Checklist for recording the cultivation and uses of hulled wheats

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Introduction

A wide range of topics concerning the hulled wheats were discussed at the farro workshop held in Castelvecchio in July 1995. During the meeting it became clear that very few data have been recorded on the traditional husbandry, crop-processing or uses of the hulled wheats, and that this kind of information is potentially useful to a wide range of specialists. This guide aims to assist researchers in all fields to accurately and fully record all aspects of hulled wheat cultivation.

The most common hulled wheats are einkorn (*Triticum monococcum*), emmer (*T. dicoccon*) and spelt (*T. spelta*). During prehistory these taxa were among the staple crops of much of Europe, the Near East and temperate Asia. Today they are largely restricted to scattered mountainous enclaves. Even in these areas cultivation of hulled wheats continues to decline each year. The case of einkorn cultivation in Spain, reduced from an official figure of 48 ha in 1990, to one field in 1995, is not unusual. Although increased consumer demand for hulled wheat products in continental Europe has led to the spread of cultivation in some areas, this is doing little to ensure the preservation of local landraces and knowledge of their husbandry and uses. We believe that now is the last opportunity to record traditional practices before they are extinct.

Much earlier work on hulled wheats is of limited usefulness, either because an account is too short or does not cover the topic of interest to the researcher, or because of fundamental misunderstandings about the differences between the free-threshing wheats such as macaroni wheat (*T. durum*) and bread wheat (*T. aestivum*) and the hulled wheats. In this paper we aim both to give a comprehensive guide to the questions that should be asked, and also to briefly explain the techniques of crop-processing that are specific to the hulled wheats.

Importance of the hulled wheats

Hulled wheats are of strong interest to a diverse range of research areas, including germplasm conservation, plant-breeding, rural development, archaeobotany and ethnography. While each of these research areas has different goals, they share a common interest in accessing the fullest possible records of traditional cultivation and uses of hulled wheats. For example, knowledge of farmers' perceptions of factors such as relative yield, response to inputs and marketability is essential for understanding why hulled wheats are declining, and thus creating viable on-farm (*in situ*) conservation strategies. Such information is equally essential for modeling decision-making of prehistoric farmers and thus explaining past agrarian change.

Knowledge of agronomic practices such as time and density of sowing both assists genebanks in efficient multiplication of holdings, and will be useful to those selecting breeding material. Knowledge of crop-processing techniques, for example pounding in mortars and grinding in mills, is useful to archaeobotanists who need to understand how food-processing artifacts were used, and also to those involved in rural development who wish to support the infrastructure for processing hulled wheats. As a final example, knowledge of food uses is of interest both to the ethnographer for its cultural significance, and to the plant breeder or grain merchant seeking new uses or markets for hulled wheat products.

It is clear that no one person will be able to collect all the information from a given region is such a way as to satisfy all possible users. However we believe that data recording can be significantly improved by using this guide, which represents a consensus view from a number of different research viewpoints. Wherever possible, fieldwork should be planned in collaboration with researchers from different areas. The hulled wheats are disappearing too quickly to allow an approach in which different researchers only collect the information that seems immediately relevant to them.

Collection and publication of data

In the checklist below we suggest a series of points about which data should be collected, arranged by the agricultural year. We must stress that despite its format, this is not intended as a questionnaire. Farming is a complex operation and simply asking a series of questions is likely to induce puzzlement or extract misleading answers. However, even on the most hasty germplasm collecting trip, there is time to sit and talk with small groups of farmers. Under these conditions, and in the course of general discussions about farming, most of our points can be raised and answers collected.

As usual in ethnographic fieldwork, we must beware of asking "leading questions" which result in us getting the answer we expect, and we must recognize that there will be some questions to which the answers are either contradictory or ambiguous. These must be recorded as such. Some hints on dealing with particularly complex areas, such as yields, are given at the appropriate points.

