

PLANT GENETIC RESOURCES FROM THE BALKAN PENINSULA IN THE WORLD'S GENE BANKS

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Abstract

An overview is given of plant genetic resources that originate from countries of the Balkan Peninsula and are preserved in genebanks worldwide. For each country, the number of genebanks holding material from this country, and the number of accessions are presented. A summary is also provided by crops (scientific names). The survey is based on databases such as FAO WIEWS (World Information and Early Warning System), EURISCO (European search catalogue for plant genetic resources), and Genesys (worldwide database on plant genetic resources).

Key words: genebanks, Balkan Peninsula.

Introduction

The Balkan Peninsula, also called the Balkans, is considered to include Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Kosovo, the Republic of Macedonia, Montenegro, Serbia, Slovenia, Romania, and the European part of Turkey. For the present study, we exclude the European part of Turkey (which is difficult to distinguish from Turkey as a whole by the data accessible through the sources used), and additionally include the Republic of Moldova.

According to the FAO World Information and Early Warning System (WIEWS), the total number of genetic resources accessions preserved in genebanks worldwide is 7,199,179 (WIEWS 2015). Of these, 126,230 accessions (or 1.8 percent) are originating from countries of the Balkan Peninsula. Based on data from three international information systems on plant genetic resources, namely, WIEWS, EURISCO and Genesys (details see below), we present information on the number of accessions originating from each of the Balkan countries, their distribution across genebanks worldwide, and their taxonomic composition (major species and genera).

For individual countries of the Balkan region, similar overviews have been carried out (e.g. Knüpffer 2010a, b for Greece), and for Albania, the composition of the genetic resources collections was studied (Gixhari et

al. 2013), but for the complete Balkan region, this is the first study of its kind.

Material and methods

There are three international online databases available that contain data relevant for this study. The following databases were searched in September 2015: WIEWS (WIEWS 2015), Genesys (a worldwide database on plant genetic resources; Genesys 2015), and EURISCO (European search catalogue for plant genetic resources; EURISCO 2015). WIEWS gives summary information on germplasm preserved in genebanks worldwide; the data were last updated between 1984 and 2014 (the majority in 2008 and 2009). Genesys includes accessions from EURISCO (transferred on request), the genebanks of the CGIAR centres, and the USDA genebank. The majority of records related to Balkan-origin accessions were last updated in April, and some in September 2015. Data in EURISCO are being updated whenever a National Focal Point (person authorized to collect data within the country and to upload them to EURISCO) updates the respective National Inventory. For the same holding institution (genebank), data in Genesys are generally more up-to-date than in WIEWS, and even more so in EURISCO, since Genesys is receiving EURISCO data from time to time on request.

A selection was made for accessions originating from any of the Balkan countries, and relevant data fields were extracted or calculated, i.e. number of accessions, holding genebank, genus, species, country of origin, status of sample, source of information, and date of last update of the information. These data were transformed into the same format and combined into a single table. For genebanks appearing in more than one of the databases, only the most recent data were used.

Holding institutions are coded by FAO institution codes downloadable from the FAO WIEWS website (FAO 2015). An institution may receive a new code if its name or affiliation changes; thus the same institution may occur under different codes. By taking this into account, the number of different holding genebanks of Balkan material was reduced from 359 to 345, and the total number of accessions reported from 135,359 to 126,230. There may be institutions that do not exist any longer, but are still documented in WIEWS. This is known to be the case in Albania (all genetic resources collections have been transferred recently to the centralized Albanian genebank).

Scientific names are a problematic issue in databases, especially when the information is compiled from a large number of different sources (Hintum and Knüpffer 2010). Therefore, they were checked for major problems (format, contents of the field, and spelling). The resulting list of names was submitted for analysis to the “List matching service” of the Catalogue of Life (CoL 2015), which returns for each scientific name its status (e.g. accepted or synonym), and lists unidentifiable names. Synonyms and unidentifiable names were checked against the taxonomic system of GRIN (USDA Genetic Resources Information Network) (GRIN 2015). Thus, the number of different genus names could be reduced from 752 to 697, and the number of different species names (combinations of genus and species) from 2,748 to 2,415. Names not found in GRIN taxonomy were generally left unaltered. Therefore, the number of different genera and species reported is likely to be slightly biased (too large).

Countries of origin. “Yugoslavia” is still reported in many records as country of origin; this could not be resolved into the single

follower-countries. In addition, the FAO WIEWS database often combines material from different countries into a single record, without indicating the number of accessions for each of the countries. The records containing Balkan countries (together with others) refer to a total of more than 13,000 accessions in 15 genebanks. Such records were excluded from the statistics.

Results and discussion

Overview by holding genebanks and countries
Germplasm from the Balkans is reported to be held in a total of 345 genebanks in 61 countries. The genebanks holding the largest collections of this material are located in Bulgaria, Romania and Germany. Genebanks with more than 200 Balkan-origin accessions are shown in Table 1. Some countries have more than one genebank; countries holding the largest numbers of accessions of Balkan origin are Romania, Bulgaria, USA, Australia and Germany. Countries holding more than 200 such accessions are listed in Table 2.

Table 3 shows the countries of the Balkan region, and the numbers of accessions conserved in genebanks worldwide from each of these countries. There are approximately 30,000 accessions each from Romania, Bulgaria and Greece, followed by ca. 9,700 accessions from former Yugoslavia (present country not specified). Material from Kosovo (79 accessions) is reported by a single genebank in the U.S.

In Table 4, the total numbers of germplasm accessions held by genebanks in the Balkan countries are compared with the numbers of accessions originating from the holding countries. In Albania, Croatia, Greece, Montenegro, and Slovenia, more than 75 percent of the accessions originate from the holding country.

Overview by status of the samples

According to the sample status, the germplasm from the Balkans can be divided into various categories, including wild, weedy forms, landraces, advanced cultivars, and other categories (cf. Table 5). The largest proportion of the Balkan material belongs to traditional cultivars and landraces, followed by breeding or research material (with several subcategories).

