Correlation of Foxtail and Broomcorn Millet Remains in House 1 at the Kashiwagigawa 11 Site, Hokkaido

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Introduction

The interpretation of carbonized plant remains from burned houses provides unique opportunities to examine issues such as seasonality and scheduling, stages of crop processing, and processes that create the archaeological record. In the latter case, comparison of soil contents exposed to a single conflagration, and similar contexts affected by no conflagration, provides some idea of the representativeness of certain kinds of plant remains. For example, at the late prehistoric Little Egypt site in Alabama, a broader range of plant remains was recovered from two structures that burned than were recovered from a house that did not burn (Hally 1981: 739). The season of burning and whether a structure burned, in general, had a significant impact on the variability of flotation sample contents at Little Egypt (Hally 1981: 723). In another study, “the snap-shot” effect of a house fire aided the association of plant remains with stages of crop processing (Dennell 1972).

The discovery of an eighth century AD house at the Kashiwagigawa 11 site in Eniwa city, Hokkaido, Japan (Figure 1) that had been destroyed in a conflagration provides an opportunity to examine these issues in a northeastern Japanese context. In this chapter, I examine specific aspects of the plant remains from House 1 at Kashiwagigawa 11. These interpretations are preliminary and will be explored more fully elsewhere. Although only two taxa, broomcorn millet (Panicum miliaceum) and foxtail millet (Setaria italica ssp. italica), are in any significant abundance, examination of the origins of the resulting grain distribution pattern indicates that stored grain was in the house when it burned. In addition, I speculate on the mechanisms that created the assemblage of burned grain found in the floor fill. For the time being, little can be inferred about seasonality or other stages of crop processing at the site.
Figure 1. Map Showing the Location of the Kashiwagigawa 11 Site.

Kashiwagigawa 11

The Kashiwagigawa 11 site is situated on the banks of the Kashiwagi River (Kashiwagigawa) in the city of Eniwa (Figure 1). The site was salvaged as a component of a road construction project in 1990 (Eniwa-shi Kyoiku linkai). Kashiwagigawa 11 has at least two components: Middle Jomon and Ezo-Haji (early Satsumon). An accelerator radiocarbon date of 1250 ± 80 BP (uncalibrated) or AD 669–883 (calibrated) (TO 2000) taken from a single broomcorn millet grain concurs with the chronological assessment of the Ezo-Haji occupation based on ceramic seriation. Flotation samples were taken from Houses 1, 2, and 5. Members of an international team assisted in the excavation of these structures. The research is part of a

Houses 1 and 2 are Ezo-Haji period structures while House 5 is a Middle Jomon pit-house. The discussion in this chapter is based on samples from House 1

**Figure 2.** The Kashiwagigawa 11 Site: House 1 Subgrid (0.5 m squares).
only. A 67 unit subgrid divided the floor into 0.5 m squares (Figure 2). The floor fill appeared to have two stratigraphic divisions. The shallower level of floor fill (level 10) was reddish and, therefore, highly oxidized, while the lower level (12) was brown and less oxidized. The colour difference between levels 10 and 12 is likely due to a temperature gradient established between the two soil layers when the houses burned. The charred superstructure of the house was intermingled with levels 10 and 12. As much soil as possible was collected from the two levels of each subgrid unit. Preservation of organic material under these circumstances was expected to be good so the remains presented an excellent opportunity to assess the nature of the potential time capsule created by the fire.

The artifact density in the house is quite low. Few items were recovered. Portions of two bowls and two pots as well as a few stone tools comprise the total collection (Eniwa-shi Kyoiku Linkai 1991). The stone tools are typologically Jomon and likely represent artifacts that were mixed in the fill that eventually lay over the house floor. The pottery was almost entirely confined to the northeastern quadrant of the floor.

To date, 45 flotation samples from level 10 and 58 samples from level 12 have been analyzed. These samples represent most of the House 1 excavation units. Nearly 8100 seeds have been recovered from these samples. The density of plant remains is quite high, ranging to as high as 600 grains per species per subgrid.

Methods

A SMAP flotation process (Watson 1976) modified to my own specifications in 1986 was used to process soil. Two machines were used, one with a large tank manufactured in Canada and a compact machine with a transparent tank made in Hokkaido. A mesh size of 0.4 mm was used to collect light fractions. Heavy fractions were collected in a 1.4 mm screen. Flotation and sample analysis are described in Crawford (1983).

Plant Remains

The plant remains recovered from Kashiwagigawa 11 are mainly wood charcoal (about 245 grams per litre of soil) and millet (about 19 grains per litre of soil). A small number of millet seeds are not further identifiable (442). The other remains include a few fragments of acorn (Quercus sp.); weedy grains: chenopod
(Chenopodium sp.), barnyard grass (Echinochloa crusgalli), foxtail grass (Setaria sp.), Paniceae, and knotweed (Polygonum sp.); and fleshy fruit seeds: Actinidia sp. and Amur corktree (Phelodendron amurense). One other cultigen was recovered from the floor of House 1: hemp (Cannabis sativa). A possible domestic bean (Vigna sp.) has also been recovered. A number of unidentifiable and unknown specimens are also among the remains. Seeds other than millet represent only 8.6 percent of the Kashiwagigawa 11 assemblage.

