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IDENTIFICATION OF WHEAT VARIETIES

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Greek and Latin terms that most frequently appear in the corpus

Nouns related to wheat: blé (fr.), *frumentum* (la.), πυρός (gr.); blé dur (fr.), blé poulard (fr.), *triticum* (la.), πυρός (gr.); amidonnier (fr.), *adoreum* (la.), *far* (la.), ζειά (gr.); froment (fr.), *siligo* (la.), πυρός (gr.)

Related themes

[plant names](#)

Principal references

[Caton, *De l'agriculture*, 34, 1-2](#)

1.DIVERSITY IN WHEAT

Wheat—*Triticum* genus— belongs to the Poaceae family, which also includes maize, rice, barley, rye, oat, triticale, millet and sorghum, bamboo, and wild plants generally known as “grasses”. Wheat currently makes up one-third of the worldwide production of cereals, which is dominated by corn, 776.5 million tonnes (mt) of which was produced in 2020–2021.¹ France is the primary producer of wheat in Europe, with an annual yield of 36 mt of bread wheat, and 2 mt of durum wheat.² While several species of wheat were grown in the past, only one has been retained through selection, primarily to supply the baking industry. The other main consumer of grain (barley) is the brewing industry. The *Triticum* genus (wheat, in the broad sense of the term) encompasses about twenty species, both wild and domesticated, twelve of which are attested in archaeological records (see bold font in the list below).

Diploid wheats (2n=14): AA

- *Triticum monococcum* subsp. *aegilopoides* (Link) Thell., 1918 (wild einkorn wheat) syn. *T. baoticum* Boiss.; includes the two grained form subsp. *thaouidar*
- *Triticum monococcum* L. subsp. *monococcum* (domesticated einkorn wheat)
- *Triticum urartu* Tuman ex Gand.

Tetraploid wheats (2n=28): BBAA

- *Triticum turgidum* subsp. *dicoccoides* (Körn. Ex. Asch. & Graebn.) Thell. (wild emmer wheat)
- *Triticum turgidum* subsp. *dicoccon* (Schrank) Thell. (domesticated emmer wheat)
- *Triticum turgidum* subsp. *durum* (Desf.) Husn. (durum wheat)
- *Triticum turgidum* L., 1753 subsp. *turgidum* (rivet wheat)
- *Triticum turgidum* subsp. *polonicum* (L.) Thell.
- *Triticum turgidum* subsp. *carthlicum* (Nevski) Löve & Löve
- *Triticum turgidum* subsp. *parvicoccum* Kislev

Tetraploid wheats (2n=28): GGAA

- *Triticum timopheevii* Zhuk. subsp. *armeniicum* (wild) syn. *T. araraticum* Jakubz.
- *Triticum timopheevii* Zhuk. subsp. *timopheevii* (domesticated) assimilated to New Glume Wheat (NGW) ([Czajkowska et al. 2020](#))

Hexaploid wheats (2n=42): BBAADD

- *Triticum aestivum* subsp. *spelta* (L.) Thell. (spelt)
- *Triticum aestivum* subsp. *macha* (Dek. & Men.) Mackey

- *Triticum vavilovii* Tuman
- *Triticum vavilovii* Tuman
- *Triticum aestivum* L., 1753 subsp. *aestivum* (bread wheat)
- *Triticum aestivum* L. subsp. *compactum* (Host) Mackey (club wheat)
- *Triticum aestivum* L. subsp. *sphaerococcum* (Percival) MK

Hexaploid wheats (2n=42): GGAAAA

- *Triticum zhukovskyi* Men. & Er.