For more than 17,000 accessions, the status is unknown or not stated.

Taxonomic composition of plant genetic resources from the Balkans

With respect to the taxonomic composition, the germplasm from the Balkan Peninsula belongs to 697 genera (Table 6) and 2,415 species (Table 7). These are likely to be slight overestimates, since some of the synonyms may not have been resolved. In fruit trees, for example, the genus *Prunus* as well as a number of smaller genera such as *Amygdalus*, *Armeniaca*, *Cerasus*, *Persica* and others belonging to the same taxonomic group, were reported as separate genera in the databases – they were brought together under *Prunus*. In addition, scientific names given at the level of genus (e.g. *Triticum* sp.) are counted as separate species. For 57 accessions, even the genus name is not known (reported as “unidentified” or “unknown”).

The most highly represented genera are *Triticum*, *Zea*, *Phaseolus*, *Hordeum*, and *Trifolium* (Table 6). At the species level, *Zea mays*, *Triticum aestivum*, *Phaseolus vulgaris*, and *Hordeum vulgare* have the largest numbers of accessions (Table 7).

Conclusions

Overviews of genetic resources material originating from a particular country or region provide a first indication of the wealth of crop plant species and their wild relatives, and they may assist in identifying gaps (need for further collecting). They may also be a good starting point for compiling checklists of cultivated plant species (and possibly their wild relatives) for certain areas, as has been shown by us for a number of countries such as Italy (Hammer et al. 1992, 1999).

The study was based solely on the three databases, which have different geographical scopes (from worldwide to European), and which differ in their up-to-dateness. Therefore, some recent changes may not have been reflected. It is known that in some countries of the Balkans, not all genetic resources collections are completely included in EURISCO, for example, in Bulgaria (N. Velcheva, pers. comm., June 2015) or Macedonia (S. Ivanovska, pers. comm., October 2015). Thus, contacting the curators of the individual genebanks of the Balkan countries, and those of other genebanks known to have

Balkan material, may have resulted in more precise figures.

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References

1. CoL (2015) Catalogue of Life. List matching service. <http://www.catalogueoflife.org/listmatching/> – accessed October 2015
2. EURISCO (2015) European search catalogue for plant genetic resources. <http://eurisco.ecpgr.org/> – accessed September 2015
3. FAO (2015) FAO Institution Codes. Downloaded from http://www.fao.org/wiews-archive/wiewspage.jsp?i_l=@@&show=DowloadinstEN.jsp – accessed October 2015
4. FAO/Bioversity (2012) FAO/Bioversity Multi-Crop Passport Descriptors. Version 2. June 2012.
5. http://www.bioversityinternational.org/fileadmin/user_upload/online_library/publications/pdfs/FAO_Bioversity_multi_crop_passport_descriptors_V_2_Final_rev_1526.pdf – accessed October 2015
6. <https://www.genesys-pgr.org/> – accessed September 2015
7. Genesys (2015) Genesys – the Global Gateway to Genetic Resources. <https://www.genesys-pgr.org/> – accessed September 2015
8. Gixhari B, Ismaili H, Lashi F, Ibraliu A, Dias S (2013) Diversity of Albanian plant genetic resources inventory assessed by EURISCO passport descriptors. *Alban J Agric Sci* 12:741-746
9. GRIN (2015) GRIN [Genetic Resources Information Network] Taxonomy for Plants. <http://www.ars-grin.gov/cgi-bin/npgs/html/queries.pl> – accessed October 2015
10. Hammer K, Knüpffer H, Laghetti G, Perrino P (1992) Seeds from the past. A catalogue of crop germplasm in South Italy

- and Sicily. Institut für Pflanzengenetik und Kultur pflanzenforschung, Gatersleben, Germany; Istituto del Germoplasma, Bari, Italy. ii+173 pp.
11. Hammer K, Knüpfper H, Laghetti G, Perrino P (1999) Seeds from the past. A catalogue of crop germplasm in Central and North Italy. IPK Gatersleben, Germany; Germplasm Institute of C.N.R., Bari, Italy. iv+255 pp.
 12. Hintum T van, Knüpfper H (2010) Current taxonomic composition of European genebank material documented in EURISCO. *Plant Genet Resour* 8:182-188
 13. Knüpfper H (2010a) Plant genetic resources from Greece preserved in the German Genebank in Gatersleben, with emphasis on Hans Stubbe's Balkan collections in 1941-1942. In: Proc 12th Panhellenic Congr, Hellenic Sci Soc Plant Breed & Genet, 8-10 Oct 2008, Naoussa, Greece, pp16-29 (on CD-ROM)
 14. Knüpfper H (2010b) The Balkan collections 1941-1942 of Hans Stubbe in the Gatersleben Genebank. *Czech J Genet Plant Breed* 46 (Special Issue): S27-S33
 15. WIEWS (2015) FAO World Information and Early Warning System for Plant Genetic Resources. http://www.fao.org/wiews-archive/germplasm_query.htm?i_1=EN – accessed September 2015

Tables

Table 1. Genebanks (FAO institution codes, explained below) holding more than 200 germplasm accessions of Balkan origin, and number of accessions per country of origin. ALB — Albania, BIH — Bosnia and Herzegovina, BGR — Bulgaria, HRV — Croatia, GRC — Greece, XKX — Kosovo (not an official FAO country code), MKD — Macedonia, MNE — Montenegro, MVA — Moldova, ROU — Romania, SRB — Serbia, SVN — Slovenia, YUG — (former) Yugoslavia