Once information has been collected and organized in written form, it must be published. Large amounts of information on hulled wheats were written in germplasm collectors' notebooks in the 1960s and 1970s, but this work resulted in just a few paragraphs of publication and is now effectively lost for ever. Written reports on germplasm collecting trips usually do not have space for extended discussion, but there are numerous other opportunities for publication. These include specialized journals of agricultural ethnography and ethnobotany, such as Tools and Tillage or Economic Botany, agronomic and plant breeding journals such as Genetic Resources and Crop Evolution and, of course, a host of regional ethnographic and scientific journals. Given the rate of decline in the opportunity to study traditional cultivation of hulled wheats, we would stress the necessity for rapid publication of fully descriptive accounts.

Understanding the processing of hulled wheats

Dehusking

Most of the agricultural sequence of husbandry, processing and food use of hulled wheats (Fig. 1) is similar to that for the better known, free-threshing macaroni and bread wheats. However, both ancient and contemporary accounts of hulled wheat use often show basic misunderstandings of the difference between hulled wheats and free-threshing wheats. Simply put, a free-threshing wheat will break up into grains and chaff on threshing. After threshing, all that is required to obtain clean grain is a series of winnowings and sievings to remove the chaff. In contrast, the spikes of hulled wheats break up into their component spikes on threshing. The grains are trapped inside the spikelets by tough glumes. An extra step is therefore required after threshing, to break open the spikelets and release the grain. After this, removal of the chaff is again a matter of winnowing and sieving.

Two techniques are widely used for extracting grain from spikelets of hulled wheats:

1. **Pounding.** Spikelets are placed in a mortar and pounded with a pestle or hammer. The husks rub against each other and slide off the grains. The buffering effect of the husks means that grains are removed intact and are usually not broken. If broken grain or flour is to be produced, this is usually a separate, subsequent step in processing.
2. **Milling between rotating millstones.** This is usually carried out in a water mill or similar apparatus, using circular millstones with a relatively high gap between them. As in pounding, this produces a mixture of intact grain and torn husks. Usually this mixture is removed from the millstones and the husks are winnowed out, before any further processing.

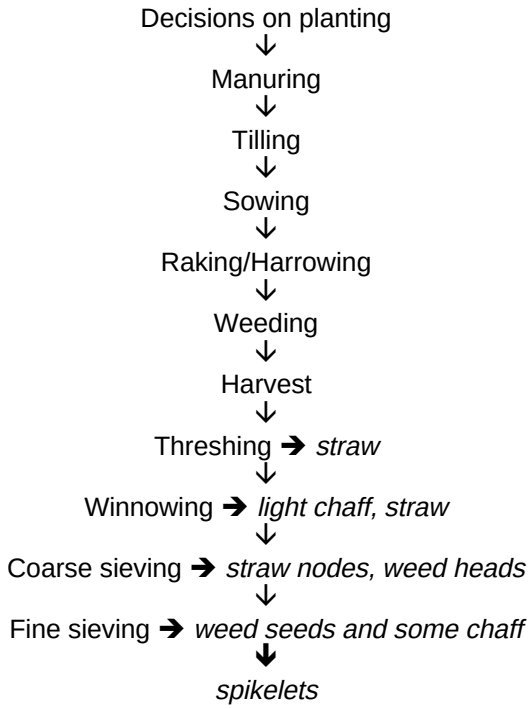

Fig. 1. Simplified sequence of crop husbandry and processing from sowing to spikelets (adapted from Hillman 1981:fig. 5, fig. 7).

Once clean whole grain has been obtained, it can then be prepared for food use in a variety of forms – as whole grain, cracked grain, or flour. At various stages in the preparation of these foodstuffs grinding or pounding will be required. In studies of modern and ancient hulled wheat processing the process of dehusking has often been confused with the process of grinding or cracking clean grain. A common example of this confusion is the suggestion that spikelets are placed in a mortar and pounded directly into flour. Ethnographic and experimental studies show that the removal of the husks (glumes, palea, lemma) from the grain is usually a distinct first step in preparation of foodstuffs. Only after clean, whole grain has been obtained are further steps such as bran-stripping, cracking or grinding carried out.

When processing of hulled wheats is being observed, it is therefore essential to fully understand what each step of the processing sequence is doing. This requires detailed observation and, equally importantly, collection of samples of the different products of processing from each stage.

