



ESSAY

# Our Daily Bread: The Origin of Modern Bread Wheat

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## HIGHLIGHTS

The emergence of modern bread wheat as a 'fusion hybrid' may not have been a natural occurrence, but rather the result of sophisticated human intervention, as evidenced by an ancient Egyptian document that challenges the notion of primitive hunter-gatherer populations.

## ABSTRACT

Modern bread wheat, *Triticum aestivum*, is a hybrid hexaploid that emerged in the Middle East region about 9000 years ago, usually considered to be the result of natural hybridization and multiple allopolyploid speciation. Contrariwise, the abrupt, late appearance of a singular cultivar with traits favoring human utilization suggests the possibility of a directed process, and this paper identifies an ancient Coptic [Egyptian] record specifically detailing the origin of the cultivated [polyploid] wheat plant by human intervention possibly facilitated by radiation.

## KEYWORDS

Bread-wheat, Durum, Emmer, hexaploidy, polyploidy, Triticum.

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## INTRODUCTION

Several economically important crops exhibit multiple sets of chromosomes, known as polyploidy, which confers the advantages of genetic stability and enhanced productivity. Tetraploid crops ( $2 \times 2n$ ) include Durum wheat, cotton, peanut, and Brussels sprouts, while less common hexaploids ( $3 \times 2n$ ) include bread wheat and Kiwifruit. Bread wheat is unusual as a hexaploid *per se*, and for occurring suddenly without a clear development history.

The principles involved in polyploidy have been reviewed by Dar et al. (2017). A primary mechanism is non-reduction of the chromosome number in meiosis, resulting in a 'fusion-hybrid' of diploid ( $2n$ ) parent gametes - which may occur by chance or may be induced by

chemical agents or facilitated by radiation. Polyploids are usually self-fertile and are reproductively isolated, unable to hybridize viably with their parents. Polyploid traits may be advantageous or disadvantageous, and it remains unclear how a small number of reproductively isolated plants attained improved fitness and achieved natural evolutionary success - sometimes rapidly.

Modern bread wheat, *Triticum aestivum*, is hexaploid with three diploid genomes ( $3 \times 2n$ ) designated A, B, and D. It is believed to be derived from *T. monococcum* (A) and an unknown [extinct?] source 'B', which combined to form tetraploid emmer (AABB), which much later hybridized with *Aegilops tauschii* (D) to form the hexaploid (AABBDD). The phylogenetic relationships and development of modern wheat have been reviewed by Matsuoka, (2011), who attempted to show an evolutionary continu-



um initiated from tetraploid Emmer wheat, followed by natural introgression via hybridization to allopolyploid speciation of the hexaploidy (sic).

The origin of wheat cultivars has been traced to the 'Fertile Crescent' of the Middle East, where ancestral diploid wheat (AA) emerged about 1 million years ago; tetraploid Emmer wheat (AABB) emerged about 0.5 million years ago and was domesticated from ca. 10,000 years ago; and hexaploid bread wheat is recorded [abruptly] from ca 8-9000 years ago.

Present-day durum wheat (*T. turgidum subsp. durum*) may also be derived from domesticated emmer. In the accepted orthodox scenario, tetraploid Emmer wheat (AABB) spread across the region by human cultivation, from ca 9,000 BP, where it hybridized with wild populations of diploid *Aegilops tauschii* (DD), forming the hexaploid *T. aestivum* (AABBDD) - 'probably by multiple allopolyploid speciation' (Matsuoka, 2011), for which the earliest known record is 8600-7800 BP in SE Turkey.

Notwithstanding wide acceptance of the orthodox scenario, several important questions remain unanswered - foremost of which is the lack of evidence of natural hybridization of tetraploid emmer with diploid *Aegilops*. Field studies have shown that cultivated emmer (*T. turgidum*) and wild *Aegilops* grew together in areas of Iran where natural hybridization 'could' have occurred. Shewry, 2009, asserted that hybridization 'probably occurred' and novel useful forms were selected by farmers from wild populations. However, no wild (intermediate) form of *T. aestivum* is actually known, and no natural hybrid of *T. turgidum* and *Ae. tauschii* has ever been reported (Matsuoka, 2011). Evidence of the fundamental hybridization platform for the proposed speciation mechanism is missing, but despite this critical anomaly, Matsuoka concluded that hybrid swarms 'can occur' and [natural] introgression between *T. turgidum* and *Ae. tauschii* 'probably' occurred more frequently than previously thought. Several anomalies or inconsistencies remain unresolved, notably:

Emmer and *Aegilops* co-existed for several hundred thousand years, then suddenly hybridized only ca. 10,000 years BP. Emmer is a self-fertile tetraploid that does not naturally hybridize with its parents or related species. There is no evidence of a wild population pool of natural hybrids. Bread wheat *T. aestivum* appeared as a sudden singular event with a range of characteristics favorable for human consumption - but unfavorable for survival in the wild.