Accs	Holding institution	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
13602	Institute for Plant Genetic Resources “K. Malkov”, Sadovo, Bulgaria	9	—	12408	—	149	—	10	—	9	559	—	24	434
11050	Suceava Genebank, Romania	—	—	78	—	18	—	—	—	39	10859	—	—	56
8227	Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany	1051	—	1723	522	2835	—	10	—	21	1453	2	8	602
5641	N. I. Vavilov Institute of Plant Production, St. Petersburg, Russian Federation	42	49	1919	68	271	—	25	8	1589	742	—	32	896
5638	International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria	67	46	952	59	3385	—	338	42	85	463	93	—	108
4823	National Small Grains Germplasm Research Facility, USDA-ARS, Aberdeen, Idaho, USA	36	292	375	135	919	—	1407	259	9	—	1391	—	—
4774	Greek Genebank, Thessaloniki, Greece	2	—	13	—	4701	—	—	—	—	—	—	—	58
3910	Australian Medicago Genetic Resources Centre, Adelaide, Australia	—	—	241	—	3400	—	—	—	—	113	—	2	154
3553	Plant Genetic Resources Center, Tirana, Albania	3443	—	53	—	42	—	5	—	—	10	—	—	—
2823	Plant Gene Resources of Canada, Saskatoon, Canada	32	82	304	79	1462	—	458	—	22	336	—	48	—
2597	Institute for Agrobotany, Tápiószéle, Hungary	12	—	534	3	93	—	—	—	2	1491	1	1	460
2377	Gene Bank, Prague-Ruzyne, Czech Republic	19	1	742	109	232	—	7	1	35	475	43	146	567
2330	Western Regional Plant Introduction Station, USDA-ARS, Pullman, Washington, USA	87	78	965	42	1017	—	63	29	13	—	36	—	—
2328	Maize Research Institute “ZemunPolje”, Belgrade, Serbia	—	324	61	285	29	—	221	—	—	25	—	103	1280
2228	Millennium Seed Bank Project, Royal Botanic Gardens, Kew, Wakehurst Place, UK	—	48	761	37	1111	—	53	11	—	31	12	164	—
2225	Faculty of Agriculture, University of Zagreb, Croatia	—	96	—	2124	—	—	4	—	—	1	—	—	—
2214	Research Institute for Cereals and Technical Plants Fundulea, Romania	—	—	167	—	25	—	—	—	33	1911	—	—	78
2030	Australian Temperate Field Crops Collection, Horsham, Victoria, Australia	21	5	605	10	1160	—	6	—	25	44	—	1	153

Accs	Holding institution	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
1976	Australian Trifolium Genetic Resource Centre, South Perth, Australia	—	—	65	—	1835	—	—	—	—	7	—	—	69
1832	Dobrudja Agricultural Institute, General Toshevo, Bulgaria	—	—	1829	—	—	—	—	—	—	3	—	—	—
1828	Institute of Plant Production “V. Y. Yurjev”, Kharkiv, Ukraine	6	—	573	80	36	—	—	—	417	389	19	4	304
1775	Plant Breeding and Acclimatization Institute, Radzików, Poland	128	—	567	12	251	—	34	—	161	388	3	2	229
1560	Agricultural Institute of Slovenia, Ljubljana, Slovenia	—	—	—	—	—	—	—	—	—	—	—	1560	—
1545	Faculty of Agriculture, University Ss. Cyril and Methodius, Skopje, Macedonia	19	—	120	8	11	—	1086	—	1	1	—	6	293
1217	Agricultural Research Station Simnic-Dolj, Romania	—	—	3	—	—	—	—	—	5	1208	—	—	1
1141	Plant Production Research Center Piešťany, Slovakia	1	—	467	32	65	—	—	—	50	255	6	35	230
1092	Fruit Growing Research Institute Mărăcineni-Argeș, Romania	—	—	56	—	4	—	—	—	7	982	—	—	43
1016	Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia	—	10	514	4	41	—	420	—	4	15	—	—	8
949	Satellite Collections North of IPK, Oil and Fodder Crops, Malchow, Germany	27	—	262	169	52	—	—	—	3	399	—	—	37
851	Asian Vegetable Research Development Center, Taiwan	—	—	177	—	19	—	—	—	3	—	—	—	652
805	Australian Winter Cereals Collection, Tamworth, Australia	29	—	121	15	209	—	—	—	—	96	—	—	335
780	Agricultural Research Station PoduIloaiei-Iași, Romania	—	—	3	—	—	—	—	—	5	770	—	—	2
739	Agricultural Research Station Suceava, Romania	—	—	1	—	3	—	—	—	12	721	—	—	2
663	University of Agricultural Sciences and Veterinary Medicine, Timișoara, Romania	—	—	—	—	—	—	—	—	—	663	—	—	—
652	North Central Regional Plant Introduction Station, USDA-ARS, Ames, Iowa, USA	37	22	114	17	164	—	269	4	17	—	8	—	—
633	Ustymivka Experimental Station of Plant Production, Ukraine	4	—	229	1	56	—	1	—	159	49	10	2	122
617	Agricultural Research Station Turda-Cluj, Romania	—	—	12	—	1	—	—	—	7	595	—	—	2

