A Green Foxtail (Setaria viridis) *Cultivation Experiment in the Middle Yellow River Valley and Some Related Issues*

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CURRENT ARCHAEOLOGICAL AND ARCHAEOBOTANICAL discoveries indicate that foxtail millet *(Setaria sativa)* was domesticated from its wild progenitor—green foxtail *(Setaria viridis)*—in the loess area of the Yellow River Valley by at least 8000 years ago. Recent genetic studies also seem to support this hypothesis (e.g., Benabdelmouna et al. 2001; d'Ennequin et al. 2000; Nakayama et al. 1999), although some geneticists argue that there might have been more than one center of indigenous domestication (Schontz and Rether 1999). Millet farming had expanded to a vast area from the middle to the lower Yellow River Valley by 7000 years B.P. (Lu 1999). Many archaeological assemblages with foxtail millet remains have been found in the Yellow and the Yangzi River valleys and Tibet, with the Yellow River Valley being the core area (Table 1). Based on the cultivation of foxtail and broomcorn millets, Chinese civilization emerged at approximately 5000 B.P.

However, many questions remain with respect to the origin of millet farming in the Yellow River Valley. The progress and remaining problems on this issue, as well as scholars who have been working on the topic, have been summarized elsewhere (Lu 1999, 2001). Briefly, the questions of where, when, how, by whom, and why foxtail millet was domesticated by 8000 years ago still remain. The domestication process is not clear, nor is it known what tools and cultivation methods were used in the initial domestication of this plant.

To date, research on the origin of millet farming in the Yellow River Valley is primarily based upon archaeological and archaeobotanical data, which, unfortunately, are very limited for the period prior to 8000 years ago. Therefore, the initial phase of millet farming in the Yellow River Valley has not been archaeologically recognized. Apart from an observation of the botanical characteristics of green foxtail *(Setaria viridis)* and a harvesting experiment on this grass in 1996 (Lu 1998), no other observations or experiments had been carried out on this topic in mainland China prior to this experiment in 1999.

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TABLE 1. ARCHAEOLOGICAL SITES WITH FOXTAIL MILLET REMAINS IN NEOLITHIC MAINLAND CHINA

RANGE OF DATES (B.P.)	CLIMATE	YELLOW RIVER VALLEY	YANGZI RIVER VALLEY	SOUTH CHINA	TIBET
9000–7000	Warm and wet	7			
7000–5000	Warm up to 6000 B.P. then start to cool down	15	2		
5000–3500	Cool	14			2

Sources: Chen 1993, 2000; Fu 2001.

Cultivation experiments have been used by scholars in North America and Europe since the 1980s to investigate the origin of wheat and barley farming in the Middle East, providing informative data for questions such as cultivation techniques and processes, domestication rate of wild grasses, and use-wear patterns on tools (e.g., Anderson 1992). Because none of these questions had been investigated in the Yellow River Valley, a cultivation experiment was designed in 1999 to obtain empirical data. The objectives of the experiment were threefold. The first objective was to investigate the techniques and the initial process of domesticating green foxtail by cultivation. It was hoped that by conducting cultivation experiments, changes to green foxtail under human manipulation would be observed. As such, the experiment focused only on green foxtail and excluded the domesticated foxtail millet. The second objective was to examine which tools were likely to have been used in the initial stage, and to obtain reference data points for further study on local Neolithic tools. The last objective was to obtain data for the yield rate of green foxtail and the possible impact of human selection on this grass.

The experiment was designed to be carried out in the loess area, where the initial domestication of green foxtail took place in prehistory, and where soil, climate, and environment are similar to that of 8000 years ago. The experiment will be long term, but the preliminary results have already provided some interesting information.

THE CULTIVATION EXPERIMENT

The cultivation experiment of 1999 was conducted in a small village of Jiyuan County, Henan Province, in the middle Yellow River Valley. The village is located at the edge of a loess plateau, with a landscape of loess ridges. The yearly average temperature is 12 °C, and the average annual precipitation is 700 mm. Generally speaking, the climate is dry and temperate.