Parching

There is a widespread assumption that spikelets of hulled wheats should be heated ("parched") in order to facilitate removal of the husks by pounding. This seems to be largely based on comments by Pliny (*Historia Naturalis* xviii, 7-8; xviii, 97). However, there is virtually no ethnographic evidence for parching of spikelets for this purpose, and experimental work in both dry areas such as Egypt (Samuel 1993) and damp areas such as Germany (Meurers-Balke and Lüning 1992) indicate that parching is unnecessary prior to pounding.

Cereal grains and spikelets are sometimes heated, for a wide range of reasons including drying of damp grain prior to storage (van der Veen 1989), or singed to remove awns as in Asturiass, Spain (Leonor Peña-Chocarro, this volume). If evidence for the use of heat in cereal processing is found, it is essential that the reason for this, as well as the means, are fully documented.

Checklist for traditional husbandry and processing of hulled wheats

Our outline of the operations involved in growing and processing hulled wheats closely follows Hillman's (1981, 1984, 1985) classic papers, to which readers are referred for more details, especially with regard to Turkey and the rest of the Near East. Operations are discussed in their approximate order through the agricultural year.

General socioeconomic information on the farming community

- Community size, economic status, ethnicity and religion.
- For each farmer or informant:
  - Name, age, gender
  - Family structure, relative economic status, ethnicity, religion.
  - Do farmers from other communities have any opinions regarding those growing or using hulled wheats; how do the latter view themselves in regard to nearby farmers growing free-threshing wheats?

Which crops are grown?

Cereals grown.

- Common names: local names often vary between villages, and even between villagers. Rather than asking for crops by name, we recommend carrying samples of the different hulled wheats and asking if they are recognized – and then seeking local names. Are hulled wheats regarded as being wheats by farmers, or as a different kind of cereal?
- Are distinct landraces recognized within each of the hulled wheats?
- Amounts of each cereal cultivated and change through time: these questions should not be restricted to hulled wheats. Changes in hulled wheat cultivation are linked to changes in other cereals.
- Factors that are changing the cultivation and uses of hulled wheats and other cereals: response to fertilizers, irrigation or pesticides; local or centralized markets; culinary uses; access to crop-processing facilities.
- Any special customs relating to the hulled wheats.

Decision-making on areas and amounts to be sown

- Number of farmers in village growing hulled wheats; area sown by each: less, same or more than previous years? Estimates of area should be recorded for each farmer, as local units and square meters, and for the community as a whole (hectares).
- Reasons why this amount of land was sown.
- Any special type of landform or soil chosen: hulled wheats are often (but not always) planted on poorer soils.
- Grown as pure crops, or as deliberate or tolerated mixtures? If grown as a mixture, for improved food value or for other reasons (for example, supporting the wheat plants)?
- Comparison of husbandry practices – especially manuring, weeding and irrigation – with other cereals.
- Villagers' perceptions of hulled wheats: old-fashioned? low / high prestige?
- Market for product: in household, village, market town.
- Expected uses of product. What are the approximate proportions of each hulled wheat used for each purpose?
- What do farmers suggest to improve their varieties, processing techniques or quality? Are there special problems with hulled wheats?

Sowing

Job distributions

- age, sex, hire of labour – should be noted for all the operations concerned with husbandry and processing.

Origin of the cultivated seed (location, persons, years)

- Fallowing and rotation
  - Place of hulled wheats in rotation / fallowing systems.
  - Reasons for adoption of these systems

Time of sowing

- Sowing dates for hulled wheats.

- Variation between different landraces, or from year to year.
- Factors affecting decision on when to sow.
- Differences in yield between cereals sown at different dates.
- How is the actual day of sowing chosen: for example, after first rain, when snow melts?

Manuring

- Timing and number of applications.
- Use of chemical or natural manures (dung, ashes, etc).
- Preferences for particular manure types.
- Types of chemical fertilizers.
- Prices of chemical fertilizers; date of introduction; government subsidies.
- Responses of hulled wheats and other cereals to different types and levels of fertilizer / manure. In addition to yield, these may include responses such as lodging.

