum</i>	Chick-pea	1				1		2.56



Botanical name	Crop	Total no.	Breeding material	Advanced. lines	Landraces	Wild relatives	Unknown	%
<i>T.incarnatum</i>	Crimson clover	1				1		2.56
<i>T.montanum</i>	Mountain clover	1				1		2.56
<i>T.alpestre</i>	Purple-globe clover	1				1		2.56
<i>T.aureum</i>	Large hop clover	2				2		5.13
<i>T.bocconeii</i>	Boccone's clover	1				1		2.56
Total		39						
Grasses								
<i>F.pratensis</i>	Meadow fescue	28				28		68.29
<i>F.arundinacea</i>	Tall fescue	1		1				2.44
<i>B.squarrosus</i>	Corn brome	2				2		4.88
<i>B.sterilis</i>	Barren brome	1				1		2.44
<i>B.japonicus</i>	Japanese brome	2				2		4.88
<i>B.tectorum</i>	Cheatgrass	1				1		2.44
<i>F.rubra</i>	Chewing's fescue	2				2		4.88
<i>D.glomerata</i>	Orchard grass	3				3		7.32
<i>K.macrantha</i>	Crested hair grass	1				1		2.44
Total		41						
Fruits								
<i>M.domestica</i>	Apple	183		183				
<i>P.communis</i>	Pear	50	22	11	3		14	
<i>P.domestica</i>	Plum	45	1	34	10			
<i>P.cerasifera</i>	Cherry plum	31		29	2			
<i>P.avium</i>	Sweet cherry	46			46			
<i>P.cerasus</i>	Soir cherry	9			9			
<i>C.avellana</i>	Hazelnut	9		9				
<i>R.fruticosus</i>	Blackberry	4		4				
<i>Fragaria x ananassa</i>	Strawberry	17		17				
<i>R.idaeus</i>	Rastberry	3		3				
<i>V.myrtillus</i>	Blueberry	4		4				
<i>P.persica</i>	Peach	88		88				
<i>A.communis</i>	Almond	74	1	71	2			
Total		563						
Vitis								
<i>V.vinifera</i>	Grapevine	410	23	100	287			100.00
Total		410						
MAP's								
<i>S.scardica</i>	Mountain tea					2		8.00
<i>S.syriaca</i>	Mountain tea					6		24.00
<i>S.officinalis</i>	Sage					6		24.00
<i>O.vulgare</i>	Oregano					4		16.00
<i>G.lutea</i>	Gentian					2		8.00
<i>S.montana</i>	Mountain tea					1		4.00
<i>S.fruticosa</i>	Greek sage					1		4.00
<i>T.polium</i>	Golden germander					1		4.00
<i>C.capitatus</i>	Wild thyme					1		4.00
<i>D.maritima</i>	Red-squill					1		4.00
Total		25						
Total		1 787						

The information system is not yet established, but it is agreed that SESTO will be used as suitable for documentation of PGR. It is planned this programme to be centralized, on-line available and continually upgraded.

All accessions (1 787) stored *ex situ* are documented with passport data, described by 33 descriptors as common for all crops and species (Table 7). For the accessions collected many years ago there are missing data on several descriptors, although there are basic information available for them (origin, taxonomy, availability...). Part of the stored accessions, approximately 200 (11.19%) are described according to relevant Descriptor lists, including characterization and evaluation of morphological, biological and productive characteristics.

All passport data are being checked by the gene bank manager before uploading to EURISCO database. List of PGR in collections is prepared to be published in illustrated catalogue form.

TABLE 7

Documentation status of collection

Crops	Passport data	Characterization		Evaluation	
		No	% of total	No	% of total
Cereals	601	55	3.08	-	-
Vegetables	84	40	2.24	-	-
Oils	24	-	-	-	-
Legumes	39	10	0.56	4	0.22
Grasses	41	25	1.4	-	-
Fruits	563	220	12.31	-	-
Vitis	410	410	22.94	300	16.79
MAP's	25	-	-	-	-

Characterization is mostly based on morphological description with the use of recommended IPGRI Descriptor lists, UPOV Guidelines and, for certain crops (common vetch) Descriptor list developed in other countries.

So far, 760 accessions (42.43%) are characterized, based on morphological and phenological traits (Table 7). Evaluation is currently being conducted for some traits, such as stress resistance or tolerance (disease, pests, frosts...), yield components, quality of products (nutritive values). Approximately 300 accessions of *Vitis* collection is evaluated. Thereby, evaluation counted to 16.79% of PGR in the gene bank. Concerning other collections, only 4 accessions (0.22%) of alfalfa are partially evaluated for particular descriptors.