Accs	Holding institution	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
608	Department of Applied Genetics, John Innes Centre, Norwich, U.K.	—	—	54	12	100	—	—	—	—	63	—	—	379
596	Department of Genetic Resources I, National Institute of Agrobiological Sciences, Tsukuba, Japan	—	—	132	1	45	—	—	—	—	90	—	—	328
583	Western Australia Department of Agriculture, South Perth, Australia	—	—	4	—	575	—	—	—	—	—	—	—	4
567	Vine Institute, National Agricultural Research Foundation, Lykovrissi, Athens, Greece	—	—	—	—	567	—	—	—	—	—	—	—	—
527	Medicinal and Aromatic Plants Research Station Fundulea, Romania	1	—	13	—	—	—	—	—	27	482	—	—	4
503	Centre for Genetic Resources The Netherlands, Wageningen, Netherlands	4	1	138	7	99	—	25	—	17	59	42	15	96
492	Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), México, Mexico	4	3	41	—	324	—	6	1	1	35	6	—	71
474	Genetic Resources Unit, Aberystwyth University, U.K.	—	10	127	8	121	—	1	—	—	101	—	10	96
439	Institute of Vegetable and Melon Growing, S. Selktsiine, Kharkivs'ka obl., Ukraine	1	—	50	—	4	—	—	—	336	19	—	—	29
437	Fruit Growing Research Station Băneasa-București, Romania	—	—	2	—	1	—	46	—	8	377	—	—	3
435	Fruit Growing Research Station Constanța, Romania	—	—	12	—	10	—	5	—	22	383	—	—	3
429	Plant Genetic Resources Conservation Unit, Southern Regional Plant Introduction Station, University of Georgia, USDA-ARS, Griffin, Georgia, USA	11	6	179	13	176	—	37	1	3	—	3	—	—
428	Northeast Regional Plant Introduction Station, Plant Genetic Resources Unit, USDA-ARS, New York State Agricultural Experiment Station, Cornell University, Geneva, New York, USA	12	2	66	1	23	—	310	—	8	—	6	—	—
384	Grassland Research Institute Brașov, Romania	—	—	—	—	1	—	—	—	—	383	—	—	—
368	Central Research Station for Crops on Sandy Soils Dăbuleni-Dolj, Romania	—	—	2	—	—	—	—	—	—	366	—	—	—
367	Nikitskyi Botanical Gardens, Yalta, Crimea, Ukraine	18	—	29	—	—	—	—	—	292	19	—	—	9
367	Station INRA, Saint Martin de Hinx, France	—	—	212	—	22	—	—	—	—	133	—	—	—
332	Institute of Agriculture, Podgorica, Montenegro	—	2	1	—	—	—	1	248	—	—	3	77	—

Accs	Holding institution	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
310	Institute of Grape and Wine 'Maharach', Yalta, Crimea, Ukraine	—	—	86	—	33	—	—	—	108	31	—	—	52
302	Fruit Growing Research Station Valcea, Romania	—	—	5	—	—	—	—	—	—	282	—	—	15
298	Fruit Growing Research Station Bistrița, Romania	—	—	1	—	—	—	—	—	3	294	—	—	—
275	Fruit Growing Research Station Iași, Romania	—	—	5	—	—	—	—	—	—	268	—	—	2
274	Nordic Genetic Resource Center, Alnarp, Sweden	6	—	117	7	113	—	—	—	—	28	—	—	3
272	Wine Growing Research Station Odobești-Vrancea, Romania	8	—	47	—	21	—	—	—	20	174	—	—	2
264	Centro Nacional de RecursosFitogenéticos, Alcalá de Henares, Madrid, Spain	12	—	37	—	194	—	—	—	1	9	—	—	11
256	Wheat Genetics Resource Center, Manhatta, Kansas, USA	11	13	13	16	90	79	3	5	—	18	6	—	2
249	AGRITEC, Research, Breeding and Services Ltd., Šumperk, Czech Republic	1	—	109	—	37	—	—	—	—	69	—	1	32
241	International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, India	2	—	170	—	39	—	—	—	4	—	—	—	26
233	Banco de Germoplasma, EscuelaTécnica Superior de IngenierosAgrónomos, Madrid, Spain	—	—	—	—	223	—	—	—	—	—	—	—	10
232	National Germplasm Repository USDA, ARS, University of California, Davis, California, USA	68	1	11	—	151	—	—	—	1	—	—	—	—
228	Institute of Genetics Academy of Sciences of Moldova, Chișinău, Moldova	—	—	9	—	—	—	—	—	184	29	—	—	6
225	Soybean Germplasm Collection, USDA-ARS, Urbana, Illinois, USA	—	2	34	4	—	—	—	—	161	—	24	—	—
213	Genetics and Plant Breeding Station, ESRA-INRA SGAP, Mauguio, France	—	—	98	—	3	—	—	—	—	74	—	—	38
212	Botany Department, University of California, Davis, California, USA	9	2	21	2	160	—	—	—	8	—	10	—	—
207	National Genebank of Kenya, Crop Plant Genetic Resources Centre, Muguga, Kenya	—	—	10	—	73	—	—	—	—	20	—	—	104

Table 2. Countries holding the largest numbers of germplasm accessions (over 200) from the Balkans, and number of accessions per country of origin. For explanation of country codes, see Table 1.