The 1999 experimental cultivation field was a deserted and isolated section of a terrace along a small stream. Measuring about 50 m^2 in size, the field was located approximately 30 m above the stream and faces southeast, exposed to plenty of sunshine. A closely guarded apple orchard bordered the northern edge of this field and cliffs bordered the other three edges. This setting prevented intrusion by animals or human beings. There were no modern cultivated cereals near the field, so pollen contamination by domesticated cereals was not likely.

Some dry-resistant grasses dominated the land before the commencement of this experiment.

According to Hillman and Davies (1992), it is necessary to shift the cultivation field each year in order to maintain species mutation (Hillman and Davies 1992). Chinese agronomic documents also state that shifting fields is a must for cultivating foxtail millet (Agronomic Institute of Shanxi Province 1987; Jia 1977). Therefore, the cultivation field for the experiment of 2000 was carried out in another village in the loess area.

The field in 2000 was located on a plain, and was much smaller, only measuring about 30 m^2. It was within a courtyard and was enclosed by walls, preventing animal and human intrusions. The whole field had been used for vegetable growing and since there were no cultivated cereals near the field, the possibility of pollen contamination was very low.

Land Clearing and Sowing

The experiment commenced in the spring of 1999. Seeds of green foxtail were gathered in the autumn of 1998 near Beijing, air-dried, and packed for sowing. According to ethnographic data in China, burning is the simplest way to clear a field, and broadcasting is the most primitive method of sowing (Agronomic Institute of Shanxi Province 1987), so these techniques were used. The land was first cleared by fire, taking only about 15 minutes until the grasses became ashes. Panicles of green foxtails were first counted, and then broadcast (seeds of green foxtail are very tiny, and difficult to count, so panicles are used as counting units). A total of 1377 panicles were sown. The land was not tilled before sowing, and the seeds were not buried afterwards. The green foxtail was then left unattended. Neither irrigation nor any other forms of cultivation were undertaken. According to the local climatologic bureau, the weather was very hot and dry in 1999, with precipitation during the summer (June, July, and August) totaling only about 200 mm, which was about 40 percent of the average precipitation in these three months. Nevertheless, the green foxtail grew very well. When the field was visited after 136 days, stands of green foxtail densely covered an area of more than 40 m^2 (Fig. 1).

Land clearing was not required in 2000, as vegetable growers had cleared the field prior to the experiment. A total of 400 panicles harvested in 1999 were broadcast on 5 April 2000, then left unattended for another 130 days. Again, neither tilling nor irrigation was conducted in 2000. However, the green foxtail did not grow as well as it had in 1999. Possible causes for this will be discussed in the following section.

Harvesting

Harvesting green foxtail was first conducted in the lower Yellow River Valley in 1996, and the results have been published (Lu 1998). While the harvesting experiment on wild stands of green foxtail in 1996 provided data on gathering returns, a similar experiment on cultivated green foxtail in 1999 and 2000 provided information regarding initial farming.

The first objective of the experiment in 1999 was to test the harvesting efficiency of two different types of tools. The second was to compare the efficiency

Fig. 1. Cultivated green foxtail *(Setaria viridis)* in 1999. (Photograph by Fu Xianguo)

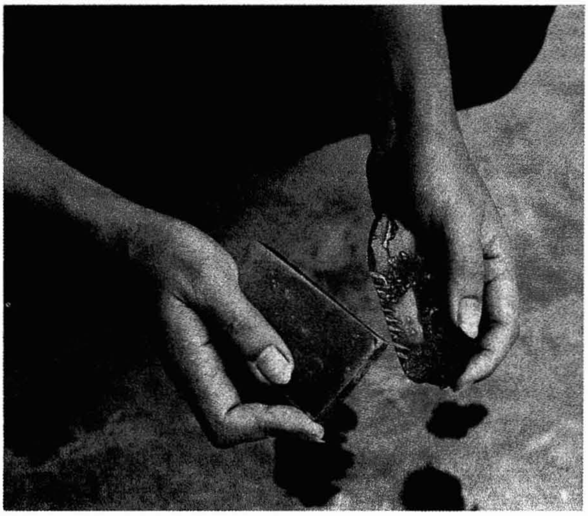

Fig. 2. Making a stone sickle. (Photograph by Fu Xianguo)

