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Claire Malleson

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UCLA ENCYCLOPEDIA of EGYPTOLOGY

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Emmer wheat and barley were the two staple foods of ancient Egypt. Every year the fertile regions of Egypt would have been covered with crops of these two cereals, and the lives of the vast majority of the population—the non-royal, non-scribal rural peoples—would have revolved around growing and processing cereals. Cereal production and processing were such vital parts of life that these activities were depicted on the walls of non-royal ("elite") tombs among the repertoire of daily-life activities. Additionally, small models showing these activities, as well as baskets of cereal grains, were placed inside the tombs in order to ensure an eternal supply of cereals to the deceased in the afterlife. Due to the close association of the god Osiris with cereals, fertility, and the afterlife, Osiris beds or bricks also became popular additions to the funerary equipment in later periods.

كان القمح الإيمّر (نوع هجين ثنائي الحباية) والشعير هما الغذاءان الرئيسيان في مصر القديمة. وكانت المناطق الخصبة في مصر تُزرع سنويًا بمحاصيل هذين النوعين من الحبوب، وكانت حياة غالبية السكان— سكان الريف من غير الملوك والكتبة — تدور حول زراعة ومعالجة الحبوب. كانت إنتاج ومعالجة الحبوب جزءًا حيويًا من الحياة إلى درجة أن هذه الأنشطة تم تصويرها على جدران المقابر غير الملكية ("مقابر النخبة")، ضمن مشاهد الحياة اليومية. بالإضافة إلى ذلك، كانت تُوضع نماذج صغيرة تُظهر هذه الأنشطة، وكذلك سلال الحبوب، داخل المقابر لضمان إمداد دائم من الحبوب للمتوفى في الحياة الآخرة. وبسبب الارتباط الوثيق للإله أوزوريس بالحبوب، والخصوبة، والحياة الآخرة، أصبحت أسرة أو طوب أوزوريس أيضًا إضافات شائعة إلى التجهيزات الجنائزية في الفترات اللاحقة.

A number of cereals have been cultivated in Egypt since at least 4,500 BCE (see Table 1). Prior to that time people relied on the gathering and perhaps cultivation of wild grasses (Barakat and Fahmy 1999; E. Attia et al. 2021). Emmer wheat (*Triticum turgidum* subsp. *dicoccon* [(Schrank) Thell.]), hulled 6-row barley (*Hordeum vulgare* subsp. *vulgare* [L.]), and 2-row barley (*Hordeum vulgare* subsp. *distichum* [L.]) were cultivated in the Pharaonic Period (fig. 1). In the Ptolemaic Period, durum wheat (*Triticum turgidum* subsp. *durum* [(Desf.) Husn.]) was introduced, while bread wheat (*Triticum aestivum* subsp. *aestivum* [L.]) became the principal crop alongside barley during the twentieth century CE. Other domesticated cereals that made an appearance in ancient Egypt and that may have been cultivated in the Predynastic Period but then grew only as a very occasional crop weed from the early Dynastic Period onwards are einkorn (*Triticum monococcum* [L.] subsp. *monococcum*) and club wheat (*Triticum aestivum* subsp. *compactum* [(Host.) Mackey]) (Cappers 2016).

Table One: List of cereals present in Egypt, either cultivated or growing as weeds		
Common name	**Scientific name**	**Selected alternative (older) scientific names and synonyms**
Hulled 6-row barley (ancient/modern Egypt)	*Hordeum vulgare* subsp. *vulgare* [L.]	*Hordeum sativum* (Jess.) *Hordeum hexastichum* [L.]
Hulled 2-row barley (ancient Egypt)	*Hordeum vulgare* subsp. *distichum* [L.]	*Hordeum sativum* (Jess.) *Hordeum distichum* [L.] *Hordeum aestivum* (Hall)
Emmer wheat (ancient Egypt)	*Triticum turgidum* [L.] subsp. *dicoccon* (Schrank) Thell.	*Triticum dicoccum* (Schrank ex Schübl.) *Triticum aestivum* var. *dicoccum* (Schrank ex Schübl.)
Durum wheat (Ptolemaic Egypt)	*Triticum turgidum* [L.] subsp. *durum* (Desf.) Husn.	*Triticum durum* (Desf.) *Triticum sativum durum* (Pers.) *Trititicum aestivum* subsp. *durum* (Thell) *Triticum turgidum* [L.]
Bread wheat (modern Egypt)	*Triticum aestivum* [L.] subsp. *aestivum*	*Triticum vulgare* (Host) *Triticum sativum* (Lam.)
Club wheat (ancient Egypt, weed)	*Triticum aestivum* [L.] subsp. *compactum* (Host) Mackey	*Triticum compactum* (Host) *Triticum sativum* var. *compactum* (Host) Desf.
Einkorn wheat (ancient Egypt, weed)	*Triticum monococcum* [L.]	*Triticum aestivum* var. *monococcum* [L.] (Voss)
Sorghum (Roman/modern Egypt)	*Sorghum bicolor* [L.] Moench	*Sorghum vulgare* (Pers.) *Sorghum vulgare* subsp. *bicolor* [L.] (Maire and Weiller)
Pearl millet (Roman/modern Egypt)	*Cenchrus americanus* [L.] Morrone	*Pennisetum glaucum* [L.] R. Br.
Maize (modern Egypt)	*Zea mays* [L.]	*Mays Americana* (Baumg.)
Rice (Roman/modern Egypt)	*Oryza sativa* [L.]	*Oryza palustris* (Salisb.)

Table 1. Cereals present in Egypt, either cultivated or growing uncultivated as weeds.

Figure 1. Left: emmer wheat (*Triticum turgidum*) and right: hulled barley (*Hordeum vulgare*).

Unlike durum wheat and bread wheat (which are "free-threshing"), emmer wheat is a glumed wheat. This means that the grains are firmly enclosed by the chaff (the glume base and rachis) and require considerably more effort to process. Free-threshing wheat grains detach from their chaff far more easily during the threshing process and are therefore considered to be far more economically viable with respect to labor input and storage requirements. The Egyptians continued to cultivate emmer wheat in antiquity, despite these costs, due most likely to its superior ability to resist pests, the chaff acting like a coat of armor around the grains. Hulled barley is differentiated from naked barley (which is rarely present in Egypt) on a similar basis. While all barley is considered to be free-threshing because it breaks away from the glume base/rachis during the threshing process, the lemma and palaea of hulled barley remain attached to the grains but break away from naked barley (see Figure 1 in van der Veen and Jones 2006 for illustration of the cereals' morphological differences).

Studying Ancient Egyptian Cereals

Numerous well-preserved plant remains were recovered from tombs during the early years of European "exploration" in Egypt, and the first publication of these appeared in 1826 (Kunth 1826). Many of the subsequent studies of ancient Egyptian cereals by botanists were mostly based on the collections that had found their way into European museums (Unger 1859; Braun 1877; Schweinfurth 1882; Bonnet 1895; Beauverie 1935). Additionally, ancient Egyptian specimens were included in more general discussions of the histories of cultivated cereals around the world (Percival 1921: 186–187). These early reports followed different taxonomy from that of today, but the botanists recognized that 6-row and 2-row barley and at least two species of wheat (glumed wheat and free-threshing wheat) were present in ancient Egypt (they grouped all pre-Islamic periods of Egypt together as "ancient"). The earliest publications mistakenly identified emmer wheat as spelt wheat (*Triticum spelta* [L.]) (Pickering 1848: 366–375; Rawlinson 1880: 82; Hartmann 1923: 48–53), and during the mid-nineteenth century there was a misidentification of flax harvest scenes in non-royal tombs as sorghum/millet harvest, largely influenced by the presence of sorghum as a crop in Egypt at that time (Pickering 1848: 366–375; Kenrick 1850: 155–160; Unger 1859: 97–100; Rawlinson 1880: 82). The issues that interested these early botanists were taxonomy (identifying which species were

present in all periods of pre-Islamic Egypt) and the identification of the earliest domestic cereals in Egypt (see Elliot-Smith 1927; Peake 1927; and Percival 1927 for a heated debate on the issue).

In the twentieth century, Vivi and Gunnar Täckholm, who established the Cairo Herbarium in the 1930s, included extended lists of evidence for ancient wheat and barley in the first volume of *Flora of Egypt*, including extensive bibliographies (V. Täckholm, G. Täckholm, and Drar 1941: 238–268, 284–301). During the 1940s and 50s there was controversy about the identification of certain specimens and the presence of certain species in ancient Egypt. Some taxonomists identified a 4-row barley (*H. vulgare* subsp. *terastichum*), and some specimens from Egypt were thought to represent this subspecies, but following long debate this idea was eventually rejected on the basis of revised taxonomies (V. Täckholm, G. Täckholm, and Drar 1941: 286–287; Lauer, V. Täckholm, and Åberg 1950: 135). Wheat discovered at el-Omari and the Djoser step pyramid was initially identified as einkorn (Debono 1948: 568; Lauer, V. Täckholm, and Åberg 1950: 156–157), but was later corrected to emmer (Helbaek 1953, 1955).

Since the late 1970s, due to developments in Egyptian archaeology, including the growth of archaeobotany, the use of flotation systems and fine-mesh sieving for the recovery of charred plant macro-remains, and an increase in the number of excavations at ancient settlements, the study of cereals (and ancient plants in general) has become highly sophisticated. The early reports by archaeobotanists on the recovered charred plant macro-remains discussed specific topics relating to cereal production such as early intensification and land use strategies (Wetterstrom 1986; Crawford 2003). Today, specialists are looking into issues such as the precise dating of the introduction of free-threshing wheats into Egypt (e.g., Agut-Labordère et al. 2020) and the agro-economics of wheat and barley in pre-Ptolemaic pharaonic Egypt (e.g., Malleson 2025; Malleson and el-Dorry 2025).

When, and from where, were the species introduced?

During the late nineteenth and early twentieth centuries, it was thought that Egypt was among the regions in which cereal domestication had taken place, perhaps even earlier than in the "Fertile Crescent" (de Candolle 1884: 17; Vavilov 1926; Childe 1936). By the mid-1950s, this was questioned on the basis of archaeological discoveries, and Hans Helbaek proposed the theory (now accepted as correct) that cereals that had been domesticated in western Asia then migrated into Egypt (Helbaek 1953: 4). The discovery of a few grains of domestic barley (and grinding stones) at Wadi Kubbaniya in the 1970s (site dated to c. 16,000 BCE) seemed to turn that theory on its head (Wendorf et al. 1979; Wendorf and Schild 1984). However, radiocarbon dates were not taken on the grains because the technology of the time did not allow for the dating of small quantities. In the mid-1980s the team was able to obtain AMS ^{14}C dates for the grains, and the results showed that they were considerably less ancient than originally thought, disproving any ideas of domestication in Egypt (Hillman 1989; Hillman, Madeyska, and Hather 1989).