Like other types of cereals, wheats were first classified according to morphological criteria, until genomics promoted a classification based on ploidy level (Zohary *et al.*, 2012). The different lines, as well as the relationships between wild progenitors and domesticated species thus became more apparent. One morphological distinction was nonetheless retained to create a first level of differentiation owing to its significant technical and agronomical implications. This distinction rests on a set of characters inherited from the mode of dissemination of wild species from which cultivated wheats originate. Wild species possess a spontaneously shattering-ear: the axis of the ear (the rachis) is brittle and the lower spikelets disarticulate naturally. Spikelets are inflorescences protected by a series of protective scales (glume and lemma/palea) that, in wheat as in other plants from the Poaceae family (e.g., barley and rye), are grouped at the top of the stem to form a compact ear (fig. 1). In a mature wild plant, spikelets spontaneously detach from the stem and fall to the ground next to the mother plant; grains germinate inside their protective hull and the seedling develops in a normal way. Some domesticated species have preserved this character inherited from their wild ancestors, even among some of the most genetically evolved types of hexaploid wheat. By contrast to the wild species, their rachis is semi-tough (non-brittle), but it will break spontaneously during threshing. The toughness of their hulls is variable. Just a few genes control these characters: Q gene produces speltoid ears (dehiscence of the spikelets); BR (brittle rachis) gene causes the axis of the ear to break into spikelets during post-harvesting processes that separates the grain from the stem; TG gene controls the toughness and adherence of the hulls.

Figure : (<https://api.nakala.fr/data/10.34847/nkl.d6bd1hoz/dd5887f7cf0ecfc887cf1b0a164cc3406025e8cc>) Exploded view of a wheat spikelet. Grains are usually attached in pairs on the ventral side, with their base (on the embryo's end) lying against the base of a spikelet. Each grain is wrapped in two thin envelopes called a lemma (lower one) and a palea (upper one). The lemma carries the bristle or awn. Each clump of grains is also protected by two tougher envelopes called glumes. Infographics: M. Coutureau, MNHN.

2.HULLED VS. FREE-THRESHING WHEAT

The persistence, or loss, of these genes defines two categories of wheat, known as “hulled wheat” and “free-threshing wheat”. The morphological expressions of these genetic characters are stable, and behave differently during post-harvest treatments. Hulled varieties require laborious cleaning procedures: regardless of the tool or method used, threshing causes the rachis to break. The produce thus obtained consists of spikelets, or clumps of grains. At this stage, each spikelet is still tightly wrapped in tough glumes, and each grain within the spikelet is encased in the lemma and palea, or secondary envelopes (fig. 2).

Figure : (<https://api.nakala.fr/data/10.34847/nkl.e6300a6m/ac21bd49d75ecc3a6cabce53a0306e545cb168b>) Product resulting from the first threshing of a variety of hulled wheat (spelt), i.e., spikelets. The lower rachis internode is visible at the base, still joined in its anatomical position to the base of the spikelet and to the glumes surrounding the grain. Further techniques must then be applied to extract the grain by weakening and breaking the hull. Photograph: V. Matteredre, CNRS.

Cumbersome dehusking methods are required to extract the grains from their hull, most often by roasting or soaking (Alonso *et al.* 2013). The detached hulls form chaff, which may be used as forage or grease remover, but is indigestible because of its high cellulose content. In comparison to hulled wheat, free-threshing wheat is much easier to clean because its fragile hulls tear during threshing and instantaneously release the grain, facilitating the separation of the grain from its waste. This is achieved through techniques that rely on differences in calibre (sifting through sieves) or in density (using winnowing fans, shovels, or forks/other tools that rely on the lighter stems and hulls being carried away by air currents, with the heavier grain falling in front of the worker).

Hulled wheat destined to be sown should not be dehusked, because this would damage the embryo, while sowing the spikelets as they are does not impede the germination or growth of the plant – like it does not either in the wild species (Willcox 1992). If the grain is stored, leaving the spikelets intact can be advantageous because the hulls protect the grain from pests and rot. Once dehusked, it would deteriorate faster than free-threshing grain, as its pericarp is thinner and therefore more vulnerable once cleaned.