Tilling

- Preparation of the fields: by ploughing with mouldboard plough or ard; spade; hoe.
- Harrowing of soil before or after sowing.
- Fineness of tilled soil required for sowing.

Sowing

- Spikelets sown by broadcasting, or dibbled into channels, or sown with a seed-ard? Note: hulled wheats are almost always sown in the spikelet owing to the difficulty in removing grains from the spikelet without some damage to the embryo.
- Density of sowing: this is usually difficult to discover by direct questioning. Number and weight of spikelets / unit area is probably the best way to present these data. This may have to be obtained by asking how much was planted in a field of known area. Spacing between plants in the field should also be recorded.

Raking or hoeing

- Coverage of the seeds after sowing.
- Depth of seeds after coverage.

Husbandry of the growing crop

Weeding

- Associated weeds; local / scientific names and herbarium vouchers if possible.
- Frequency and timing of manual weedings or application of weedkiller.
- Use of weeds for fodder or human food.
- Presence of tolerated weeds or of weeds with undesirable characters that must be removed.

Irrigation

- Frequency and timing of irrigation.
- Source of water and mode of distribution in fields.

- Choice of crops and fields for irrigation.
- Effect on yield; comparison of irrigated and unirrigated crops.

Drainage

- As above

Stone clearing

- As above

Harvest

Harvesting

- Timing of harvest in relation to other crops.
- Basis of decision on exact harvesting date.
- Part of plant harvested: whole plant by uprooting, harvest of spike and straw together, or harvest of spike only.
- Tools and procedures used. While the sickle and scythe are most common in traditional agriculture, other procedures include hand-plucking of spikes and trapping of spikes between reaping sticks. The semi-brittle rachis of hulled wheats makes their spikes particularly suitable for this kind of harvesting, and it is therefore possible that harvesting techniques may differ for free-threshing and hulled wheats. Sickles are often used in conjunction with harvesting claws or wooden hooks.

From spikes to spikelets

Collection of sheaves and temporary field storage

- Use of tools to move cut sheaves into stocks: simply for convenience in transport, or to allow the crop to dry out?

Transport of threshed crop to farmstead or threshing yard

- In carts, panniers or nets.

Threshing

During threshing the spikes will be separated from the straw and broken up into their constituent spikelets. Five different methods are described below. For whichever method is used, the following should be noted:

- Is the whole of the harvest threshed at once, or is it processed piecemeal through the year?
- Does processing take place in a special area (for example, a threshing yard), inside or outside?
- Is threshing undertaken on a household basis or a communal basis?

- **By beating:** the crop is placed on the ground and beaten with sticks, mallets, flails or other implements.
- **By lashing:** sheaves are swung against a wall or frame.
- **By sledging:** the crop is spread out on the ground while a sledge, either wooden or metal, set either with stones or with metal disks, is pulled by animals over the crop.
- **By trampling:** animals, sometimes shod with metal plates, or humans tread the crop.

- **By crushing with rollers:** used in a similar fashion to a threshing sledge.

Removal of large straw pieces

After sledging or trampling large straw pieces are removed by raking. After flailing or lashing, the straw usually remains in bunches and can be lifted clear with a fork.

Winnowing

After threshing with a threshing sledge, the lighter fragments of chopped straw and light weed seeds can be removed by winnowing. The threshed mixture is thrown into the air, allowing a breeze to separate the light and heavy components. This procedure can be repeated to ensure full separation.

Coarse-sieving

A large-meshed coarse sieve is used which allows the spikelets to fall through, while retaining straw nodes and weed heads in the sieve.

Medium-coarse sieving

A finer-meshed sieve is used, which retains the spikelets in the sieve but allows loose weed seeds to fall through.

We must emphasize that although the basic sequence of winnowing, coarse-sieving and finer-sieving has been widely recorded in the Near East for free-threshing wheats, few ethnographic records are available for hulled wheats. More data are urgently needed on how the mixtures resulting from threshing are treated. It is likely that variant sequences to that described here exist. Today threshing and cleaning of spikelets may be combined in one action in a threshing machine or combine harvester.

