

## The Balkan Collections 1941–1942 of Hans Stubbe in the Gatersleben Gene Bank

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**Abstract:** The German Federal Gene Bank at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben comprises ca. 148 000 accessions of crop plants and their wild relatives. Among these, material from Albania and Greece is represented with ca. 1100 and more than 2700 accessions, respectively. IPK's collection of Albanian germplasm is the world's largest collection, while IPK's Greek germplasm collection is the third largest holding of Greek crops and their wild relatives. The largest part of this material (ca. 200 and 1600 accessions from Albania and Greece, respectively) originates from two collecting expeditions carried out by Hans Stubbe, the founder of the Institute for Cultivated Plant Research, and other German collectors during the Second World War, in 1941 (ca. 700 accessions) and 1942 (ca. 1100 accessions). Stubbe's expeditions are described with respect to the regions visited, species collected, plus a comparison between the original collections and their present state in the IPK Gene Bank is provided. A formal scientific report about the results of these expeditions had never been published before. The material from these expeditions can be freely requested from the IPK Gene Bank, after signing a Material Transfer Agreement.

**Keywords:** Albania; collecting expedition; crop plants; Greece; plant genetic resources

During the Second World War, German scientists collected plant genetic resources in the Balkan region. The expeditions were organised by Hans Stubbe, who was strongly influenced by the Russian explorer Nikolai Vavilov. They covered Northern Greece and Albania in 1941, and the Peloponnese and Crete in 1942. The crops and their wild relatives that were collected, constituted a considerable portion of the germplasm collection of the Kaiser Wilhelm Institut für Kulturpflanzenforschung when it was founded by Stubbe in Tübingen near Vienna in 1943. It was transferred to Gatersleben (its present location) after the end of the war. Stubbe's expeditions were the first to be organised as multi-crop expeditions, which later became typical for the collecting expeditions of the Gatersleben Institute (HAMMER *et al.* 1995).

A scientific report of those expeditions has never been published, but the material has been widely evaluated and used in breeding programmes. A

large part of the materials has been preserved in the Gene Bank of the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben, right up to the present. The present publication set its sights on giving a first overview of the itineraries and the materials collected during Stubbe's Balkan expeditions.

The Gatersleben collections from Greece and Albania are also compared with other large collections of worldwide genetic resources.

### MATERIAL AND METHODS

The original reports of Stubbe's Balkan expeditions (STUBBE 1941, 1942) provide an overall description of the itineraries, the material collected, observations about agriculture in the regions visited, as well as maps of the regions. They do not contain detailed collecting lists. Lists of the collected ma-

terial were compiled later by the staff of the IPK Gene Bank, and have been used as the basis for its documentation; first put on card files, and from the 1980's on also into electronic information systems. Information about the IPK's present collection from Albania and Greece was derived from GBIS, the Gene Bank Information System.

An overview of worldwide germplasm holdings from Albania and Greece was compiled from the Bioversity Directory of Germplasm Collections, where it is possible to search by the country of origin. FAO's more up-to-date World Information and Early Warning System (WIEWS), while similar in scope, is not searchable by the country of origin of the material. Therefore, relevant information from WIEWS was requested (S. DIULGHEROFF, pers. comm., January 2009). These results were complemented with information from the European Search Catalogue for Genetic Resources, EURISCO, and the System-wide Information Network for Genetic Resources of the CGIAR, SINGER. Individual websites of large gene banks, such as GRIN (USA) and PGRC (Canada), were also consulted.

## RESULTS AND DISCUSSION

### Material from Greece and Albania in gene banks worldwide

The Gene Bank of the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersle-

ben comprises 147 765 accessions of crop plants and their wild relatives, belonging to 774 genera and 2593 species in 98 plant families.

There are 28 000–30 000 accessions of Greek material in ca. 200 gene banks in ca. 50 countries worldwide. According to the size of these collections, IPK's Gene Bank, with 2756 accessions, is rated third, after the Greek Gene Bank (5432 ccessions) and the Australian Medicago Genetic Resources Centre, Adelaide (3170).

Albanian material is kept by ca. 65 gene banks in 26 countries, with the collections totalling ca. 3300 accessions. Among these, IPK has by far the largest collection with 1075 accessions, followed by three gene banks in Albania with 709, 320, and 243 accessions, respectively.

### Material from Greece and Albania in IPK's Gene Bank

The main sources of Greek materials in IPK's Gene Bank collection are Stubbe's Balkan expeditions of 1941 and 1942 (Table 1). Other accessions were received in 2002 from the former Braunschweig Gene Bank, during the course of the fusion of the German gene banks; additionally, 267 accessions, mainly of *Aegilops*, were collected in the Greek islands by the University of Halle.

