

## The Origin of the Apple, Xinjiang in China<sup>©</sup>

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In 1931, the Soviet botanist Vavilov proposed that the vast area of the north slope in the Caucasus Mountains was the place of origin of cultivated apples (*Malus pumila* Miller var. *domestica* Schneider) (Vavilov, 1931). However, Dr. Yu (1979) reported that a primeval forest of wild apple exists in the altitude zone of 1, 250 m of the Tian Shan Mountains in China. This report set in motion a reexamination of Vavilov's opinion about the origin of the modern apple.

The United States Department of Agriculture, Agricultural Research Service (USDA-ARS) announced in 1979 the inauguration of a plan to accumulate germplasm of fruit trees including apples, and other fruits and nuts in repositories in the USA.

Entrance into the whole of Central Asia including Kazakhstan became possible after the Soviet Union withdrew its forces from Afghanistan in 1985.

In 1987, Vavilov stated that the wild apple [*M. sieversii* (Ledeb.) M. Roemer] originated in the mountain range from the Tian Shan Mountains in China through Kazakhstan, Kyrgyzstan, and Tajikistan to the Caspian Sea. The largest diversity of this species is seen around the Kazakhstan capital, Almaty, which is suitable for a place of origin because its meaning is "the father of apple." The wild apple of Kazakhstan belongs to the species that produces big fruits like the cultivated apple, but differs from that of the Caucasus which tends to have small fruits, and it excels in fruit taste (Vavilov, 1987).

Botanist Dr. Aimak Djangaliev of Kazakhstan decided to develop a new project concerning germplasm resources with the apple repository of USDA-ARS, which involved collecting samples representing the genetic diversity of the wild apple. Kazakhstan and the United States decided to save germplasm by sharing all the material collected. Fourteen samples of seeds were collected in the first exploration of the wild apple of Central Asia (in Kazakhstan, Uzbekistan, and Tajikistan). Then a large-scale investigation of the wild apple (*M. sieversii*) was conducted in Kazakhstan in 1995-1996. This was a joint research project of the USDA-ARS research team (led by Dr. Phillip L. Forsline) and the research team of Kazakhstan (led by Dr. Aimak Djangaliev). The USDA-ARS team collected about 20,000 seeds of *M. sieversii*, and many scions of superior trees over 2 years <http://www.ars.usda.gov/Aboutus/docs.htm?docid=6310> and <http://www.ars.usda.gov/Aboutus/docs.htm?docid=6311>.

In 1992, I agreed to build the Genetic Resources Preservation Center to save this precious genetic resource, seeing the primeval forest of the wild apple of Xinyuan guided by Prof. Lin Peijun, Professor of the Yili State Horticultural Research Institute, China. In 1999, the Genetic Resources Preservation Center was completed jointly by Japan and China.

It had been the accepted theory that the origin of the cultivated apple (*M. domestica*) was by the chance crossing of various wild species ([http://en.wikipedia.org/wiki/Malus\\_pumila](http://en.wikipedia.org/wiki/Malus_pumila)).

However, it recently came to be seen that this theory may be wrong. The Edmond Mac Foundation of Italy, an international research team, announced that it had deciphered all the genetic code (genome) of the apple (Velasco et al., 2010). By progress in a gene analysis in recent years, the ancestor of the present cultivated apples turned out to have been the wild species, *M. sieversii*, that grew in the mountainous region in Central Asia, which exists in Kyrgyzstan, Kazakhstan, and Yili of Xinjiang, China, was confirmed to be the ancestor of the modern apple (Ikegaya et al., 2009; [http://en.wikipedia.org/wiki/Malus\\_sieversii](http://en.wikipedia.org/wiki/Malus_sieversii)). *Malus sieversii* of Xinjiang came to be considered the only ancestor of almost all the kinds of the present cultivated species (*M. domestica*). Moreover, it was added to the IUCN Red List of endangered species in 2006 (<http://www.iucnredlist.org/apps/redlist/details/32363/0>).

The capital of Kazakhstan, Almaty, means "father of the apple" in Kazakh, and many communities in the vicinity of Almaty, for example Mt. Zongal Alatauy, reference the apple in their names. In China, the main distribution area of *M. sieversii* is in the provinces of Xinyuan, Gongliu, and Huocheng, all located in the Yili Valley in Xinjiang. Here also it is extant in many

names of a places, such as “Almali” and “Almalu” that mean an apple. According to my view, geographical features and the present distribution state of *M. sieversii*, I am sure that the Yili area is the origin of the apple. This view is supported also from the existence of old trees of *M. sieversii* (up to 600 years or more) estimated still inhabiting Mt. Tasba at an altitude of 2,000 m (Ikegaya et al., 2009; Peijun and Nairan, 2000). I think that distribution of this species spread downstream along the Yili River from the three provinces and then arrived in Kazakhstan and Kyrgyzstan.

Preservation of vegetative germplasm in a distant place (ex situ) is important in order to protect from a climatic disaster or damage by harmful insects and pathogens. Nevertheless in situ preservation is also important. The maintenance preservation of in situ collection may be able to be carried out at low cost. Moreover, preservation in a seed bank or by tissue culture methods, including cryogenics, is also useful. However, an in situ collection in the natural environment of the place of origin is indispensable to future research. When in situ collection is not carried out, even if germplasm remains in a large amount, it becomes impossible to understand the environmental conditions in which the species originated, and whether and how the species may have changed. It becomes a cause by which the foundation of research between an environmental condition and vegetative growth potential is lost. (Guorong et al., 1999; Ooishi et al., 1989). In the crisis of extinction of the various wild species, I think that in situ collection is indispensable to research on the continuous process of evolution to the acquired resistance and adaptation to environment.

In August, 2010, I presented an application to the Xinjiang government and the connected institute to establish a Nature Preserve immediately in Xinyuan, Gongliu, and Huocheng provinces, to ensure a system for preservation of the existing wild apple trees in the Yili area as soon as possible. I also requested that the Chinese Academy of Sciences, Institute of Botany in Beijing, undertake a gene analysis of the wild apples of Yili, Kazakhstan, Kyrgyzstan, Uzbekistan, and Caucasus in order to clarify the relationship among these populations.

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