Since the beginning of agriculture, important fluctuations in the uses of these two categories of wheat have occurred, depending on the quality of grain needed. Hulled wheat is generally more rustic and requires less

fertilising. It is suitable for the production of gruels and flours, and for bread making, with the exception of emmer wheat, whose gluten content is the lowest. Hulled wheat began to be replaced by free-threshing wheat when large quantities of “ready-to-use” grain became necessary. This transition took place throughout most of the ancient world concurrently with the spread of urbanisation; when people began to gather in large groups in a given area, societies became more hierarchical, and categories of “non-agricultural” people (craftsmen, soldiers) began to appear and multiply (Zech-Matterne *et al.* 2014, Agut-Labordère *et al.* 2020).

3. IDENTIFICATION OF WHEAT IN ARCHAEOLOGICAL REMAINS

Among archaeological plant remains, specific fragments belonging to hulled and free-threshing forms can be distinguished during identification. The importance of this distinction throughout history is primarily linked to the technical aspects mentioned above. The preservation of archaeological remains may occur through waterlogging, desiccation, mineralisation, or carbonisation. Some of these modes of preservation entail the degradation or variable degrees of conservation of the organs or vegetal parts of a plant. Hulls, rachises, and stems may be preserved in wet environments, but grains decay rapidly because their albumen contains high amounts of starch – a water-soluble substance. It is rare to find cereals in mineralised remains, with the exception of a few hulled grains. “Fossilisation” occurs most often through desiccation and carbonisation whereby contact with a heat source transforms organic matter into carbon. However, this process affects relative dimensions of seeds (Braadbaart 2008) and results in the hulls and rachis being destroyed more quickly than the grains (Boardman and Jones 1990). Desiccation is the least destructive process, often preserving whole rachis and ears.

Hulled wheat remains include spikelets preserved in anatomical connection, detached spikelet bases and grains when this connection is lost, glume bases when the spikelet bases are broken in half, and fragments of stems and awns (or bristles). Free-threshing wheat is preserved as whole ears or as grains detached from their rachis—which may be found whole or segmented into internodes and nodes as a result of intense carbonisation.

The category of free-threshing wheats is an inclusive group. It is not possible to differentiate species according to their grains (or caryopses). All types of free-threshing wheat have round, stubby grains, the sides of which are bent around the deep ventral furrow. This category includes common wheat (*T. aestivum* subsp. *aestivum*), durum wheat (*T. turgidum* subsp. *durum*), and rivet wheat (*T. turgidum* subsp. *turgidum*). Differentiation can be attempted by assessing the parts of the rachis, but the best criterium is the level of ploidy. Tetraploids of the *turgidum* branch (durum wheat, in the broad sense of the term) can be distinguished from hexaploids belonging to the *aestivum* branch. The distinction between durum wheat and common wheat rests on the morphology of internodes and nodes of the rachis. Internodes in tetraploid wheat have straight, parallel sides, whereas in hexaploid wheat they are sinuous and bi-convex and narrow at the base. The nodes in tetraploids are thick, while they are simply indicated by a double curve in hexaploids. The frames of the glume bases persist as stumps in tetraploids. In hexaploids, the base of the upper internode is generally conserved, whereas the fracture tends to occur below the node in tetraploids (fig. 3).

Figure : (<https://api.nakala.fr/data/10.34847/nkl.1f36844v/ca548a70573448a93ea6dc0f018fbbc814a72ed0>) Identification of free-threshing wheats according to the rachis. Hexaploid wheats (top) vs. tetraploid wheats (bottom). Photograph: F. Toulemonde, associate researcher at UMR 7209 AASPE, MNHN.

Common wheat is generally ground into flour and used for making bread, pastries, and the like. Durum wheat is usually reserved for making semolina and pasta, but it can also be used for bread-making. In colder climates, durum wheats lose their vitreous nature and are crushed during grinding. Unlike durum wheat, but like common wheat, rivet wheat is usually transformed into flour. The respective food uses of these three types of wheat in ancient times are not documented in written sources, and are therefore unknown.

