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Originalarbeit

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Collecting fruit genetic resources in the North Caucasus region*

Sammlung von obstgenetischen Ressourcen im Nordkaukasus

Abstract

From August 22 to September 4, 2011 a joint expedition of scientists from Germany and Russia of the Julius Kühn-Institut (JKI) and the Nikolaj I. Vavilov Research Institute of Plant Industry (VIR) into North Caucasus has been taken place. The expedition was aimed on collection of fruit genetic resources in this region and their introduction into national collections for fruit genetic resources of both countries. Subsequently, the collected material will be evaluated by the participating partners regarding sources of agronomical important traits in order to provide new resources for breeding purposes.

Key words: Apple, pear, *Malus orientalis*, *Pyrus caucasica*, Russia, fruit species, wild germplasm

Zusammenfassung

Vom 22. August bis 4. September 2011 fand eine gemeinsame Sammelreise von Wissenschaftlern des Julius Kühn-Institutes (JKI) und russischen Wissenschaftlern des Nikolai I. Vavilov Forschungsinstitutes für Pflanzenbau (VIR) im nördlichen Kaukasus statt. Ziel der Expedition war es, genetische Ressourcen von im Kaukasus vorkommenden Obstarten zu sammeln und diese in die Genbanken der beteiligten Institute zu überführen. Anschließend soll das gesammelte Material von den beteiligten Partnern gleichermaßen evaluiert und auf das Vorkommen wertgebender Eigenschaften geprüft werden, um nachfolgend neues Ausgangsmaterial für künftige Züchtungsarbeiten bereitstellen zu können.

Stichwörter: Apfel, Birne, *Malus orientalis*, *Pyrus caucasica*, Russland, Obstarten, Wildarten

Introduction

Wild relatives of domesticated fruit crop species constitute an increasingly important resource to improve the quality of fruit. With the advent of climate change and greater ecosystem instability wild relatives are likely to provide useful genes which can be utilized in modern fruit varieties with improved characteristics, like resistance to biotic and abiotic stress factors. It was Nikolaj Vavilov who first realized the importance of crop wild relatives and the centres of their diversity in the early 20th century. Based on expeditions of Russian scientists in the beginning of the 20th century it was proposed that there are four main centres of origin (centres of diversity) for fruit species on the Asian continent (Caucasus, Central Asia, Far East, and Siberia) (Fischer and Schmidt, 1938). The centres of origin can be found in mountain areas, and the diversity declines towards the periphery as well as the traits inherited

* Scientific transliteration of Cyrillic into Latin was according to GOST 7.79-2002 and ISO 9:1995.

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in a recessive way increase (VAVILOV, 1930). In the Caucasus region abundant forests characterized by wild fruit species of apple, pear, sweet cherry, and cherry plum of large diversity can be found (VORONOV, 1925; PAŠKEVIČ and SIGOV, 1928; POPOV, 1929; VAVILOV, 1930, 1931; cited in FISCHER and SCHMIDT, 1938).

In late summer of 2011, the N.I. Vavilov Research Institute of Plant Industry (VIR) and the Julius Kühn-Institut, Federal Research Centre for Cultivated Plants (JKI) carried out a joint Russian-German collecting mission on the territory of the North Caucasus. Geographically, the North Caucasus comprises the northern slope and western extremity of the Caucasus Major mountain range as well as a part of its southern slope to the West. Politically, the Northern Caucasus includes several Republics (Adygeâ, Karačaj-Čerkessiâ, Kabardino-Balkariâ, North Ossetiâ-Alaniâ, Ingušetiâ, Čečniâ, and Dagestan) and provinces (Krasnodar and Stavropol) of the Russian Federation. The collecting mission was attended by VIR's staff members (Russia), Majkop experiment station members of VIR (Russia, Republic of Adygeâ), as well as scientists from the Institute for Breeding Research on Horticultural and Fruit Crops Dresden (Germany). The route of the collecting mission passed along the Western slopes of the Greater Caucasus Range in the Belaâ, Hakodz, Psebe and Kurdžips valleys (Majkop district of the Republic of Adygeâ and Tuapsinskij district of the Krasnodar province) and made up around 1,500 km. The main objective of the collecting mission comprised study and collection of the population diversity of *Malus orientalis* species, as well as wild relatives of *Prunus, Fragaria, Pyrus,* and *Rubus* species as well as landraces of apple, pear and cherry plum trees originated from Circassia. As a result of the collecting mission a total of 146 and 207 accessions of fruit and berry crops was introduced to the VIR`s and to the JKI's collection, respectively.

The North Caucasus as centre of diversity for fruit species

The Caucasus is one of the world's richest centre of diversity of wild fruit species: over 260 species of 37 genera occur in Caucasian forests (BURMISTROV, 1995). N.I. VAVILOV regarded this area as the major formation base of species and varieties for a number of wild fruit plants. Fruit plants are widely distributed in Central Asia, but the diversity of their species and forms is not as rich as in the Caucasus. The distribution of fruit species over this area is not even. In the desert belt there are oleaster thickets without admixtures, in the foothill belts – almond and dwarf cherry, in the upland steppe zone – pear, apricot, etc. The richest area is the mountainous forest-steppe belt where all wild species can be found (BURMISTROV, 1995). According to SCHMIDT (2006) there is a range of fruit tree and bush species especially of the *Rosaceae* family which are native to the Caucasus region, for example *Amelanchier ovalis*, *Aronia mitchurinii*, *Cotoneaster* sp., *Crataegus orientalis*, *Cydonia oblonga*, *Mespilus germanica*, *Prunus* sp. (genus *Amygdalus*, *Armeniaca*, *Cerasus* incl. *Microcerasus* and *Padellus*, *Padus*, *Persica*, *Prunus* s.str.), *Pyrus* sp., *Rosa* sp., *Rubus* sp., and *Sorbus* species.