Accessions	Holding country	Genebanks	Country of origin												
			ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
23094	Romania	45	9	—	440	—	86	—	52	—	208	22079	—	1	219
15454	Bulgaria	4	9	—	14257	—	149	—	10	—	9	562	—	24	434
10103	USA	27	378	484	1855	295	2753	79	2128	321	228	32	1498	16	36
9449	Australia	8	50	5	1065	25	7201	—	9	—	25	311	—	3	755
9420	Germany	15	1078	—	2039	702	2921	—	11	—	37	1911	4	17	700
5878	Greece	7	2	—	13	—	5805	—	—	—	—	—	—	—	58
5641	Russian Federation	1	42	49	1919	68	271	—	25	8	1589	742	—	32	896
5638	Syria	1	67	46	952	59	3385	—	338	42	85	463	93	—	108
4380	Ukraine	39	29	—	1278	81	164	—	2	—	1501	641	33	17	634
3578	U.K.	7	—	58	1004	74	1384	—	56	11	1	230	32	178	550
3553	Albania	1	3443	—	53	—	42	—	5	—	—	10	—	—	—
3300	Czech Republic	15	23	3	1043	131	307	—	9	1	40	735	44	182	782
2823	CAN –Canada	1	32	82	304	79	1462	—	458	—	22	336	—	48	—
2653	Croatia	8	—	96	—	2547	—	—	5	—	—	1	4	—	—
2597	Hungary	1	12	—	534	3	93	—	—	—	2	1491	1	1	460
2328	Serbia	1	—	324	61	285	29	—	221	—	—	25	—	103	1280
2287	Poland	10	139	—	754	13	326	—	34	—	161	564	6	14	276
1669	Slovenia	2	—	—	—	—	—	—	—	—	—	—	—	1669	—
1545	Macedonia	1	19	—	120	8	11	—	1086	—	1	1	—	6	293
1456	Slovakia	9	2	—	573	34	74	—	—	—	61	354	6	40	312
1018	Colombia	2	—	10	514	4	43	—	420	—	4	15	—	—	8
949	Italy	36	190	2	143	36	314	—	—	2	30	16	37	3	176
916	Spain	20	58	—	76	11	658	—	2	—	3	22	3	—	83
851	Taiwan	1	—	—	177	—	19	—	—	—	3	—	—	—	652
691	France	7	—	—	347	2	80	—	—	—	—	217	—	—	45
602	Japan	2	—	—	132	1	51	—	—	—	—	90	—	—	328
507	Netherlands	2	4	1	138	7	102	—	25	—	17	60	42	15	96
492	Mexico	1	4	3	41	—	324	—	6	1	1	35	6	—	71
403	Moldova	3	—	—	16	—	—	—	—	—	311	67	—	—	9
354	Montenegro	2	—	2	1	—	—	—	1	270	—	—	3	77	—
332	India	2	2	3	220	—	54	—	—	—	4	13	—	3	33
274	Sweden	1	6	—	117	7	113	—	—	—	—	28	—	—	3

Accessions	Holding country	Genebanks	Country of origin												
			ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
235	Austria	7	3	1	20	45	21	—	—	—	1	38	8	69	29
207	Kenya	1	—	—	10	—	73	—	—	—	—	20	—	—	104

Table 3. Countries of origin in decreasing order of number of Balkan germplasm accessions held in genebanks worldwide. The percentage is given in relation to the total number of Balkan accessions, i.e. 126,230

Accessions	Percentage	Country of origin	Number of			
			holding countries	holding genebanks	genera	species
31382	24.9	Romania	45	187	296	675
30659	24.3	Bulgaria	52	211	468	1280
28735	22.8	Greece	45	181	318	941
9743	7.7	former) Yugoslavia	42	165	125	286
5616	4.4	Albania	29	70	148	247
4905	3.9	Macedonia	22	40	80	148
4529	3.6	Croatia	27	71	291	457
4399	3.5	Moldova	32	111	91	147
2524	2.0	Slovenia	23	45	178	276
1822	1.4	Serbia	17	42	47	82
1181	0.9	Bosnia and Herzegovina	18	33	101	146
656	0.5	Montenegro	8	18	38	57
79	0.1	Kosovo	1	1	4	15

Table 4. Total numbers of accessions in genebanks of Balkan countries (according to EURISCO data), and numbers of “own” accessions for each country. The genebanks of Macedonia and Serbia also report accessions from former Yugoslavia.

Country	Genebanks	Total accessions	Own accessions	Accessions from Yugoslavia
Albania	1	4105	3443	
Bulgaria	3	63608	14241	
Bosnia and Herzegovina	2	434	10	
Greece	4	6265	5492	
Croatia	8	3264	2547	
Moldova	3	1211	311	
Macedonia	1	2158	1086	293
Montenegro	2	356	270	
Romania	37	42837	21979	
Serbia	1	5475	0	1280

Country	Genebanks	Total accessions	Ownaccessions	AccessionsfromYugoslavia
Slovenia	2	1776	1669	

Table 5. Accessions from the Balkans grouped by sample status according to the FAO/Bioversity Multi-Crop Passport Descriptors, Version 2 (FAO/Bioversity 2012). In FAO WIEWS, the sample status is coded by two-letter abbreviations, which have been transformed into the three-digit codes, which are hierarchical, i.e. 100 also includes 110, 120 etc.

Accessions	Sampstat — Status of sample	FAO WIEWS codes included
17431	Unknown or not stated	
18044	100 — Wild	WS: Wild
3942	110 — Natural	
444	120 — Semi-natural/wild	
643	130 — Semi-natural/sown [onlyusedforforagecrops]	
1078	200 — Weedy	WE: Weedy
42453	300 — Traditional cultivar/landrace	CU: Cultivated; LR: Traditional cultivar/Landrace; OL: Old cultivar
12641	400 — Breeding/research material	
7574	410 — Breeder's line	BL: Breeder's line
225	411 — Syntheticpopulation	
792	412 — Hybrid	
446	413 — Founder stock/basepopulation	
3725	414 — Inbredline (parent of hybrid cultivar)	
21	415 — Segregatingpopulation	
401	420 — Mutant/genetic stock	GS: Genetic stock; MT: Mutant
13510	500 — Advanced/improved cultivar	AC: Advanced cultivar
2860	999 — Other (to be elaborated in the REMARKS field)	

Table 6. Genera of germplasm from the Balkans with more than 100 accessions, and number of accessions per country of origin. For explanation of country codes, see Table 1.

