

THE ORIGIN OF CULTIVATED BUCKWHEAT IN MANKANG DISTRICT OF THE SANJIANG AREA OF EASTERN TIBET AND ITS DIFFUSION TO INDIA AND THE HIMALAYAN HILLS

IZVOR GOJENE AJDE NA OBMOČJU DISTRIKTA MANKANG OBMOČJA SANJIANG VZHODNEGA TIBETA IN RAZŠIRITEV V INDIJO TER NA OBMOČJE HIMALAJE

Ohmi OHNISHI¹

<http://dx.doi.org/10.3986/fbg0062>

ABSTRACT

The origin of cultivated buckwheat in Mankang district of the Sanjiang area of Eastern Tibet and its diffusion to India and the Himalayan hills

Natural populations of the wild ancestor of cultivated common buckwheat were searched and collected, starting from its discovery in 1990 and finishing the collections in 2005. Among the collections, the samples Zhuka, Xihe from Mankang district of Tibet are most closely related to cultivated common buckwheat. On the other hand, cultivated populations of common buckwheat in Zhoubia, Zhubalong both from Mankang district are most closely related with the wild ancestor of common buckwheat. This leads to the hypothesis on the origin of cultivated buckwheat in Mankang district in the Sanjiang area. The diffusion route from the original birthplace to India and the Himalayan hills is proposed. Several characteristics of Indian and Himalayan common buckwheat are discussed. A main conclusion of the discussion is that European buckwheat is not of Indian origin nor of the Himalayan origin. It probably came from the northern China through the Silk Road

Key words: buckwheat, wild ancestor, origin, diffusion, India, Himalaya, short day plant

IZVLEČEK

Izvor gojene ajde na območju distrikta Mankang območja Sanjiang Vzhodnega Tibeta in razširitev v Indijo ter na območje Himalaje

Iskali in zbirali so naravne populacije divjega prednika gojene navadne ajde, začeli so leta 1990 in zaključili 2005. Med zbranimi vzorci je bil vzorec Zhuka, Xihe iz Mankanga, Tibet, najbolj soroden gojeni navadni ajdi. Po drugi strani, vzorca gojenih ajd iz Zhoubia in Zhubalonga, oboje iz Mankanga, so najbolj sorodni divjemu predniku navadne ajde. Na osnovi tega lahko oblikujemo hipotezo o izvoru gojene ajde v Mankangu na območju Sanjianga. Pot širjenja od prvotnega izvora v Indijo in na območja gorovja Himalaje je predlagana v tej razpravi. Avtor opisuje lastnosti navadne ajde v Indiji in na območju Himalaje. Glavni zaključek je, da ajda v Evropi ne izvira iz Indije ali z območja Himalaje. Verjetno je v Evropo prišla iz Severne Kitajske po Svilni poti.

Ključne besede: ajda, divji prednik, izvor, razširjanje, Indija, Himalaja, rastlina kratkega dne.

¹ Professor emeritus of Kyoto University, Jinryo 3-10-3, Ohtsu city, Shiga prefecture 520-2132, Japan, e-mail: Ohmi.Ohnishi@zd.ztv.ne.jp

1. INTRODUCTION

Since the time of DE CANDOLLE (1883), (a) what is the wild ancestor of cultivated common buckwheat and (b) where is the original birthplace of cultivated buckwheat, these two problems have been the main issues to be solved by buckwheat scientists.

The wild ancestor of cultivated buckwheat was clarified as *F. esculentum* ssp. *ancestrale* Ohnishi, which was first discovered in 1990 in the Wulang river valley in Yongsheng district of Yunnan province, in China by OHNISHI (1991). As for the birthplace of buckwheat, OHNISHI (2004, 2007, 2010, 2016, and 2018) has repeatedly claimed that the Sanjiang area of Yunnan, Sichuan provinces and east Tibet in China is the original birthplace of cultivated buckwheat.

In the Himalayan countries, India, Nepal, Bhutan, and Pakistan, buckwheat is cultivated extensively and buckwheat is consumed well. Buckwheat in India and the Himalayan hills has some characteristics which are not seen in other regions such as China, Japan and European countries.

Today, I discuss the original birthplace of buckwheat in more details, and I consider the diffusion route from the place of origin to India and to the Himalayan hills. Finally, I discuss the characteristics of Indian and the Himalayan buckwheat. As a conclusion, I suggest that the cultivated buckwheat in European countries has never come from India nor from the Himalaya, it probably came from northern China through the Silk Road.