Hulled wheats may be classified according to the morphology of their caryopses, or of their spikelet bases for more exact results. Among domesticated taxa, four species are concerned: einkorn wheat, emmer wheat, new glume wheat (NGW), and spelt. Archaeological analyses based on morphological characteristics of the glumes shows that NGW corresponds to a species already in existence at the end of the Neolithic period. Very recently, paleogenetic studies have confirmed that it belongs to the same branch as *Triticum timopheevii* (Zanduri wheat), whose genotype GGAA is unique, and may still be cultivated in Georgia.

Einkorn wheat (*Triticum monococcum* subsp. *monococcum*) has narrow caryopses; because each spikelet contains a single grain, this grain is not compressed and its ventral side (the furrow’s side) follows a regular, convex curve. Emmer wheat grains (*Triticum turgidum* subsp. *dicoccon*) are slightly bigger and of variable raindrop or bi-convex shape, when seen from their dorsal side. The ventral furrow is a thin, shallow slit. From the dorsal side, the widest part is in the lower third of the grain, just above the *scutellum*. A dorsal, often irregular keel is also visible, which gives the grain an asymmetrical shape. Viewed from the side, the curve is more pronounced above the embryo

(“gibbous” shape of the grain), but gentler towards the apex. The caryopses of NGW are very long and narrow in comparison, with parallel sides (in dorsal view) and a truncated apex. Those of spelt (*Triticum aestivum* subsp. *spelta*) are also long and quadrangular, but larger. In lateral view, the dorsal curve is rather flattened and very regular (Jacomet 2006).

As for the spikelet bases, those of einkorn wheat are thin, with parallel, narrow branches. Both keels are of similar size and visible at the back of the glume. The abscission scar of the upper internode is wide and shaped like a slit. On those of emmer wheat, the starting point of the glumes is positioned diagonally from the spikelet base—considered in its longitudinal direction; the abscission scar is triangular and narrower than in einkorn wheat. Spikelet bases in Zanduri wheat display characteristics that are midway between those of einkorn and emmer wheat. The glume branches are very tough and curved, and the longitudinal bulge is pronounced. The protruding carina is not oriented in the same direction as that of emmer wheat. When seen from above, the main keel of emmer wheat is perpendicular to the glume; in Zanduri wheat, it is a prolongation of the glume. The abscission scar is oval and wide open. Spikelet bases of spelt are at least 2 mm wide, underlined by a bulge, and wide open because the glumes are arranged in a clear obtuse angle, fan-shaped, and pointing upwards. Seen from above, they are thin and display protruding nerves rather than a carina (Jacomet 2006).

Wheat by-products and their use in alimentation are numerous. Spelt provides very high-quality flour. Different species have been in and out of fashion throughout history; einkorn and emmer wheats were pillars of Neolithic agriculture, but became less and less prevalent after the end of the Metal Ages (Salavert 2011). Spelt is mainly grown in North-Eastern France (Zech-Matterne 2020). These three types of wheat are still currently cultivated, albeit in small amounts (Ruas 2007). On the contrary, *T. timopheevii*, first identified in central Europe and Greece, has since been found in numerous sites. The oldest evidence of its presence in France dates to the fifth millennium BCE, but it seems to have been cultivated for only a brief period and is not found in archaeological remains after the first millennium BCE (Toulemonde et al. 2015).

Thus, all species of wheat found in archaeological remains can be identified if the anatomical parts that bear distinctive criteria are well preserved, with the exception of free-threshing tetraploid wheats: it is not possible to distinguish between durum wheat and rivet wheat. The difficulty then resides in matching botanical identification to names and descriptions of wheat in the works of ancient “agronomists”.

