Einkorn and ancient grains

A night with einkorn

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19/11-2024

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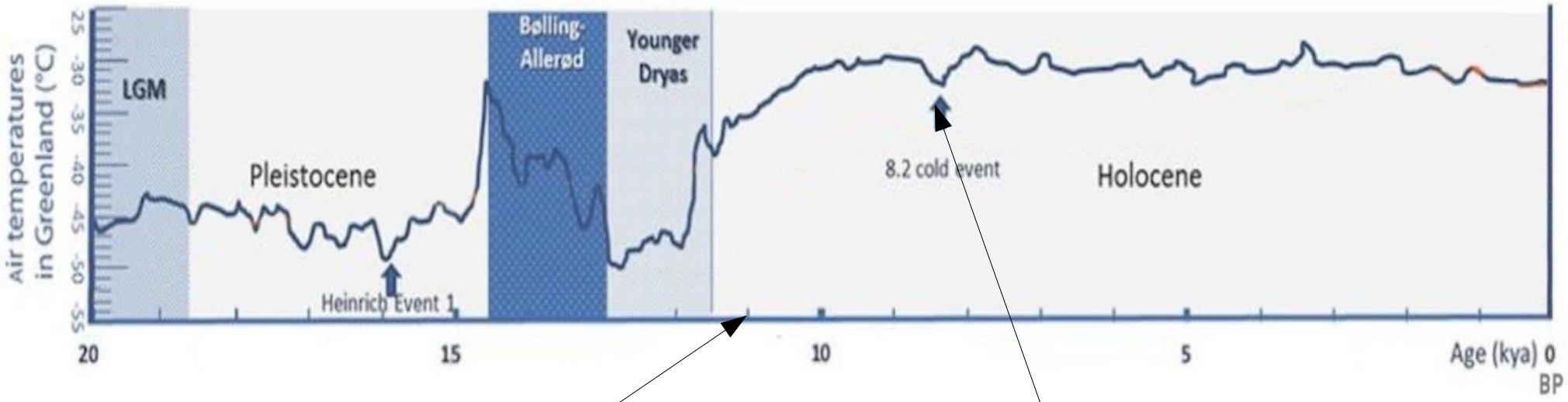
Project funding by
BOOST (Organic RDD-6)

Stone tools before einkorn and after einkorn

Is grain important for us?

- Grain has always be the dominating crops and still contributes with +50% of our calories and ca 40% of or protein-intake
- All public revolutions in history are based on increasing prices of bread
- World population cannot be fed by fishing and hunting wild game.



Einkorn, emmer and barley domesticated

The Arch of Noah

What is paradise?

Paradise is a place without:

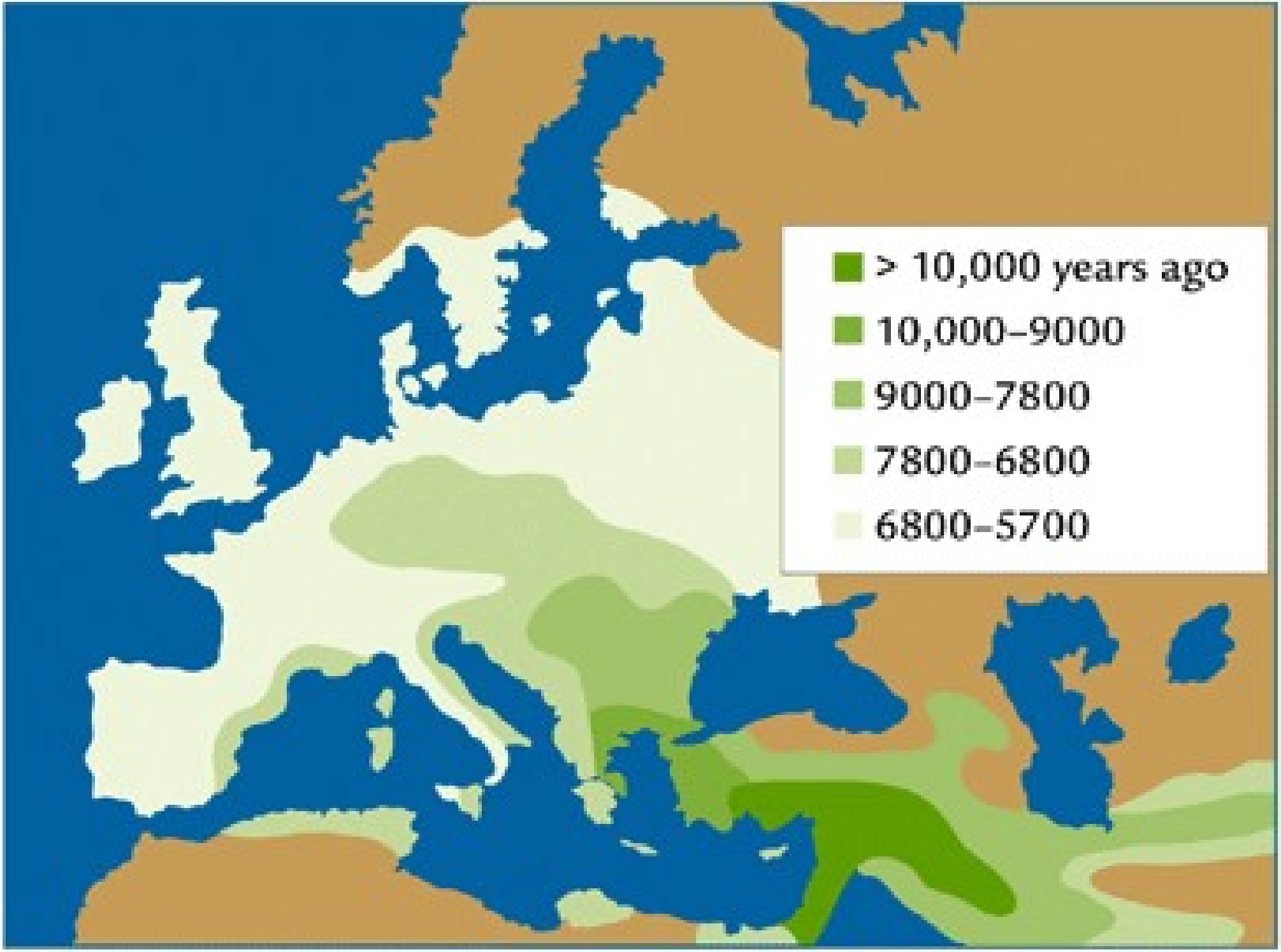
- malnutrition
- violence among humans
- authority and suppression
- inequality
- hard labour and attrition
- a fair chance to survive from birth to elderhood