2. THE EXACT ORIGINAL BIRTHPLACE OF COMMON BUCKWHEAT

The wild ancestor of cultivated common buckwheat was first discovered in Yongsheng district in Yunnan province of China in 1990 (OHNISHI, 1991). Ten-years searches for the wild ancestor in Yunnan and Sichuan provinces, and the searches in Mankang district of

eastern Tibet in 2002 and 2004, and finally the searches in the Tongyi river valley and the Nyiru river valley in 2004 and 2005 clarified the distribution areas of the wild ancestor of common buckwheat (OHNISHI 2007, see also OHNISHI and TOMIYOSHI, 2005).



Photo 1: Cultivated common buckwheat in Sanjian area (Weixi district, Yunnan province). Flower color in this area near the original birthplace is beautiful pink.



Photo 2: The wild ancestors growing in the Xihe river valley of Mankang district in eastern Tibet. The wild ancestors in this valley are genetically most closely related with cultivated buckwheat. Hence, the Xihe river valley along with the towns in northern Mankang district are considered as the original birthplace of common buckwheat.



Photo 3: The cultivation of common buckwheat in Yanjing town of southern Mankang district. The brown part of the cultivated field is common buckwheat just before harvest. Yanjing town has a good weather condition for buckwheat cultivation and the wild ancestors of common buckwheat are also growing at the margin of buckwheat fields, although those wild ancestors are not so closely related with cultivated buckwheat.

The wild ancestor is distributed in

1. The Sanjiang area of Yunnan province and eastern Tibet,
2. Sporadic distribution in northwestern Yunnan province and southwest corner of Sichuan province, and
3. The Tongyi river valley in Muli district of Sichuan province and the Nyiru river valley in Shangrila district of Yunnan province. Both the Tongyi river and the Nyiru river are small tributary of the Shuiluo river, a tributary of the Jinshajiang river.

Cultivated common buckwheat and wild ancestors are illustrated with Photos 1 – 4.

Among the collected wild ancestor populations, the wild ancestors from the Sanjiang area were revealed to be the most closely related with cultivated common buckwheat in AFLP variation (KONISHI et al., 2005) and allozyme variability (see Figure 1, see OHNISHI and NISHIMOTO, 1988, for the procedures of the electrophoresis and the names of enzymes analyzed). A part of the data on the frequencies of allozymes can be found in OHNISHI (2007). The N-J tree of Figure 1 was written following by SAITOU and NEI (1987) using PAUP* (Phylogenetic analysis using parsimony) version 4.0 (SWOFFORD, 1990, 2002).

The wild ancestors in the Tongyi river valley and the Nyiru river valley are highly variable in AFLP and allozymes, however, the populations from those valleys are most distantly related with cultivated popula-

tions of common buckwheat. The sporadically distributed ancestral populations in Yunnan and Sichuan provinces showed intermediate closeness to cultivated buckwheat (Fig. 1).

This may leads to the conclusion that the Sanjiang area is the original birthplace of common buckwheat. KONISHI and OHNISHI (2007) showed that close genetic relationship between the wild ancestor in the Sanjiang area and cultivated populations is not due to recent hybridization between them.

Now, by observing Fig. 1 more carefully, you may find that the Zhuka population and the Xihe population from Mankang district are most closely related with cultivated populations. The Adong population (in Yunnan province) and the Yanjing population (close to the border between Yunnan and Tibet, see Fig. 2) are both from the Sanjiang area, but they are slightly far away from the cultivated populations as compared with the Zhuka and the Xihe populations (Fig. 1).

Furthermore, by observing Fig. 1 from the cultivated population side, you may find that the cultivated populations of Zhubalong and Zhouba (both come from northern Mankang district) are closely related with the wild ancestor of cultivated buckwheat (Figs. 1 and 2).

Now, as a conclusion, we can say that the Yunnan part of the Sanjiang area is not involved in the origin of buckwheat cultivation, rather, Mankang district of the



Photo 4: The landscape of northern Mankang district. Although this area is believed to be the original birthplace of common buckwheat, barley is mainly cultivated in cultivation fields.