4. BOTANICAL IDENTIFICATION OF TYPES OF WHEAT IN ANCIENT WRITTEN SOURCES

The association of a Greek or Latin phytonym to a specific botanical taxon rests on the consideration of several criteria. The first of these is the set of details given by ancient texts: descriptions of the appearance of plants (size, shape, colour), of their preferred habitat (damp or dry soil, etc.), of the type of grain (hulled or free-threshing), or of its uses; comparisons with other plants; categories and classifications proposed by ancient authors themselves—although different authors, and sometimes a single author, may propose problematic or contradictory classifications. Modern authors rely on this textual evidence in their works, which it is prudent to consult: some are authoritative as a result of their precision, their knowledge of the texts, and their methods and have in a way become a second set of authoritative sources. This is the case of N. Jasný (1944) with regard to wheats, J. André for Latin works, and S. Amigues for Greek works. In the past century, archaeologists have provided analyses of remains found in excavation sites that offer evidence for the spontaneous or cultivated vegetation of the Ancient World; these analyses either confirm or contradict the information derived from written sources.

In most cases, Latin authors recognise three categories of wheat:³ *far* (or *far adorem*, *adorem*, *semen*), *triticum*, and *siligo*.

According to Latin authors, *far* is the main species of wheat grown in Latium; it is used in the preparation of a mash (*puls*⁴). F. De Romanis (2021, 49) explains that this type of wheat was a predominant cereal for Romans until at least 250 BCE. In agricultural texts, *far* is described as a tough species, with hulled grain, and preferring damp soil.⁵ Such clues would suit emmer wheat or spelt, to which *far* has usually been identified in the philological tradition: both the Gaffiot and Lewis and Short Latin dictionaries suggest this translation. Indeed, spelt was widespread in Central and Northern Europe. Modern philologists working on translations and editions of ancient texts tend to adopt this interpretation of *far* as a common species that matches the descriptions given by Latin authors. Thus, Gesner, in his commentary on Columella 2, 9, 14, writes: “Clearly, the grain called *far adorem* by ancient authors does not correspond to our barley, Gerste, but to what is called Dünkel⁶ by those who cultivate it, in France and in Swabia (I have not found it in Saxony) [...]”.⁷ And yet this is not a unanimous interpretation: in the entry “Blé” of the *Encyclopedia*, Edme Beguillet suggests that *far* may refer to winter barley, and adds: “Which of our modern species should be identified as the *far* of ancient authors will always be uncertain”.⁸ Indeed, rustic, hulled wheats are rarely differentiated in use, and even now, the Italian term *farro* (derived from Latin *far*) may refer to emmer wheat, spelt, or einkorn wheat.

Archaeobotanists have found that emmer wheat was the most widely cultivated type of hulled wheat in Roman Italy—it is better suited to the Mediterranean climate than spelt. Since *far* is a type of hulled wheat considered by Latin authors as essential and widely grown in Italy, the identification of *far* as emmer wheat is the most convincing, despite the uncertainties inherent to the identification of the ancient names of hulled wheats.⁹ For Pliny, the Greek term ζεία (*zeia*) is not strictly equivalent to *far*, but refers to a variety of *far* found in some countries and in Campania, where it is called semen.¹⁰

The other two types of wheat recognised by Latin authors, *triticum* and *siligo*, are self-threshing wheats.¹¹ All ancient sources note that *triticum* prefers dry soil and warm climates, while *siligo* thrives in damp soil.¹² *Triticum* is abundantly mentioned in texts from the Republican period, as early as Plautus; it is the wheat sold by grain merchants, and is a prominent feature of Mediterranean trade.¹³ *Siligo*, however, although it is mentioned by Cato, becomes an increasingly widespread crop in the early years of the Imperial era.¹⁴ It produces flour that is famous for its whiteness, is used in pastries, and makes the best bread, according to Pliny; Seneca mentions “siligo bread” as the opposite of cheap bread.¹⁵ Such indications suggest that *siligo* was a type of common wheat, for which we adopted the general term “froment” in the French translations; it remains impossible to determine its varietal taxon.

