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# The beginnings of rice and millet agriculture in prehistoric Japan

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## ABSTRACT

This paper reviews recent archaeobotanical evidence of the beginnings of rice and millet agriculture in prehistoric Japan, focusing on agricultural weed assemblages from early rice cultivation sites. In this study we show that the most reliable dispersal timing of rice and millet cultivation was the end of the Final Jomon period, corresponding to the Initial and Early Yayoi period of northern Kyushu. Rice and millet were introduced from China via Korea probably at the same time, as a pair. Early rice cultivation was likely practiced, not in slash-and-burn fields but in primitive paddy fields, which did not possess clearly defined paddy ridges or compartments, and were constructed in human-managed open wetlands near forests. Millets were probably cultivated on upland farmlands close to rice paddy fields. The use of berries and nuts which was the subsistence base of Jomon period continued during this time, and rice and millet agriculture gradually spread up until the Middle to Late Yayoi period.

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## 1. Introduction

The spread of agriculture from its center of origin to marginal areas is one of the key issues in understanding the cause of cultural diffusion and subsistence changes in various human societies. In East Asia, the cultivation of rice and millet was assumed to have begun in China in the early Holocene (ca.8000–5000 BC) (Fuller, 2007; Cohen, 2011; Zhao, 2011) and subsequently propagated out of China into the Korean Peninsula ca. 3000–1000 BC (Lee, 2011). The timing and the process of the introduction of the earliest rice and millet cultivation in prehistoric Japan have to date been a controversial subject.

Jomon culture (ca.14000–1000 BC) in prehistoric Japan is believed to have been a hunting–gathering–fishing society; however, recent archaeobotanical studies revealed that the Jomon people were not merely hunter–gatherers. They probably managed or cultivated chestnut (*Castanea crenata*) (Kuri), lacquer tree (*Toxicodendron vernicifluum*) (Urushi), hemp (*Cannabis sativa*) (Asa), and even soybean (*Glycine max*) (Daizu) and azuki bean (*Vigna angularis*) (Azuki) (Kitagawa and Yasuda, 2008; Crawford, 2011; Noshiro and Sasaki, 2014; Nasu et al., 2015). However, this pattern of Jomon subsistence eventually underwent a

transformation into an agricultural society by the introduction of irrigated paddy rice (*Oryza sativa*) (Ine) agriculture from the continent in the Yayoi period (1000 BC–300 AD). Why did this change happen? To answer this question, we need to first find a clear answer as to when and how rice and millet agriculture was introduced into the Jomon culture and how was it adopted in relation to social and environmental change.

The transition from the Jomon to the Yayoi period in prehistoric Japan was characterized by the introduction of irrigated paddy rice agriculture. However, there are reports of the existence of carbonized/waterlogged rice remains, rice impressions on pottery, and rice phytoliths in the Jomon period, before the emergence of clearly defined paddy fields. On the basis of these “Jomon rice” reports, researchers have argued that the Jomon people were farmers who cultivated rice (Sato, 2002). Concomitant occurrences of carbonized seeds and/or impressions of foxtail millet (*Setaria italica*) (Awa) and common millet (*Panicum miliaceum*) (Kibi) have led some researchers to suggest that the Jomon people grew rice and millet through an early slash-and-burn or shifting agriculture, similar to practices shown in modern ethnological examples (Sasaki, 2003, 2011). However, to the best of our knowledge, no archeological evidence of a slash-and-burn agriculture in this period (Noto, 2002) because of the difficulty in detecting the remains of the fields in and around archaeological sites.

One method of investigating the cultivation form of rice and millet during the Jomon period is to focus on the weeds. Weeds are

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defined as a plant population that interfere with human activities and that grow well in the human environment, having partially the nature of both cultivated plants and wild plants (Yamaguchi, 1997). Since the species composition of weeds differs depending on the degree of interference with human activities, they can be used to estimate the degree of human interference when the site was in use. Using this method, Kasahara (1976a, 1982) pointed out that there was an increase in paddy weeds between the Yayoi and Jomon periods. Thus, by looking at the species composition of weeds associated with crops, it is possible to indirectly estimate the location and form of the cultivation environment at that time (Willcox, 2012).

In this paper, we examine the manner in which rice and millet were cultivated, by focusing on the composition of the weeds and wild grasses that accompany these two crops. First, we will review recent archaeobotanical records of rice and millet in Japan during the transition from the Jomon to Yayoi period. Second, we describe our impression of an initial form of rice cultivation using human-managed open wetlands before the development of clearly distinct paddy fields, based on the example of Kitashirakawa-oiwakecho site in Kyoto Prefecture, Japan, dated to the end of the Final Jomon period (corresponding to the Early Yayoi period of northern Kyushu; ca. 1000 BC). This paper expands upon Nasu's (2014) paper, written in Japanese, with additional data and ideas.