of different harvesting methods. The last was to examine the return of cultivating green foxtail. Thus, two types of stone harvesting tools were prepared: an edge-polished sickle and three flakes. These tools were made by striking flakes from large limestone slabs, then polishing them on fine-grade sandstone, using water as a smoothing agent. The denticulate edge of the sickle was made by holding a small piece of sandstone and sawing and abrading the edge from an angle of about 30 degrees (Fig. 2). Two men and one woman worked for a total of 1 hour and 35 minutes to make these tools. The output was one axe, three flaked knives, and one sickle, all edge-polished. The tools were designed to be replicas of Neolithic tools commonly found in the Yellow River Valley.

Fig. 3. Harvesting by cutting the whole plant. (Photograph by Fu Xianguo)

Fig. 4. Harvesting by reaping off the panicles. (Photograph by Fu Xianguo)

Two types of harvesting methods were tried: one was to cut the plant from about 3 to 5 cm above the ground; the other was to reap the panicles only (Figs. 3 and 4). Both the sickle and a flaked knife were used to cut the stem near the ground. The polished sickle proved to be more efficient. It took only 4 minutes for a man using this sickle to harvest an area of 2 m^2, but it took 12 minutes for the same area when the same harvester used a flaked knife. The efficiency of the sickle was thus three times greater than the flaked knife. When the sickle was used, the denticulate edge can hold and cut into the stem of the plant in one motion, after which only a slight effort was needed to sever the plant. But when the edge-polished flaked knife was used, a much greater effort had to be made—first to press the knife edge into the stem, then to cut the plant—because there was no denticulate edge to hold the stem.

However, when harvesting panicles only, the difference in efficiency between a flaked knife and a sickle was insignificant. The average harvesting efficiency was 24 panicles per minute with an edge-polished knife used by a woman harvester and 26 panicles per minute for the sickle.

The method of reaping panicles was designed to imitate the gathering of green foxtail, which may or may not be part of cultivation activity. It has been argued that cutting the plant near the ground or pulling the whole plant would be necessary harvesting methods for domesticating cereals, but reaping panicles could have been done for both gathering wild plants or harvesting domesticated cereals (e.g., Anderson 1992). Based on results from harvesting experiments and use-wear analysis, it has been proposed that the domestication process in the Middle East began by cutting whole plants near the ground (Anderson 1992). However, to date, no use-wear analysis has been conducted for the early Neolithic harvesting tools found in the Yellow River Valley. By trying these two methods (reaping and cutting), we have tested the harvesting efficiency of the tools, and have obtained use-wear data that can be used for future study on Neolithic tools found in the Yellow River Valley.

After the plants were harvested, the next step was threshing and husking. According to an ethnoarchaeological survey conducted in 1999 in the village where the cultivation experiment was carried out, domesticated foxtail millet *(Setaria sativa)* was harvested by first cutting down the whole plant, then cutting off the panicles. An iron sickle was used for both steps. Then the panicles were scattered on a prepared ground surface and threshed by using stone rollers. Husking is usually done with pestles and mortars or millstones. Such implements are still in use today (Fig. 5).

For those plants harvested by cutting the whole stem, the next step was to cut off the panicles (Fig. 6). This step was quite time-consuming: the average rate of cutting panicles was 19–21 panicles per minute. Thus, at least 17.5 hours would have been needed to cut off 21,000 panicles (based upon calculations discussed below). On the other hand, if reaping panicles was used as the harvesting method, then the panicles could be directly taken into the threshing and husking steps. It seems that the reaping method was more efficient than the cutting method. So why did the farmers use the latter? This question will be discussed later.

Calculation of the yield in 1999 was based upon two standard blocks within the field, each measuring 2 m^2. The green foxtail harvested from each block was counted; the average was 1053 panicles from each block. Thus, in the field measuring 40 m^2, the total yield should be approximately 21,000 panicles. Because 1377 panicles were sown in the spring, the yield ratio is about 15.25 to 1. Panicles from one block (randomly selected) were kept for the following year as seeds. This seed grain represented about 5 percent of the yearly output.