Focusing on the genus *Malus* five gene centres are described by ZHUKOVSKY (1965): The East-Asiatic centre (*M. baccata* (L.) Borkh.), the Middle-Asiatic centre (*M. sieversii* (Ledeb.) Roem.), the Caucasian centre (*M. orientalis* Uglitzk.), the European centre (*Malus sylvestris* (L.) Mill. and its south Ukrainian, south Russian relative *M. praecox* (Pall.) Borkh.), and the North-American centre. According to TZVELEV (2001, cited in SCHMIDT, 2006) the distribution of the European wild apple also expands to the Northern Caucasus foreland. In the genesis of the domesticated apple *M.* × *domestica* Borkh., the predominant species is *M. sieversii* which has its centre of origin in Kazahstan. However, other species like the wild Caucasian apple *M. orientalis*, as well as crabapples from Europe (*M. sylvestris*), Siberia (*M. baccata*), Manchuria (*M. mandshurica* (Maxim) V. Komarov), and China (*M. prunifolia* (Willd.) Borkh.), probably also contributed genes (HOKANSON et al., 1997; GHARGHANI et al., 2009; VELASCO et al., 2010).

M. orientalis (Fig. 1) is the main wild apple species in North Caucasus. It is notable for the dense pubescence of the hypanthium, pedicels and young shoots (ZHUKOVSKY, 1965). According to SCHMIDT (2006) the species is highly polymorphic and occurs in community with *Pyrus caucasica*. It can be found in western sections of the east/west trade routes that eventually became the "Silk Road" in the Russian Caucasus as well as in Turkey. Comparative genetic studies using Iranian apple cultivars and landraces, wild *Malus* species and representative old apple cultivars revealed a high genetic identity between *M. orientalis* and *M. sieversii,* and a poor identity between *M. orientalis* and most other *Malus* species and cultivars. The close grouping of *M. sieversii* and *M. orientalis* is not surprising, probably due to close geographical distribution of these species around the Central Asian region (GHARGHANI et al., 2009).

The diversity of pear in the Caucasus region is tremendous and it may be accepted as the centre of origin of *Pyrus*; more than 20 *Pyrus* species can be found in this region (ZHUKOVSKY, 1965; SCHMIDT, 2006). A range of species are involved in the genesis of domesticated pear. The most important wild relative is *Pyrus caucasica* Fed. (syn. *P. communis* L. subsp. *caucasica* (Fed.) Browicz) which is closely allied with the European wild pear species *P. pyraster* (L.) Burgsd. *P. caucasica* (Fig. 2) can be found in broad-leaved forest, on forest glade and edges, often along river valleys. The trees can reach heights of 25 m, characterized by bare shoots, round-ovate leaves and globular fruit (SCHMIDT, 2006). From the ancient time local people were dealing with selection and grafting. This region is a main centre for evolution of pear. It can be assumed that lots of spontaneous interspecific and intergeneric hybridizations took place. It is proposed that the technology of grafting was developed in particular in North Caucasus (ZHUKOVSKY, 1965).

Besides wild apple and wild pear another fruit tree species which can be found abundantly in forests, forest

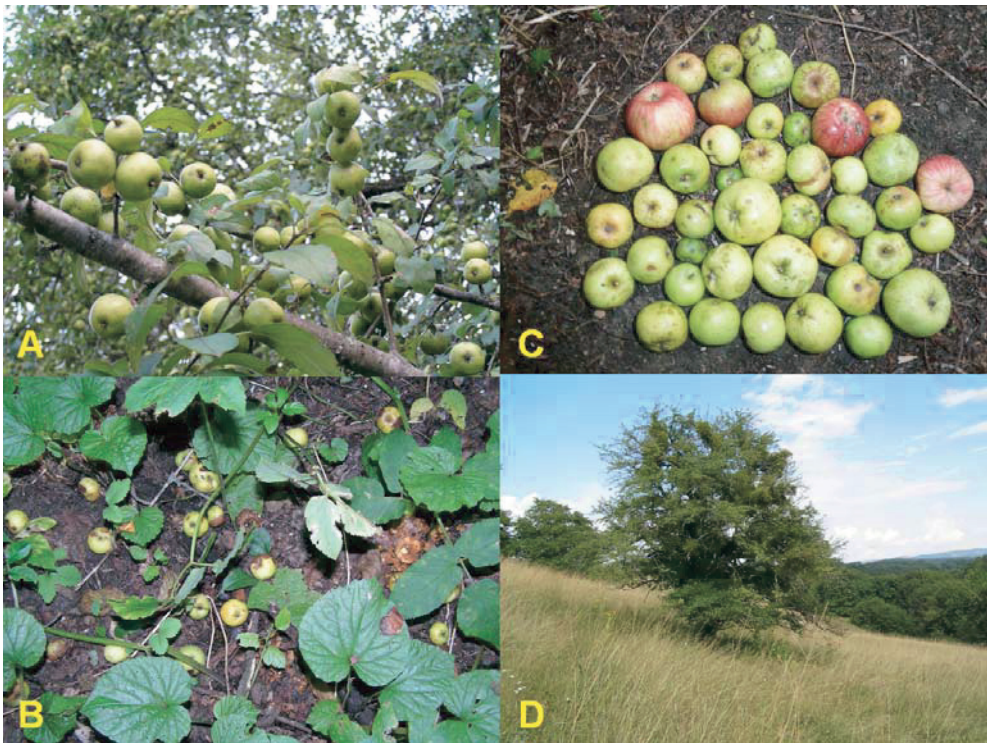

Fig. 1. Naturally grown *Malus orientalis*. (**A**) Fruits on a tree grown at the roadside, (**B**) dropped fruits of a tree grown in the wood, (**C**) fruit diversity of naturally grown apple trees, (**D**) solitary mature *M. orientalis* tree grown in the open field.