### 1.1. Rice and millet in the Jomon period

When do rice and millet begin to appear in the archaeological record in Japan? The recent progress of archaeobotanical studies in

Japan represented by the newly advanced replication method of seed impressions on pottery fragments, phytolith analysis, and direct dating of carbonized crop grains, has made it necessary to re-examine previous records of Jomon period rice and millet remains (Nakazawa, 2009; Nakayama, 2010; Obata, 2011). Here, we will present the latest reports on the identification of rice and millet, as well as researchers' opinions, and problems in the evaluation of these reports (Fig. 1, Table 1).

### 1.2. Beginnings of rice cultivation in Japan

Nakayama's (2010) report on rice remains from Jomon and Yayoi sites, which included data on impressions, carbonized grains, phytolith, and pollen, is currently the most methodical-body of data on the subject. According to this report, the oldest examples of rice remains are phytoliths which were found at Kagoshima University Campus site of the Middle Jomon period. Yet, because phytoliths are small silica particles found in the soil, we cannot completely rule out the possibility of contamination from upper layers into the lower layers, which can occur through the disturbance effect of the root systems of plants and organisms in the soil. Thus, some researchers accept this phytolith record as evidence of rice cultivation, whereas others do not. Nakayama (2010) evaluated the data as follows: "Reliability of the data is high because quantitative analysis shows the phytolith fluctuation in each layer, but there is no other evidence to support the results of this analysis, such as traces of cultivated fields and paddies, or carbonized rice grains" (p. 209). If rice was cultivated in the Middle Jomon period,

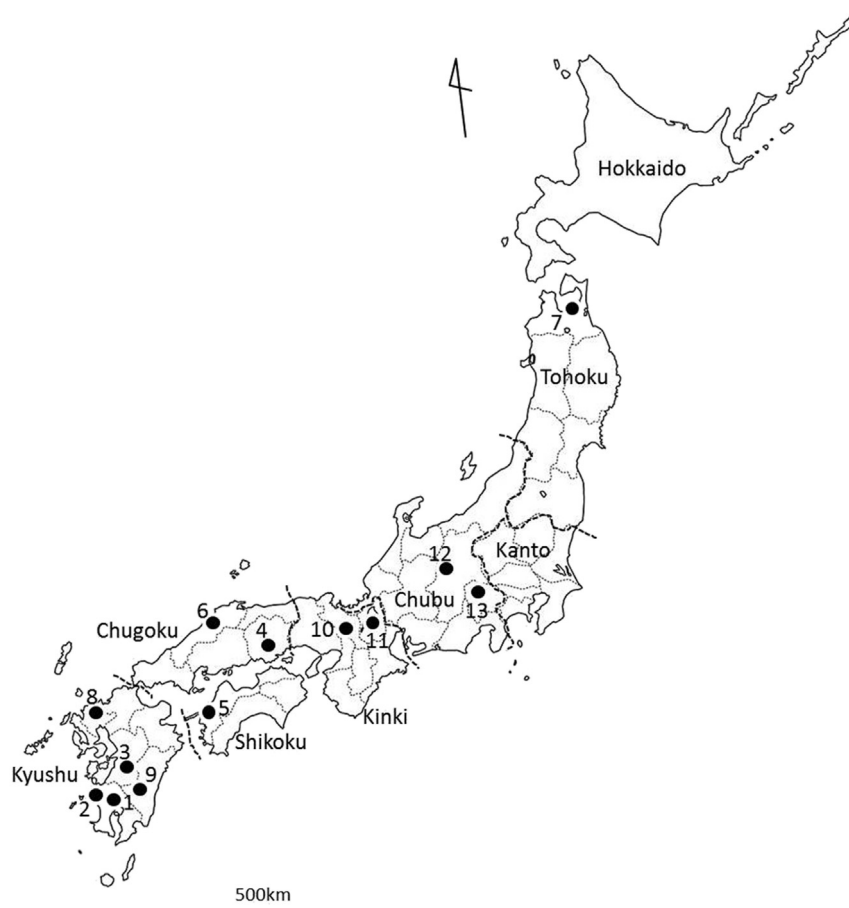


Fig. 1. Map showing Jomon and Yayoi sites mentioned in the text. 1: Kagoshima University Campus, 2: Suitenmukai, 3: Ishinmoto, 4: Minami-mizote, 5: Bunkyo, 6: Itaya III, 7: Kazahari, 8: Nabatake, 9: Sakamoto A, 10: Kitashirakawa-Oiwakecho, 11: Ryugasaki A, 12: Yazaki, 13: Yashikidaira.

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