


Brief History of Plant Breeding (I): from *In-situ* Care to *Ex-situ* Planting

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Abstract How human beings began to consciously plant breeding may need to find the answer from the evolution of human beings. Primitive humans experienced the evolution process from migration (nomadic) to settlement, from gathering to planting, and from hunting to raising livestock. The development of early plant breeding includes two stages of in-situ care and ex situ planting, which is caused by food demand. This study expounds the Breeding Ideas of early human beings from in-situ care to ex situ planting, and expounds and restores the possible facts of early plant breeding through some examples of wild resources utilization that still exist so far.

Keywords Brief history of plant breeding; *In-situ* care; *Ex-situ* planting

When did humans begin to consciously breed plants? The answer to this question may be found in the process of human evolution.

Primitive humans experienced an evolutionary process from migration (nomadism) to settlement, from group living to race gathering, from picking to planting, from hunting to raising livestock. Finding enough food to meet the basic needs of survival runs through the process of human evolution.

In the period of migration, humans lived by “fruit” and went wherever there was “fruit”. When the “fruit” in one place was polished off, they kept looking for another place, year by year and over and over again. Gradually, humans knew which places had what kind of “fruit”.

When humans realized that a certain place can meet the food needs of the ethnic group, they were unwilling to leave the place and settle down, and there was rich food around the settlement, which meant that the era of settlement had arrived. Humans living together began to have a division of labor. Some people were responsible for hunting or domesticating wild animals, and some were responsible for picking fruits or planting. Obviously, from this time on, humans began to consciously care for specific places and specific plants in order to pick and collect the fruits, which is the so-called *in-situ* care; Perhaps because the plants under *in-situ* care were far away from the settlement, humans began to migrate these plants to the vicinity of the settlement for planting, that is, *ex-situ* planting.

1 *In-situ* Care

When ancient humans found that there were edible fruits in a certain place, perhaps they would make a “landmark” so that they could find the place again in the fruit ripening season next year. If there were abundant food sources, they may settled down nearby and took care of these “food” producing plants to prevent wild animals or people of different clans from eating or picking. The fact of *in-situ* care may not only happen to ancient humans, but also to modern people. Here I give some examples.

In the 1960s and 1970s, food was scarce in vast areas of China, especially in southern mountainous areas. My grandfather lived in the southeastern mountainous areas in China. He worked at sunrise and rested at sunset. He was a hardworking and intelligent farmer. He had accumulated rich experience in long-term work and knew the

wild “food source” plants dozens of li (a Chinese unit of length) around his residence very well. He mastered the original habitats of dozens of wild “food source” plants. Every winter, he would go up the mountain to “care” these original habitats, mainly to clean up or cut down other plants with strong competitiveness around, so that the plants can grow vigorously and blossom and bear fruit in the coming year. These plants included the “Niunaizi”, with the scientific name of raspberry (*Rubus idaeus* L.), “Wumituofan”, with the name of “Nanzhu” (*Vaccinium bracteatum* Thunb.), “Banzha”, with the scientific name of “Hutuizi” (*Elaeagnus pungens* Thunb.), “Tengli”, with the scientific name of wild kiwifruit (*Actinidia chinensis* Planch.), “Hongbu”, with the scientific name of wild hawthorn (*Crataegus cuneata* Sieb. et Zucc.), “Agonggong”, with the scientific name of “Penglei”, which I used to eat when I was a child. The facts of *in-situ* care are numerous, and the detailed locations of the original habitats are often the keepers’ secrets.



Figure 1 Several plants under *in-situ* care (from Baidu Gallery)

2 *Ex-situ* Planting

Ex-situ planting is an important symbol of ancient humans from migration, nomadism to settlement, and an important step towards an agricultural society. In 1976, 84-year-old grandfather dictated the secret of the above original habitats to his son. Because my father was not a farmer and he didn’t have time to take care of these plants, he decided to move these plants to his backyard for planting. These *ex-situ* plants included raspberry (*Rubus idaeus* L.), wild hawthorn (*Crataegus cuneata* Sieb. et Zucc.), wild kiwifruit (*Actinidia chinensis* Planch.), “Hutuizi” (*Elaeagnus pungens* Thunb.) and “Nanzhu” (*Vaccinium bracteatum* Thunb.). Since then, we no longer need to go to the mountains and forests dozens of li away to collect these edible and medicinal “fruits”.