Most of the Albanian material preserved in IPK's Gene Bank originates from collecting expeditions. Besides the material from the 1941 expedition

Table 1. Main sources of IPK's accessions, originating from Greece and Albania (source: IPK's Gene Bank Information System)

Accessions	Expedition or donor	Remarks, references
<b>Greece</b>		
1103	Balkan 1942	Peloponnese, Crete
524	Balkan 1941	Northern Greece; the expedition also included material from Albania (Table 2), Yugoslavia and Hungary
400	Braunschweig Gene Bank	transferred to IPK in 2002–2004
267	University of Halle	mainly <i>Aegilops</i> , collection from Greek islands; SCHUBERT (1996)
<b>Albania</b>		
377	Albania 1994	GLADIS <i>et al.</i> (1995)
207	Balkan 1941	the expedition also included material from Greece (Table 2), Yugoslavia and Hungary
176	Albania 1993/2	HAMMER <i>et al.</i> (1994)
141	Albania 1995	HAMMER <i>et al.</i> (1996b)
121	Albania 1993/1	HAMMER <i>et al.</i> (1994)
25	Braunschweig Gene Bank	transferred to IPK in 2002–2004

(207 accessions), four joint expeditions carried out by the IPK and Albanian institutions in 1993–1995 yielded a total of 645 accessions (Table 1).

### **The 1941 expedition to Northern Greece and Albania**

During the Second World War, parts of the Balkan region were occupied by the Italian and German armies. These regions, including the border regions between the Balkan countries, thus became easily accessible for German crop plant researchers. This led Hans Stubbe, influenced by Vavilov's work, to organise his first expedition to Northern Greece and Albania during the summer of 1941, from July 1 to September 2. The aims (STUBBE 1941) were to collect wild and primitive forms of cultivated plants in Northern and Central Greece and Albania, and to carry out phytogeographical and taxonomic studies, on wild plants as well. The region belongs to the Mediterranean centre of origin or diversity for many crops, and thus a high diversity could be expected, especially in the mountains and valleys. It was anticipated to find forms tolerant to drought, frost, and various diseases.

The team consisted of five scientists and ten soldiers, the latter acting as drivers and support personnel. Three groups led by H. Stubbe, R. Freisleben, and W. Hoffmann independently collected 289, 692, and 653 samples, respectively. On the way to/from Germany, materials were also gathered in sites in Hungary (16 accessions) and Yugoslavia (145). Altogether, according to the collecting lists, 948 samples were collected in Greece and 525 in Albania, totalling 1634 samples. Some Greek wheat and barley accessions were donated by the plant breeder and geneticist I. S. Papadakis of Thessalonica (cf. Table 2). A summary of the material collected by plant genera, based on the collecting lists, is provided in Table 2. The total (i.e. 1246) is lower than that in the report, because only those accessions that had at least initially been included in the Gene Bank collection were counted. The itinerary of this expedition is shown on a map attached to the original report (STUBBE 1941).

Stubbe observed that after only one year of Italian occupation, genetic erosion of traditional crops was already progressing in Albania, due to the easier distribution of new Italian cultivars after the construction of roads. Generally, a large diversity was found, especially in wheat, and it was

concluded that the thorough investigations of the materials collected would require several years by several research institutions (STUBBE 1941).

### **The 1942 expedition to Peloponnese and Crete**

Encouraged by the promising results of the 1941 expedition, Hans Stubbe organised a second expedition in the Balkan region in 1942. Two teams were formed, collecting independently in the Peloponnese Peninsula and on Crete.

The first team was led by R. Freisleben (a crop scientist) and W. Rothmaler (a botanist), and collected a total of 1168 samples (STUBBE 1942). The region was visited by the collectors from the 24<sup>th</sup> of April until the 7<sup>th</sup> of June. Dr. Caravias from the German Embassy in Athens contributed additional material (155 samples, cf. Table 3) that he had collected separately.

Stubbe led the Crete team, which collected 332 samples between May 5<sup>th</sup> and July 16<sup>th</sup>. His team also included the botanist K. H. Rechinger. The areas visited by both teams are shown on maps attached to the report (STUBBE 1942). This time, the aims of the expedition were even broader than those of the 1941 expedition. Besides the collection and description of plant genetic resources (including questions of the variation, distribution, and origin of some crops), phytogeographical, taxonomic, and zoological (faunistic) studies were also carried out. The studies were also extended towards domesticated animals.