It is now recognized that the principal domestic plants and animals that formed the basis of ancient Egyptian farming (sheep, goat, cattle, pig, emmer wheat, and hulled barley) were introduced to northeast Africa from western Asia through the Levant (Wetterstrom 1993; Barich 2016; Shirai 2021; but see Marshall and Hildebrand 2002, Stock and Gifford-Gonzales 2013, and Brass 2018 for debate about cattle). Until recently it was impossible to prove the "origin" of Egyptian cereals, but DNA analysis has now indicated that ancient Egyptian emmer was indeed related to southern Levantine wheats (Scott et al. 2019). Following the domestication of cereals in western Asia between 11,600 and 9,900 BCE (see, e.g., Flannery 1973; Nesbitt 2002; Zeder 2011; Asouti and Fuller 2012; Willcox 2012a, 2012b; Zohary, Hopf, and Weiss 2012; Asouti and Fuller 2013), varying elements of the so-called "Neolithic crop package" are known to have gradually and

unevenly spread northeast to central Asia (Spengler and Willcox 2013; Spengler 2015), west to Cyprus (Peltenberg, Colledge, Croft, et al. 2000, 2001), and southwest to Egypt—replacing the existing practices of wild grass exploitation (Wetterstrom 1993; Barich 2016; Shirai 2021; Malleson fc.).

Just five sites provide good archaeobotanical evidence for the earliest presence of domestic cereals in Egypt: the north Fayum shore, Merimde Beni Salama, el-Omari, Kharga Oasis, and Sais (Sa el-Hagar). The precise chronology of these sites is hard to determine due to the lack of sufficient numbers of reliable radiocarbon dates. ^{14}C dating has placed the earliest Fayum samples at c. 5,000 BCE (± 500 years) (Wendrich, Taylor, and Southon 2010: 1000). Merimde samples have an oldest possible date of c. 4,800 BCE (± 60 years) (Hassan 1985: 98), while Kharga samples date between c. 4,800 – 4,100 BCE (Briois et al. 2012: Table 1), and the el-Omari samples between c. 4,500 – 4,100 BCE (Wilson 2006: 100). The Sais samples have been placed between 4,700 – 4,400 BCE on the basis of comparative typologies (Wilson, Gilbert, and Tassie eds. 2014: 160). At these sites, remains of both domestic barley and emmer were recovered, alongside some specimens of club wheat and einkorn. Both club and einkorn wheats were clearly identified by the archaeobotanists as being incidental crop weeds, not deliberately cultivated, and certainly not staples (Caton-Thompson and Gardner 1934; Werth 1939; Helbaek 1955; Barakat 1990; Cappers 2012, 2016; Clapham 2014; Holdaway and Wendrich eds. 2017).

The general lack of well-dated settlement sites dating to the "Neolithic" – Predynastic transition in Egypt means that at present it is impossible to chart the spread of cereals along the Nile. However, clear evidence for cultivation of emmer and barley at Egyptian sites such as Naqada and Hierakonpolis dating to the early Predynastic Period (4,000 – 3,400 BCE) does indicate a swift uptake/adoption of the new crops across the country (see, e.g., Wetterstrom 1986; el-Hadidi, Fahmy, and Willerding 1996; Cappers, Van Thuyne, and Sikking 2004; Fahmy, Friedman, and Fadl 2008; E. Attia et al. 2018).

Despite the fact that domesticated free-threshing wheats—durum wheat and bread wheat—appeared in western Asia not long after emmer (the earliest evidence dates to c. 9,200 BCE: Nesbitt 2002; Willcox 2012b), and thus were being cultivated at the time the "crop package" entered Egypt, they were not established within Egyptian agriculture until the fourth century BCE at the earliest. Around the middle of the Ptolemaic Period (c. 200 BCE) durum became the staple wheat, replacing emmer (Cappers 2012, 2016; Agut-Labordère et al. 2020), but it was not until the modern period (1970s) that bread wheat became the staple wheat crop in Egypt (Cappers 2012, 2016). Other Classical and modern cereal introductions include millet, domestic sorghum, rice, and maize (Cappers 2012, 2016).

The persistent, but only occasional, presence of einkorn, bread wheat, club wheat, and durum wheat grains and chaff in some pre-Ptolemaic botanical assemblages is not valid evidence that they were ever deliberately cultivated during the traditional Pharaonic Period: they were certainly never staples. It is quite possible that they were introduced alongside emmer and barley from Western Asia during the fifth millennium BCE, but not adopted as primary crops. Most of the pre-Ptolemaic identifications of einkorn, club, bread, and durum wheats come from Pre- or Protodynastic sites, indicating that even if these were cultivated early in Egyptian history (still unproven), they were definitely not adopted into the ancient Egyptian agricultural regime. The extremely low relative presence of these species in samples from the Old Kingdom through Late Period, and the almost complete lack of chaff (a significant marker of cultivation), are more indicative of their being minor crop weeds, alongside the many other taxa infesting cereal crops.

Ancient Egyptian Cereal Cultivation

There can never be any question that the success of ancient Egyptian farming relied on the natural hydrology of the Nile. Without its

annual inundation and fertile floodplain, cereal cultivation would have been impossible. The level of the Nile in ancient Egypt started to rise in July, reaching a peak in August. By September, the flood was over, and between October and November the basins drained naturally, leaving a layer of rich, wet, nutrient-rich silt across the floodplain, creating a patchwork of farmland of varying quality (Murray 2000).

The nutrients in the inundation silts derive from the breakdown of minerals and organic matter that were carried in the floods from the southern regions of the Nile and deposited in the floodplain; much of the fertility is derived from volcanic input (Williams 2019: 53). Technically, the Nile in Egypt is an alluvial floodplain: the soils are vertisols (clay-rich soils), formed on the alluvial silts and clays (Millington 1993: 12; Khalifa and Moussa 2017: 82; Williams 2019: 47–54). The precise chemical and mineral composition of the silt/clay/soils varies throughout Egypt, due to variations in the form of the Valley, and the velocity, duration, and quantity of flooding throughout the Valley and Delta (Foaden 1908: 22–23; Williams 2019: 54). The mineral composition is not always the most important factor in soil fertility: soil bacteria (the soil microbiome) and water (presence, absence, salinity) are also vital (Foaden 1908: 22–28). We have no records of ancient Egyptian soils prior to the inception of country-wide perennial irrigation in the nineteenth century CE, but pre-Aswan Dam measurements show that the soils were rich in essential minerals: nitrogen, phosphorus, sulfur, potassium, calcium, magnesium, and iron. Perennial irrigation (implemented in the nineteenth century) and the construction of the Aswan High Dam (1960s) have caused irreversible degradation to the soil in Egypt. The water table is rising (causing damage to monuments) and is increasingly saline due to the lack of the flood washing the salts out of the soil, and the country has, in consequence, become dependent on chemical fertilizers (Foaden 1908; Millington 1993; Khalifa and Moussa 2017). It was the regular deposition of nutrient-rich silt that facilitated ancient Egyptian agriculture, enabling the Egyptians to cultivate cereals successfully.

Anciently, following the receding of the waters after the inundation, some land may have been ploughed or hoed (tilled) to loosen the soils before seed-grain was "broadcast" (sown). Animals (sheep/goat) would have sometimes been used to trample in grains, and occasionally seeds were ploughed-in. The land would then have been left with little or no intervention before harvest about six months later, sometime between February and May (Murray 2000). The timing of activities varied, with southern farmers working on an earlier "schedule" than northern ones due to the simple fact that the inundation moved from south to north, meaning that the southern farmers started their work a few weeks earlier. Until the implementation of perennial irrigation by Mohammad Ali in the 1800s (primarily driven by the desire to produce cotton), Egyptians had followed the same regular annual cycle of agricultural work, dependent on the inundation, with minimal intervention. There were no formalized "irrigation" systems (reliant on canals) for agriculture in Egypt prior to the Ptolemaic Period, when large-scale interventions took place in the Fayum (Malleson 2019: 110–113); instead, farmers implemented small- and local-scale management of the basin system.

Shaduf water-lifting devices do appear in funerary art (non-royal tombs), but there are remarkably few images of them, and these depictions are restricted to small vegetable plots and palace pleasure-garden contexts: they are never depicted in association with crops. Their earliest occurrences date to the 18th Dynasty at Luxor and el-Amarna (Neferhotep TT50, Meryre TA4), hinting that they were introduced alongside various other technologies (e.g., horses, chariots) during the Second Intermediate Period. The shaduf continued to be used in Egypt until recently (fig. 2). In pharaonic Egypt its use was almost certainly devoted to irrigating smaller (vegetable) plots during the low-water season (Eyre 1994). Pots of water suspended on a yoke being carried to small vegetable plots are depicted in non-royal tombs from the Old

Figure 2. Facsimile by Norman de Garis Davies from the New Kingdom tomb of Ipuy at Deir el-Medina, depicting a shaduf being used to water a garden containing a pomegranate tree, and possibly an olive tree.

Figure 3. Partial scenes from the Old Kingdom tombs of Mereruka (left), Niankhkhnum and Khnumhotep (right) at Saqqara, depicting pots of water being tipped into garden plots of (romaine) lettuces.

Figure 4. A crop of bread wheat infested with canary grass and rumex, western Delta.

Kingdom onwards (e.g., Duell 1938a: plate 21; Moussa and Altenmüller 1977: abb. 8). As with the shaduf, this method was restricted to gardens and would never have been used to irrigate cereal crops (fig. 3) (Eyre 1994; Murray 2000; Cappers 2012, 2016).

The Ecology of Ancient Egyptian Cereal Fields

Prior to the invention of herbicides during the Second World War farmers (globally) had to rely exclusively on manual methods to manage weeds in crops, either by the removal of unwanted plants by hand ("weeding" or "rogueing"), strategic sowing to minimize the chances of weed survival, or by the painstaking removal of weed species seeds from seed-grain. However, the perceived need for a "clean" crop is very subjective, depending to a great extent on patterns and allocation of pre- and postharvest labor, use of by-products, and the need (or lack thereof) to maximize crop yields. Even today, many Egyptian fields still contain a rich variety of "weeds" (fig. 4).

It will never be possible for us to know the full range of weedy plants that grew in ancient Egyptian cereal fields. For (probably) symbolic reasons, tomb scenes of fields being harvested show weed-free cereals, with just a small number of exceptions, e.g., the tomb of Mereruka at Saqqara (fig. 5) and the tomb of Menna (TT69) (Duell 1938b: plate 169; Hartwig ed. 2013: fig. 2.3a). Archaeobotanical work is therefore crucial, being the only good source of data for weed plants. While only those plants that had matured (formed seeds) at the time of harvest are found, the archaeobotanical evidence is not only vital, but frequently rich and always highly informative; this was identified early in the history of Egyptian archaeobotany (Unger 1866, 1867; Newberry in Petrie 1890: 50).