Regeneration is carried out in close cooperation with crop/species curator, following the limits for all crops.



THE STATE OF USE

The fact that the conservation of plant genetic resources for food and agriculture is in initial phase in the Republic of Macedonia may partly explain the low application of existing resources in plant breeding programs. The capacity of plant breeding sector, as a main consumer of plant genetic diversity, is largely reduced in the last twenty years, due to the presence of global market seed companies and negligible governmental support for research in agriculture. The only active breeding program that have been functioning in this difficult period is cereals program, mainly wheat breeding. Even this program has not made use of local landraces and wild relatives. Having established the cereals collection it is expected that the material will be intensively used for improvement and creation of new varieties.

Plant genetic resources have been directly used by small farmers in rural areas, for their own needs. There are examples where well known landraces have been grown on larger acreage for marketing. Lately, there are attempts for registration of landraces (beans, rice) with geographic origin.

Although pastures are used in livestock production and represent the most important economic non-cultivated plant resource, their total productivity, which is directly influenced by seasonal climatic conditions, has not been calculated to date. Most pastures are not utilised, being present in the high mountains. They are managed by the Public Enterprise for Pastures at the national level. The lack of significant grazing in these pastures has contributed to a change in the composition of herbaceous vegetation, the invasion of woody shrubs and the degradation of the humic layer.

For the use of other species there are legal regulations (*Regulations on the Manner of Use of Other Forest Products*, Official Gazette of the Republic of Macedonia 13/00), but they do not provide a mechanism for obtaining a precise assessment of the current status of wild plant species. Moreover, the concessionaire with the right to use the particular resource has no legal responsibility for its management. Thus, one of the priorities is to prepare legal regulations defining the sustainable use of these species, in order to prevent their disappearance. The implementation of an organic system of controlled usage of biological resources, with adequate certification and labelling of the local products, will increase their availability in international markets and, at the same time, the obligation for permanent supervision and control.

Regarding the species of plants intended for human consumption, without respect to processing technique, the following groups of wild plants are of greatest economic importance:

Mushrooms

There are about 2 800 species of mushrooms, 800 of which are edible, with about 50 being commonly collected in Macedonia. They appear to possess an enormous economic value for the local population; however, there is no published data on the number of collectors or the quantity of fresh wild mushrooms purchased domestically. The most purchased species are reported to be: *Boletus pinicola*, *B. edulus*, *B. aereus*, *Cantharellus cibarius*, *Marasmius oreades*, *Amanita caesarea*, *Lactarius deliciosus*, *Morchella* spp., *Agaricus campestris*, *Macrolepiota procera*, *Calvatia* spp. *Bovista* spp. and *Lycoperdon* spp. They represent an important export product (328 693 kg/year; estimated value \$2 000 000) for the companies registered to purchase wildcollected mushrooms. These firms have annual contracts for a specific quantity with the concessionaire which is, in general, either the public enterprise "Makedonski Shumi" (Macedonian Forests) or the national parks themselves, but the real quantity collected per year is never known. Although a permit for the export of commercial species (i.e., not on the list of endangered species) can be obtained from the MoEPP, no regional or local productivity data exists on which to base sustainable use restrictions or regulate the quantities available for purchase.

Tea

A large spectrum of wild plants is used for the preparation of tea or as spices. In the Republic of Macedonia, there is virtually no cultivated tea production. What exists is insignificant in relation to the wild collection performed by various companies (e.g., Alkaloid Bilka, Jaka, Koro etc) and by the local population for personal use. The amount of tea exported in 2001 was 1 127 825 kg, with a value of \$1 453 052. In other years, as much as \$4.5 to 5 million were realised from tea exports.



Wild fruit and nuts

These consist mainly of high mountain fruits, the most important of which is the blueberry (*Vaccinium myrtillus*), a product used chiefly for export (in 2001, 83 284 kg worth \$86 196). Blueberries are found in almost all high pastures (over 1 300 m msl). Following in importance are dog rose, raspberries, blackberries, Cornelian cherry and plums, used by the local population for making juice and jam. In recent years, there has been an increase in the collection of wild apples, pears and cherries, which are used as ingredients in the fruit teas very much in demand for export. They are found throughout Macedonia. In addition, the collection of Chestnuts (*Castanea sativa*) is very significant, with approximately 250 000 kg collected per year, intended mostly for the home market.