Nevertheless, it was realized that many of the panicles harvested in 1999 were not ripe since the harvesting conducted in 1999 was not selective. Green fox-

Fig. 5. A pestle and mortar. (Photograph by Fu Xianguo)

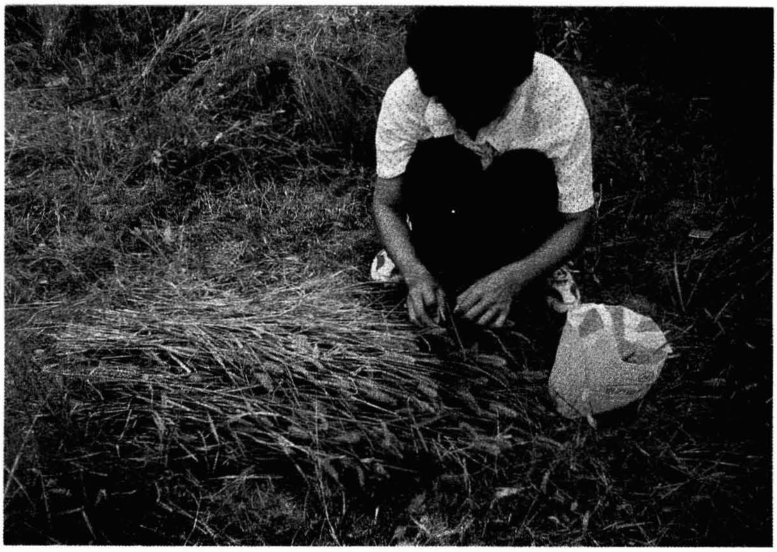

Fig. 6. Cutting off the panicles in the field. (Photograph by Fu Xianguo)

tail, like many other wild grasses, has a long and highly heterochronous growth cycle, which has been lost in domesticated foxtail millet (Lu 1998). It has been hypothesized that human selection might have been a major mechanism for the loss of heterochronicity (Lu 1998). Thus the harvesting in 2000 was designed to exercise human selection by cutting only ripe panicles on the day of harvesting.

The 2000 harvesting experiment was conducted on 10 August. Small stone flakes were used as harvesting tools. A woman harvester selected and reaped ripe panicles only. This combined process of selection and harvesting took only 32 minutes for a field of about 30 m^2. On the day of harvesting, only 211 panicles were ripe and harvested, which accounted for approximately 7.5 percent of the total panicles produced that year. The rest were still in the process of flowering and ripening. However, the green foxtail did not grow very well in 2000. The plants were shorter and were not densely packed. The yield ratio in 2000 was very low, the average panicles per 2-m^2 block was 184, and it was estimated that only approximately 2800 panicles were produced. This is only about seven times that sown in the spring. One possible reason for this bad year could be the extremely dry weather in the Yellow River Valley in 2000. The climatic record from April to August 2000 indicates the total precipitation was only 243 mm and totaled only 42 mm in April. Because April is the time for germination, the low spring rainfall might have had a strongly negative effect on the germination and growth of the grass. A small germination test conducted in April 2000 revealed that of 200 grains of green foxtail sown, none germinated. Another possible reason for the low yield could be the lack of fertilizer, as no land clearing was carried out in 2000, there was no plant ash to act as fertilizer for the grass. A controlled experiment will be carried out in the future to provide more data on issues of water and fertilizer, both of which are crucial for cultivation.

DISCUSSION

Scholars have carried out cultivation experiments on wild wheat and barley (Anderson 1992; Hillman and Davies 1992), and wild rice (Oka and Morishima 1971), although the latter was for a purpose other than investigating the origins of farming. It has been proposed that at least five years of cultivation are required to establish the mutation that resulted from human selection (Oka and Morishima 1971). As we have carried out our cultivation experiment on green foxtail for only two years, we did not expect such biological mutation to be visible. However, the cultivation experiment does provide some interesting and important data for several issues on the origin of millet farming in the Yellow River Valley.