Although *triticum* sometimes refers to free-threshing wheats in general, agronomical texts underline its preference for heat and for dry soils, a characteristic of durum wheat or rivet wheat, the presence of which is clearly shown by archaeobotany. In our translations, we have opted to render *triticum* as “durum wheat” rather than as “rivet wheat” because of widespread cultivation of durum wheat in Southern Italy even now. This choice is also supported by recent studies in ancient botany: for Jasny (1944, 95 especially), *triticum* generally means “durum wheat” (particularly in the context of Italian agriculture), but it can sometimes refer to “rivet wheat” (e.g., in African and Hispanic agriculture), or even to “wheat”.¹⁶ “Branching” (*ramosum*) wheat, however, mentioned by Pliny as a type of *triticum*,¹⁷ is a form of *T. turgidum* subsp. *turgidum* (rivet wheat) with branched spike, known as “miracle wheat”.¹⁸

These three types of wheat are frequently mentioned in their numerous variations by ancient authors, in particular *triticum* or πυρός. They are generally characterised by their geographic origin (Sicilian wheat, Boeotian wheat, etc.), and, in rare cases, by physical characteristics (branching wheat or “*dracontias*/δρακοντίας” wheat, for instance). It is not possible to associate these names with specific varieties, nor even to know whether they all correspond to one.

The difficulties raised by the classification of types of wheat are sometimes highlighted by the ancient authors themselves. This is the case with “*trimestre*” wheat, sown in spring: Columella considers it a type of *siligo*, whereas Pliny resolutely challenges this classification and regards it as a species in its own right.¹⁹ Moreover, many Greek and Latin terms remain problematic, either because they are not accompanied by a detailed description, or because different authors provide contradictory characteristics. In addition, the question of the interpretation of Greek phytonyms and their equivalent in Latin presents itself, particularly in Latin authors such as Pliny: for instance, ὄλυρα, transcribed as *olyra* in Latin, is most likely a type of hulled wheat. In Latin texts, Pliny links it to *far*, and considers it to be synonymous with *arinca* in Homer. It could therefore be a variety of emmer wheat, an interpretation supported by Herodotus, who reports that the Egyptians’ *olyra* is sometimes called *zeia*;²⁰ but Pliny also explains (18, 75) that, for Turranius, *olyra* is the same plant as *oryza* (rice) and, because *olyra* seems to be a common cereal in Egypt, modern interpretations have suggested that it might refer to sorghum (see. J. André, 1985, 177). Indeed, Pliny’s description of Egyptian *olyra* is based solely on interpretations made by his predecessors (Turranius or Theophrastus) rather than on his own observation. This makes the identification of this phytonym particularly difficult. Despite Herodotus’ suggestion of equating it with ζεία, the Greek term ὄλυρα is used by Theophrastus to refer to a separate plant—spelt, according to S. Amigues, who based this analysis partly on archaeological discoveries from Northern Greece. In Galen, however, ὄλυρα seems to refer to a type of emmer wheat (like ζεία), but Galen also mentions a ζεόπυρον, growing in cold regions of Bithynia, possibly a type of spelt.²¹ Indeed, Galen himself is very undecided when it comes to identifying types of wheat; in his short treatise On slimming diets (*De victu attenuante*, ed. Kalbfleisch, §§41–42), he explains that what used to be called *zeia* in former times is known as *olyra* and *tiphè* in his time, but he also admits that Mnesitheus, a fourth-century BCE physician, disagrees with his interpretation.

Thus, in attempts to associate the many references to wheats or cereals found in ancient texts to modern plants, the identification of the species or variety, and even, sometimes, of the genus, is often uncertain.