Accessions	Genus	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
18831	<i>Triticum</i>	945	222	6425	284	2773	58	935	209	358	3018	1057	19	2528
15629	<i>Zea</i>	856	338	2919	609	284	—	408	71	890	7093	2	116	2043
10232	<i>Phaseolus</i>	445	10	2728	193	676	—	483	—	472	3835	8	1049	333
6897	<i>Hordeum</i>	122	115	1317	176	2306	1	916	61	70	1018	240	39	516
5143	<i>Trifolium</i>	24	104	571	155	3461	—	91	24	2	344	24	122	221
4283	<i>Medicago</i>	18	8	472	55	3202	—	7	6	21	292	16	37	149
4134	<i>Vicia</i>	118	8	1335	21	1520	—	21	—	53	733	15	59	251

Accessions	Genus	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
3422	<i>Vitis</i>	291	1	499	163	1011	—	94	27	254	559	26	77	420
3348	<i>Prunus</i>	275	4	216	43	225	—	75	4	183	2149	12	—	162
3092	<i>Aegilops</i>	49	13	610	28	2124	19	84	14	—	47	35	—	69
2672	<i>Avena</i>	105	83	448	90	746	—	163	27	21	447	185	12	345
2427	<i>Pisum</i>	92	—	1100	19	551	—	13	1	34	497	10	—	110
2399	<i>Capsicum</i>	112	1	1028	28	80	—	125	—	66	327	1	4	627
2036	<i>Lycopersicon</i>	165	1	658	32	68	—	202	—	365	345	2	5	193
1851	<i>Linum</i>	3	—	337	3	130	—	—	1	3	1341	—	10	23
1834	<i>Secale</i>	54	8	886	6	36	—	346	14	—	407	53	7	17
1472	<i>Lens</i>	21	12	533	41	685	—	24	22	2	39	16	1	76
1435	<i>Nicotiana</i>	146	1	329	8	783	—	5	3	2	71	4	2	81
1372	<i>Glycine</i>	6	2	123	25	—	—	1	—	597	329	25	2	262
1341	× <i>Triticosecale</i>	—	—	776	1	21	—	—	—	64	463	—	1	15
1280	<i>Lupinus</i>	—	—	22	4	1190	—	1	—	—	31	—	—	32
1249	<i>Allium</i>	69	—	488	39	297	—	72	—	20	219	3	6	36
1208	<i>Cucurbita</i>	33	—	376	29	59	—	177	—	18	429	1	3	83
1175	<i>Beta</i>	8	—	66	9	758	—	27	—	8	267	1	2	29
1093	<i>Malus</i>	106	—	21	47	4	—	13	19	256	550	3	9	65
1026	<i>Festuca</i>	2	3	226	69	98	—	57	—	2	478	—	49	42
993	<i>Dactylis</i>	3	8	289	35	229	—	4	2	3	317	—	62	41
991	<i>Cicer</i>	18	—	451	5	336	—	2	12	110	21	2	—	34
988	<i>Lactuca</i>	13	—	244	47	160	—	6	—	1	251	1	187	78
986	<i>Lolium</i>	11	—	293	57	168	—	—	—	3	425	—	13	16
948	<i>Lathyrus</i>	55	3	172	5	651	—	—	1	13	15	1	10	22
907	<i>Brassica</i>	28	—	142	90	336	—	74	1	15	148	2	20	51
900	<i>Cucumis</i>	102	—	338	19	75	—	16	—	58	209	2	3	78
808	<i>Helianthus</i>	9	—	126	3	4	—	—	—	6	562	—	2	96
729	<i>Oryza</i>	—	—	270	—	67	—	124	—	—	243	—	—	25
702	<i>Pyrus</i>	150	—	53	21	5	—	37	3	120	267	4	—	42
594	<i>Solanum</i>	9	1	92	2	24	—	27	52	23	282	—	19	63
555	<i>Arachis</i>	—	—	408	1	16	—	15	—	—	106	—	2	7
456	<i>Salvia</i>	163	37	19	133	57	—	3	11	4	13	—	10	6
399	<i>Daucus</i>	10	1	58	28	155	—	2	—	19	95	—	2	29
388	<i>Lotus</i>	3	5	46	13	222	—	2	—	1	45	2	15	34

Accessions	Genus	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
378	<i>Gossypium</i>	11	—	156	—	177	—	—	—	—	9	—	—	25
360	<i>Papaver</i>	1	1	81	22	3	—	1	—	1	234	—	3	13
324	<i>Citrullus</i>	14	—	154	5	12	—	3	—	52	62	2	—	20
299	<i>Vigna</i>	8	—	36	1	42	—	2	—	1	206	—	—	3
286	<i>Sesamum</i>	—	—	200	—	74	—	10	—	—	1	—	—	1
284	<i>Dasypyrum</i>	7	2	23	10	237	1	2	1	—	—	—	—	1
277	<i>Juglans</i>	19	—	28	—	3	—	—	—	9	210	4	—	4
273	<i>Panicum</i>	1	1	60	5	3	—	—	—	27	115	—	2	59
261	<i>Satureja</i>	115	1	31	27	3	—	2	—	1	73	—	7	1
246	<i>Sorghum</i>	18	—	149	8	15	—	—	—	4	45	—	3	4
241	<i>Origanum</i>	139	—	4	46	21	—	—	—	—	27	—	3	1
238	<i>Ornithopus</i>	—	—	7	—	231	—	—	—	—	—	—	—	—
228	<i>Bromus</i>	1	—	61	8	66	—	13	—	5	58	4	6	6
216	<i>Phleum</i>	3	—	53	8	30	—	1	—	1	66	—	35	19
207	<i>Petroselinum</i>	7	—	48	11	18	—	43	—	8	67	3	—	2
205	<i>Cannabis</i>	1	—	10	1	—	—	—	—	1	155	—	4	33
199	<i>Poa</i>	2	—	88	27	12	—	—	—	—	58	—	8	4
197	<i>Olea</i>	92	—	—	37	45	—	—	15	—	—	—	—	8
193	<i>Silene</i>	—	8	66	11	64	—	18	3	—	13	—	10	—
182	<i>Fagopyrum</i>	2	2	3	10	—	—	—	7	2	19	2	118	17
181	<i>Mentha</i>	6	1	32	37	2	—	—	—	12	87	—	—	4
179	<i>Astragalus</i>	—	—	47	2	84	—	—	—	7	35	—	3	1
172	<i>Trigonella</i>	2	—	18	1	145	—	—	—	—	6	—	—	—
166	<i>Anethum</i>	4	1	45	17	14	—	1	—	21	62	—	1	—
164	<i>Hypericum</i>	13	3	25	109	2	—	—	—	—	8	—	4	—
147	<i>Onobrychis</i>	—	—	42	—	48	—	1	—	3	33	2	7	11
137	<i>Cydonia</i>	27	—	20	—	—	—	—	—	19	62	3	—	6
136	<i>Raphanus</i>	4	—	40	1	28	—	4	—	6	48	—	1	4
127	<i>Hymenocarpus</i>	—	—	2	—	123	—	—	—	—	—	—	—	2
116	<i>Ficus</i>	72	—	14	16	13	—	—	—	—	—	—	—	1
112	<i>Melilotus</i>	1	—	31	3	43	—	—	—	7	14	3	8	2
109	<i>Datura</i>	1	—	8	3	3	—	—	—	—	91	—	—	3
108	<i>Brachypodium</i>	2	—	20	3	78	—	—	—	—	3	—	2	—
108	<i>Tanacetum</i>	—	—	7	80	1	—	—	—	3	16	—	1	—