Based on the results of systematic archaeobotanical investigations at settlement sites in Egypt, a broad range of species can be identified as having been cereal crop weeds in ancient Egypt, and we can infer that fields

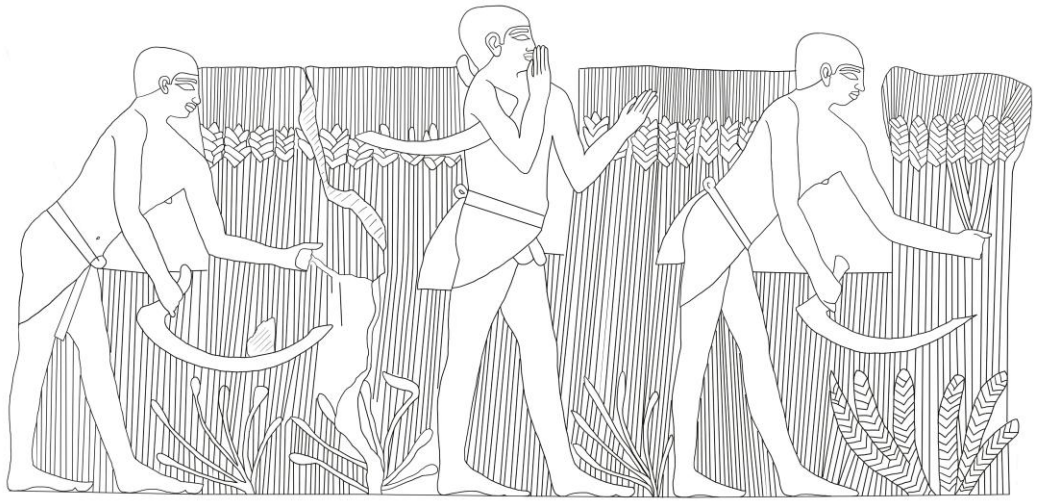

Figure 5. Detail from a harvest scene from the Old Kingdom tomb of Mereruka, Saqqara. Weeds, the shorter non-cereal plants growing low in the field, are clearly depicted, but it is not possible to reliably identify them.

were "infested" with these non-cereal plants (see de Vartavan 1990 for information from Tutankhamun's grain baskets; Fahmy 1997; Malleson 2020). The relative abundance or presence of crop-weeds would have varied greatly between different areas of Egypt, and most likely also between different fields, dependent on their location within the floodplain and the varied moisture levels/quality of the soils. Careful statistical analyses of the diversity, relative quantities, and ubiquity of crop-weed taxa have been very revealing, providing information about long- and short-term shifts in local environmental conditions and changing agricultural strategies (Crawford 2003; Malleson 2021).

Figure 6. Detail showing sieving as part of an Old Kingdom cereal-processing scene in a relief from the Saqqara tomb of Kaemrahu.

The reduction in crop yield due to weeds may not have been as problematic as we might assume, since farmers were clearly able to produce sufficient quantities of the cereals as long as the flood was not catastrophic. Postharvest processing would have been a lengthy and tedious process, with endless sieving to remove seed and grain "contaminants" prior to malting or grinding, but this was likely accepted as inevitable, being often depicted in tomb scenes (fig. 6) (Hillman 1984, 1985; Murray 2000; D'Andrea and Haile 2002). The fact that so much of the harvest comprised non-cereal plants dramatically increased the quantity of valuable by-products that were used as fuel, fodder, temper in ceramics, mudbrick and plaster, bedding, etc. (van der Veen 1999; Murray 2000, 2009). The weed seeds and unripe plants also incidentally added beneficial

nutrition to by-products used as animal fodder, although they did not constitute an optimally nutritious food source (Redding 2024: 45–49).

The strategy of planting maslins—mixed crops of two or more different plants—is known for some ancient Mediterranean and modern African regions (Jones and Halstead 1995; van der Veen 1995; D'Andrea and Haile 2002; McAlvay et al. 2022). This is usually adopted as an insurance tactic against crop failure, and attempts at reviving this practice to support modern sustainable farming are currently being made (McAlvay et al. 2022; Tarlach 2022). There have not been investigations, as yet, into the possibility of identifying maslins in ancient Egypt.

The Textual Record

A range of different words for cereals or cereal products appear in ancient Egyptian texts and scenes: ***jt*** (***jt-mḥ, jt-šmˁ, jt-dšr***); ***smˁ***; ***bdt/btj*** (***btj-ḥḏt, btj-kmt, btj-dšrt, btj-ḫˁ, btj-ḫrnt, btj-kṯ, btj-Ptḥ***); ***swt***; ***pḫꜣ*** (***pḫꜣ-mḥ, pḫꜣ-šmˁ***); ***šs***; ***sšr*(*w*)**; ***dḏw***; ***bšꜣ***. The "correct" translation of most of these terms is unclear. As highlighted by Germer (Germer 1998), identifying or finding appropriate translations of ancient Egyptian words for plants is rife with problems. The names given to plants in any language vary greatly, both through time and across regions. Farmers often use different words to authorities dealing with their products, and colloquialisms also play a large role (Murray 2000: 512). A good example is the use of the word "corn" in English. Until around the turn of the millennium, "corn" was used in the United Kingdom to mean any kind of grain crop, while "sweetcorn" referred to maize. Thanks to the influence of American culture, "corn" is now widely used in the American way to refer to maize. The evidence from ancient Egypt is almost exclusively the official record, created by officials (administrative documents), or by scribes/artists (inscriptions in temples, tombs, on stelae, etc.). So, while we can safely assume that "official" terms were used, we should never assume that the names of cereals or cereal products/by-products remained the same (Murray 2000: 512). Rather, due to the many external influences and the immigration into Egypt from various neighboring regions, as well as the simple passage of time, we should assume that names and meanings *did* change though time and varied throughout Egypt; even modern scientific botanical taxonomy does not remain stable (Bowker 1999; Gledhill 2008).

Another important consideration is the fact that traditional (non-mechanized, non-industrialized) farming communities today utilize a wide range of terms for different grades of cereal products/by-products. Glume wheats and hulled barley require various stages of processing to reach their final "clean grain" stage—ethnographic work clearly shows, for example, that people do not begin with hulled/glumed grains and simply clean them before grinding them. Moreover, the idea that the results of ancient cereal-processing were a clearly defined final product (clean grains) and a by-product (glumes, hulls, rachises) is too simplistic. A late 1990s study in the Tigrai region of Ethiopia (D'Andrea and Haile 2002) recorded nine different terms for different admixtures of (emmer) grains/chaff. The study also showed that even with each kind of admixture theoretically comprising a specific mix of items, the botanical content of samples varied greatly. The idea that some of the ancient Egyptian terms might refer to, for example, unprocessed v. processed (clean) grain has been suggested (Florès 2015: 299–300). Some of the terms may well have been used for different types of partially processed product or different admixtures of grains/by-products, or even maslins, and the usage of these terms will most probably have differed geographically (even in the official record), and through time. The crucial economic value of by-products, which would have been stored and transported/traded, should not be underestimated (van der Veen 1999; Malleson 2025). Additionally, farmers still often use several different names for the same species of cereal, as the present author discovered during a conversation with her brother, a dairy farmer in the UK, when discussing his

feed crops. For example, cereals might be classified/named based on their harvest season, or intended use (human v. animal consumption).

A key to identifying "correct" translations of the Egyptian terms for different cereals/by-products is the context of the words. From the moment a crop is harvested the terminology has the potential to become complex because the processing creates different types of products/by-products. The name for a specific cereal growing in the field may refer explicitly to the cereal at that stage in its life. Anciently, therefore, it seems highly likely that following threshing—the first processing stage—new words would have been used for the different types of products, by-products, and admixtures destined for different uses. Unless the name appears in a text that unequivocally refers to a crop in a field, we cannot be certain what part of the crop the word is describing. It may refer, for example, to a mix of grain and chaff, chaff and straw, spikelets, or de-hulled grains—products destined for use in baking and brewing, as fodder, etc., or for use in various institutions (e.g., temple v. household). For this reason, much of the evidence is not helpful to us when we try to ascertain which words refer specifically to different cereal species or varieties. Old Kingdom non-royal tomb scenes do occasionally contain a "label" in a harvest scene, and the Middle Kingdom Hekanakht Papyri refer directly to crops being cultivated, but other records are less useful. Labels in scenes of storage facilities, in the Lahun Papyri, and in the many New Kingdom administrative texts that refer almost exclusively to grain transport and storage, cannot safely be used to help us understand which words specified different cereal species/varieties, because they designate cereal products/by-products postharvest. Just two names (discussed below) can be firmly identified as referring to actual cereal plants; all other known terms are designations of postharvest cereals, and at present it is not possible to confirm whether any of those words refer to a specific cereal species.

bdt and jt, and Their Variations

The two most frequently attested names throughout the Pharaonic Period are *jt*, and *bdt* (fig. 7). There can be no question that during the Old Kingdom these were the terms for crops of barley and emmer, respectively, due to their appearance as labels in harvest scenes in non-royal mastabas, and these are the only two terms that occur in that context during that period (Florès 2015: 291). The early 12th Dynasty Hekanakht Papyri provide evidence that at least during the early Middle Kingdom *jt-mḥ* was a term for a cereal crop alongside *bdt* (Allen 2002). A mouthful of *jt-šmˁ* from the edge of a field is eaten by the donkey in (some versions of) the Tale of the Eloquent Peasant (Parkinson ed. 1991: 9–11, B1/Bt-30, B1-36, B1-43, B1-41; 1999: 59), indicating that this was a term for a crop being cultivated. There appears to be no evidence from the New Kingdom of words for cereals in contexts that relate specifically to cultivation.

Figure 7. The terms *jt* (top) and *bdt* (bottom) written in hieroglyphs.

The distinction between *jt-šmˁ* (or *šmˁw*) and *jt-mḥ* (or *mḥj*/*mḥw*) has traditionally been thought to refer to geographical differences, due to the fact that *mḥt* translates as Delta and *mḥw* as Lower Egypt (Faulkner 1962: 114), while *šmˁw* means Upper Egypt (Faulkner 1962: 266). *jt-šmˁ* is therefore most often translated as Upper Egyptian barley and *jt-mḥ* as Lower Egyptian barley (Erman and Grapow 1926: 142; Faulkner 1962: 32, 266; Wild 1977; Germer 1998: 84). This has been contested. In 1987 it was suggested that these terms refer to the difference in morphology/appearance between 2-row (*H.*

vulgare subsp. *distichum*), 4-row (*H. vulgare* ssp. *terastichum*; but see the discussion, above, on the correction to this taxonomy), and 6-row barley (*H. vulgare* subsp. *vulgare*, previous classified as *H. hexatichum*). The suggested translation of ***jt-šmˁ*** is "narrow barley" (2-row) and that of ***jt-mḥ*** is "full barley" (6-row) (Müller-Wollermann 1987; Bardoňová 2019: 258). Another suggestion that has been put forward is that the terms refer to different stages in barley processing, so that ***jt-mḥ*** ("full barley") refers to hulled barley and ***jt-šmˁ*** ("narrow barley") to the clean/de-hulled (or de-husked) grain (Florès 2015: 299–300). However, this too has been contested on the grounds that ***jt-šmˁ*** appears as a crop in some sources. A further argument against ***jt-mḥ*** and ***jt-šmˁ*** referring to hulled v. de-hulled barley is the fact that there is no need to de-hull barley to produce good quality flour (Cappers 2016: 29).