## THE EVOLUTIONARY TIME SEQUENCE

Ancestral diploid wheat (*T. monococcum*) emerged

about 1 million years ago, and tetraploid emmer (*T. turgidum*) about 0.5 million years ago - over which period it co-existed with *Ae. tauschii*, which had a wide natural range. Then, from ca. 10,000 BP, archaeological records suggest that Emmer was domesticated and rapidly spread by human intervention, with the earliest known records from Syria in 9800-9300 BP and from Fayum in Egypt ca. 7000 BP (Bard, 1999). Domesticated hexaploid *T. aestivum* followed closely in 8600-7800 BP in SE Turkey. Despite the accepted orthodox scenario of gradual natural hybridization and speciation, the data actually suggests Emmer and *Aegilops* co-existed for several hundred thousand years *without* any natural hybridization - then abruptly, almost simultaneously on an evolutionary timescale, Emmer was domesticated and hybrid hexaploid *T. aestivum* emerged as a spontaneous singular event. The time sequence alone is 'unnaturally' abrupt, suggesting possible human intervention.

## THE EVOLUTIONARY FITNESS OF HYBRID TRAITS

If hybridization (fusion) of Emmer and *Aegilops* occurred naturally and gradually, the process could be expected to generate a range of traits - advantageous or disadvantageous to evolutionary success. There could be competing and contradictory indications between natural evolutionary advantages versus 'improvements' for human utilization. For example, indeterminate maturity and seed-shedding would favor natural seed survival and dispersal, whereas determinate maturity and seed retention facilitate human harvest. Likewise, hard seeds with strong husks might favor natural seed survival and dispersal, but the opposite is the case for ease of human utilization. Shewry, 2009, noted experiments at Rothamsted, UK, in which domestic wheat barely survived beyond three years in a 'wild' uncultivated field.

The abrupt singular emergence of hexaploid *T. aestivum* with traits dominantly suitable for human utilization, strongly suggests a process involving [sophisticated] human intervention - in both the initiation and selection phases.

## RECORD OF POSSIBLE HUMAN INTERVENTION

Against this background, a written 'legendary' record of possible human intervention in the development of bread wheat has emerged. Not just in passive selection but directly in the initiation phase and in cultivation. The record is in a collection of manuscripts held by the British Museum, obtained from Coptic [Christian] monasteries in Egypt and thought to date broadly from the 10th to 11th century CE. A particular manuscript (Brit Mus Oriental

MS No 7026; Budge, 1913) contains an account attributed to St John Chrysostom (309-427 CE), Archbishop of Constantinople - in which Christ supposedly instructed an angel to reveal certain mysteries. The story - in translation - is heavily overlaid with the imagery of early evangelical Christianity, but nonetheless provides a plain account of the origin of 'the wheat plant'. It is a curiously innocent account - you couldn't make it up! The manuscript relates in part -

... 'Lord, I wish that thou wouldst inform me concerning the matter of the wheat plant, and tell me where, before the earth had been cultivated, it was found that man might live upon it.'

After Adam was banished from the Garden, he was hungered and could not find food and cried out in grief to the Lord, who pleaded on his behalf to God the Father ... who responded, 'I will give unto thee some of my own flesh which is invisible. And the Father took a portion of his own body, and he made it into a grain of wheat, and he brought forth the seal of light, and he sealed the grain of wheat in the middle thereof.'

Then [archangel] Michael went to Adam and '... gave unto him the grain that had been sealed with light, and he taught him how to sow and reap it'.

Wallis Budge (1857-1934) was a one-time Director of Egyptian and Assyrian Antiquities at the British Museum and a renowned scholar of Egyptian and Near Eastern literature. The anecdote, in translation, is heavily embroidered with Christian evangelism, but it conveys a sense of innocent authenticity. It is an oddly specific subject and contains curiously obscure technical details. A grain of [wild] wheat was sealed up with a portion of 'invisible light'. The manuscript was written in 'native dialect' by Coptic priests in Egypt but apparently originated from Constantinople in modern Turkey. It is dated before any modern knowledge of crop development, and even Budge's translation is prior to modern appreciation of genetics and certainly before any understanding of polyploidy or radiation. It would be difficult to accuse Budge of anything other than a naïve literal translation - at that time, he could not have had any appreciation of the significance of the detail. According to this account, the wheat plant was made suitable for human cultivation by 'sealing it up with a portion of invisible light', and men were actively taught how to sow and reap it.