Conditions and Techniques Required for Domesticating Green Foxtail

Based upon observations conducted in 1996, 1999, and 2000 in the lower and the middle Yellow River Valley, there are several different traits between green foxtail *(S. viridis)* and foxtail millet *(S. sativa),* summarized in Table 2. Except the loss of dormancy, all traits are visible, particularly trait numbers 1–3 and 7, which would be eye-catching even for people without any farming knowledge. However, some of the traits could be causal while others are consequential. For example, it is possible that a plant with significantly fewer panicles would transport, distribute, and use water or other fertilizing materials from the soil more intensively and efficiently than would a plant with abundant panicles. Consequently, the stem could become more robust, florets from each panicle would significantly increase, and seeds would become heavier and rounder, containing more edible starch.

Both plant dormancy and the long and highly heterochronous cycle of flowering and ripening are characteristics of *S. viridis*. It has been observed that after a heavy rain (around 40–50 mm) occurring anytime between April and August, many plants and panicles quickly germinate, flower, and ripen (Lu 1998). The

TABLE 2. DIFFERENCES BETWEEN GREEN FOXTAIL AND FOXTAIL MILLET

NO.	TRAIT	GREEN FOXTAIL	FOXTAIL MILLET
1	Panicles per plant[a]	Varying from 4–56 panicles	Mainly between 1 and 3 panicle(s)
2	Diameter of stems[a]	Around 0.2–0.3 cm	Around 0.6–1.1 cm
3	Florets per panicle[a]	Between 68 and 374	Between 3300 and 6700
4	Shape of the grains	Oval	Round
5	Weight per 1000 grains	1.3 g	3 g
6	Rachis	Fragile, shattered when ripe	Tough, unshattered
7	Growing of new panicles from the stem	Can occur during the flowering-ripe period	Occur only before the flowering period
8	Ripening time	Highly heterochronous	Simultaneously
9	Dormancy	Present	Lost

[a] Sample population: 30 plants.

process from flowering to ripening of green foxtail could last for 4 months, from June to October (Lu 1998). These characteristics would enable *S. viridis* to optimize water and other nutrition from the soil during these several months, and to produce as many seeds as possible. Apparently, these are adaptive mechanisms for survival in the dry loess area, and the loss of these characteristics could result only from human interference. So it seems that at least mutations for trait numbers 1 and 6–9 must have resulted from the cultivation of *S. viridis* in the Yellow River Valley, and that human manipulation must have provided the selective pressure for these mutations.

Many scholars have argued that cultivation is a human selection mechanism for the changes from wild to domesticated plants (Anderson 1992). Judging from the results obtained during the cultivation experiments in 1999 and 2000, and the harvesting experiments conducted in 1996 (Lu 1998, 1999, and 2000), it can be inferred that mutation numbers 6–9 of green foxtail could have occurred by cultivation and harvesting even under "unconscious selection" (Hillman and Davies 1992), as harvesting and repeated cultivation of harvested seeds would have selected for tough rachis, simultaneous growth cycle, and loss of dormancy (Hillman and Davies 1992; Lu 1998), although the mechanism of controlling dormancy is still under debate (Viémont and Crabbé 2000). Whether cultivation would have the same effect for the changes in other traits remains unclear.

Theoretically, mutations for trait numbers 1–5 could result only from conscious selection by human beings. According to ethnographic data, certain groups of indigenous Taiwan people still cultivated foxtail millet in the 1970s (Fogg 1983). They selected plants with fewer but stronger panicles during harvesting, and kept these plants for the following year (Fogg 1983). This clearly represents human selection for trait numbers 1–3 in Table 2. A similar process might have occurred in the Neolithic Yellow River Valley, causing the reduction of panicles per plant and the increase of robustness of the stem. In the coming years, further experiments will be conducted to examine this hypothesis.