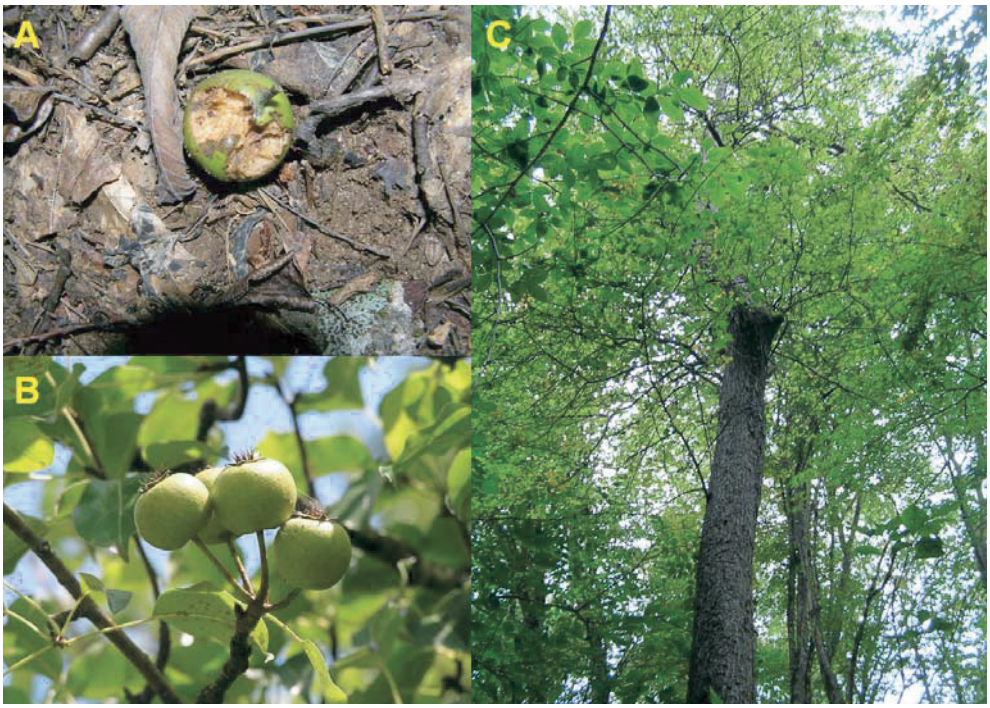

Fig. 2. Naturally grown *Pyrus caucasica*. (**A + B**) *P. caucasica* fruits, (**C**) naturally grown *P. caucasica* tree in the wood.

edges or open areas of this region is *Prunus cerasifera* Ehrh., the myrobalan or cherry plum. The fruit size and coloration is highly diverse. Ellipsoid and round, yellow, red and blue fruits can be found (Fig. 3). This species obviously contributed to the genesis of the domesticated plum *Prunus domestica* L. RYBIN (1936) reported on hybridization between *P. cerasifera* (2n = 16) and *P. spinosa* (2n = 32). In the Caucasus, these two species frequently grow side by side. In Majkop region Rybin detected highly sterile interspecific hybrids. Using artificial hybridization he resynthesized *P. domestica*. ZOHARY (1992) assumed that *P. domestica* evolved directly from the variable *P. cerasifera*.

It has to be noticed that everywhere in the forest regions of the Caucasus beside wild relatives large areas are occupied by apple, pear and other fruit trees that have become wild. Old neglected orchards produced seedlings by natural seeding and exhibit an extraordinary genotypic diversity, thus affording a very valuable initial material for selection (ZHUKOVSKY, 1965).

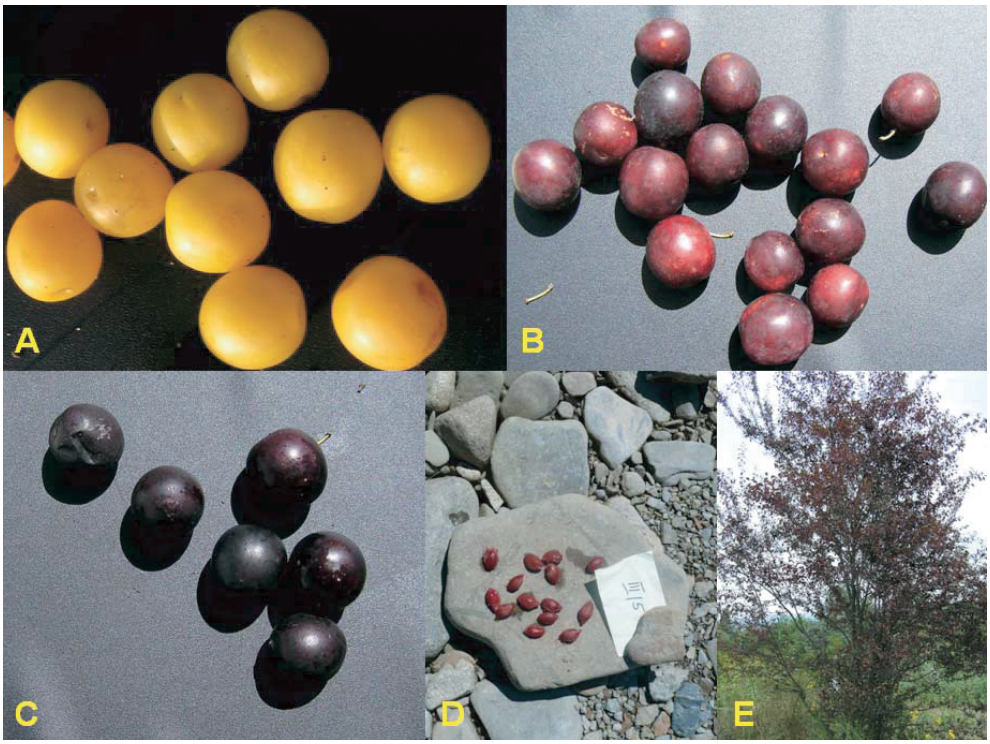

Fig. 3. Naturally grown *Prunus cerasifera*. **A** Yellow fruits, **B** red fruits, **C** blue fruits, **D** collected stones, **E** naturally grown *P. cerasifera* tree with red colored leaves and fruits.

Expedition to North Caucasus in 2011

The Julius Kühn-Institut in Dresden-Pillnitz maintains an extensive *Malus* collection consisting of apple cultivars and *Malus* species as relatives of the domesticated apple *M.* × *domestica*. The collection consists of 1,338 accessions belonging to 47 species or species hybrids. The majority of these accessions is clonally propagated and stored as duplicate orchard trees. In 1996 and 1997 the collection was improved receiving seeds of *Malus sieversii* from the U.S. Department of Agriculture (USDA) Plant Genetic Resources Unit (PGRU) in Geneva, New York. Accessions of *Malus sieversii* have been collected in Central Asia (mostly from Kazahstan) from 12 distinct habitats and 894 tree sources during four expeditions carried out in 1989, 1993, 1995 and 1996 by USDA in collaboration with scientists from other institutions. Collaborative evaluation for disease resistance and horticultural and molecular characterization is being conducted on 25,000 of these seedlings in 24 worldwide laboratories (FORSLINE et al., 2003). The material received from PGRU in Geneva was profoundly evaluated in Dresden-Pillnitz for disease resistance to scab, mildew and fire blight, morphological traits, like growth parameters, fruit size and quality (WIEDOW, 2006). Based on the polymorphic traits of the species a core collection of 94 seedlings was planted into the field which represents the biodiversity of the *Malus sieversii* species. Besides, several accessions were found which will be used in apple breeding as donors for special traits.