NOTES

1. <https://www.usda.gov/oce/commodity/wasde/wasde0421.pdf>
2. <http://www.fao.org/country-showcase/item-detail/fr/c/1313449/>

3. Pliny the Elder, *Natural History*, 18, 82; Columella, *De re rustica*, 2, 6, 2.
4. See Pliny the Elder, *Natural History*, 18, 62, and 83–84.
5. Cato, *De agricultura*, 34, 2; Varro, *Res rusticae*, 1, 9, 4; Columella, *De re rustica*, 2, 6, 3; 2, 9, 3; 2, 8, 5; Pliny the Elder, *Natural History*, 18, 61, and 163.
6. Still called *Dinkel* in German.
7. Gesner (1735), Tome 1, 429: *far adorem autem ueterum non cum hordeo nostro, Gerste, sed cum eo, quem Dinkel uocant, qui habent, Franci & Sueui (per Saxoniam non obseruauit) conuenire, apparet [...]*.
8. Diderot and d'Alembert (ed.), *Encyclopédie ou dictionnaire raisonné des sciences des arts et des métiers, Volume 5, Part 1, 1781*, 144. “[...] il sera toujours incertain à quelle espèce de nos grains modernes il faut rapporter le far des anciens.”
9. This is discussed in Jasny, 1944, 112–124. For the history of the translation of the term *far* and its assimilation to emmer wheat, see M. Blandenet, V. Matteredne et M.-P. Ruas (2024) .
10. Pliny the Elder, *Natural History*, 18, 81–82.
11. See Columella, *De re rustica*, 2, 8, 5, and Pliny the Elder, *Natural History*, 18, 61.
12. See Cato, *De agricultura*, 34, 2 and 35, 1; Columella, *De re rustica*, 2, 6, 4 and 2, 9, 3; Pliny the Elder, *Natural History*, 18, 163.
13. See De Romanis, 2021, 249–253.
14. See De Romanis, 2021, 256–258.
15. Pliny the Elder, *Natural History*, 18, 86; Seneca, *Letters to Lucilius*, 119, 3.
16. Jasny's conclusions are summarised by André (1985), s. u.
17. Pliny the Elder, *Natural History*, 18, 95.
18. See Chauvet, 2018, 316.
19. Columella, *De re rustica*, 2, 6, 2; Pliny the Elder, *Natural History*, 18, 70.
20. Herodotus, *Histories*, 2, 36, 2.
21. *De alim. fac.* I 13 = 6, 515 K. See Chauvet, 2018, 311.

BIBLIOGRAPHY

- AGUT-LABORDÈRE Damien, BOUCHAUD Charlène, LEROUXEL François et NEWTON Claire, 2020. « De l'amidonner au blé dur : un changement dans la céréaliculture égyptienne dans la seconde moitié du Ier millénaire a. C. », dans François LEROUXEL, Julien ZURBACH (éd.), *Le changement dans les économies antiques*, Bordeaux, Ausonius, vol. 140, p. 29–79.
- ALONSO N., ANTOLÍN F., LÓPEZ D., CANTERO F. J. et PRATS G., 2013. « The effect of dehusking on cereals: experimentation for archaeobotanical comparison », dans Patricia ANDERSON, Carole CHEVAL, Aline DURAND (éd.), *Regards croisés sur les outils liés au travail des végétaux. XXXIIIe rencontres internationales d'archéologie et d'histoire d'Antibes*, Antibes, Éditions APDCA, p. 131–144.
- ANDRÉ Jacques, 1985. *Les noms des plantes dans la Rome antique*, Paris, Les Belles Lettres.
- BOARDMAN S. et JONES G. E. M., 1990. « Experiments on the effects of charring on cereal plant components », dans *Journal of Archaeological Science*, 17, n° 1, 1990, p. 1–11.
- BRAADBAART F., 2008. « Carbonisation and morphological changes in modern dehusked and husked *Triticum dicoccum* and *Triticum aestivum* grains », dans O. BRINKKEMPER, W. KUIJPER, L. KOOISTRA, C. VERMEEREN (éd.), *A present from the past for Corrie C. Bakels to honour her impact in Archaeobotany*, p. 155–166.
- CHAUVET Michel, 2018. *Encyclopédie des plantes alimentaires*, Paris, Belin.
- CZAJKOWSKA B., BOGAARD A., CHARLES M., JONES G., KOHLER-SCHNEIDER M., MUELLER-BIENEK A. et BROWN T.A., 2020. « "Ancient DNA typing indicates that the "new" glume wheat of early Eurasian agriculture is a cultivated member of the *Triticum timopheevii* group" », dans *Journal of Archaeological Science*, 123, 2020, DOI: <https://doi.org/10.1016/j.jas.2020.105258>.
- DE ROMANIS Frederico, 2020. « Entre contraintes pédo-climatiques et tendances du marché : Notes sur les céréales chez Columelle De Rustica, I et II », dans Maëlys BLANDENET, Marine BRETIN-CHABROL (éd.), *La terre et le grain. Lectures interdisciplinaires de Columelle De rustica*, Lyon, France, CEROR, p. 245–258.
- JACOMET S., 2006. *Identification of cereal remains from archaeological sites*, Basel University, Archaeobotany Lab. IPAS.
- JASNY Naum Mikhaïlovitch, 1944. *The wheats of classical Antiquity*, Baltimore, The Johns Hopkins Press.