Accessions	Genus	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
107	<i>Thymus</i>	51	—	12	24	4	—	—	—	—	16	—	—	—
102	<i>Agrostis</i>	—	—	34	1	2	—	—	—	1	56	—	5	3

Table 7. Species of germplasm from the Balkans with more than 200 accessions, and number of accessions per country of origin. For explanation of country codes, see Table 1.

Accessions	Species	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
15612	<i>Zea mays</i> L.	856	338	2917	594	284	—	408	71	890	7093	2	116	2043
13772	<i>Triticum aestivum</i> L.	422	181	4738	247	1136	4	695	121	305	2620	977	18	2308
8771	<i>Phaseolus vulgaris</i> L.	434	10	2552	173	647	—	465	—	464	3644	8	43	331
6357	<i>Hordeum vulgare</i> L.	120	115	1260	175	1884	—	914	61	70	995	239	38	486
3023	<i>Vitis vinifera</i> L.	291	1	377	163	1008	—	94	27	154	425	25	77	381
2397	<i>Pisum sativum</i> L.	91	—	1089	19	538	—	13	1	34	497	10	—	105
2384	<i>Capsicum annuum</i> L.	112	1	1021	28	80	—	125	—	66	320	1	4	626
2380	<i>Triticum durum</i> Desf.	294	—	1297	4	518	—	68	—	48	122	—	—	29
2058	<i>Avena sativa</i> L.	48	83	431	81	306	—	159	23	21	413	174	12	307
1809	<i>Secale cereale</i> L.	52	8	877	6	27	—	346	14	—	403	53	6	17
1771	<i>Lycopersicon esculentum</i> Mill.	164	1	547	32	65	—	202	—	299	306	2	5	148
1706	<i>Linum usitatissimum</i> L.	3	—	327	3	117	—	—	—	2	1226	—	5	23
1534	<i>Triticum turgidum</i> L.	28	36	183	27	815	28	169	84	5	45	58	—	56
1531	<i>Vicia sativa</i> L.	50	1	703	5	607	—	6	—	22	29	7	—	101
1529	<i>Vicia faba</i> L.	23	—	204	10	456	—	14	—	17	646	—	48	111
1419	<i>Nicotiana tabacum</i> L.	145	1	324	8	780	—	5	3	2	68	4	—	79
1417	<i>Phaseolus coccineus</i> L.	10	—	156	20	25	—	17	—	8	182	—	997	2
1385	<i>Lens culinaris</i> Medik.	21	1	532	3	684	—	24	6	2	39	16	—	57
1341	× <i>Triticosecale</i> sp.	—	—	776	1	21	—	—	—	64	463	—	1	15
1326	<i>Glycinemax</i> (L.) Merr.	6	2	123	25	—	—	1	—	597	313	25	2	232
983	<i>Cicer arietinum</i> L.	18	—	444	5	335	—	2	12	110	21	2	—	34
974	<i>Dactylis glomerata</i> L.	3	8	270	35	229	—	4	2	3	317	—	62	41
913	<i>Beta vulgaris</i> L.	6	—	39	9	527	—	27	—	8	267	1	2	27
873	<i>Cucurbita pepo</i> L.	25	—	241	22	26	—	125	—	14	360	—	3	57
836	<i>Trifolium subterraneum</i> L.	—	—	12	—	785	—	—	—	—	—	—	—	39
830	<i>Lactuca sativa</i> L.	12	—	199	39	72	—	6	—	1	242	1	181	77
821	<i>Lolium perenne</i> L.	5	—	252	47	115	—	—	—	3	384	—	9	6