In recent years it was found that *M. orientalis* being an important species in the genetic background of the domesticated apple is a critical species that lacked representation in the *Malus* collection at JKI. As present cultivars of the commercial apple have a narrow genetic base and most commercial production is based on very few cultivars (SCHWARTAU, 2011), *Malus orientalis* could be a valuable genetic resource for the domesticated apple potentially containing more genetic diversity for important horticultural and environmentally adapted traits. It does not have the diversity of fruit quality like *M. sieversii*, but may have contributed to the domesticated apple other valuable traits such as later blooming, adaptation to a wider array of habitats, and capacity for longer storage of the apples (FORSLINE et al., 2003). VOLK et al. (2008, 2009) identified *M. orientalis* individuals that exhibited resistance to apple scab (*Venturia inaequalis)*, fire blight (*Erwinia amylovora*), and cedar apple rust (*Gymnosporangium juniperi-virginianae*) from Turkey, Russia, Georgia, and Armenia. *M. orientalis* accessions were evaluated recently as resistant to Alternaria blotch caused by *Alternaria alternata* (ABE et al., 2010).

The expedition took place between August 22 and September 4, 2011. The main objectives of the expedition were: (1) Collect germplasm of *Malus orientalis* in its centre of diversity; (2) Collect other crop species found in association with apple; and (3) Expand contacts with Russian scientists to develop cooperation in maintaining *ex situ* collections and develop strategies for phenotypic and genotypic evaluation. During the expedition eight collection sites were visited which were designated in relation to the nearest village or town (Fig. 4). Most collections were made as seeds, and altogether 7,955 seeds were collected from 103 individual trees of *Malus orientalis*. Localities of collection are listed in Tab. 1. A global positioning system device was available for the collection permitting latitude and longitude to be associated with each site. The main area for collection was between

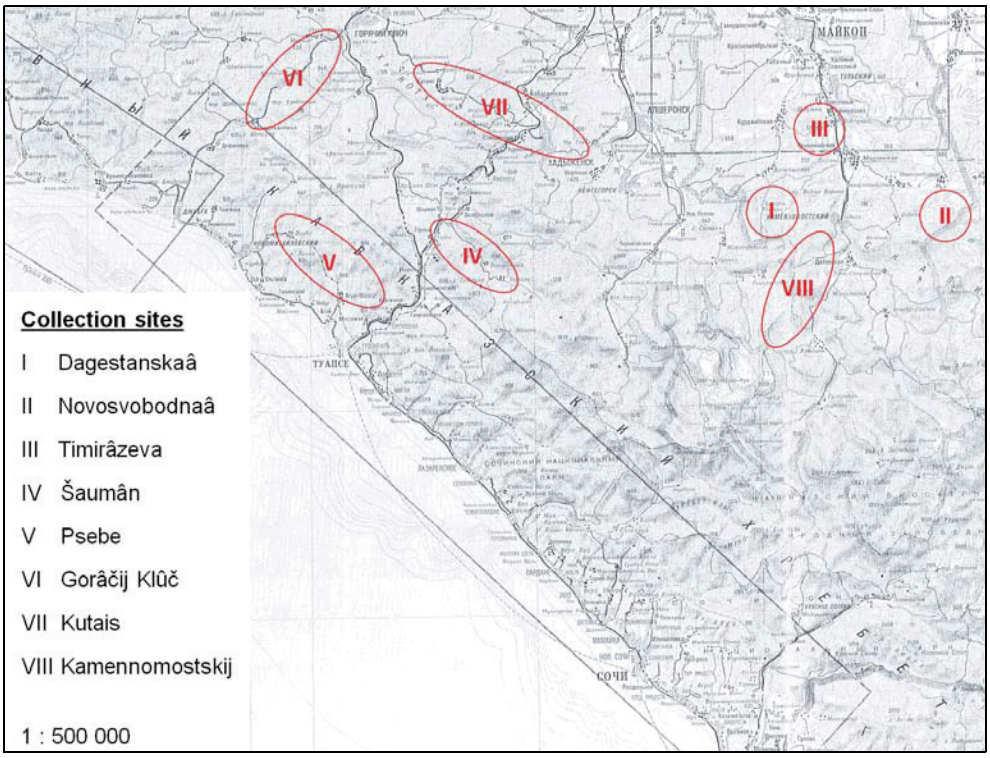

Fig. 4. Schematic illustration of collection sites of the expedition to Adygeâ and Krasnodar region.

Tab. 1. Description of *Malus orientalis* collection sites

Site Name	Latitude	Longitude	Elevation (m)	Number of Acc.
Dagestanskaâ	44°17'–18'N	40°00'E	460–711	6
Novosvobodnaâ	44°19'–21'N	40°24'–26'E	490–656	14
Timirâzeva	44°22'–26'N	40°05'–12'E	294–651	18
Šaumân	44°13'–17'N	39°18'–28'E	242–315	15
Psebe	44°10'–17'N	38°54'–39°03'E	67–74	6
Gorâčij Klûč	44°27'–35'N	38°04'–54'E	88–338	8
Kutais	44°26'–33'N	39°15'–40°00'E	207–377	20
Kamennomostskij	44°09'–34'N	40°04'–12'E	459–1,033	16

44°10' N latitude and 40°26' E longitude. The individual trees selected for seed collection were grown between 67 and 1,033 m elevation. The fruits were selected at random from trees at the collection sites. Depending from the crop load and the accessibility we collected between two and 20 fruits per tree, trying to get 10 samples. Fruit size of *M. orientalis* from the different sites was diverse (Fig. 1C), but not as much as stated in *M. sieversii* (WIEDOW, 2006). A summary of total seeds collected is listed in Tab. 2. Besides seeds, from trees of local apple, pear, sweet cherry varieties scion bud wood was obtained for vegetative propagation of the original genotype. Strawberry plants of two species were also collected from the wild. The material obtained is listed in Tab. 3.