Bulk-storage of spikelets

After cleaning, spikelets are usually placed in storage. If some or all of the spikelets are to be processed to grain, this may be done in bulk, or piecemeal through the year. Germination losses compared with other cereals should be discussed.

Measuring yields

Accurate assessments of yield are particularly difficult to make for the hulled wheats. This is because yield can be measured both as spikelets and as free grain. Measurements may be in local units of weight or volume, and may not correspond to the units used to measure the seed spikelets. We recommend two approaches to this problem. First, farmers may be able to estimate yield by ratio: for example, one spikelet sown yields 20 at harvest. Estimates of this ratio should be collected from as many farmers as possible for as many different cereals as possible. However, as sowing at a lower density will result in higher yields for each plant, this may not be a good guide to yield from a given area (Powell 1985:34-36). Second, actual quantities sown and harvested for a given field or unit area can be obtained. In this case, it is essential to find out whether grain or spikelets are referred to, and to find out what different units of measurement mean. The same caveats apply to information on prices.

In most cases a more productive approach will be to consider yield and yield stability in relation to other crops. Farmers are usually willing to rank crops in relation to different soil conditions, resistance to cold, diseases or pests.

It is important to find out what inputs are associated with different relative yields. How do yields relate to fertilizer, irrigation or soil quality? Have yields changed within living memory? Figures that are not supported by explanations of inputs and on units of measurement can be highly misleading.

Use of different products

For the remaining part of the checklist we have felt it more important to explain the basic questions than to detail points to be recorded. It will be obvious for most of the following actions as to what needs to be recorded.

Straw

The importance of straw products to many small-scale farmers is increasingly recognized. As straw properties may be valuable for plant-breeding purposes, it is important to collect farmers' observations of the quality of straw for different purposes. This information should be obtained for all the cereals grown by a farmer, not just the hulled wheats.

Fodder: chopped straw is generally preferred for fodder rather than whole straw. If crop-processing does not result in adequately chopped straw, it may be placed under a threshing sledge or otherwise broken up. Different classes of straw may be given different names and used for different purposes. Information should be collected on the different classes and their uses.

Potential uses include fodder for different animals, bedding, fuel, temper for mudbrick, plaster or dung-cakes.

Intact straw may be used for thatch, basketry or straw-hats. Other uses for straw include stuffing saddles and mattresses.

Chaff

As with straw, chaff can be a valuable commodity with different classes of material with different names and uses. Uses as for straw.

Whole spikelets

The spikelets can either be used as whole spikelets, or processed further to whole grain (Fig. 2). Uses for intact spikelets include:

Seed: this may be subject to further cleaning, including hand-picking of remaining weed seeds. Spikelets may be further sieved to remove small spikelets. Spikelets may be stored in special cupboards, pits or other well-protected storage locations until sowing time.

Animal feed: Spikelets may be fed intact or be partly ground or pounded prior to feeding. They may be mixed with another feedstuff. The animals to which the spikelets are fed should be recorded, with any special properties of this animal feed.

Human food: The siliceous and barbed nature of hulled wheat chaff makes it unsuitable for human consumption, and in any case whole spikelets would be highly indigestible. However, spikelets are ideal for malting purposes. As in hulled barley, the husk holds the solid parts of the grain together during the malting process. If a malted or fermented drink is prepared from hulled wheats, the recipe should be obtained, and it should be established whether whole spikelets are used.

Dehusking the spikelet

Stripping the husks

As discussed earlier, there are two basic techniques for stripping off the husks (glumes, lemmas and paleas) of hulled wheats: pounding and milling. These are discussed separately.

Pounding: Spikelets are placed in mortar, may be dampened with water, and are pounded with a pestle or mallet. The size, shape and materials (wood, stone) of the tools should be noted, as well as the exact procedures used. If the spikelets have been dampened the resulting mixture of grain and shredded chaff must be dried before the chaff is removed by winnowing. The mortar may be specific to dehusking spikelets or may be multipurpose.