A total of seven different types of ***bdt*** are listed in the Third Intermediate Period Onomasticon of Amenemope, although only a few of these types are named in other sources (Gardiner 1947: nos. 494–502). The seven types of emmer (transliterated ***btj*** in this example from the Onomasticon) are distinguished primarily by color: white (***btj-ḥḏt***), black (***btj-kmt***), red (***btj-dšrt***), and orange-red (***btj-kt***). Two types are un-translatable (***btj-ḥrnt***, ***btj-ḥˁ***), and one type (no. 501) is "emmer of Ptah" (***btj-Ptḥ***). Although it is impossible to be certain that these terms refer to crops rather than different admixtures of grain/chaff, the fact that most of the terms differentiate by color does mean they are likely to be literal, and therefore probably refer to different landraces (varieties) of emmer. The colors, of course, are not preserved in ancient specimens, but several differently colored landraces of emmer do exist today, and it is safe to assume that there would have been a number of varieties cultivated in ancient Egypt.

Swt (*Zwt*)

The term ***swt*** (sometimes transliterated ***zwt***) is also relatively commonly found in texts and inscriptions and has been traditionally translated as wheat, or a type of wheat (Erman and Grapow 1929: 426; Faulkner 1962: 218; Wild 1964: 120; Agut-Labordère et al. 2020: 35).

Vivi Täckholm initially specified that ***swt*** referred to free-threshing wheat (*T. aestivum* or *T. durum*), but noted the lack of importance of these species in Egypt prior to the Ptolemaic Period, based on archaeobotanical samples (V. Täckholm, G. Täckholm, and Drar 1941: 253). She later revised this idea, stating that ***swt*** must be einkorn (*T. monoccum*) (Lauer, V. Täckholm, and Åberg 1950: 128), but this, too, cannot be correct. Other suggestions are that it might refer to a "variety of emmer" (Helbaek 1953: 13; Germer 1986), a maslin (or poly-crop) of emmer and barley together (Faltings 1995: 43), or cleaned (de-husked/de-hulled) wheat or barley (Florès 2015: 301; contested by Bardoňová 2019: 265, due to considerations relating to the need to retain the husk for malting; Agut-Labordère et al. 2020: 35, citing Bats' 2019 unpublished doctoral thesis).

A decisive factor in potential translations of ***swt*** is that this term never occurs in direct relationship to cultivation of a crop (Florès 2015: 29; Bardoňová 2019: 262–265). This supports the theories that the word was not used to designate a species/variety of cereal, but referred instead to a cereal at a specific stage of processing, or an admixture of grains, chaff, straw, etc.

Cereals in Ancient Egyptian Funerary and Ritual Contexts

Art

While plants appear in some Pre- and Early Dynastic funerary art (e.g., palettes), the oldest certain depictions of cereals are in Old Kingdom non-royal mastabas, among the "daily life" scenes of agriculture. Possibly the oldest (preserved) tomb with an identifiable scene of cereals is the tomb of Nefer-ʔ, numbered 22 by Petrie, at Maidum (Petrie 1892: fig. XXVIII), dated to the early 4th Dynasty (Scene-Details Database, Linacre College, Oxford: n.d.). The crop is depicted very simply, painted red on a yellow

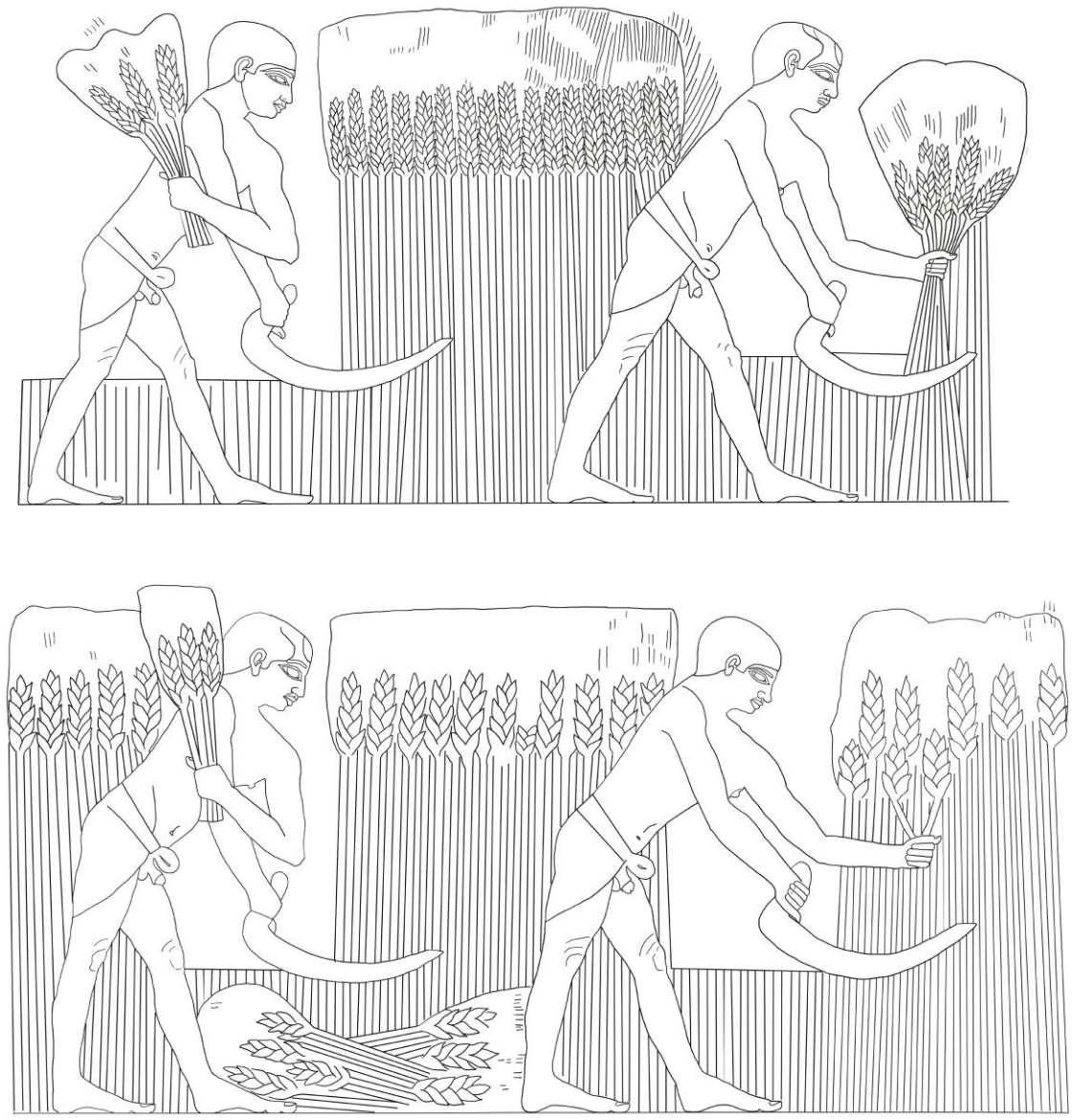

Figure 8. Scenes from the Old Kingdom mastaba of Ti at Saqqara, showing the harvesting of barley (top) and emmer wheat (bottom).

background. There are numerous scenes in 5th and 6th Dynasty tombs depicting cereals either being harvested or prepared for threshing. Among these Old Kingdom scenes, only one—in the mastaba of Ti (Saqqara)—shows both emmer and barley, drawn to show a distinction between the two cereals (fig. 8), while, moreover, the emmer is clearly labeled in the inscriptions (Wild 1966: figs. CLII–CLIII). A fragment of a New Kingdom scene from Deir el-Bahri (JE49926) also depicts the cereals, with a clear differentiation between the two.

Based on the way in which the emmer and barley are drawn in the mastaba of Ti, it is tempting to assign a species identification to the cereals depicted in other tombs, but this would be extremely unwise. The "copy-paste" activities of the ancient artists are well known,

and scenes often contain obvious mistakes due to the lack of knowledge of artists responsible for creating scenes. In the mastaba of Mereruka (Saqqara), for example, the harvest scene appears to depict emmer, but shows one worker with a handful of what looks like barley (Duell 1938b: plate 169). Very few images of cereals are accompanied by an identification, and in many cases the scene was almost certainly designed to represent the generic activity of cereal production, specifically showing neither emmer wheat nor barley in order to "cover all the bases" in the afterlife. And vitally, these scenes were designed to fulfill a specific symbolic purpose, not a detailed literal communication (Murray 2000; Moreno García 2007).

While scenes of cereal production and processing in Middle and New Kingdom non-royal tombs show some stylistic differences from those of the Old Kingdom, and are generally "abbreviated," the essential processes of land-preparation, sowing, harvesting, threshing, winnowing, and storage remained the same. Cereal storage is an issue recently re-examined by several scholars (e.g., Bats 2017; Bardoňová 2019).

Food-offerings

Perhaps the best-known examples of funerary food-offerings are those from the tomb of Tutankhamun. Howard Carter found 128 baskets/jars/granary models containing seeds, grains, and fruits, and took samples from 20 back to London for identification; the samples were stored at Kew Gardens and were only studied in detail in the late 1980s (de Vartavan 1990). While acknowledging that this assemblage relates to a specific and unique context, the fact that many of the samples represented semi-clean grain (e.g., grains and spikelets mixed with weeds) is significant. Analysis of the samples showed that 51% of the total number of identified non-cereals items could be considered to have been field weeds (de Vartavan 1990: 491). Given that we might expect royal food-offerings to represent the "best of the best," the high levels of "contamination" in these stored cereals provides direct evidence of (New Kingdom) field ecology in Egypt.

Figure 9. Middle Kingdom granary model from the tomb of Meketra at Thebes.

Granary models

From the 4th Dynasty onward, Egyptian non-royal tombs of the wealthier, higher-class members of society regularly contained models—that is, three-dimensional versions of the "daily life" scenes that also often decorated the walls. These models fulfilled the same role as funerary goods: to provide everything the body would need in the afterlife, especially sustenance. In the first part of the Old Kingdom these were usually made of stone and featured one person working, but from the late 6th Dynasty they were made of wood, and often represented a building with several workers, e.g., bakeries or breweries (Tooley 1995: 8). The largest collections of these wooden models come from First Intermediate Period and Middle Kingdom burials. Granaries were a regular component of the assemblages of these funerary models, and a small number of them contained cereal grains when they were discovered (fig. 9).