Geographic sites

On August 24, we left to south-west from the Experimental Station of VIR in Timirâzeva, Majkop district, for our first expedition to the surrounding area of stanica Dagestanskaâ in the valley of the river Kurdžips. In the beginning of the 19th century this place was the homeland of a Circassian tribe named Abadzeks. The Circassian orchards surrounding the aul Koj-Habl' testify from this era (GAPONOVA, 2011). In 1863, the stanica was established by Cossack families which belonged to the Army of the Kuban Cossacks at the site of the aul. Among the first settlers were the families of the brothers' Ševyrëv. In 1864, Kuz'ma Ševyrëv established on the right side of the

Tab. 2. Total number of seeds collected

Species	No. Accessions	No. Seeds
Malus orientalis	103	7.955
Pyrus caucasica	26	891
Prunus cerasifera	10	160

Tab. 3. Bud wood collected form elite trees

Species	No. Accessions
Prunus avium	1
Pyrus communis	12
Malus × *domestica*	27
Fragaria viridis	7*
Fragaria vesca	21*

* plants

river Hakodz around 2 km from the stanica Dagestanskaâ an orchard. He received the planting material from abroad; especially form England, as elite varieties of that time. The orchard was around 1 ha at the beginning and 5 ha in 1896. His brother Vasilij was the ataman of the stanica (BOROMOTOV, o.J.(a); SEDOV pers. comm.). The main aim of the expedition was to discover the former orchard of Ševyrëv. The trees of this orchard could not be found as the forest was abundantly covered with vegetation, and it was nearly impossible to move forward. We collected *M. orientalis*, *P. caucasica* and *P. cerasifera* on the forest edges, glades and river banks (Fig. 5). Driving uphill, obviously on old Circassian roads, we crossed the river Hakodz several times (Fig. 6) when we also discovered the abandoned former settlement of the Cossacks named Hakodz. Possibly more than 150 years old apple and pear trees of local varieties still remained in this place.

On August 25, we started for a one-day expedition from Timirâzeva to the stanica in the valley of the river Fars, south-east of Majkop. This place belonged also to the Circassian tribe of Abadzeks until their expulsion after the Caucasian war. Later there was founded the stanica Carskaâ which was renamed to Novosvobodnaâ in the Soviet era. On a hill plateau named Mamrûk-Ogoj (644 m) outside the stanica a historical monument (called Chapel) was erected in 1881 in honour of imperator Aleksandr II to remind his visit on September 17, 1861 at this place (Fig. 7A). Inside of the Monument was a bronze bust of the tsar. The monument was destroyed during the Civil war in the 1920s. On the plateau the tsar met a delegation of chiefs of the Caucasian tribes to negotiate the termination of the Caucasian war (BOROMOTOV, o.J.(b)). The place was not selected by chance. From the hill side opens a beautiful panorama of Adygeâ: the little houses of the stanica in the valley of the river (Fig. 7B), small fields and large meadows, exploited in Soviet time by intensive grain production, the twin peaks of the mountain Fisiabgo and the back of the mountain Bogatyrka (Fig. 7C,D). The hill is surrounded by small forests where wild apple and pear trees can be found.

On August 26, we discovered the region around the Experimental Station of VIR. The first place was at the hillside of river Šuntuk called Duln'naâ balka where we found very old trees of *Pyrus caucasica* in the beech forest (Fig. 8). There are also several ponds in the valley where wild apple trees can be found on the banks abundantly. A little higher in the hillside we stopped at large forest glades which were used in Soviet time for agricultural production. In this time they are not under cultivation, and the process of evolution can be followed by necked eye (Fig. 9). There are lots of seedlings of different fruit tree species in various ages on the glades. The seedlings, especially in apple, are very different in the phenotype

Fig. 5. Apple and other fruit trees were mainly find on forest edges and river banks.

Fig. 6. Former Adyghe roads crossing rivers were also used to get deeper into the forest.

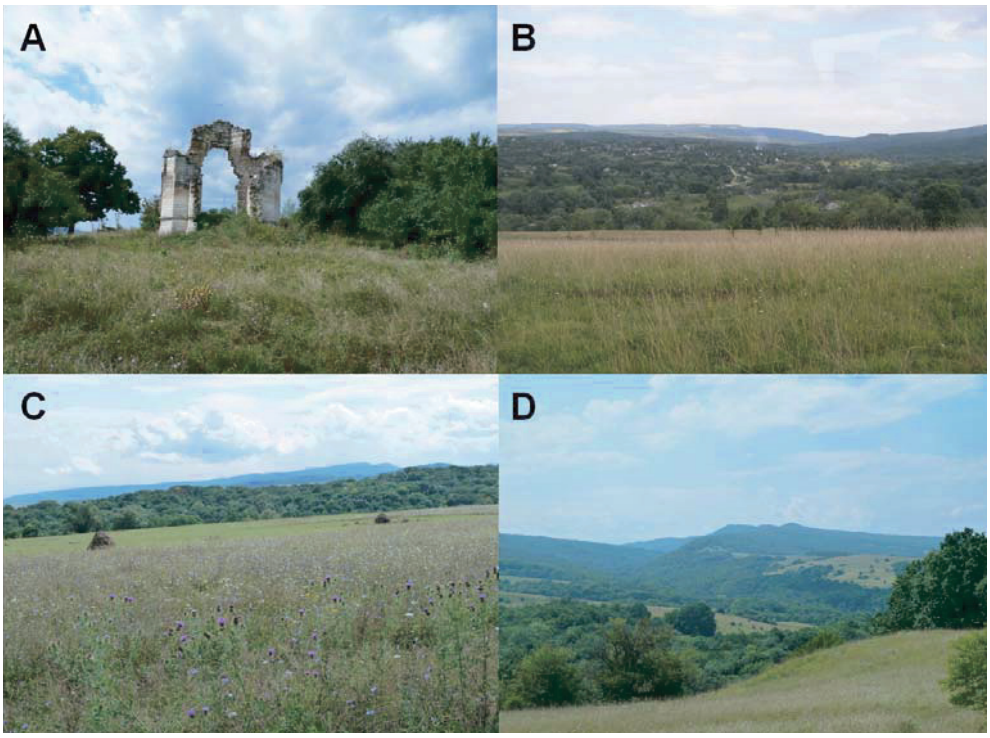

Fig. 7. Near stanica Novosvobodnaâ. **A** The historical monument at the hill plateau Mamrûk-Ogoj, **B** View to stanica in the river valley, **C** + **D** panorama around the monument.