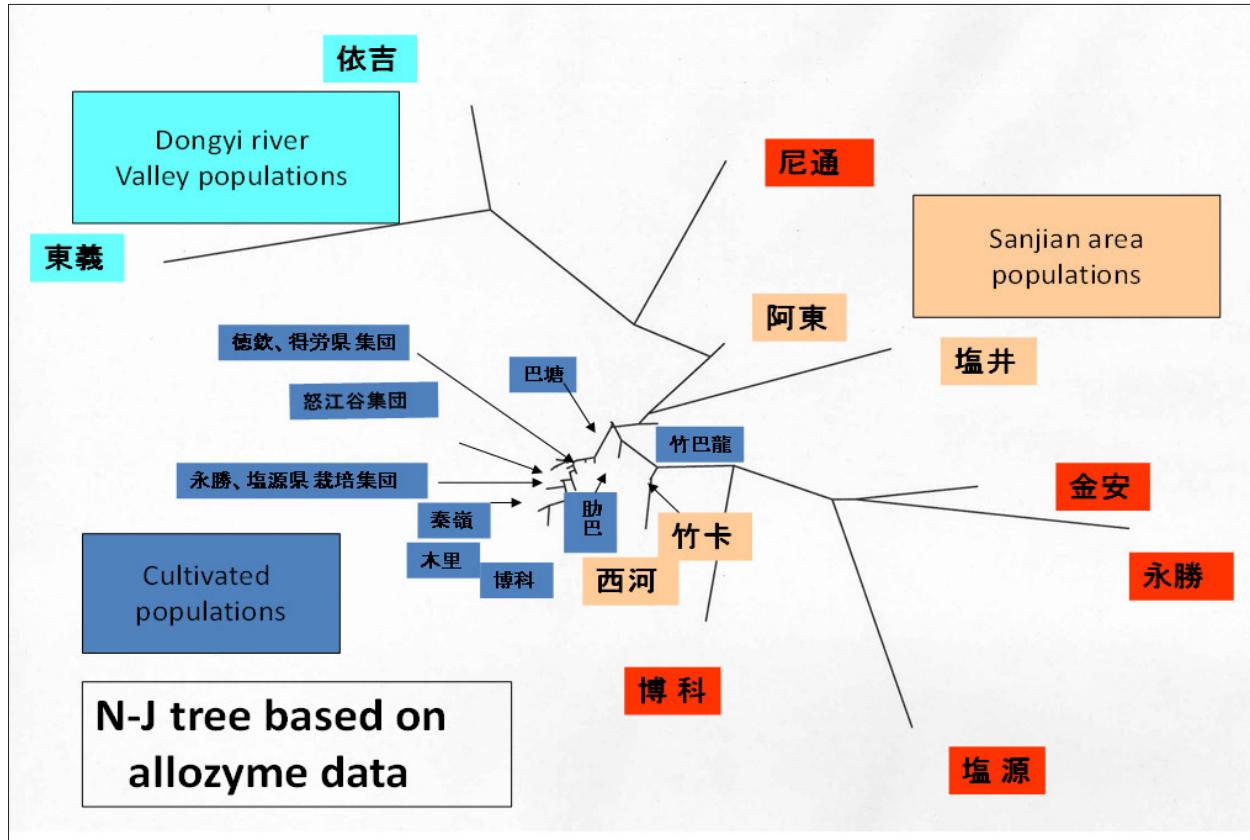


Figure 1: The N-J tree among the populations of wild ancestor and cultivated populations of buckwheat based on allozyme data. The name of locations written in Chinese letters in the figure should be expressed in pinyin as is shown in parentheses. Only the locations appeared in text are listed below.

西河(Xihe) 竹卡(Zheke) 阿東(Adong) 塩井(Yanjing) 博科(Boke) 塩源(Yanyu) 金安(Jinan) 永勝(Yongsheng)
尼通(Nidong) 東義(Tongyi) 依吉(Yiqi) 竹巴龍(Zhebalong) 巴塘(Batang) 助巴(Zhoub)

Sanjiang area, particularly, north part of Mankang district is the original birthplace of cultivated buckwheat. So, it is reasonable that WANG (1986) reported archaeological remains (buckwheat seed grains) in the archaeo-

logical site of Karuo village near Chamdu of east Tibet. This site is close to the original birthplace Mankang district of eastern Tibet (see Fig. 3)..