Traditionally, wild species of flowers, as well as decorative plants, are grown in home gardens. A small percentage are collected and sold in local markets, such as: *Buxus sempervirens*, *Colchicum autumnale*, *Crocus* spp., *Cyclamen hederifolium*, *Galanthus nivalis*, *Geranium* spp., *Helleborus odoratus*, *Narcissus poeticus*, *Primula* spp., *Syringa vulgaris*, *Viola* spp. etc.

There are approximately 3 500 vascular plant species in Macedonia, of which 700 have medicinal properties, but only 120 species are utilised. Most of these plants are herbaceous, a small portion are shrubby and the fewest, woody. Their qualitative and quantitative distributions within the Republic have not been fully determined (i.e., a chorographic atlas of the medicinal plants has yet to be published). Available data do not reflect the current situation with medicinal plants, due to a lack of legal regulations on their collection, use, care, conservation, trade and export. The data, although insufficient, do indicate an alarming situation, demonstrated in the maximum annual quantities of medicinal plant material exported in the last decade: *Altahea officinalis* (80 tonnes), *Chamomilla recutita* (75 tonnes), *Gentiana lutea* and *G. punctata* (3-4 tonnes), *Hypericum perforatum* (5 000 tonnes), *Lichenes* (1 200 tonnes) and *Tilia cordata* (60 tonnes).

Table 4 lists the medicinal plant species used in Macedonia. The collection and use of medicinal plants can be divided into three categories: personal use, retail/wholesale trade and other economic purposes. A mechanism for regulation and classification is necessary before it can be determined how much dry plant material an individual can collect from an area and before a permit for this collection can be issued. The collection of medicinal plants for economic purposes in Macedonia varies widely with the species collected, the collectors themselves and the seasonal quantity of the collected material. Most serious is the large seasonal demand by foreign buyers for specific plant species, facilitated by certain local trade companies which have no previous experience in this field. According to the nature of the plant material used (e.g., root, fruit, leaf, flower or stem), the greatest risks and threats are for those plants which are used whole, followed by those whose roots are collected and then those with useful bark. Species with a restricted area of distribution are most threatened (e.g., *Acorus calamus*, *Salvia officinalis* and *Sideritis scardica*). Based on data from the past ten years, the most troubling situations are with the species: *Adonis vernalis*, *Colchicum autumnale*, *Herniaria glabra*, *H. hirsuta*, *Gentiana lutea*, *G. punctata*, *Hypericum perforatum*, *Lichenes*, various species within the genera of the family *Orchidaceae*, whose parts are used in the production of salep, *Sideritis scardica*, *S. raeserii* and *Thymus* spp.

Wild species are sometimes used in the cosmetics, alcohol and construction industries. Lichens and mosses, used in the cosmetics industry, are collected in the eastern and western mountains of Macedonia and then exported (the annual purchase reaches 600-800 tonnes dry weight; the exported amount in 2001 was 83 334 kg, valued at \$79 624). Essential oils are extracted from cones, needles or seeds of Pine and other plant species. For the production of gin, the alcohol industry uses the berries (mainly the blue ones) of the juniper bush. The exported amount in 2001 was 991,067 kg, valued at \$758 463. The annual purchase of juniper berries by various organisations is 3-4 000 tonnes. Reeds, Cattails and Willows are used in construction, either dried, woven, as thatch or in handicraft products. They are mainly collected on the lakes (Ohrid, Prespa, Dojran), however this activity is on the decline.

STATE OF NATIONAL PROGRAMS, TRAINING AND LEGISLATION

5.1 State of national programs

Macedonia does not have an official national program for crop genetic resources. Within the documents adopted by the Government in 2004: Country Study for Biodiversity in the RM, Biodiversity Strategy and Action Plan of the RM, that are dealing with biodiversity in total, there is insignificant part relating to crop genetic resources. Therefore there is an urgent need Ministry of Agriculture, Forestry and Water Economy to prepare and adopt a national program for PGR. Genebank activities are however mentioned in several laws and strategies, whereas Genebank is responsible for maintenance of crop diversity, as well of the referent collection (registered varieties). However, this system is not practically in force, as the Government does not provide any financial support to the Genebank.

5.2 Legislation

Basic issues related to environmental protection are regulated under the 1996 *Law on the Conservation and Promotion of the Environment and Nature*. The original text has been modified and supplemented (Revision: 51/00; modification and supplementation: 96/00 and 45/02).