Fig. 8. Old trees of *Pyrus caucasica* in the beech forest.

(morphology and resistance to diseases). Side by side you can find seedlings extremely affected by apple scab and others completely healthy. There is a beautiful view from this place down to the wide Majkop valley and the river Belaâ (Fig. 10). Majkop means valley of apples in local Adyghe language.

On August 27, we started a round-trip tour from the Experimental Station of VIR in Timirâzeva, through Apšeronsk (Krasnodar region) to Hadyžensk (Krasnodar region). We found a lot of wild apple trees along the road between these two towns. From Hadyžensk we went along the valley of the river Pšiš through the village Šaumân up to the Šaumân Pass. We collected material along the road and in the nearest forests. Crossing the pass we turned to the East along the river Pšiš uphill through the village Gojth to the Armenian village Terziân where the road ended in the mountain forest. In this place we collected material from old Circassian pear.

The next day we returned from the side valley to the main road leading from Hadyžensk to Tuapse and went south to Black Sea coast crossing the Gojthskij pass. In the village Georgievskoe we turned to east the road into the mountains until we reached the aul Bolšoe Pseušho. In this aul we visited the gardens of Madin and of Ruslan Hagurov where we collected old apple and pear varieties. We found the well-known ancient pear cultivar Circassian Bergamot (Čerkesskij bergamot, in Adyghe – Hutemy) which was selected by local people from the wild (Fig. 11). It still survived in some regions. It is resistant to winter frost and pear scab. During ripening the fruit flesh is browning which is very much favored by local people. The fruits are used for jam and drying. We stayed overnight at village Šepsi on the river of the same name at the Black Sea coast. We collected plant material in forests and old orchards not far from the road.

From Šepsi we started to return to Majkop. The first leg was from Šepsi through Tuapse when we visited the aul Aguj-Šapsug at the river Aguj north of Tuapse. This aul was the place of the largest community of the Šapsugs, a tribe of the Adyghe branch which is the original folk on the coast of the West Caucasus. In Aguj-Šapsug we visited the garden of Damir Nagučev and others. Here we found the well-known Circassian apple variety Čerkesskij Rozmarin (in Agyghe language – Aguemy). Later on we entered another tributary valley of the river Psebe where we visited the aul Psebe, also a Šapsug's settlement of descendant families which decided not to emigrate to Turkey after the Caucasian war in 19th century. The Šapsugs were engaged in agriculture, cattle and horse breeding, gar-

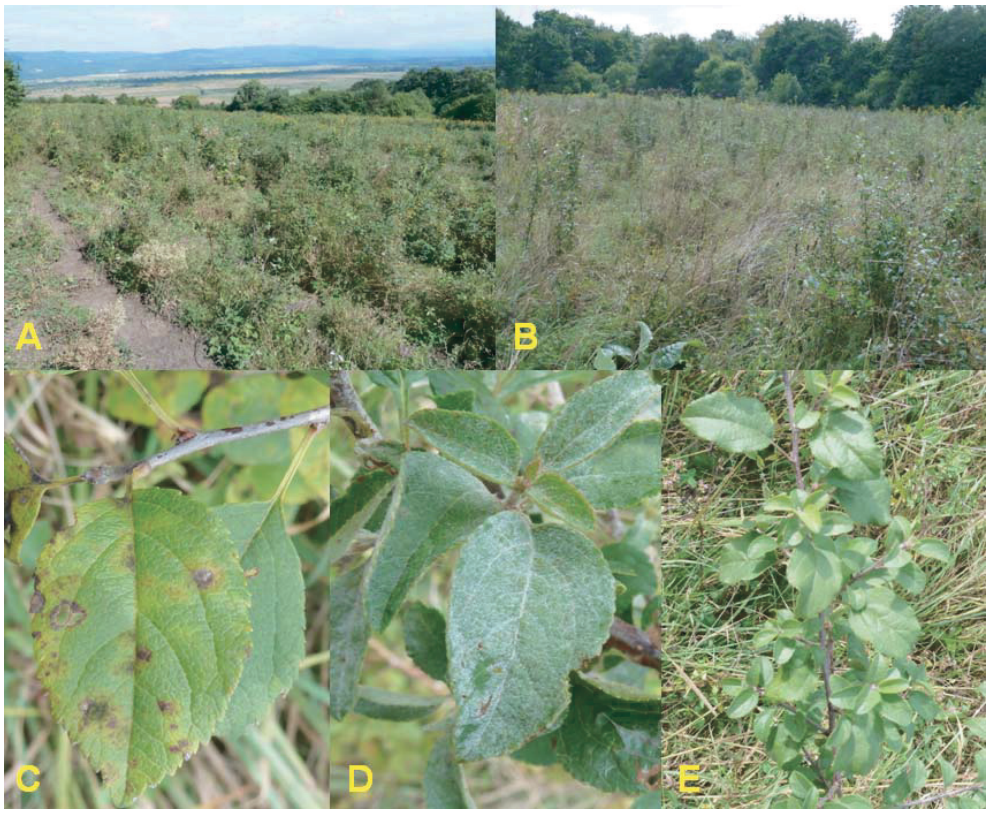

Fig. 9. The Caucasus region as a hot-spot for fruit tree evolution. **A + B** Large forest glades which were used in Soviet time for agricultural production, but now they are not under cultivation anymore. There are lots of fruit tree seedlings on these glades. **C + D** Apple seedlings susceptible and infected by various pathogens, **E** healthy apple seedling directly side by side to the infected once.

Fig. 10. Beautiful view from the hillside down to the Majkop valley and the river Belaâ.