In her survey of these artifacts, Angela Tooley recorded four models from Beni Hassan that contained "grains," some of which were identified as emmer and barley (Tooley 1989: 89–128), but juniper berries are also listed (British Museum: BM EA 41573, n. d.). It is highly likely that all such models contained grains when they were placed in the tombs, but droppings from mice—which probably consumed the grains—provide evidence for why so few models were found with grains inside them (Tooley 1989: 96 notes this specifically for the model of Meketra, but observed droppings in several other models).

Osiris beds, Osiris bricks, and corn (or grain) mummies

Cereals were "considered living and changing substances of a cyclic nature, embodying the ideas of resurrection and revival" (Raven 1982: 7). For this reason, they played an important role in many ancient Egyptian rites and rituals, much as they did in virtually every society around the world—and often continue to do so. Cereals were closely linked with ideas of fertility and regeneration—the cycle of life—and so they played a role in certain festivals and in some burial practices. There are two main categories of "ritual" grain objects: 1) Osiris beds, which date from the New Kingdom (it should be noted here that the term "Osiris bed" refers specifically to the artifacts found in tombs) and 2) corn (or grain) mummies and Osiris bricks, which date primarily to the Late, Ptolemaic, and Roman Periods.

Figure 10. Osiris bricks from the Third Intermediate or Late Period.

Osiris beds are Atef-crowned-Osiris-shaped receptacles made of linen and matting or wood, filled with soil and grains. They relate to the symbolic revival of the deceased, through which the pharaoh (or individual) was connected with Osiris upon death. A total of seven Osiris beds have been found in six royal/high-elite New Kingdom tombs at Thebes, although possible precursors may have existed (Raven 1982; Tooley 1996). The examples from the tombs of Tutankhamun (TT62) and Horemheb (TT57) are particularly fine, comprising well-made wooden boxes containing preserved (but not viable) germinated grains (Raven 1982; Tooley 1996).

Osiris bricks and corn mummies are closely associated with the cult of Osiris and the cult of Ptah-Sokar in Thebes and were featured in the rituals of the Festival of Khoiak, which took place during the fourth month of inundation. These rituals related to the symbolic cyclical revival of Osiris in the afterlife.

Osiris bricks are rectangular, fired-clay objects, with a recess in the shape of a mummiform Osiris wearing the Atef crown (in profile), designed to be filled with soil and cereal grains (fig. 10). Most date to the Late Period, with some examples possibly produced during the Third Intermediate Period (Tooley 1996). Thirteen Osiris bricks registered in museum collections (most of which have no known provenance) were published as a group in the late 1990s (Tooley 1996). Two of the examples still contain (ungerminated and unviable) grains, but most are empty.

Corn (or grain) mummies date largely to the Ptolemaic and Roman Periods, but there are a few earlier examples; at least 70 are present in museum collections. They are small mummiform bundles of soil, sand, clay, and grains, wrapped in linen bandages, coated in resins and oils, wax, or gum, and sometimes contained within small, usually falcon-headed, coffins. Occasionally they also have "masks," hands, false beards, or a phallus (Schultz 2005). Only a small number have been examined by an archaeobotanist, and in those cases, the grain within them proved to be germinated barley (Raven 1997). Most of the corn mummies identified as containing barley (germinated or not) date to the Late Period. They total around nine, of which four were identified as containing just "corn"/"grain" (Raven 1982).

Summary

Cereals played a central role in the lives of ancient Egyptians, in both daily life and in the funerary sphere. They were a staple, as they are today, not only for nutrition but also—as a consequence—in the economy. While today we live in a dangerously globalized world where many of us depend on the stability of "producer" nations to maintain our supply of cereals, ancient Egypt was self-sustaining. Based on improved methods of the recovery of plants from archaeological sites and correct identifications of the species present in Egypt, we know that domesticated cereals were introduced in the mid-fifth millennium BCE, but not all were adopted for cultivation. Emmer wheat and hulled barley became the staple cereals, growing in "weedy" fields along the Nile, and in the Delta and oases. New cereals were introduced into Egypt at later dates: first durum wheat, which replaced emmer wheat during the Ptolemaic Period, then rice, millet, and sorghum by the Roman Period, and finally bread wheat, which replaced durum. Maize was introduced in modern times. Along with the changes in crops, innovations in irrigation appeared with the Ptolemies. Cereals naturally played a key role in the funerary world, being frequently depicted in agricultural scenes (particularly in the Old Kingdom), and occurring in granary models of the Middle Kingdom and, later, as a constituent of the Osiris bricks.

There has been a considerable amount of research into the processing of cereal-foods (e.g., bread and beer) (Samuel 1989, 1993, 1994, 1999, 2000, 2010; Malleson 2017; Warden 2017) and numerous studies on the official administration of farmlands (Menu 1971, 1982, 1998; Katary 1989, 2013, 2014; Eyre 1997, 1999; Moreno García 2001, 2007, 2008, 2014, 2016; Menu ed. 2004). In contrast, the production of cereals—the work

of the farmers—has been generally overlooked. There is, however, a growing trend in the social sciences, spreading now into archaeology, to untangle and investigate the roots of social inequality (Cooney 2021; Graeber and Wengrow 2021). By investigating cereals from a bottom-up rather than top-down point of view, thinking more carefully about the methods and strategies employed by farmers, we can start to gain a more nuanced perspective of ancient Egypt and the lives of the overwhelming majority of the population. This will shed more light on the people who made it possible for the rulers and educated classes of ancient Egypt to build wealth and power and impose a long-lasting social hierarchy.

Bibliographic Notes

The most valuable source for this topic is Murray (2000), which provides a full overview of the evidence for cereals (and cereal processing) in ancient Egypt. The more general "Flora of Ancient Egypt" (Malleson 2020) provides additional background on archaeological and Egyptological methods, and the history of the subject. Studies of the shifts in cultivation of different crops include Cappers (2012, 2016) and Agut-Labordère et al. (2020). Currently, the most comprehensive review of the introduction of cereals into Egypt is Wetterstrom (1993), but new work is in progress (Malleson fc.). Field-weed ecology is summarized in lists presented by Fahmy (1997) and by Malleson (2020). The most comprehensive survey of the terms used for cereals is (currently) Florès (2015). For terms used for granary models, see Tooley (1989), and for Osiris bricks or beds, see Tooley (1996). A good reference for the publications of (Old Kingdom) agricultural scenes is the Oxford Expedition to Egypt Scene-Details Database, Linacre College: https://doi.org/10.5284/1000009, and for the Middle Kingdom, see the Meketre Scene Repository, Universität Wien: https://meketre.org/. A valuable list of agricultural scenes in non-royal Theban tombs is provided in a recent publication of the tomb of Khaemhat (A. Attia 2022), drawn from the *Topographical Bibliography* of Porter and Moss (1970). For discussion of aspects of cereal cultivation, processing, and field ecology in archaeobotanical reports/research papers, see Moens and Wetterstrom (1988); Thanheiser (1996); Barakat and Fahmy (1999); Crawford (2003); Cappers (2006); E. Attia et al. (2021); Malleson (2016, 2021, 2025); and Malleson and el-Dorry (2025).

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References

Agut-Labordère, Damien, Charlène Bouchaud, François Lerouxel, and Claire Newton
2020 De l'amidonnier au blé dur: Un changement dans la céréaliculture égyptienne dans la seconde moitié du I^er^ millénaire a. C. In *Le changement dans les économies antiques*, ScriptaAntiqua 140, ed. François Lerouxel and Julien Zurbach, pp. 29–80. Bordeaux: Éditions Ausonius.

Allen, James P.
2002 *The Heqanakht Papyri*. The Metropolitan Museum of Art Egyptian Expedition. New York: Metropolitan Museum of Art.

Asouti, Eleni, and Dorian Fuller
2012 From foraging to farming in the Southern Levant: The development of epipalaeolithic and pre-pottery neolithic plant management strategies. *Vegetation History and Archaeobotany* 24, pp. 149–162.

2013 A contextual approach to the emergence of agriculture in Southwest Asia. *Current Anthropology* 54(3): 299–345.

Attia, Amany Hussein Ali
2022 *Tomb of Kha-em-hat of the Eighteenth Dynasty in Western Thebes (TT57)*. Archaeopress Egyptology 35. Oxford: Archaeopress.

Attia, Elshafaey A. E., Claire Malleson, Ahmed G. Fahmy, and Giulio Lucarini
2021 New data on plant use in the Eastern Sahara: The macro-remain assemblage from Shiekh el-Obeiyid villages and Bir el-Obeiyid Playa, Farafra Oasis, Egyptian Western Desert. *Journal of African Archaeology*, pp. 1–24. https://doi.org/10.1163/21915784-bja10009.

Attia, Elshafaey A. E., Elena Marinova, Ahmed G. Fahmy, and Masahiro Baba
2018 Archaeobotanical studies from Hierakonpolis: Evidence for food processing during the Predynastic Period in Egypt. In *Plants and people in the African past*, ed. Anna Maria Mercuri, A. Catherine D'Andrea, Rita Fornaciari, et al., pp. 76–89. New York: Springer.

Barakat, Hala
1990 Plant remains from El Omari. In *El-Omari: A Neolithic settlement and other sites in the vicinity of Wadi Hof, Helwan*, ed. Fernand Debono and Bodil Mortensen, pp. 109-111. Mainz am Rhein: Philipp von Zabern.

Barakat, Hala, and Ahmed G. Fahmy
1999 Wild grasses as "Neolithic" food resources in the Eastern Sahara. In *The exploitation of plant resources in ancient Africa*, ed. Marijke van der Veen, pp. 33–46. New York: Kluwer.

Bardoňová, Martina
2019 *Grain storage in ancient Egypt (2600 – 1650 BC): Typology and socio-economic considerations*. PhD dissertation. Prague: Charles University.

Barich, Barbara E.
2016 The introduction of Neolithic resources to North Africa: A discussion in light of the Holocene research between Egypt and Libya. *Quaternary International* 410, pp. 198–216.

Bats, Adeline
2017 Le stockage des céréales dans l'Égypte pharaonique: Aspects, techniques et stratégies économiques. In *Les céréales dans le monde antique: Regards croisés sur les stratégies de gestion des cultures, de leur stockage et de leurs modes de consommation*, NeHeT 5, ed. Adeline Bats, pp. 155–177. Paris: Centre de recherches égyptologiques de la Sorbonne.
2019 *Les céréales et les produits céréaliers au Moyen Empire: Histoire technique et économique*. Unpublished doctoral thesis. Paris: Sorbonne Université.