3. DIFFUSION OF CULTIVATED BUCKWHEAT TO INDIA AND THE HIMALAYAN HILLS

Cultivated common buckwheat migrated from its original birthplace, the Sanjiang area of southwestern China to northern China first, then to the Korean peninsula and Japanese islands (MURAI and OHNISHI, 1996). From northern China, cultivated buckwheat migrated west, to the central Asian countries, then to European countries through the Silk Road as I discussed in the previous 13th International Symposium on Buckwheat (OHNISHI, 2016).

From the original birthplace of common buckwheat, Mankang district, cultivated buckwheat first went west (MURAI and OHNISHI, 1996), overcoming high mountains, the Hengdan mountains, in the three-river region (the Sanjiang area), and entered to the Yaruzanpu river basin, then finally arrived at Bhutan, Sikkim, Nepal and India. There exists only one route connecting Mankang district in the Sanjian area and the Yaruzanpu basin in Tibet as seen in Fig. 3. After

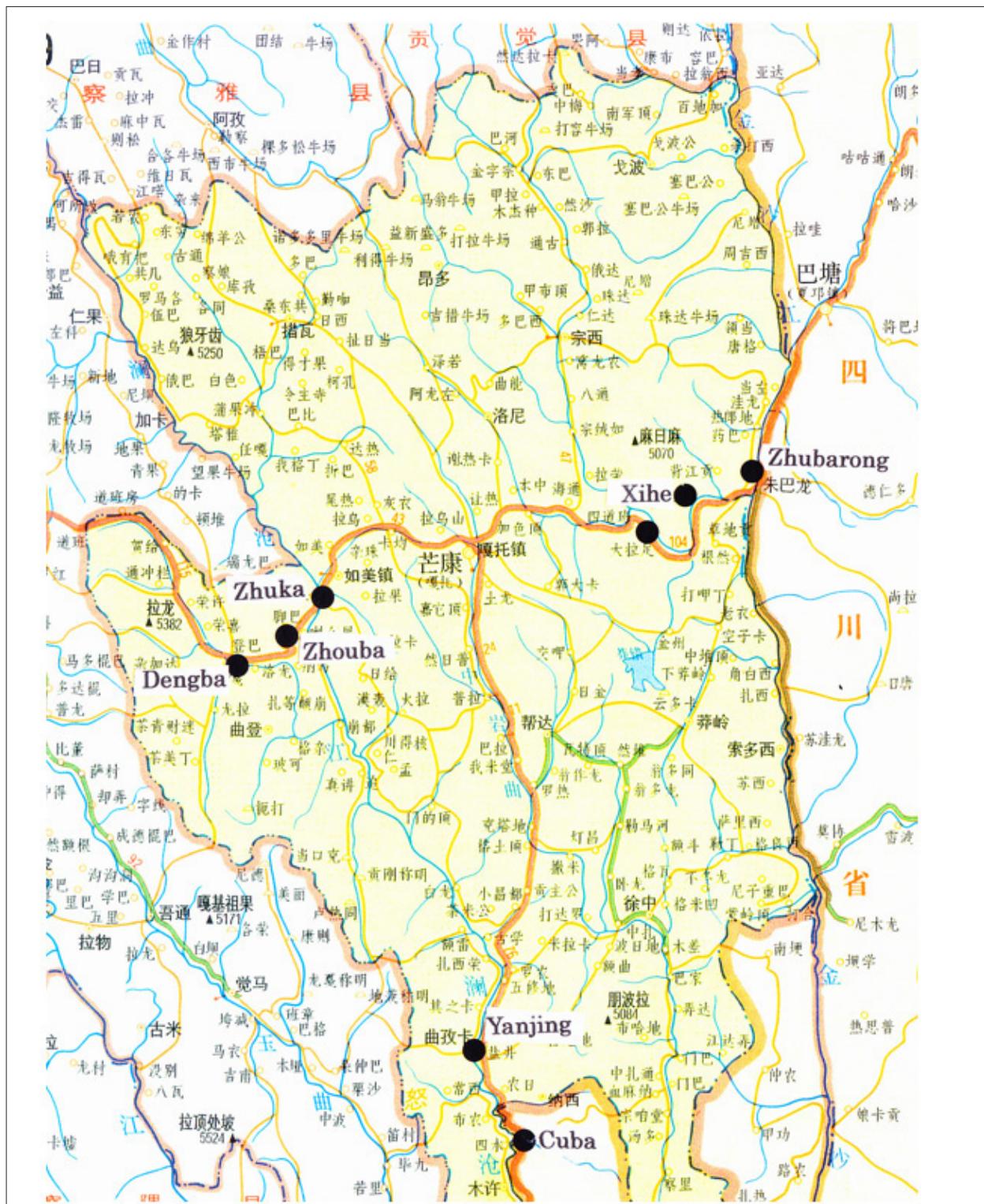


Figure 2. Distribution of the wild ancestor of cultivated common buckwheat in Mankang district of the Sanjiang area.
 ●: village or town where the wild ancestor was found. Northern population such as Zhouba, Zhuka and Xihe are close to cultivated populations (Fig. 1)