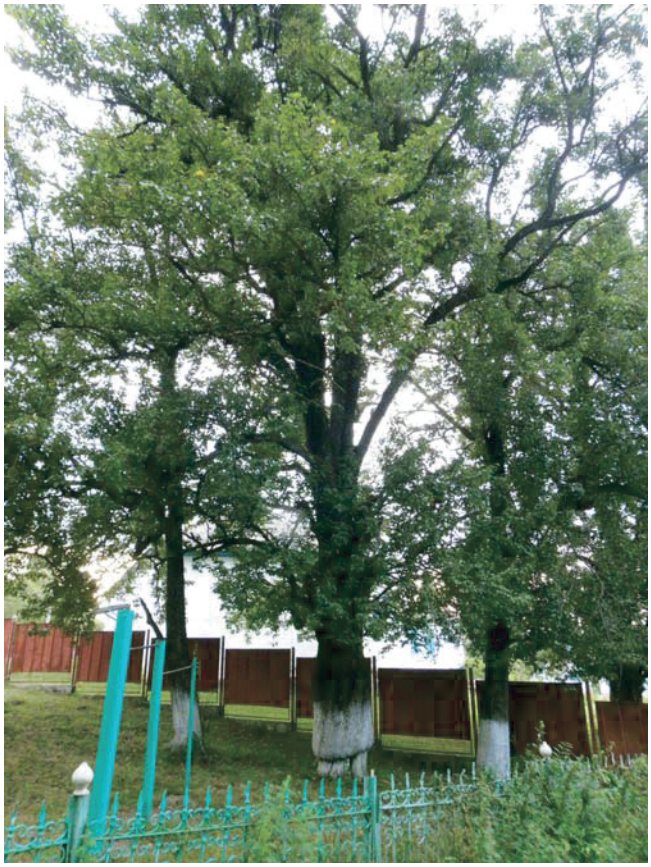

Fig. 11. The old Circassian pear cultivar 'Bergamot Circassian'. Distinctly visible is the incompatibility of rootstock and scion at the grafting site which is characteristic for trees in Circassian gardens (found in the stanica Sevastopol'skaâ).

dening, viticulture and bee-keeping. This area has been described for the so-called Circassian gardens. Visiting the above mentioned auls we met the local people and asked for very old Circassian varieties of apple and pear. In Psebe we visited the gardens of Šaban Alalo, V. Ačmizova and O. Alper.

We continued our way to Džubga and then turning northwards direction Gorâčij Klûč the next day, and then turned to east towards Hadyženssk. We collected plant

material in the forest along the road, and returned to Timirâzeva.

On September 1, we made a short mission from Majkop south towards the plateau Lagonaki at the Caucasus ridge. We stopped and collected plant material in the surroundings of the village Kamennomostskij. In the forest such fruit species, like pear, apple, cherry, cherry plum, hazelnuts, walnut etc. can be found. In this area beside the wild species there are also single gigantic hundred years old pear trees. Beside top fruit species a lot of berry species can be seen: cornel cherry *Cornus mas*, hawthorn species *Crateagus*, arrow-wood *Viburnum*. The fruits are used by the local population for diet and medicine purposes. On this day we collected samples of *Malus orientalis* at different altitudes until 1,350 m when the vegetation changed completely from broad-leaved forest to coniferous woodland. We ascended the mountains up to the Azišskij pass at 1,745 m. Exactly 69 years ago at this place an awful battle has been taken place between the Soviet and the German armies in World War II. The Soviet army succeeded to defend the pass from breakthrough of the German fascist army to the Black Sea. From the pass a beautiful view opens to the broad Alpine meadows between two karst mountain massifs. This area is well-known for the exciting waterfalls and caves. We took the route back to Majkop passing the Svâto-Mihajlovskij abbey near the village Pobeda. The abbey founded in 1878 was one of the most important men's abbeys in the Caucasus region. In 1928 the Abbey was closed, the buildings were destroyed. Since 2001 the Abbey is being rebuilt. Close to the monastery complex there is an old orchard which dates back to the foundation of the abbey. The old trees were planted in rows; the orchard was in good condition. Based on the phenotype of the fruits we collected bud wood for vegetative propagation of old Russian and possibly foreign apple and pear cultivars (Fig. 12).

On September 2, we discovered the region around Timirâzeva and tried to find another orchard of fruit trees, named orchard of Krylov, in the forests. We drove up to the so-called Kon' Gora and descended by foot to the assumed place which really was found after a few kilometres. The trees remained in the forest as planted, however the situation of the orchard was awful and no fruits could be found, possibly due to extreme spring frost. The local guide told us that these trees are every year highly crop loaded. On the way back to the station we crossed again former agricultural fields where nature has completely taken over control. Lots of fruit seedlings are growing on meadows and former driveways. It can be assumed that these areas will be dense forests in a few years.

Circassian gardens

At sites of ancient Circassian settlements in the North-West Caucasus and along the Black Sea coast there were numerous fruit plantations, so-called "Circassian gardens". The history of gardening is over 3,000 years old in this region, possibly belonging to the oldest one in the world. We are not talking about home gardens but about immense areas which were covered with orchards. In former times gardening was performed in valleys but mainly concentrated even in the mountains as it was safer to protect fruit plantations in the mountains than in the low land from enemies. In this region large forest massifs of wild fruit species could be found which were utilized by