Beauverie, Marie-Antoinette
1935 Description illustrée des végétaux antiques du Musée égyptien du Louvre. *Bulletin de l'Institut français d'archéologie orientale* 35, pp. 115–151.

Bonnet, Edmond
1895 Le piante Egiziane del Museo Reale di Torino. *Nuovo Giornale Botanico Italiano, Nuova Serie* 2(1): pp. 21–28.

Bowker, Geoffrey, C.
1999 The game of the name: Nomenclatural instability in the history of botanical informatics. In *Proceedings of the 1998 Conference on the History and Heritage of Science Information Systems*, ed. Mary Ellen Bowden, Trudi Belardo Hahn, and Robert V. Williams, pp. 74–83. Medford: American Society for Information Science.

Brass, Michael
2018 Early North African cattle domestication and its ecological setting: A reassessment. *Journal of World Prehistory* 31(1), pp. 81–115.

Braun, Alexander
1877 Die Pflanzenreste des ägyptischen Museums in Berlin. *Zeitschrift für Ethnologie* 9, pp. 289–310.

Briois, François, Béatrix Midant-Reynes, Sylvie Marchand, and Yann Tristant
2012 Neolithic occupation of an artesian spring: KS043 in the Kharga Oasis, Egypt. *Journal of Field Archaeology* 37(3), pp. 178–191.

British Museum
n.d. Model group: Middle Kingdom, Beni Hassan. British Museum Images. Accessed August 1, 2022. https://www.bmimages.com/preview.asp?image=00559726001.

Cappers, René
2006 The reconstruction of agricultural practises in ancient Egypt: An ethnographical approach. *Palaeohistoria* 47(48), pp. 429–446.
2012 Modelling shifts in cereal cultivation in Egypt from the start of agriculture until modern times. In *Annual Report of the Netherlands Institute for the Near East 2012*, ed. J. Eidern and C. H. van Zoest, pp. 20–31. Leiden: Nederlands Instituut voor het Nabije Oosten.
2016 Modelling shifts in cereal cultivation in Egypt from the start of agriculture until modern times. In *News from the past: Progress in African archaeobotany: Proceedings of the 7th International Workshop on African Archaeobotany in Vienna, 2 – 5 July 2012*, Advances in Archaeobotany 3, ed. Ursula Thanheiser, pp. 27–36. Eelde, NL: Barkhuis.
Cappers, René, Thijs Van Thuyne, and Laila Sikking
2004 Plant remains from Predynastic el-Abadiya-2 (Naqada area, Upper Egypt). In *Egypt at its origins: Studies in memory of Barbara Adams*, Orientalia Lovaniensia Analecta, ed. Stan Hendrickx, Renée F. Freidman, Krzysztof Cialowicz, and Marek Chlodnicki, pp. 277–293. Leuven: Peeters.
Caton-Thompson, Gertrude, and Elinor Wight Gardner
1934 *The desert Fayum*. London: Royal Anthropological Institute of Great Britain and Northern Ireland.
Childe, V. Gordon
1936 *Man makes himself*. Reprint 1962. New York: New American Library of World Literature.
Clapham, Alan
2014 Archaeobotanical analysis. In *Sais II: The Prehistoric period at Sa el-Hagar*, ed. Penelope Wilson, Gregory Gilbert, and Geoffrey Tassie, pp: 149–151. London: Egypt Exploration Society.
Cooney, Kara
2021 *The good kings: Absolute power in ancient Egypt and the modern world.* Washington, D.C.: National Geographic.
Crawford, Patricia
2003 Weeds as indicators of land-use strategies in ancient Egypt. In *Food, fuel and fields: Progress in African archaeobotany*, Africa Praehistorica 15, ed. Katharina Neumann, Ann Butler, and Stephanie Kahlheber, pp. 107–122. Köln: Heinrich Barth Institut.
D'Andrea, A. Catherine, and Mitiku Haile
2002 Traditional emmer processing in highland Ethiopia. *Journal of Ethnobiology* 22(2), pp. 179–217.
Debono, Fernand
1948 El-Omari (près d'Hélouan): Exposé sommaire sur les campagnes des fouilles 1943 – 1944 et 1948. *Annales du Service des Antiquités de l'Égypte* 48, pp. 561–569.
de Candolle, Alphonse
1884 *Origin of cultivated plants*. London: Kegan Paul, Trench & Co.
de Vartavan, Christian
1990 Contaminated plant-foods from the tomb of Tutankhamun: A new interpretative system. *Journal of Archaeological Science* 17(5), pp. 473–494.
Duell, Prentice
1938a *The mastaba of Mereruka, Part 1: Chambers A 1–10*. The University of Chicago Oriental Institute Publications 31. Chicago: The University of Chicago Press.
1938b *The mastaba of Mereruka, Part II: Chambers A 11–13*. The University of Chicago Oriental Institute Publications 39. Chicago: The University of Chicago Press.
el-Hadidi, M. Nabil, Ahmed Fahmy, and U. Willerding
1996 The palaeoethnobotany of Locality 11C, Hierakonpolis (3800 – 3500 BC), Egypt. *Taeckholmia* 16, pp. 45–61.
Elliot Smith, Grafton
1927 The beginning of agriculture. *Nature* 119(2985), pp. 81–82.
Erman, Adolf, and Hermann Grapow
1926 *Wörterbuch der aegyptischen Sprache,* Vol. 1. Leipzig: J. C. Hinrichs.
1929 *Wörterbuch der aegyptischen Sprache,* Vol. 3. Leipzig: J. C. Hinrichs.
Eyre, Christopher
1994 The water regime for orchards and plantations in pharaonic Egypt. *Journal of Egyptian Archaeology* 80, pp. 57–80.
1997 Peasants and "modern" leasing strategies in ancient Egypt. *Journal of the Economic and Social History of the Orient* 40(4), pp. 367–390.

1999 The village economy in pharaonic Egypt. In *Agriculture in Egypt: From pharaonic to modern times*, Proceedings of the British Academy 96, ed. Alan K. Bowman and Eugene Rogan, pp. 33–60. Oxford: Oxford University Press.

Fahmy, Ahmed G.
1997 Evaluation of the weed flora of Egypt from Predynastic to Graeco-Roman times. *Vegetation History and Archaeobotany* 6, pp. 241–247.

Fahmy, Ahmed G., Renée F. Friedman, and Mohamed Fadl
2008 Archaeobotanical studies at Hierakonpolis Locality HK6: The Pre and Early Dynastic elite cemetery. *Archéo-Nil* 18, pp. 169–183.

Faltings, Dina
1995 *bšꜣ* und *zwt* – Zwei ungeklärte Begriffe der Getreidewirtschaft im Alten Reich. *Göttinger Miszellen* 148, pp. 35–44.

Faulkner, Raymond O.
1962 *A concise dictionary of Middle Egyptian*. Oxford: Griffith Institute.

Flannery, Kent
1973 The origins of agriculture. *Annual Review of Anthropology* 2, pp. 271–310.

Florès, Jérémie
2015 *Les céréales: Analyse d'une gestion au Protodynastique et sous l'Ancien Empire*. Studien zur Altägyptischen Kultur, Beihefte 17. Hamburg: Helmut Buske Verlag.

Foaden, George P.
1908 *Text-book of Egyptian agriculture*, Vol. 1. Cairo: National Printing Department.

Gardiner, Alan H.
1947 *Ancient Egyptian onomastica: Text*, Vol. II. Oxford: Oxford University Press.

Germer, Renate
1986 Weizen. In *Lexikon der Ägyptologie*, Vol. VI, ed. Wolfgang Helck and Wolfhart Westendorf, columns 1209–1210. Wiesbaden: Otto Harrassowitz.
1998 The plant material found by Petrie at Lahun and some remarks on the problems of identifying Egyptian plant names. In *Lahun Studies*, ed. Stephen Quirke, pp. 84–91. Reigate: SIA.

Gledhill, David
2008 *The names of plants*. Fourth edition. Cambridge: Cambridge University Press.

Graeber, David, and David Wengrow
2021 *The dawn of everything: A new history of humanity*. New York: Farrar, Straus and Giroux.

Hartmann, Fernande
1923 *L'agriculture dans l'ancienne Égypte*. Paris: Librairies – Imprimeries Réunies.

Hartwig, Melinda (ed.)
2013 *The tomb chapel of Menna (TT69): The art, culture and science of painting in an Egyptian tomb*. The American Research Center in Egypt Conservation Series 5. New York: The American Research Center in Egypt.

Hassan, Fekri
1985 Radiocarbon chronology of neolithic and predynastic sites in Upper Egypt and the Delta. *The African Archaeological Review* 3, pp. 95–115.

Helbaek, Hans
1953 Queen Icheti's wheat: A contribution to the study of Early Dynastic emmer of Egypt. *Kongelige Danske Videnskabernes Selskab, Biologiske Meddelelser* 21(8), pp. 1–22.
1955 Ancient Egyptian wheats. *Proceedings of the Prehistoric Society* 21, pp. 93–95.

Hillman, Gordon
1984 Traditional husbandry and processing of archaic cereals in recent times: The operations, products and equipment which might be featured in Sumerian texts, Part 1: The glume wheats. *Bulletin on Sumerian Agriculture* 1, pp. 114–152.
1985 Traditional husbandry and processing of archaic cereals in recent times: The operations, products and equipment which might be featured in Sumerian texts, Part 2: The free-threshing cereals. *Bulletin on Sumerian Agriculture* 2, pp. 1–31.
1989 Late palaeolithic plant foods from Wadi Kubbaniya in Upper Egypt: Dietary diversity, infant weaning, and seasonality in a riverine environment. In *Foraging and farming: The evolution of plant exploitation*, One World Archaeology 13, ed. David R. Harris and Gordon Hillman, pp. 207–239. London and Boston: Unwin Hyman.

Hillman, Gordon, Ewa Madeyska, and Jonathan Hather
1989 Wild plant foods and diet at Late Paleolithic Wadi Kubbaniya: The evidence from charred remains. In *The prehistory of Wadi Kubbaniya, Volume 2: Stratigraphy, paleoeconomy, and environment*, ed. Angela E. Close; assembled by Fred Wendorf and Romuald Schild, pp. 162–242. Dallas: Southern Methodist University Press.

Holdaway, Simon J., and Willeke Wendrich (eds.)
2017 *The desert Fayum reinvestigated: The early to mid-Holocene landscape archaeology of the Fayum North Shore, Egypt*. Los Angeles: The Cotsen Institute of Archaeology Press.

Jones, Glynis, and Paul Halstead
1995 Maslins, mixtures and monocrops: On the interpretation of archaeobotanical crop samples of heterogeneous composition. *Journal of Archaeological Science* 22(1), pp. 103–114.