Milling: The spikelets are placed in a rotary quern or between millstones. The millstone is set higher than for flour production. A mixture results of whole grain, fragmented grain and chaff. The chaff can be separated by winnowing, and the different grades of whole and fragmented grain can be separated by sieving. In some cases the grains are ground into flour at this stage, and the husks and bran are then removed by sieving. The mill may be multipurpose, or specially designed for dehusking spikelets.

Cleaning the grain

After winnowing, weed seeds, pieces of chaff and stones that remain mixed with the grain must be removed. Typically whole grain will be sieved first through a coarse sieve, which will retain items such as large spikelet fragments. After this, grain will be sieved with a fine-meshed sieve. This will allow small weed seeds and pieces of chaff to fall through. After this, remaining weed seeds and stones can be picked out by hand. A supplementary process is grain-washing, in which grain is dipped into a stream. Weed seeds such as grains of wild oats, and fungus-infested grains will float off.

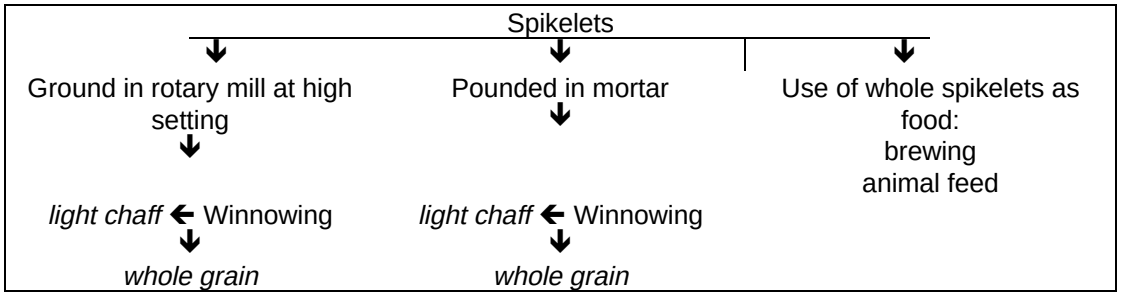

Fig. 2. Processing options for spikelets.

Processing and uses of grain

Storage of grain

A variety of sacks, jars, baskets, silos or pits can be used.

Animal feed

Grain may be fed to animals whole, crushed or ground. It may be fed pure or mixed with other feedstuffs.

Whole and cracked grain products

Untreated grain: whole grain and cracked grain can be used for bulgur and porridge-type dishes. As Hillman (1984:136) points out, emmer is thin-branned compared with *T. durum*, and does not need to be subjected to the full bulgur process described below.

Bulgur: a typical Near Eastern food in which whole grain is boiled in water and sun-dried. The bran is then stripped off by pounding the moistened grain in a mortar or by milling it with a vertical millstone. The bran is then winnowed away and the grain sun-dried. If the grain is to be consumed in cracked form, it will then be pounded in a special mortar. Note that it is therefore possible for hulled wheat to be subjected to pounding on three separate occasions, perhaps in a different type of mortar each time. The potential for confusion in describing these operations is obvious. Only by talking to the processors and physically examining the contents of each mortar can the processing sequence be clarified.

Greencorn: in Germany unripe grain of spelt wheat is harvested and dried over fires, before being sold as whole grain.

Flour products

Bread and other baked foods: hulled wheats have often been used to make bread, but few detailed ethnographic records exist. As bread represents a major potential market for glume wheats, better information is of considerable economic interest. Points that need to be recorded include:

- Was the flour used pure or mixed with other species?
- Was the flour wholemeal or white?
- What are the baking procedures? Is yeast or sourdough added? Could the bread be described as leavened?
- What are the special properties of the bread? Does it taste better? Keep longer?
- Colour of the flour, dough and final product.
- Medicinal properties.

Processing beyond the farm

- How much of the crop is consumed by the farmer's household; how much is shared or sold to others?
- Destination of spikelets or processed products. If necessary, consumers should be visited to record uses and perceptions of hulled wheat products.
- Prices of grain, spikelets or other products, related to a standard market product such as hens or eggs. This information should be recorded for all the cereals being sold.

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