arriving these countries, it is easy for buckwheat to travel further west along the Himalayan hills, because the Himalayan hills may provide a comfortable cultivated conditions for cultivated buckwheat.

Only a few crops diffused through the same route as buckwheat. Tea plant, *Camellia sinensis*, originated in Yunnan province in China, diffused through the same route as common buckwheat, became an important cultivated plant in India and the Himalayan hills. Only the crop diffused opposite direction from the Himalayan hills to the Sanjiang area is the finger millet (*Eleusine coracana*), originated in Africa. It arrived at the Indian subcontinent, India and Pakistan. Then it diffused to southern China, through the same route as of buckwheat, but in the opposite direction (HOSHIKAWA, 1992).

As shown in Fig. 3, the Karuo archaeological site, from where the oldest buckwheat seed grains were reported, is located not so far away from the original birthplace of cultivated buckwheat. Along the diffusion route, wild perennial buckwheat, *F. cymosum* ssp. *pillus* (syn. *Fagopyrum pillus* Chen, see CHEN, 1999) and a weed species *F. gracilipes* are found, near to Dongmai village, Bomi district of Tibet, and Paro of Bhutan, respectively (Fig. 3).

It is well-known that *F. cymosum* growing in the west of the Yaruzampu grand canyon is all tetraploid, and is often called *F. dibotrys* in Nepal and India (see HARA, 1972).



Figure 3. Diffusion route of cultivated buckwheat from Mankang district in the Sanjiang area to India and the Himalayan hills.

4. CHARACTERISTICS OF BUCKWHEAT IN INDIA AND IN THE HIMALAYAN HILLS

Here, I mention several characteristics of buckwheat and buckwheat cultivation in India and the Himalayan hills.

4.1. Buckwheat cultivation as a fresh vegetable in India

Both common buckwheat and Tartary buckwheat are cultivated as a fresh vegetable in India, rather than as a grain crop. As a result of long history of cultivation as a fresh vegetable, local varieties for such purpose have become the varieties with very small grains. I observed such a small grain variety in Bageshwar town, the state of Uttar Pradesh, west India. This custom of buckwheat use as a fresh vegetable is found both in eastern India and western India.

4.2. Common buckwheat in India and in the Himalayan hills is a short day-length plant

Common buckwheat in India and in the Himalayan hills is usually cultivated in fall to early winter, from September to December. As a result of cultivation under the condition of mild temperature and of short day-length, buckwheat in India and the Himalayan hills have become short day-length plant, with characteristics of tall vigorous vegetable parts with relatively longer cultivation period as compared with buckwheat from northern China and Japan.

European common buckwheat has the characteristics of long-day to neutral day-length plant as the descendants of diffused buckwheat through the Silk Road (OHNISHI, 1993, 2016). The characteristics of buckwheat in the Himalayan hills, short-day plant, is opposite to the characteristics of European buckwheat, day-neutral to long day-length plant. This leads to the conclusion that European buckwheat does not have the origin in India nor in the Himalayan hills.

4.3. Making buckwheat noodle by hands in Ladakh of India

Buckwheat noodle was not developed well in Nepal, India, and Pakistan.

Two methods of making buckwheat noodle (OHNISHI, 2016), one using a noodle making wooden equipment, I call this as a Chinese method, one using special cooking knife to cut and make fine noodle of buckwheat dough, I call this as a Japanese method.

Neither methods diffused to Nepal and India. In Bhutan a buckwheat noodle making equipment, called Putta in Bhutan, is used, hence buckwheat noodle is served as a daily food. If peoples know neither methods, what happens for them? In a section of this symposium, Mr. INAZAWA and his group will report the method for making buckwheat noodle by hands in Ladakh of India, where peoples make buckwheat noodle by their own hands only without using any special equipments, such as putta in Bhutan or special kitchen knife as in Japan.