The materials collected during the 1942 expeditions are shown in Table 3. These figures, based on the collecting lists compiled in Gatersleben in the 1940s–1950s, almost correspond to those from the report (STUBBE 1942, see above).

### **Material from the 1941 and 1942 expeditions in the IPK Gene Bank**

LEHMANN (1963) reported that from the two Balkan expeditions, altogether 1850 accessions were included in the Gene Bank collection, among them 1040 cereals and 729 legumes. For 1993, HAMMER *et al.* (1994) reported 1954 accessions for the two expeditions. In 2006, 1886 Balkan accessions were documented in the previous IPK Gene Bank information system. The present figure (cf. Tables 2 and 3) is 1848. Tables 2 and 3 also provide the present number of accessions per crop genus in

Table 2. Overview of crops and wild species, collected by the three teams of Stubbe's Balkan expedition in 1941; source: abridged collecting lists; the figures for Greece and Albania include the subtotals from Stubbe's, Freisleben's, and Hoffmann's teams; while collections in Yugoslavia and Hungary were only carried out by Freisleben's and Hoffmann's teams; the last column gives the accessions present in the IPK Gene Bank

Genus	Greece	Albania	Yugoslavia, Hungary	Total	Gene Bank
<b>Cereals, grasses</b>	561	296	109	966	539
<i>Triticum</i>	294*	151	36	481	345
<i>Hordeum</i>	91*	31	25	147	97
<i>Zea</i>	49	48	20	117	43
<i>Secale</i>	60	23	11	94	
<i>Avena</i>	49	36	7	92	52
sorghum and millets ( <i>Panicum</i> , <i>Pennisetum</i> , <i>Setaria</i> , <i>Sorghum</i> )	13	4	6	23	2
<i>Aegilops</i> , other grasses	5	3	4	12	
<b>Legumes</b>	171	51	4	226	178
<i>Vicia</i>	55	26		81	71
<i>Phaseolus</i>	54	18	3	75	30
<i>Lens</i>	23	2		25	23
<i>Cicer</i>	17		1	18	8
<i>Pisum</i>	12	1		13	41
<i>Lathyrus</i>	7	4		11	5
<i>Glycine</i> , <i>Medicago</i> , <i>Trifolium</i>	3			3	
<b>Vegetables</b>	43	2		45	23
<i>Cucurbitaceae</i> (melons, cucumbers)	11			11	8
<i>Brassica</i>	4	2		6	
<i>Lactuca</i>	5			5	2
<i>Allium</i>	4			4	
<i>Raphanus</i>	4			4	
<i>Lycopersicon</i>	3			3	2
<i>Beta</i>	2			2	
<i>Cichorium</i>	2			2	2
<i>Apiaceae</i> ( <i>Anethum</i> , <i>Anisum</i> , <i>Apium</i> , <i>Daucus</i> , <i>Foeniculum</i> , <i>Petroselinum</i> )	7			7	4
<i>Spinacia</i>	1			1	5
<b>Other species</b>	3	6		9	–
<i>Linum</i>	1	4		5	
<i>Nicotiana</i>	1	1		2	
<i>Papaver</i>		1		1	
<i>Poterium</i>	1			1	
<b>Total</b>	<b>778</b>	<b>355</b>	<b>113</b>	<b>1246</b>	<b>740</b>

\*incl. 20 *Triticum* and 2 *Hordeum* received from Prof. I. S. Papadakis, Thessalonica

Table 3. Overview of crops and wild species, collected by the two teams (Crete and Peloponnese) of Stubbe's Balkan expedition in 1942; Dr. Caravias, German Embassy in Athens, provided additional material collected separately; source: collecting lists; the last column gives the accessions present in the IPK Gene Bank