Ex-situ planting is actually the beginning of domestication of wild plants. The fruits that humans can often eat are domesticated from wild plants. For example, cultivated kiwifruit is selected from wild kiwifruit. Wild hawthorn is very similar to domesticated hawthorn, and the latter may be selected from the seedlings of wild hawthorn. Generally speaking, the size, color and taste of domesticated fruit will be more suitable for human preferences. In particular, the domesticated fruit is much larger than the wild fruit, but the nutritional value is generally much lower than that of the wild fruit. With the development of modern biological breeding technology and biochemical determination technology, this deficiency can be easily overcome as well.



Figure 2 *Ex-situ* planting of “Hutuizi” (*Elaeagnus pungens* Thunb.) in the backyard

3 Case study: *in-situ* Care and *ex-situ* Planting of Wild Kiwifruit

Kiwifruit is known as the “king of fruits” all over the world. China is the original place and origin center of kiwifruit. Wild kiwifruit is kiwifruit grown in the wild natural environment. At the beginning of the 20th century, Britain, the USA, France, New Zealand and other countries successively introduced wild kiwi trees from China, which began to be used as a garden ornamental plant, and gradually domesticated into today’s kiwifruit.



Figure 3 Wild kiwifruit (*Actinidia chinensis* Planch.) (from Baike Tashuo of Baidu)

Chinese people discovered kiwifruit more than 2800 years ago. The growth of wild kiwifruit is described in 《Kuai-Feng》 in “Shi-Jing (Book of Poetry)” of the pre-Qin Dynasty that Changchu (kiwifruit) grows on the low-lying land freely without being taken care, with long vines wrapping around luxuriant branches, flowers blooming beautifully, and fruit hanging all over the vines. The “Changchu” mentioned in the poem is the wild kiwifruit we are familiar with now. Obviously, we have the reason to believe that the fact of *in-situ* care of wild kiwifruit occurred in the early years of the Eastern Zhou Dynasty in 770 B.C..

The name of kiwifruit is named after that macaques like to eat this kind of fruit. Li Shizhen said in 《Bencao Gangmu (Compendium of Materia Medica)》 that “its shape is like a pear, its color is like a peach, and macaques like to eat it, so it gains the name”. The *ex-situ* planting of kiwifruit was first seen in the poem written by Cen Shen, a poet of Tang Dynasty (born in A.D. 718 and died in A.D. 769), that “on the well railing in the atrium, are growing kiwifruit”, which proves that there has been courtyard cultivation (*ex-situ* planting) of wild kiwifruit in Shaanxi since 1250 years ago.

Since the Tang Dynasty, the edible and medicinal records of wild kiwifruit have been recorded in the materia medica annals of all dynasties. In A.D. 739, it was recorded in the 《Bencao Shiyi (Gleaning Herb)》 of the Tang Dynasty that “kiwifruit is sweet, acid, non-toxic and can be used for medicine, which mainly treats osteoarthritis, paralysis, long-term white hair, hemorrhoids, etc”.

In A.D. 973, the 《Kaibao Bencao》 of Song Dynasty recorded that “Kiwifruit is also known as Mihoutao-Li (kiwi pear) and Tengli (vine pear)”. Tang Shenwei recorded in《Jingshi Zhenglei Beiji Bencao》, abbreviated as《Zhenglei Bencao》, that “kiwifruit, also known as Tengli (vine pear), Muzi, or Mihouli (kiwi pear), tastes sweet and sour and grows in the valley. Its vines grow on trees, its leaves are circular and hairy, and its fruit looks like the egg of duck and goose, with brown peel. It is sweet and edible after frost”.

Although since A.D. 739, the 《Bencao Shiyi (Gleaning Herb)》 and the later works such as 《Kaibao Bencao》 and 《Bencao Gangmu (Compendium of Materia Medica)》 have all introduced the morphological growth, edible and medicinal conditions of wild kiwifruit, the history of human domestication, breeding and utilization of kiwifruit is only more than a hundred years.

4 Conclusion

In ancient times, the *in-situ* care experienced by humans was a kind of possession behavior, which was caused by food demand. The reasons for *ex-situ* planting are that humans have experienced from migration to settlement, the population in habitation has increased, humans have begun to divide labor, and there are people specialized in farming to meet the growing food demand. Obviously, since ancient times, humans have begun to consciously select, optimize and breed species. Nowadays, in 21st century, *in-situ* care and *ex-situ* planting are still a common behavior and research activity, whether for the convenience of possession and collection of “fruits” of farmers, or for the research, protection or breeding and utilization of useful wild resources of botanists, wild resource conservationists or crop breeders. Different from primitive humans, modern humans are completely conscious and purposeful to carry out scientific research and breeding utilization of these wild resources.

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