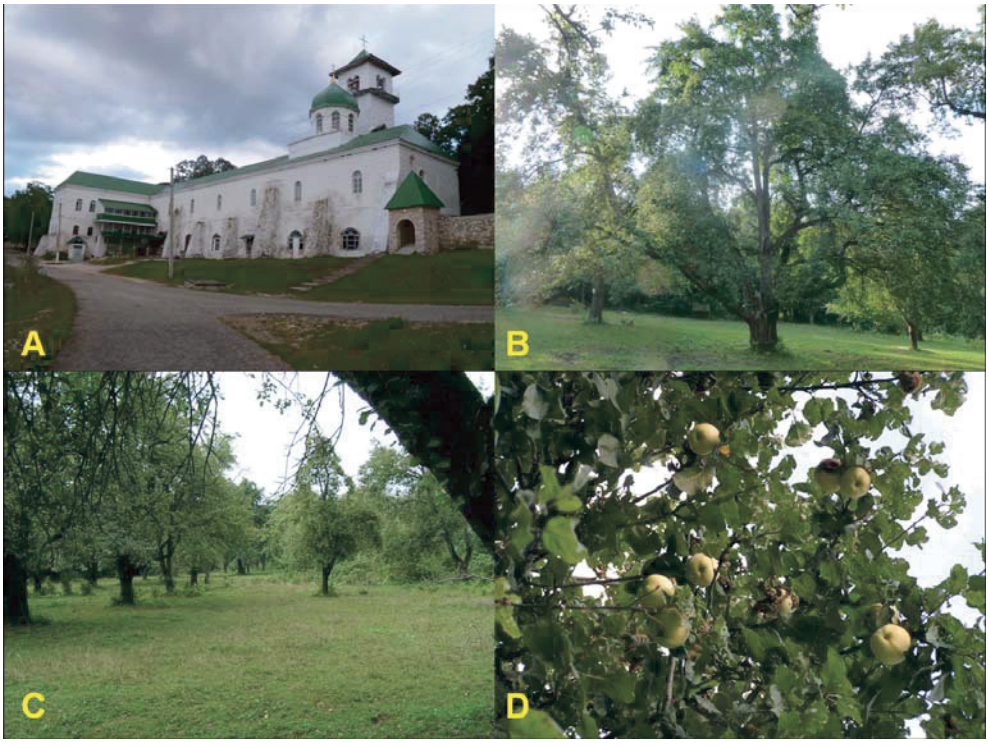

Fig. 12. The Svâto-Mihajlovskij abbey and the closely located orchard. **A** Main building of the Svâto-Mihajlovskij abbey, **B** old pear tree in the orchard of the abbey, **C** very old trees of traditional Russian and possibly foreign apple and pear cultivars, **D** Tree of the cultivar 'Antonovka polutorafuntovaâ'.

local people for diet and medical purposes. They propagated the best forms of trees from the wild domesticating them. Wild growing trees were also used as rootstocks and selected forms were grafted on it. These trees were highly adapted to the local soil-climatic conditions and were extremely long living (80–150 years). The peculiar feature of ancient plantations in comparison with gardens of today is that they grew in small groves either in the middle or on the border of the fields and forests. But there were also orchards designed on terraces from mountain plateaus downhill. The ancient people almost knew how to irrigate and to cultivate different fruit species according to their requirements. One of the specific characteristics of the Adyghe fruit production was the highly diverse structure concerning varieties. The fruit production was not limited to orchards close to their homes. The surrounding forests were transformed into so-call forest-gardens. In Šapsug regions it was like a tradition that everybody in spring had to go to the forest and to graft a variety of his own home garden on a tree in the forest. These people were always used to carry bud wood with them. Subsequently, everybody left in the surrounding forests hundreds of new fruit trees. It happens that a man in the aul Aguj left in the surrounding area around 300 fruit trees when he died. Countess Uvarova, archeologist, visited Caucasus in 1886 and described the ambition of the Circassians to cultivate landscape. She wrote that one of the very creditable traditions of the mountaineer was the following: The older people which were not able to work anymore and to take over other responsibilities of the society had to perform certain number of graftings on fruit trees (KARATABAN, o.J.; UNAROKOVA, 1998; HATKO, 2009). What was the reason that Adyghes were so much engaged with propagation of unlimited gardens on their homeland? In their mythology a key position was dedicated to the tree. All substantial things of the universe impersonate in the Caucasian mythology the tree of live. Besides in the Holy Books the garden symbolizes the Paradise, as on Earth as in Sky. This means that Adyghe people tried to realize the eternal dream of paradise on earth planting unlimited number of gardens (NUTRIHIN, 2011).

Practically in every region there were special kinds of fruit trees best suited for the region's climate. The Caucasian war in 19th century and industrial development of agriculture in the 20th century led to the decline of gardening and numerous old cultivars have been lost. A fundamental research on Circassian (Adyghe) gardens was provided by Nuh Ahmedovič THAGUŠEV. He systematically studied tradition, history and experience of fruit culture which goes back centuries. He prepared maps showing the regions of cultivating apple, pear, plum, cherry, hazelnut, walnut, and chestnut and tried to reanimate the traditional Adyghe horticulture. THAGUŠEV also described ancient cultivars as in apple as in pear (MAFEHABL, o.J.) Remaining parts of ancient Circassian gardens can be find until now in places were Circassian people are still living. This is in Abchasia, Adygeâ, Karačaj-Čerkessiâ and other places of the North Caucasus.

Conclusion

The expedition was conducted with founding from the Program on Bilateral Cooperation in Agriculture between Russia and Germany. Personnel participating in the expedition are listed in Tab. 4. The expedition successfully introduced large quantities of seeds as well as a limited number of clonal accessions to the *ex situ* collections at JKI Dresden-Pillnitz and VIR St. Petersburg and Majkop. Extensive evaluations have been initiated focused on four main objectives especially in *Malus orientalis*:

- Evaluation of resistance to biotic stress and other important traits in order to define donors for breeding,
- Maintenance of *Malus orientalis* biodiversity *ex situ* as a core collection representing the phenotypic and genotypic characteristics of the species,
- Evaluation of population genetics and biodiversity between and within collection sites,
- Description of genetic relationship between *Malus orientalis* and other *Malus* species as well as local/international cultivars.

Tab. 4. Participating personnel in the expedition

Expedition personnel	Affiliation	City/Country
BANDURKO, Irina	Professor, VIR Experimental Station	Majkop, Russia
FLACHOWSKY, Henryk	Scientist, Molecular Genetics, JKI	Dresden, Germany
HANKE, Magda-Viola	Professor, JKI	Dresden, Germany
HÖFER, Monika	Scientist, Fruit Gene Bank, JKI	Dresden, Germany
LILITKO, Nikolaj	Driver for expedition	Majkop, Russia
SEMËNOV, Valentin	Host and Leader for expedition, VIR Experimental Station	Majkop, Russia
ŠLÂVAS, Anna	Scientist, Fruit Genetic Resources Department, VIR	St. Petersburg, Russia

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Legend

ataman	– was a commander title of the Cossacks
aul	– a settlement of Turkic ethnic groups
Cossacks	– are a group of predominantly East Slavic people who originally were members of democratic, semi-military communities in Ukraine and Southern Russia inhabiting areas in the Dnieper and Don basins; played an important role in the historical development of those nations
stanica	– a settlement of Cossacks in Russia and Ukraine

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