**Distributions**

Carbonized plant remains recovered from burned house contexts are created by at least two processes: the fire itself and processes such as accidents during cooking and parching for storage that occurred before the conflagration. I assume that most of the carbonized remains in House 1 are a result of the conflagration for the following reasons. First, carbonized remains on Ezo-Haji house floors are usually rare. Second, the remains are densely distributed in both layers 10 and 12, the soil matrix among the burned structural supports. Level 12 also includes soil on the house floor but the similar high densities of seeds in levels 10 and 12 indicate that these contexts are unique to this burned house and the floor was likely as clean as other Ezo-Haji floors we have excavated that are not from burned structures.

In general, the highest densities of seeds are found in the north half of the house near the oven, in the center of the floor, and at the west side of the floor opposite the oven (Eniwa-shi Kyoiku linkai 1991). There is a general low density scatter of seeds over the rest of the house floor. The average densities are higher in level 12 (51 seeds per litre) than in level 10 (24 seeds per litre).

Broomcorn millet and foxtail millet associations are examined to determine whether the two grains are associated in some non-random way. Data were analyzed using JMP, the SAS Institute Inc. Apple Macintosh statistical software. The Pearson correlation coefficient (Pearson r) calculated for the densities of the two species by subgrid indicates a strong non-random correlation in both levels 10 and 12. In fact, grouping by level strongly indicates that the two millet taxa correlate in a similar manner in each level. In level 10 (n=43), r=0.9382 while in level 12 (n=40), r=0.971. The probability of obtaining this linear relationship by chance is nil. Two outliers are not included in this calculation: subgrids 31 and 55 in level 12. A linear regression analysis further quantifies this relationship between the
Figure 3. Scattergrams of Millet Densities.
distribution of the two millet types in each level (Figure 3). Similar regression lines are obtained for levels 10 and 12. Rsquare values for levels 10 and 12 respectively are 0.88 and 0.94. A value of 1 would mean that the linear fit is perfect. In each case the Rsquare value is close to 1. In addition, significance probabilities (Prob > F) for both regressions are 0. Regression effects are often considered to exist when this probability is less than 0.05. These statistics strongly support the contention that broomcorn millet and foxtail millet are non-randomly associated in the house.

In the foregoing analysis, the variation between levels 10 and 12 appears to be non-random as well (Figure 3). In order to test for randomness between the plant remains in levels 10 and 12, the Pearson r value for the total millet densities in the two levels by grid unit was calculated. For this analysis there were four outliers: subgrids 3, 28, 31, and 55. The total grain densities by subgrid in levels 10 and 12 (n=37) have a Pearson r value of 0.55 with a 0.04 probability that the correlation is due to chance. Furthermore, the Pearson r value calculated for broomcorn millet is 0.64 and for foxtail millet is 0.60. In this latter correlation there is a nil probability that the correlation is due to chance. Also, because a linear relationship appears to exist between the grain densities in each level, a linear regression analysis was conducted to check for the extent of linear relationship that may exist between the data from levels 10 and 12 (Figure 3). The Rsquare values are not as high as they are for within level comparisons (0.40 for broomcorn millet, 0.36 for foxtail millet, and 0.30 for both grains combined). In each case the Prob > F is the same as those noted above for the Pearson r calculations.

Discussion

The quantitative similarity between levels 10 and 12 on the one hand, and between foxtail millet and broomcorn millet within levels by subgrid on the other hand, are remarkable. The similarity between levels 10 and 12 strongly indicates that the stratigraphic distinction made in the field has no functional basis. That is, plant remains in the two levels are from the same source. For the most part, levels 10 and 12 were contiguous, separated at times only by burned timbers that were given the field designation, 'level 11'. The weaker correlations and linear relationship between density values in the level 10 and 12 comparison may be related to the lower densities in level 10 and whatever factors caused the vertical mixing
through the layers. It is generally assumed that Ezo-Haji pit house roofs were covered in earth. When House 1 burned, this earth would have fallen to the house floor. This is likely the source of the levels 10 and 12 fill. The carbonized grain likely came from the floor and became mixed with the soil when the earth fell to the floor. Subsequent processes such as freezing and thawing, worm disturbance, and perhaps rainfall would further affect the vertical distribution of the plant remains. This analysis provides evidence that some grain was moved vertically at most about ten centimeters during and after the fire.

The strong correlation of the densities of the two millets over the floor of House 1 at the resolution of 0.5 meter squares in each level is not so easily explained. The two grains may have been stored together in quantity at least in one location in House 1. One, and at most three, high grain density locations can be discerned in the level 10 and 12 samples (Eniwashi Kyoikuinkai 1991). The collapsing superstructure of the house would likely have produced sufficient force by its own weight, and by forcing air out of the house, to distribute the grains outward from their storage location(s). The process affecting the grain distribution did not act independently on the two species. I suspect that the distribution patterns are not a result of Ezo-Haji sieving or other grain processing activities in the house, although there is no a priori reason to reject this notion. The grain is almost uniformly without husks (palea and lemma), although a few retain these structures. The grain appears to have been prepared for storage and eating. The correlation of the types of grain over the house floor indicates that the two grains were stored in mixed form, or at least quite close together.

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