Genus	Crete	Peloponnese			Total	Gene Bank
		Freisleben & Rothmaler	Caravias	subtotal		
<b>Cereals, grasses</b>	161	398	77	475	636	521
<i>Triticum</i>	70	135	33	168	238	221
<i>Hordeum</i>	43	102	20	122	165	236
<i>Zea</i>		92	12	104	104	15
<i>Avena</i>	28	33	6	39	67	48
<i>Secale</i>	9	19	4	23	32	
Sorghum and millets ( <i>Panicum</i> , <i>Pennisetum</i> , <i>Setaria</i> , <i>Sorghum</i> )		7	2	9	9	
<i>Aegilops</i> , other grasses	11	8		8	19	1
<i>Oryza</i>		2		2	2	
<b>Legumes</b>	98	400	36	436	534	516
<i>Vicia</i>	25	127	9	136	161	168
<i>Phaseolus</i>	3	133	18	151	154	108
<i>Lens</i>	5	43	8	51	56	59
<i>Lupinus</i>	11	36		36	47	14
<i>Medicago</i>	31				31	8
<i>Pisum</i>	9	21		21	30	41
<i>Lathyrus</i>	4	21		21	25	108
<i>Cicer</i>	1	19	1	20	21	7
Other ( <i>Lotus</i> , <i>Melilotus</i> , <i>Trifolium</i> , <i>Trigonella</i> )	9				9	1
<i>Vigna</i>						2
<b>Vegetables</b>	11	130	13	143	154	58
<i>Cucurbitaceae</i> (melons, cucumbers)	1	38	1	39	40	20
<i>Sinapis</i>	2	21	2	23	25	4
<i>Lactuca</i>		10	1	11	11	1
<i>Abelmoschus esculentus</i>		8	2	10	10	
<i>Apiaceae</i> ( <i>Anethum</i> , <i>Apium</i> , <i>Carum</i> , <i>Daucus</i> )	2	6	2	8	10	
<i>Spinacia</i>		8	1	9	9	1
<i>Lycopersicon</i>		7	1	8	8	6
<i>Raphanus</i>	2	6		6	8	3
<i>Beta</i>	1	3	2	5	6	
<i>Allium</i>	2	3		3	5	
<i>Brassica</i>	1	3		3	4	18

Table 3 to be continued

Genus	Crete	Peloponnese			Total	Gene Bank
		Freisleben & Rothmaler	Caravias	subtotal		
<i>Solanum</i> ( <i>S. melongena</i> , <i>S. tuberosum</i> )		6		6	6	
<i>Cichorium</i>		3		3	3	4
<i>Capsicum</i>		2		2	2	
Leafy vegetables		6	1	7	7	1
<b>Other species</b>	63	80	29	109	172	13
<i>Linum</i>	7	22		22	29	13
<i>Gossypium</i>		6		6	6	
<i>Sesamum</i>		5		5	5	
<i>Arachis</i>		2		2	2	
<i>Helianthus</i>		1	1	2	2	
<i>Salvia</i>	2				2	
<i>Nicotiana</i>		1		1	1	
Other spp. (wild, fruit, not identifiable)	54	43	28	71	125	
<b>Total</b>	<b>333</b>	<b>1 008</b>	<b>155</b>	<b>1 163</b>	<b>1 496</b>	<b>1 108</b>

the IPK Gene Bank, compared to the originally collected materials.

The differences between the number of samples of crops and their wild relatives collected in 1941 and 1942 in Greece and Albania (Tables 2 and 3), and the figures for the presently existing accessions from this expedition in the IPK Gene Bank (Tables 1 to 3), are a result of several reasons. Some materials collected may not have been suitable for inclusion in the Gene Bank, or they may have been lost during the decades, while some of the highly variable landrace accessions are being split into several morphologically distinct lines and kept as separate accessions in the Gene Bank (cf. KNÜPFER 2002).

## CONCLUSIONS

The rich material collected by Stubbe's two Balkan expeditions in 1941 and 1942 formed part of the initial collection of the Institute of Cultivated Plant Research founded in 1943, which in recent years became the German Federal Gene Bank.

Over the decades, the material was studied in various directions; and numerous accessions with interesting characteristics were identified and utilised in plant breeding programmes.

By comparing the infraspecific diversity in different crop species between the material collected in 1941 and more recently (1993–1995), we found that for Albania, genetic erosion is progressing (HAMMER *et al.* 1996a). The material and information collected in Greece in 1941 and 1942 would also allow a comparison between the situation more than 65 years ago and the present. For example, the results of a recent collecting expedition in Crete (LAGHETTI *et al.* 2008) and of other landrace collections in Greece carried out in recent decades, would allow conclusions to be drawn about the genetic erosion that may have affected crop landraces in Greece.

In the process of studying the historical documentation available at IPK, it became obvious that the quality and completeness of the passport data of the materials from the 1941 and 1942 expeditions, as reflected in IPK's Gene Bank information system, deserve some attention in order to add

collection sites and collector's remarks. Some collection numbers need to be traced back to the collecting lists in order to connect the original documentation with the present material.

The material collected by German researchers during the Second World War in Albania and Greece has largely been preserved in the German Gene Bank, and is ready for repatriation whenever such requests arrive. For example, after the civil war in Albania in the 1990's, some collections that were lost or destroyed were able to be replaced with materials from the Gatersleben Gene Bank. Like much other gene bank material, the materials from these expeditions can be freely requested from the IPK Gene Bank, after signing a Material Transfer Agreement.

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