5. REFERENCES

CHENG, Q. F., 1999. A study of resources of *Fagopyrum* (Polygonaceae) native to China. Bot. J. Linnean Soc. 130: 53-64.

DE CANDOLLE, A., 1883. L'Origine des Plantes cultivees. Japanese translation by G. KAMO, Kaizousya, Tokyo, 1941.

HARA, H., 1972. New or noteworthy plants from Eastern Himalaya. J. Jap. Botany 47: 132-143.

HOSHIKAWA, K., 1992. Edible Crops. Yokendo, Tokyo (in Japanese).

KONISHI, T., YASUI, Y. and OHNISHI, O., 2005. Original birthplace of cultivated common buckwheat inferred from genetic relationship among cultivated populations and natural populations of wild common buckwheat revealed by AFLP analysis. Genes Genet. Syst. 80: 113-119.

KONISHI, T. and OHNISHI, O., 2007. Close genetic relationship between cultivated and natural populations of wild common buckwheat in the Sanjiang area is not due to recent gene flow between them — An analysis using micro-satellite markers. Genes Genet. Syst. 82: 53-64.

MURAI, M. and OHNISHI, O., 1996. Population genetics of cultivated common buckwheat, *Fagopyrum esculentum* Moench. X. Diffusion routes revealed by RAPD markers. Genes Genet. Syst. 71: 211-218.

OHNISHI, O., 1991. Discovery of the wild ancestor of common buckwheat. Fagopyrum 11: 5-10.

OHNISHI, O., 1993. Population genetics of cultivated common buckwheat, *Fagopyrum esculentum* Moench. VIII. Local differentiation of landraces in Europe and the Silk Road. *Jps. J. Genet.* 68: 303-316.

OHNISHI, O., 1998. Search for the wild ancestor of buckwheat. III. The wild ancestor of cultivated common buckwheat and of Tatarian buckwheat. *Economic Botany* 52: 123-133.

OHNISHI, O., 2004. On the origin of cultivated buckwheat. *Proc. 9th Intl. Symp. Buckwheat in Prague*, 16-21.

OHNISHI, O., 2007. Natural populations of the wild ancestor of cultivated common buckwheat, *Fagopyrum esculentum* ssp. *ancestrale* from the Tongyi river valley — Their distribution and allozyme variations. *Proc. 10th Intl. Symp. Buckwheat in Yangling*, 13-18.

OHNISHI, O., 2010. Detailed geographical distribution of the wild ancestor of common buckwheat, *Fagopyrum esculentum* ssp. *ancestrale* Ohnishi. *Proc. 11th Intl. Symp. Buckwheat in Orel*, 30-36.

OHNISHI, O., 2016. On the diffusion of buckwheat cultivation and the diffusion of consumption of buckwheat noodles. *Proc. 13th Intl. Symp. Buckwheat at Cheongju*. 77-82.

OHNISHI, O., 2018. Search for the wild ancestor of cultivated common buckwheat — Cultivated buckwheat was originated in the Sanjiang region (three river region) of southwestern China. *Himalayan Study Monograph* 19: 106-114. (in Japanese with English summary)

OHNISHI, O. and NISHIMOTO, T., 1988. Population genetics of cultivated common buckwheat, *Fagopyrum esculentum* Moench. V. Further studies on allozyme variability in the Indian and Nepali Himalaya. *Jpn. J. Genet.* 63: 51-66.

OHNISHI, O. and TOMIYOSHI, M., 2005. Distribution of cultivated and wild buckwheat species in the Nu river valley of southwestern China. *Fagopyrum* 22: 1-5.

SAITOU, N. and NEI, M., 1987. The neighbor-joining method: a new method for reconstructing phylogenetic trees. *Mol. Biol. Evol.* 4: 405-425.

SWOFFORD, D. L., 1999. PAUP*: Phylogenetic analysis using parsimony (* and other methods). Version 4.0b4a. Sinauer, Sunderland, Mass. USA.

SWOFFORD, D.L., 2002. PAUP*. Phylogenetic analysis using parsimony (* and other methods). Version 4.0. Sinauer, Sunderland, Mass. USA.

WANG, T. 1986. Genetic resources in Tibet. *Variety Resources of Crops* 1986(2): 23-25. (in Chinese)