## DISCUSSION

Re-consideration of the apparently sudden emergence of tetraploid Emmer and hexaploid bread wheat from ca. 10,000 BP onward in the Middle East region - (a) highlights several difficulties with the natural evolution scenario, and (b) supports the possibility of human mediation, indicated here by an explicit 'legendary' record using 'invisible light'.

In the accepted view, the sudden domestication of Emmer and the emergence of hexaploid *T. aestivum* occurred spontaneously, naturally, then was fostered by naïve farmer selection and husbandry of wild populations - notwithstanding that there is no evidence at all of the intermediate hybrids or of landrace populations of *T. aestivum* and experiments show that it does not survive in the wild. A further difficulty with this view is the probable mismatched timing sequence of human development and crop development. Husbandry of Emmer wheat and putative selection of bread wheat must have required a reasonable degree of sophistication - but several studies have reported that the regional indigenous population of that era remained in a sparse primitive hunter-gatherer state until around 8000 BCE. Spencer (1993) reported that there was no evidence of human activity in the Nile Valley in the period 11-8,000 BCE; while Hole, (1987), recorded no dated archaeological evidence [of settlement] across Mesopotamia from 10-8,000 BCE, and Frankfort, (1968), wrote that the population of lower Mesopotamia remained in a pre-historic state until the middle of the 4<sup>th</sup> millennium BCE, with no sign of the impending transition to civilization. On the other hand, sudden technological advance is broadly coincident with the abrupt immigration of the Sumerians into the region, centered on Ur near Basra in modern Iraq. The Sumerians, whose origin is also enigmatic, were culturally and ethnically distinct from the indigenous populations, and are firmly recorded to have introduced a wide range of cultural and technological innovations, including in agriculture. Coincidentally, emmer wheat (and barley) appeared abruptly in the Fayum in Egypt from ca 5000 BCE (Bard, 1999).

On the other hand, while domestication of Emmer could be attributed to normal progressive crop husbandry, the sudden emergence of technologically advanced hexaploid wheat implies a different degree of intervention - or extreme serendipity. The suggested possibility of radiation-induced mutation (by 'invisible light') has three potential explanations: One, It is fictitious and fallacious. Two, it could be attributed to serendipitous occurrence - where wheat happened to be stored in or exposed to something that was naturally radioactive, such as certain granite stone. In that scenario a radiation-induced muta-

tion could happen by chance – requiring only to be recognised and fostered. Or Three, it could be attributed to the deliberate, active use of some radiation source – implying an incongruous level of technological knowledge.

The available English translation of the Coptic account attributes human intervention specifically to [actively] ‘sealing up’ grain together with ‘invisible light’ - where Budge’s naïve rendition of ‘invisible light’ could be interpreted in modern terms as a form of radiation. The concept of ‘unseen radiation’ was essentially unknown in Budge’s era, where X-rays were just discovered by Roentgen in 1895, and the natural radiation of radium was not identified by Curie until 1898. However, the occurrence of ‘invisible emanations’ was widely documented elsewhere in ancient Egyptian literature. Standard published translations of classic Egyptian texts commonly describe emanations from the ‘sun god’ as an invisible ‘efflux’. Birch described the effect as ... *water of fire [like] a foul flux emanating from Osiris* (Birch, 1867), while more modern translations rendered it as ... *[the] efflux which issued from putrefaction [decay] of Osiris*. (Faulkner, 1969). Several instances of unusually high and localized radiation have been confirmed in ancient Egyptian mastaba tombs (Bigu et al, 2000; Salama et al, 2018); and other accounts have suggested active knowledge of radiation implicit in Ancient Egyptian literary references to the invisible ‘efflux’ of ‘light food’ in portions of 2-3-5, and to the storage of noxious ‘excrements’ (wastes) in underground storage vaults – called the *per d’jet*, house of millions of years. (Fellowes, 2024).

Altogether, the pattern of events supports the possibility that hexaploid bread wheat, *T. aestivum*, was developed via human intervention – both initiated by a form of radiation and followed by agronomic tuition on how to sow and reap. The possible involvement of radiation could be fallacious, serendipitous, or conscious. Deliberate use is supported, to a degree, by the innocence of the legendary account, and is consistent with other evidence of radiation in ancient Egypt.

## IMPLICATIONS AND APPLICATIONS

There are logical and evidentiary difficulties with mainstream accounts of sudden evolution of hexaploid bread wheat. Evidence here indicates conscious human intervention in both initiation and cultivation, possibly utilising radiation – which is at variance with accepted views.

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