Following Laws related to biodiversity in general are:

- *Law on Nature Protection* (Official Gazette of RM 67/04, with Laws for its modification/ supplement 14/06 and 84/07).
- *Law on Environment* ((Official Gazette of RM 53/05, with Laws for its modification/ supplement 81/05; 24/07 and 159/08)
- *Law on Forests* (Official Gazzete of RM 47/97, with its modification/supplement, 7/00 and 89/04);
- *Regulations on the Use of Other Forest Species* (Official Gazzete of RM 13/00).
- *Law on Genetically Modified Organisms* (Official Gazzete of RM 35/08, from 14.3.2008)

Special laws relating to crop genetic resources include:

- *Law on Plant Protection* (Official Gazzete of RM 25/98, with its modification/ supplement, 6/00);
- *Low on seeds and seedlings material of agricultural plants* (Official Gazette 30/06)
- *Law on Protection of New Varieties*, (Official Gazzete of RM 4/07), currently revised as *Law on Protection of Breeder's Rights* (since Macedonia became a member of UPOV), it is in Parliamentarian procedure and it is expected to be enforced in May 2009.
- *Law on Organic Agriculture Production* (Official Gazzete of RM 16/04)
- *Law on Pastures* (Official Gazzete of RM 3/98, with its modification/supplement, 101/00);
- *Law on Agriculture and Rural Development* (in force since 1.1.2008)

Studies, Strategies and Action Plans related to PGR are as follows:

- *National strategy on Agriculture and Rural Development with Action Plan (2007-2013)*, june 2007, Minsitry of Agreiculture, Forestry and Water Economy
- *Country Study for Biodiversity of the Republic of Macedonia* (2003) and *Biodiversity Strategy and Action Plan of the Republic of Macedonia* (2003), published by the Ministry of Environment and Physical Planning and UN/GEF/WB, adopted by the Government of the Republic of Macedonia in January, 2004.
- *National Environmental Action Plan (NEAP)*, Chapter 12, 'Conservation of Biological Diversity in Protected Areas', MUPCE, Skopje. pp. 1-76.

- *Strategy on development of agriculture, forestry and water utilization in Macedonia (1996)*, Ministry of Agriculture, Forestry and Water Economy

5.3 Training

To date, no thematic survey has been conducted regarding the quantum and adequacy in which biodiversity conservation is addressed in the curriculum of public educational institutions, neither at the primary, secondary nor university level. Further, there are no comparative analyses of university teaching plans and programmes in the fields of biology, forestry, agriculture, environmental protection, environmental law and other educational areas with regard to the subject of biodiversity conservation.

Concerning the crop genetic resources there are two state universities with study programs related to conservation and use of PGR, breeding and seed production:

- University Ss Cyril and Methodius, Skopje
 - Faculty of Agricultural sciences and Food (graduate, postgraduate and doctoral studies)
 - Institute of Agriculture (master studies)
- University Goce Delchev, Shtip
 - Agricultural faculty (graduate and master studies)

Training on PGR, as an activity out of the official study programs, is mainly organized by the Institute of Agriculture/ Gene Bank in cooperation with SEEDNet program or independently. Within the last 4 years, several national trainings were undertaken, such as: Policy on PGR, Management of Gene Bank, *ex situ*, *in situ* and on-farm conservation, documentation on PGR, regeneration of PGR, collection, characterization and evaluation of PGR etc. These trainings took place at the Institute of Agriculture and were organized by the Gene bank Manager. Experts and scientist in the field were engaged as lecturers, while participants were mainly researchers working with various crops.

Beside the national trainings, there were 3 international trainings with the participants from the other countries of the region. The applied training methods were: presentations, exercises (working in groups) and panel discussions.

1. Title: *Strengthening of Macedonian Gene Bank Management*
Place/Date: Institute of Agriculture-Skopje, FACE / 2007 November 05.-08.
No of participants: 12
Person(s) in charge: Louise Bondo, Leader section, NGB (expert) and Suzana Kratovalieva, GB Manager (MnGB)
2. Title: *Regeneration strategies*
Place/Date: Institute of Agriculture-Skopje, FACE / 2008 June 16.-20.
No of participants: 13
Person(s) in charge: Louise Bondo, Leader section, NGB (expert), John Kristoffersen, Field Section, NGB, Fredrik Ottoson, Seed handling Section NGB (expert), Suzana Kratovalieva, GB Manager (MnGB) (Lecturer, Exercises in field), Gjoshe Stefkov: trip to botanical garden, Emilja Siemonska: Exercises in field, Zoran Dimov: Exercises in field and Rükie Agic: Exercises in field
3. Title: *Strengthening of Gene Bank Management in Republic of Serbia*
Place/Date: Institute of Agriculture-Skopje, FACE / 2008 June 23.-27.
No of participants: 8
Person(s) in charge: Suzana Kratovalieva, GB Manager (MnGB)