- RUAS Marie-Pierre, 2007. « La parole des grains : enquête archéobotanique sur l'engrain (*Triticum monococcum* L.) au Moyen Âge en France », dans Aline DURAND, L. MAGGIORI (éd.), *Plantes exploitées, plantes cultivées: cultures, techniques et discours*, Aix-en-Provence, France, Publications de l'Université de Provence, p. 149-170.
- SALAVERT A., 2011. « Plant economy of the first farmers of central Belgium (Linearbandkeramik, 5200-5000 B.C.) », dans *Vegetation History and Archaeobotany*, n° 20, 2011, p. 321-332.
- THÉOPHRASTE, 2006. *Recherches sur les plantes. Tome V, livre IX*, Suzanne Éditeur scientifique AMIGUES (éd.), Paris, Les Belles Lettres.
- TOULEMONDE F., DURAND F., BERRIO L., BONNAIRE E., DAOULAS G. et WIETHOLD J., 2015. « Records of « new » glume wheat in France : a review », dans *Vegetation History and Archaeobotany*, n° 24, 2015, p. 197-206.
- WILLCOX G., 1992. « Archaeobotanical significance of growing Near Eastern progenitors of domestic plants at Jalès (France) », dans P. ANDERSON (éd.), *Préhistoire de l'agriculture, Nouvelles approches expérimentales*, Paris, éd. du C.N.R.S, p. 159-177.
- ZECH-MATTERNE V., WIETHOLD J., PRADAT B. et TOULEMONDE F., 2014. « L'essor des blés nus en France septentrionale : systèmes de culture et commerce céréalier autour de la conquête césarienne et dans les siècles qui suivent », dans X. DERU, R. GONZÁLEZ-VILLAESCUSA, W. DE CLERC (éd.), *Consommer dans les campagnes de la Gaule romaine. Actes du Xe colloque AGER tenu à Lille en Avril 2012*, Revue du Nord hors-série, p. 23-50.
- ZECH-MATTERNE Véronique, 2020. « L'épeautre en France et dans les pays limitrophes : témoignages carpologiques d'un blé devenu 'secondaire' », dans François LEROUXEL, Julien ZURBACH (éd.), *Le changement dans les économies antiques méditerranéennes (1000 avant J.-C. - 1000 après J.-C.)*, Bordeaux, Ausonius, p. 145-190.
- ZOHARY Daniel, HOPF Maria et WEISS Ehad, 2012. *Domestication of Plants in the Old World. The Origin and Spread of Domesticated Plants in South-west Asia, Europe, and the Mediterranean Basin*, Oxford, Oxford University Press.
- ZOHARY Daniel, HOPF Maria et WEISS Ehad, 2018. *La domestication des plantes. Origine et diffusion des plantes domestiquées en Asie du Sud-Ouest, en Europe et dans le bassin méditerranéen*, Michel CHAUVET (trad.), Arles, Actes Sud / Errance.