The experiments of 1999 and 2000 showed that no special techniques are required for initial cultivation of green foxtail. On the other hand, quick germination of plants and panicles after rain, and the extremely low yield of 2000 due to spring drought, might have been noticed by the first millet farmers a few thousand years ago. They would have realized that water was good for the plants. Eventually, this observation would have led them to practice irrigation to insure better yields. It should also be noted that the long and uneven process of flowering and ripening of *S. viridis* has two important consequences. First, it is impossible to determine when the whole stand will reach the stage of ripe or half-ripe. Harvest has to be carried out sometime in the autumn (August to October), but not every floret of every plant would have been ripe or edible when harvesting was taking place. Therefore, the real gain of cultivation is much less than it appears. Second, many seeds would have shattered from the panicles before being harvested. Some of these seeds would have survived various predators—birds, rodents, etc.—and germinated the following year. The survival rate for green foxtail seeds has not yet been investigated, but, according to an observation made in 1996, the quantity of seeds shattered in any one given day between July and October is always greater than the quantity of seeds being harvested (Lu 1998). For example, within the population of 668 panicles, 263 panicles had already shattered and dispersed some or all of their seeds when harvesting was planned for 5 August (Lu 1998). It is clear that many seeds would have been shattered naturally during initial stages of cultivation. Therefore, if the same land is used for cultivation the following year, those seeds sown by human beings will germinate along with those self-shattered grains. People would eventually harvest the plants resulting from human-sown seeds and the self-shattered seeds. Therefore, if the same land was used continuously for the cultivation of the same grass, then it would be very difficult, if not impossible, to preserve the mutations leading towards a domesticated plant. On the other hand, by shifting the land every year, one can preserve any possible mutations in the cultivated grains of the previous year, and can continuously select for them (Hillman and Davies 1992).

According to local farmers, continuous use of the same land results in lower output and an increase in weeds even for the cultivation of foxtail millet *(S. sativa)*. Therefore, foxtail millet crops must be shifted to different fields every year. Does this suggest that some of the characteristics of *S. sativa* are still reversible, or at least have to be maintained by shifting fields every year? This question requires further investigation. In summary, the occurrence of certain mutations in *S. viridis* is the prerequisite for producing domesticated foxtail millet. Shifting fields every year and harvesting at a certain time are both necessary stimuli for such mutations, and consequently for the domestication process.

Sedentism and Farming

It seems that green foxtail can grow well without human attention. Provided that the climate was balanced and there were no animal or human intrusions, the first farmers did not have to tend the field after sowing. They could have left the field for four months and returned to the field at harvest time. However, an essential condition for the first farmers is that they must have had their own territory.

Even with a clearly bordered territory, protection was still required when the crops were about to ripen. According to local farmers in the village where this experiment was carried out in 1999, they often protect their crops before harvesting by "camping" on the field. Quite often this is also a task for males. It can be inferred that the initial farmers in prehistory would have encountered a similar problem, and would have to remain near the fields in order to ensure the return of their cultivation. This would be a strong impetus for the occurrence or increase of sedentism. Therefore, the occurrence of sedentism and farming does seem to have a close correlation. Sedentism initially might not have been for the purpose of tending plants, but for protecting the crops at the harvest stage. Further, as this cultivation experiment indicates that the edible grains obtained from initial farming were limited, it would be impossible for the first farmers to rely purely on cultivation. The first farmers probably took the seeds as storable foods for the lean season. Foraging must have been still the major subsistence strategy for the first farmers. In fact, archaeological discoveries in China illustrate that hunting and gathering were important activities even for Neolithic farming societies (for a summary see Lu 1999). Therefore, the first farmers could still be foragers.

Meanwhile, the two-year cultivation experiment seems to suggest that certain attention was, in fact, necessary if the cultivators wanted to have a reasonable return every year. As discussed above, prehistoric farmers might have noticed the benefit of water, and might have wanted to tend their plants. In order to do so, however, the farmers would have had to stay near the land, or at least regularly return to the land. This would have reduced their traveling distance and would also have affected their foraging activities. In this case, the prehistoric farmers and foragers might have had to choose between farming and foraging, one as their major subsistence strategy and the other becoming a supplement. Alternatively, some members of the group could be farmers and the others foragers. Division of labor by gender is also possible, although that would be difficult to find in the archaeological record. Once farming became the major economic activity, along with sedentism, the consequences would be population increase and cultural development, and the occurrence of prosperous farming villages. If this were the case in the prehistoric Yellow River Valley, and the first farmers were still mobile and only returned to their field regularly, it would be difficult to recognize such archaeological remains. It is probably when farming became a major subsistence strategy and villages grew that such societies become clearly recognizable.