STATE OF REGIONAL AND INTERNATIONAL COLLABORATION

Most of the activities on PGR carried out in Macedonia are within the official program of SEEDNet, where Macedonia cooperates with Albania, Kosovo, Serbia, Republic of Srpska, Federation of Bosnia and Herzegovina, Croatia, Slovenia, Bulgaria, Romania and Moldova. Internationally, as a member of the ECP/GR, Macedonia participates in the meetings and some actions of the Commission. On scientific level, there is an active cooperation with many countries around the World, in many segments of conservation and sustainable use of PGR. This cooperation is not officially bounded in some project or network.

International agreements and conventions relating PGR includes:

- *Convention on Wetlands of International Importance Particularly as Waterfowl Habitat* (Ramsar, 1971), ratified by decree (Official Gazette of SFRY 9/77). The Republic of Macedonia acceded to this convention with an Act of Succession in 1995;
- *Convention on the Protection of the World's Cultural and Natural Heritage* (Paris, 1972), ratified by law (Official Gazette of SFRY 56/74);
- *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) (Washington, 1973), ratified by law (Official Gazette of RM 82/99). The Republic of Macedonia has been a member of this convention since 2 October 2000;
- *Convention on the Conservation of European Wildlife and Natural Habitats* (Bern, 1982), ratified by law (Official Gazette of RM 49/97) and implemented in April 1999;
- *Convention on Biological Diversity* (Rio de Janeiro, 1992), ratified by law (Official Gazette of RM 54/97) and implemented in 1998;
- *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters* (Aarhus, 1998), ratified by law (Official Gazette of RM 40/99);
- *Convention on Environmental Impact Assessment in a Transboundary Context* (Espoo, 1991), ratified by law (Official Gazette of RM 44/99);
- *Convention on the Protection of the Ozone Layer* (Vienna, 1985), ratified by law (Official Gazette of SFRY 1/90);
- *Montreal Protocol on Ozone Layer Depleting Substances* (Montreal, 1987), ratified on 10 March 1994;
- *London Amendment to the Montreal Protocol* (London, 29 June 1990), ratified on 27 May 1998 (Official Gazette of RM 25/98);
- *Copenhagen Amendment to the Montreal Protocol* (Copenhagen, 25 November 1992), ratified on 27 May 1998 (Official Gazette of RM 25/98);
- *Montreal Amendment to the Montreal Protocol* (Montreal, 17 September 1997), ratified on 30 July 1999 (Official Gazette of RM 51/99);
- *United Nations Convention to Combat Desertification in Countries Experiencing*
- *Serious Drought and/or Desertification, Particularly in Africa* (UN, 2000), ratified in February 2002 (Official Gazette of RM 13/02);
- *United Nations Framework Convention on Climatic Changes* (New York, May, 1992), ratified by law (Official Gazette of RM 6/97);
- *International Convention on Plants Protection* (1951), ratified in 1985 (Official Gazette of SFRY 1/85);
- *European Convention on Landscape* (Firenza, 2000), ratified by law (Official Gazette of RM 44/2003).

These international acts define extensive obligations which must get their normative expression in the national legislation. As a matter of course, the harmonisation of the national legislation with both the ratified international agreements and those still under the ratification procedure should be a priority task in the normative policy of the sphere of biodiversity conservation.

CHAPTER 7

ACCESS TO PGRFA, SHARING BENEFITS OF THEIR USE AND FARMERS RIGHTS

This issue is not legally regulated in Macedonia. However, access to the Genebank material is free for scientific purposes, and exchange of material is accompanied by MTA.



CONTRIBUTION OF PGRFA TO FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

Having in mind that Macedonia is agricultural country, with relatively poor economy, PGR are very often main source of income and food for the farmers. The program for Rural Development was adopted recently, and many projects are going on in this direction. This Government has clearly defined priorities in development of agriculture, rural areas and tourism, which will contribute and support farmer's tradition to maintain local landraces. Several actions were undertaken for protection of geographic origin of some products (beans, rice, cherries, potatoes etc.). In this case farmers will have higher profit from growing traditional landraces and will be motivated to continue growing such crops.