Katary, Sally L. D.
1989 *Land tenure in the Ramesside Period*. New York: Kegan Paul International.
2013 The administration of institutional agriculture in the New Kingdom. In *Ancient Egyptian administration.*, ed. Juan Carlos Moreno García, pp. 719–784. Leiden: Brill.
2014 The Wilbour Papyrus and the management of the Nile riverbanks in Ramesside Egypt: Preliminary analysis of the types of cultivated Land. In *Riparia, un patrimoine culturel: La gestion intégrée des bords de l'eau*, BAR International Series 2587, ed. Ella Hermon and Anne Watelet, pp. 199–215. Oxford:Archaeopress.

Kenrick, John
1850 *Ancient Egypt under the pharaohs*, Vol. 1. Clinton Hall, New York: Redfield.

Khalifa, H. E., and H. A. Moussa
2017 Soil and agriculture after the Aswan High Dam. In *Irrigated agriculture in Egypt: Past, present and future*, ed. Masayoshi Satoh and Samir Aboulroos, pp. 81–124. New York: Springer.

Kunth, Karl
1826 Recherches sur les plantes trouvées dans les tombeaux égyptiens par M. Passalacqua. *Annales des Sciences Naturelles* 8, pp. 418–423.

Lauer, Jean-Philippe, Vivi Täckholm, and Ewert Åberg
1950 Les plantes découvertes dans les souterrains de l'enceinte du Roi Zoser à Saqqarah (III^{e} Dynastie). *Bulletin de l'Institut français d'archéologie orientale* 32, pp. 121–157.

Malleson, Claire
2016 Informal intercropping of legumes with cereals? A reassessment of clover abundance in ancient Egyptian cereal processing by-product assemblages: Archaeobotanical investigations at Khentkawes Town, Giza (2300 – 2100 BC). *Vegetation History and Archaeobotany* 25(5), pp. 431–442.
2017 The logistics of bread production in Old Kingdom Egypt: A nutritional perspective. In *Exploring the materiality of food "stuffs": Transformations, symbolic consumption and embodiments*, Routledge Studies in Archaeology 23, ed. Louise Steel and Katharina Zinn, pp. 131–151. Abingdon: Routledge.
2019 *The Fayum landscape: Ten thousand years of archaeology, texts, and traditions in Egypt*. Cairo: The American University in Cairo Press.
2020 Flora of ancient Egypt. In *The Oxford handbook of Egyptology*, ed. Ian Shaw and Elizabeth Bloxam, pp. 125–150. Oxford: Oxford University Press: https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199271870.001.0001/oxfordhb-9780199271870-e-5.
2021 Agriculture and environment in the Wadi Tumilat, Egypt, 2nd – 1st millennium BC. *Journal of Archaeological Science: Reports* 37: 102942.
2025 The management of agricultural resources in ancient Egypt: Production and storage of by-products. *Journal of Egyptian Archaeology* 111: https://doi.org/10.1177/03075133251338862.
fc. *Cereals and society: The agricultural foundations of ancient Egypt.* Cambridge Elements. Cambridge, UK: Cambridge University Press.

Malleson, Claire, and Mennat Allah el-Dorry
2025 Assessing ancient agricultural regimes: A case study of the Egyptian Nile Delta. *Journal of Field Archaeology* 50(6), pp. 544–557. https://doi.org/10.1080/00934690.2025.2508088

Marshall, Fiona, and Elisabeth Hildebrand
2002 Cattle before crops: The beginnings of food production in Africa. *Journal of World Prehistory* 16(2), pp. 99–143.

McAlvay, Alex, Anna DiPaola, A. Catherine D'Andrea, et al.
2022 Cereal species mixtures, an ancient practice with potential for climate resilience: A review. *Agronomy for Sustainable Development* 42(5): 100:1-17. https://doi.org/10.1007/s13593-022-00832-1.

Menu, Bernadette
1971 Le régime juridique des terres en Égypte pharaonique: Moyen Empire et Nouvel Empire. *Revue historique de droit français et étranger* 49(4), pp. 555–585.
1982 *Recherches sur l'histoire juridique, économique et sociale de l'ancienne Égypte (gathered papers)*. Versailles: Bernadette Menu.
1998 *Recherches sur l'histoire juridique, économique et sociale de l'ancienne Égypte II (gathered papers)*. Bibliothèque d'étude 122. Cairo: Institut français d'archéologie orientale.

Menu, Bernadette (ed.)
2004 *La dépendance rurale dans l'antiquité égyptienne et proche-orientale*. Bibliothèque d'étude 140. Cairo: Institut français d'archéologie orientale.

Millington, A. C.
1993 Physiography, geology, and soils. In *The agriculture of Egypt*, ed. Gillian M. Craig, pp. 1–15. Oxford: Oxford University Press.

Moens, Marie-Francine, and Wilma Wetterstrom
1988 The agricultural economy of an Old Kingdom town in Egypt's west Delta: Insights from the plant remains. *Journal of Near Eastern Studies* 47(3), pp. 159–173.

Moreno García, Juan Carlos
2001 L'organisation sociale de l'agriculture dans l'Égypte pharaonique pendant l'Ancien Empire (2650 – 2150 avant J.-C.). *Journal of the Economic and Social History of the Orient* 44(4), pp. 411–450.
2007 The state and the organisation of the rural landscape in 3rd millennium BC pharaonic Egypt. In *Aridity, change and conflict in Africa: Proceedings of an international ACACIA conference held at Königswinter, Germany, October 1 – 3, 2003*, Colloquium Africanum 2, ed. Michael Bollig., Olaf Bubenzer, Ralf Vogelsang, et al., pp. 313–330. Köln: Heinrich Barth Institut.
2008 Estates (Old Kingdom). In *UCLA encyclopedia of Egyptology*, ed. Elizabeth Frood and Willeke Wendrich. Los Angeles. http://digital2.library.ucla.edu/viewItem.do?ark=21198/zz001ndr97.
2014 L'organisation sociale de l'agriculture pharaonique: Quelques cas d'étude. *Histoire, Sciences Sociales* 69(1), pp. 39–74.
2016 Temples and agricultural labour in Egypt, from the Late New Kingdom to the Saite Period. In *Dynamics of production in the ancient Near East 1300 – 500 BC*, ed. Juan Carlos Moreno García, pp. 223–256. Oxford: Oxbow Books.

Moussa, Ahmed M., and Hartwig Altenmüller
1977 *Das Grab des Nianchchnum und Chnumhotep*. Archäologische Veröffentlichungen 21. Mainz: Philipp von Zabern.

Müller-Wollermann, Renate
1987 Die sogenannte ober- und unterägyptische Gerste. *Varia Agyptiaca* 3, pp. 39–41.

Murray, Mary Anne
2000 Cereal production and processing. In *Ancient Egyptian materials and technology*, ed. Paul Nicholson and Ian Shaw, pp. 505–536. Cambridge, UK: Cambridge University Press.
2009 Questions of continuity: Fodder and fuel use in Bronze Age Egypt. In *From foragers to farmers: Papers in honour of Gordon C. Hillman*, ed. Andrew Fairbairn and Ehud Weiss, pp. 254–267. Oxford: Oxbow Books.

Nesbitt, Mark
2002 When and where did domesticated cereals first occur in Southwest Asia? In *The dawn of farming in the Near East*, Studies in Early Near Eastern Production, Subsistence, and Environment 6, ed. René Cappers and Sytze Bottema, pp. 113–132. Berlin: Ex Oriente.

Parkinson, Richard B. (ed.)
1991 *The Tale of the Eloquent Peasant*. Oxford: Griffith Institute.
1999 *The Tale of Sinuhe and other ancient Egyptian poems 1940 – 1640 BC*. Oxford: Oxford University Press.

Peake, Harold J. E.
1927 The beginning of agriculture. *Nature* 119(2987), pp. 158–159.

Peltenberg, Edgar, Sue Colledge, Paul Croft, Adam Jackson, Carole McCartney, and Mary Anne Murray
2000 Agro-pastoralist colonization of Cyprus in the 10th millennium BP: Initial assessments. *Antiquity* 74, pp. 844–853.

2001 Neolithic dispersals from the Levantine corridor: A Mediterranean perspective. *Levant* 33, pp. 35–64.

Percival, John

1921 *The wheat plant: A monograph*. London: Duckworth and Co.

1927 The beginning of agriculture. *Nature* 119(2987), pp. 157–158.

Petrie, William Matthew Flinders

1890 *Kahun, Gurob, and Hawara*. London: Kegan Paul, Trench, Trübner and Co.

1892 *Medum*. London: David Nutt.

Pickering, Charles

1848 *The races of man; and their geographical distribution*. United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 under the Command of Charles Wilkes, United States Navy. Boston and London: Little and Brown; John Murray.

Porter, Bertha, and Rosalind L. B. Moss

1970 *Topographical bibliography of ancient Egyptian hieroglyphic texts, reliefs, and paintings I: The Theban Necropolis, Part 1: Private tombs*. Second edition. Oxford: Griffith Institute.

Raven, Maartin J.

1982 Corn-Mummies. *Oudheidkundige Mededekingen* 63, pp. 7–38.

1997 Four corn-mummies in the Archaeological Museum at Cracow. *Materialy Archaeologiczne* 30, pp. 5–11.

Rawlinson, George

1880 *History of ancient Egypt*, Vol. 1. New York: A. L. Burt.

Redding, Richard W.

2024 *A view from the herd: Cattle, sheep, goats, and pigs in pharaonic Egypt: A primer for Egyptologists and archaeologists*. Archaeobiology 5. Columbus: Lockwood Press.

Samuel, Delwen

1989 Their staff of life: Initial investigations on ancient Egyptian bread baking. In *Amarna Reports V, Occasional Publications 6*, ed. Barry J. Kemp, pp. 253–290. London: Egypt Exploration Society.

1993 A new look at old bread: Ancient Egyptian baking. *Archaeology International* 3, pp. 28–31.

1994 Cereal food processing in ancient Egypt: A case study of integration. In *Whither environmental archaeology?*, Oxbow Monographs 38, ed. Rosemary-Margaret Luff and Peter Rowley-Conwy, pp. 153–158. Oxford: Oxbow Books.

1999 Bread making and social interactions at the Amarna Workmen's Village, Egypt. *World Archaeology* 31(1), pp. 1.

2000 Brewing and baking. In *Ancient Egyptian materials and technology*, ed. Paul T. Nicholson and Ian Shaw, pp. 537–576. Cambridge, UK: Cambridge University Press.

2010 Experimental grinding and ancient Egyptian flour production. In *Beyond the horizon: Studies in Egyptian art, archaeology and history in honour of Barry J. Kemp*, ed. Salima Ikram and Aidan Dodson, pp. 456–477. Cairo: American University in Cairo Press.

Schultz, Regine

2005 A corn mummy decoded. *The Journal of the Walters Art Museum* 63, pp. 5–14.

Schweinfurth, Georg August

1882 De la flore pharaonique. *Bulletin de l'Institut de l'Égypte*, Series 2(3), pp. 51–76.

Scott, Michael F., Laura R. Botigué, Selina Brace, et al.