In the Yellow River Valley, from 10,000 to 9000 years B.P., there are few archaeological remains, none of which can be clearly recognized as those of farming societies. However, after 8500 years B.P. there were numerous farming societies, some with advanced culture such as the Jiahu assemblage found in the Huai Valley (Zhang 1999). Could the seemingly sudden outburst of farming societies in the Yellow River Valley be the result of farming becoming a major subsistence strategy? Could the sparse archaeological record prior to 9000 B.P. be due to mobile part-time farmers in the region who were mainly foragers? If this was the case, what were the reasons for the first farmers to choose farming as their major subsistence strategy at the cost of foraging? Was it the shrinking of natural resources, or the attractiveness of seeds being storable for the cold winter, or both? Those questions require further investigation.

Tools for Cultivation and More

This experiment indicates that very few tools are needed for cultivation. One axe for land clearing (if there are few trees, not even the axe is necessary), and one flake for harvesting are all that is necessary. For grain processing, grinding slabs and rollers are sufficient. All these tools have been present in the Yellow River Valley since the terminal Pleistocene. Of course, this is not to say that the presence of these tools indicates the practice of cereal cultivation. It is only to suggest that the simplicity of the tool assemblage does not necessarily indicate the absence of cultivation in an archaeological assemblage.

As mentioned above, a sickle seems to be more efficient than a flaked knife in cutting the whole plant. In the Yellow River Valley, the initial agricultural societies that date from 8500 to 7000 B.P. did use sickles, as polished stone sickles are commonly found dating to this period. However, after 7000 B.P. the quantity of sickles significantly reduced in the Yellow River Valley, and it seems that knives became popular in agricultural societies dating from 7000 to 5000 B.P. Why did this occur? Does this change from sickle to knife indicate some changes in agricultural activities or reliance upon different cultivars? Or was this the outcome of different cultures? These questions are unanswered at this moment.

According to my ethnographic survey, the millet stalks are often used for fuel and for feeding livestock. That is why the whole plant is cut from the ground first, then the panicles are cut from the stalk. Thus, cutting the whole stem is necessary not only for the process of plant domestication but also for animal husbandry. However, according to local farmers, if the land is too far from home, or if the stalks are no longer needed, they cut only the panicles, and set fire to the stalks after harvesting. By doing so, they have to reap the panicles only once and carry only the panicles back home, thus greatly reducing their workload. Moreover, the ash from the stalks is good fertilizer for next year. Are these practices applicable to prehistoric farmers in the Yellow River Valley? As both knife and sickle are similar in terms of harvesting efficiency for reaping panicles only, but the labor cost of producing knives is lower than that of the sickle, does the popularity of knives in the Neolithic Yellow River Valley between 7000 and 5000 B.P. indicate a shift from cutting the whole plant to reaping only panicles? Did people during that time extend their farming to distant fields so that they preferred to carry only the panicles home? Further use-wear analysis may provide data to test this hypothesis.

In summary, the transition from foraging to farming and the origin of foxtail millet domestication in the Yellow River Valley is still a question awaiting further investigation. Archaeological experiment is only one of the approaches used to gather information. By integrating various approaches, we can obtain more information to further our knowledge about this subject.

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ABSTRACT

Green foxtail, the progenitor of foxtail millet, was domesticated in the Yellow River Valley by 8000 B.P. However, the domestication process is not known. Hence a cultivation experiment was conducted in 1999 and 2000. Although biological change indicative of domestication is usually not manifest in two years, this experiment provides information relevant to the origin of millet farming, sedentism and farming, and the Neolithic tools used for millet farming in the Yellow River Valley. KEYWORDS: Green foxtail, Yellow River Valley, cultivation experiment, farming, sedentism.