Accessions	Species	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
785	<i>Prunus</i> sp.	—	2	76	—	6	—	—	—	23	623	—	—	55
769	<i>Helianthus annuus</i> L.	9	—	106	3	4	—	—	—	4	553	—	2	88
748	<i>Malus domestica</i> Borkh.	1	—	14	47	3	—	13	19	215	367	3	9	57
747	<i>Medicago sativa</i> L.	14	6	218	51	94	—	5	4	21	218	15	26	75
737	<i>Trifolium pratense</i> L.	10	39	95	105	104	—	53	21	1	219	5	57	28
729	<i>Oryza sativa</i> L.	—	—	270	—	67	—	124	—	—	243	—	—	25
724	<i>Lupinus angustifolius</i> L.	—	—	2	—	719	—	—	—	—	1	—	—	2
722	<i>Prunus armeniaca</i> L.	17	—	37	—	34	—	55	1	72	486	6	—	14
700	<i>Aegilops triuncialis</i> L.	4	—	168	6	474	1	30	1	—	5	7	—	4
656	<i>Triticum monococcum</i> L.	177	5	71	4	127	24	3	4	—	149	19	1	72
550	<i>Medicago polymorpha</i> L.	—	—	28	—	498	—	—	—	—	3	—	—	21
549	<i>Arachis hypogaea</i> L.	—	—	407	—	13	—	15	—	—	106	—	1	7
546	<i>Allium cepa</i> L.	39	—	232	17	48	—	56	—	8	139	1	1	5
545	<i>Brassica oleracea</i> L.	23	—	100	65	155	—	74	1	14	62	2	18	31
518	<i>Prunus avium</i> (L.) L.	67	—	40	4	57	—	2	—	9	324	—	—	15
499	<i>Prunus persica</i> (L.) Stokes	20	—	23	2	35	—	—	—	42	367	—	—	10
479	<i>Medicago orbicularis</i> (L.) Bartal.	—	—	23	—	438	—	1	—	—	6	—	—	11
455	<i>Cucumis sativus</i> L.	37	—	118	10	16	—	5	—	41	178	2	—	48
450	<i>Festuca pratensis</i> Huds.	—	—	125	17	2	—	52	—	1	217	—	18	18
431	<i>Medicago truncatula</i> Gaertn.	—	—	2	—	426	—	—	—	—	1	—	—	2
404	<i>Trifolium repens</i> L.	1	15	105	17	186	—	7	—	—	38	1	22	12
400	<i>Aegilops biuncialis</i> Vis.	1	6	98	—	261	1	18	—	—	1	12	—	2
371	<i>Gossypium hirsutum</i> L.	11	—	150	—	176	—	—	—	—	9	—	—	25
370	<i>Solanum tuberosum</i> L.	—	—	54	—	—	—	—	52	9	207	—	19	29
369	<i>Aegilops geniculata</i> Roth	34	1	83	11	206	2	7	4	—	11	1	—	9
358	<i>Cucumis melo</i> L.	65	—	154	9	58	—	11	—	11	28	—	3	19
358	<i>Pyrus communis</i> L.	123	—	28	21	—	—	19	1	110	21	1	—	34
352	<i>Lupinus albus</i> L.	—	—	14	2	302	—	1	—	—	16	—	—	17
348	<i>Aegilops neglecta</i> Req. ex Bertol.	7	6	85	11	200	1	21	8	—	—	1	—	8
329	<i>Papaver somniferum</i> L.	—	—	72	18	1	—	—	—	1	225	—	—	12
322	<i>Daucus carota</i> L.	8	1	57	27	83	—	2	—	19	94	—	2	29
316	<i>Citrullus lanatus</i> (Thunb.) Matsumuraet Nakai	14	—	149	5	10	—	3	—	51	62	2	—	20
315	<i>Lathyrus sativus</i> L.	48	—	101	4	143	—	—	1	9	5	—	—	4
315	<i>Vitis</i> sp.	—	—	103	—	3	—	—	—	39	132	—	—	38

Accessions	Species	Country of origin												
		ALB	BIH	BGR	HRV	GRC	XKX	MKD	MNE	MVA	ROU	SRB	SVN	YUG
311	<i>Triticum</i> sp.	23	—	73	2	115	—	—	—	—	57	—	—	41
306	<i>Aegilops comosa</i> Sm.	—	—	5	—	301	—	—	—	—	—	—	—	—
302	<i>Salvia officinalis</i> L.	162	37	1	73	2	—	3	11	—	11	—	—	2
300	<i>Prunus domestica</i> L.	90	1	16	21	40	—	12	3	35	34	2	—	46
291	<i>Festuca arundinacea</i> Schreb.	—	—	29	10	70	—	2	—	1	157	—	5	17
289	<i>Pyrus</i> sp.	3	—	21	—	2	—	—	1	8	246	2	—	6
288	<i>Aegilops lorentii</i> Hochst.	1	—	9	—	277	—	—	—	—	—	—	—	1
285	<i>Vigna unguiculata</i> (L.) Walp.	7	—	32	1	37	—	—	—	1	205	—	—	2
284	<i>Dasypyrum villosum</i> (L.) Borbás	7	2	23	10	237	1	2	1	—	—	—	—	1
275	<i>Vicia ervilia</i> (L.) Willd.	37	—	49	—	186	—	1	—	—	1	—	—	1
271	<i>Sesamum indicum</i> L.	—	—	200	—	60	—	10	—	—	—	—	—	1
270	<i>Panicum miliaceum</i> L.	1	1	60	4	2	—	—	—	27	115	—	1	59
253	<i>Lathyrus cicera</i> L.	—	—	2	—	248	—	—	—	3	—	—	—	—
251	<i>Allium sativum</i> L.	8	—	127	5	17	—	1	—	10	61	1	1	20
235	<i>Medicago rigidula</i> (L.) All.	—	—	31	—	186	—	—	1	—	4	—	—	13
234	<i>Cucurbita maxima</i> Duchesne	4	—	53	6	27	—	51	—	4	63	1	—	25
230	<i>Medicago minima</i> (L.) L.	1	1	50	3	156	—	—	—	—	17	—	—	2
229	<i>Lycopersicon</i> sp.	1	—	75	—	3	—	—	—	66	39	—	—	45
218	<i>Origanum vulgare</i> L.	139	—	3	46	1	—	—	—	—	25	—	3	1
214	<i>Ornithopus compressus</i> L.	—	—	5	—	209	—	—	—	—	—	—	—	—
213	<i>Solanum melongena</i> L.	9	—	37	—	24	—	27	—	14	72	—	—	30
206	<i>Petroselinum crispum</i> (Mill.) Fuss	7	—	47	11	18	—	43	—	8	67	3	—	2
205	<i>Prunus cerasus</i> L.	2	—	12	13	7	—	5	—	2	142	4	—	18
204	<i>Cannabis sativa</i> L.	1	—	10	—	—	—	—	—	1	155	—	4	33
202	<i>Medicago arabica</i> (L.) Huds.	—	—	20	—	172	—	—	—	—	1	—	—	9
202	<i>Sorghum bicolor</i> (L.) Moench	18	—	114	8	13	—	—	—	1	41	—	3	4