2019 A 3,000-year-old Egyptian emmer wheat genome reveals dispersal and domestication history. *Nature Plants* 5, pp. 1120–1128.

Shirai, Noriyuki

2021 The development of cereal cultivation and the evolution of lithic technology in Egypt in the Middle Holocene. In *Revolutions: The neolithisation of the Mediterranean Basin: The transition to food-producing economies in North Africa, Southern Europe, and the Levant*, Berlin Studies of the Ancient World 68, ed. Joanne Rowland, Giulio Lucarini, and Geoffrey Tassie, pp. 245–264. Berlin: Edition Topoi.

Spengler, Robert N.

2015 Agriculture in the Central Asian Bronze Age. *Journal of World Prehistory* 28(3), pp. 215–253.

Spengler, Robert N., and George Willcox

2013 Archaeobotanical results from Sarazm, Tajikistan, ~~and~~ an Early Bronze Age settlement on the edge: Agriculture and exchange. *Environmental Archaeology* 18(3), pp. 211–221.

Stock, Frauke, and Diane Gifford-Gonzales

2013 Genetics and African cattle domestication. *African Archaeological Review* 30, pp. 51–72.

Täckholm, Vivi, Gunnar Täckholm, and Mohammed Drar
1941 *Flora of Egypt*, Vol. 1. Cairo: Fouad I University.
Tarlach, Gemma
2022 This ancient method of sowing grain could be the future of agriculture. *Wired: Science*, October 29, 2022. https://www.wired.com/story/ancient-grain-crops-future-of-farming/
Thanheiser, Ursula
1996 Local crop production versus import of cereals in the Predynastic Period in the Nile Delta. In *Interregional contacts in the later prehistory of northeastern Africa*, Studies in African Archaeology 6, ed. Lech Kryżaniak, Karla Kroeper, and Michel Kobusiewicz, pp. 291–302. Poznan: Poznan Archaeological Museum.
Tooley, Angela M. J.
1989 Middle Kingdom burial customs: A study of wooden models and related material. Ph.D. dissertation. Liverpool: University of Liverpool.
1995 *Egyptian models and scenes*. Shire Egyptology 22. Buckinghamshire, UK: Shire Publications.
1996 Osiris bricks. *Journal of Egyptian Archaeology* 82, pp. 167–179.
Unger, Franz
1859 Botanische Streifzüge auf dem Gebiete der Culturgeschichte IV: Die Pflanzen des Alten Ägyptens. *Sitzungsberichte der Akademie der Wissenschaften mathematisch-naturwissenschaftliche Klasse* 38, pp. 69–140.
1866 Botanische Streifzüge auf dem Gebiete der Culturgeschichte VII: Ein Ziegel der Dashurpyramide in Ägypten nach seinem Inhalte an organischen Einschlüssen. *Sitzungsberichte der Akademie der Wissenschaften mathematisch-naturwissenschaftliche Klasse* 54, pp. 33–62.
1867 Botanische Streifzüge auf dem Gebiete der Culturgeschichte VIII: Die organischen Einschlüssen eins Ziegels der alten Juden-stadt Ramses in Ägypten. *Sitzungsberichte der Akademie der Wissenschaften mathematisch-naturwissenschaftliche Klasse* 55, pp. 198–206.
van der Veen, Marijke
1995 The identification of maslin crops. In *Res Archaeobotanicae*, ed. H. Kroll and R. Pasternak, pp. 335–343. Kiel: Oetker-Voges.
1999 The economic value of chaff and straw in arid and temperate zones. *Vegetation History and Archaeobotany* 8, pp. 211–224.
van der Veen, Marijke, and Glynis Jones
2006 A re-analysis of agricultural production and consumption: Implications for understanding the British Iron Age. *Vegetation History and Archaeobotany* 15, pp. 217–228.
Vavilov, Nicolai Ivanovich
1926 Studies on the origin of cultivated plants. *Bulletin of Applied Botany and Plant Breeding* 16(2), pp. 139–248.
Warden, Leslie Anne
2017 Grain as wealth in Egypt: Field - silos - bread and beer. In *Les céréales dans le monde antique: Regards croisés sur les stratégies de gestion des cultures, de leur stockage et de leurs modes de consommation*, NeHeT 5, ed. Adeline Bats, pp. 141–156. Paris: Centre de recherches égyptologiques de la Sorbonne.
Wendorf, Fred, and Romuald Schild
1984 Some implications of Late Palaeolithic cereal exploitation at Wadi Kubbaniya (Upper Egypt). In *Origin and early development of food-producing cultures in North-Eastern Africa*, Studies in African Archaeology 1, ed. Lech Krzyżaniak and M. Kobusiewicz, pp. 117–127. Poznan: Poznan Archaeological Museum.
Wendorf, Fred, Romuald Schild, Nabil el Hadidi, et al.
1979 Use of barley in the Egyptian Late Palaeolithic. *Science* 205(4413), pp. 1341–1347.
Wendrich, Willeke, R. Ervin Taylor, and John Southon
2010 Dating stratified settlement sites at Kom K and Kom W: Fifth millennium BCE radiocarbon ages for the Fayum Neolithic. *Nuclear Instruments and Methods in Physics Research B* 268, pp. 999–1002.
Werth, Emil
1939 Emmer und Gerste aus dem 5. Jahrtausend v. Chr. und andere vorgeschichtliche Kulturpflanzenfunde. *Plant Biology* 57(9), pp. 453–462.
Wetterstrom, Wilma
1986 *Ecology and agricultural intensification in Predynastic Egypt*. Pamphlet. National Science Foundation Grant. Cambridge, MA: Botanical Museum, Harvard University.
1993 Foraging and farming in Egypt: The transition from hunting and gathering to horticulture in the Nile Valley. In *The archaeology of Africa: Food, metals and towns*, One World Archaeology 20, ed. Thurstan Shaw, Paul Sinclair, Bassey Andah, et al., pp. 165–226. London and New York: Routledge.

Wild, Henri
1964 Brasserie at panification au tombeau de Ti. *Bulletin de l'Institut français d'archeologie orientale* 64, pp. 95–120.
1966 *Le tombeau de Ti: Fascicule III: La chapelle (deuxième partie).* Mémoires publiés par les membres de l'Institut français d'archéologie orientale 65. Cairo: Institut français d'archéologie orientale.
1977 Gerste. In *Lexikon der Ägyptologie,* Vol. 2, ed. Wolfgang Helck and Wolfhart Westendorf, columns 553–555. Wiesbaden: Harrassowitz.
Willcox, George
2012a Pre-domestic cultivation during the Late Pleistocene and Early Holocene in the Northern Levant. In *Biodiversity in agriculture: Domestication, evolution, and sustainability*, ed. Paul Gepts, Thomas R. Famula, Robert L. Bettinger, et al., pp. 92–109. Cambridge: Cambridge University Press.
2012b The beginnings of cereal cultivation and domestication in Southwest Asia. In *A companion to the archaeology of the ancient Near East*, ed. Daniel T. Potts, pp. 161–180. Malden, MA, Oxford, and Chichester: Wiley-Blackwell.
Williams, Martin A. J.
2019 *The Nile Basin: Quaternary geology, geomorphology and prehistoric environments*. Cambridge, UK: Cambridge University Press.
Wilson, Penelope
2006 Prehistoric settlement in the Western Delta: A regional and local view from Sais (Sa el-Hagar). *Journal of Egyptian Archaeology* 92, pp. 75–126.
Wilson, Penelope, Gregory Gilbert, and Geoffrey Tassie (eds.)
2014 *Sais II: The Prehistoric period at Sa el-Hagar*. Egypt Exploration Society Excavation Memoirs 107. London: Egypt Exploration Society.
Zeder, Melinda
2011 The origins of agriculture in the Near East. *Current Anthropology* 52(S4), pp. S221–S235.
Zohary, Daniel, Maria Hopf, and Ehud Weiss
2012 *Domestication of plants in the Old World: The origin and spread of domesticated plants in Southwest Asia, Europe, and the Mediterranean Basin*. Fourth edition. Oxford: Oxford University Press.

Online Databases

- Oxford Expedition to Egypt: Scene-Details Database, Linacre College, Oxford: https://doi.org/10.5284/1000009.

- Meketre Scene Repository, Universität Wien: https://meketre.org/.

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Table 1. Cereals present in Egypt, either cultivated or growing uncultivated as weeds.

Figure 1. Left: emmer wheat (*Triticum turgidum*) and right: hulled barley (*Hordeum vulgare*). (Photograph to the left is a work of the United States Department of Agriculture. Public domain via Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Usdaemmer2.jpg. Photograph to the right by Razbak under Creative Commons license CC-by-SA-3.0 via Wikimedia Commons: https://commons.wikimedia.org/wiki.)

Figure 2. Facsimile by Norman de Garis Davies from the New Kingdom tomb of Ipuy at Deir el-Medina, depicting a shaduf being used to water a garden containing a pomegranate tree, and possibly an olive tree. (New York: Metropolitan Museum New York 30.4.115, Rogers Fund. https://www.metmuseum.org/art/collection/search/557816.)

Figure 3. Partial scenes from the Old Kingdom tombs of Mereruka (left), Niankhkhnum and Khnumhotep (right) at Saqqara, depicting pots of water being tipped into garden plots of (romaine) lettuces. (Redrawn by author after Duell 1938a: plate 21 and Moussa and Altenmüller 1977: abb. 8.)

Figure 4. A crop of bread wheat infested with canary grass and rumex, western Delta. (Photograph by author, 2012.)

Figure 5. Detail from a harvest scene from the Old Kingdom tomb of Mereruka, Saqqara. Weeds, the shorter non-cereal plants growing low in the field, are clearly depicted, but it is not possible to reliably identify them. (Redrawn by author after Duell 1938b: plate 169.)

Figure 6. Detail showing sieving as part of an Old Kingdom cereal-processing scene in a relief from the Saqqara tomb of Kaemrahu, Egyptian Museum in Cairo CG1534. (Drawn by author from photographs.)

Figure 7. The terms *jt* (top) and *bdt* (bottom) written in hieroglyphs. (Drawn by the author.)

Figure 8. Scenes from the Old Kingdom mastaba of Ti at Saqqara, showing the harvesting of barley (top) and emmer wheat (bottom). (Redrawn by author after Wild 1966: figs. CLII– CLIII.)

Figure 9. Middle Kingdom granary model from the tomb of Meketra at Thebes (TT280, MMA1101). (New York: The Metropolitan Museum of Art 20.3.11, Rogers Fund and Edward S. Harkness Gift. https://www.metmuseum.org/art/collection/search/545281.)

Figure 10. Osiris bricks from the Third Intermediate or Late Period. (New York: The Metropolitan Museum of Art 20.2.30, Rogers Fund. https://www.metmuseum.org/art/collection/search/553820.)