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

Is grain important for us?

- Einkorn, emmer and barley were the first crops grown by Kain after leaving Paradise.
- All civilisation descent from these crops
  - money
  - military
  - writing
  - laws


Karacadağ
Göbekli Tepe
Diyarbakir
Eufrat


> 10,000 years ago
10,000–9000
9000–7800
7800–6800
6800–5700

Effects of grain based civilisation?

When agriculture was introduced

- Dayly work hours increased from 2½ h/day to 12-14 h/day
- child death (<5y) increased
- Life expectancy decreased
- Hight decreased by 11cm
- Mineral deficiency increased
- Infections incl. dental caries increased
- violent deaths increased from 1:25 or 1:4
- osteoarthritis increased (Slidgigt)

but most importantly:

- Female fertility increased significantly!

Modern effects of a grain based diet

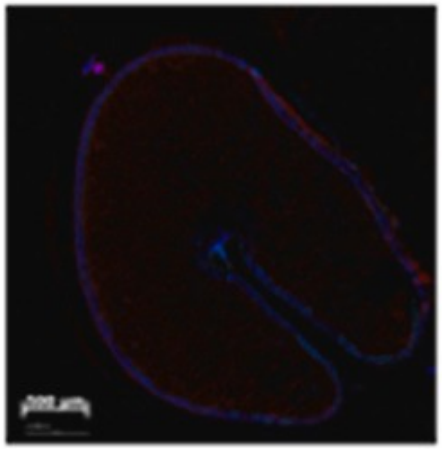
- Diabetes
- Allergy
- Cardio-vascular diseases
- Cancer
- Inflammations
- Autism, Schizophrenia, anorexia, depression, anxiety

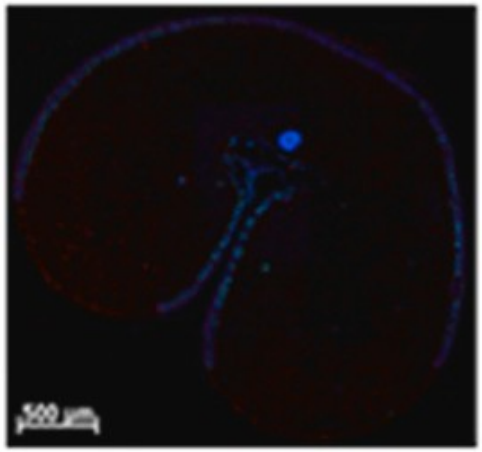
Einkorn

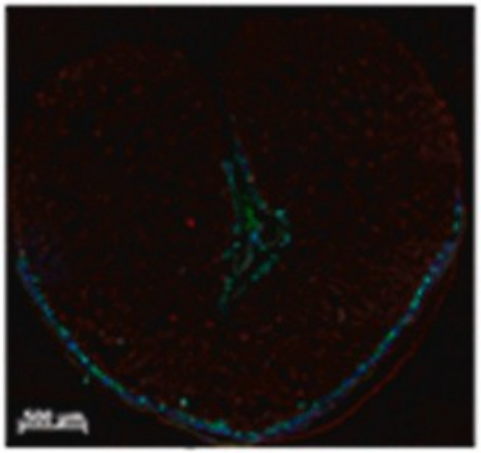
Emmer

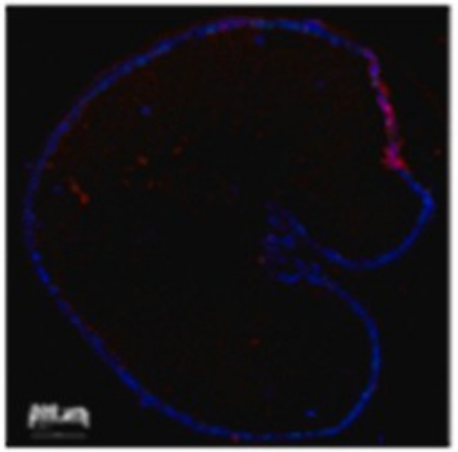
Spelt

Hard Red Spring

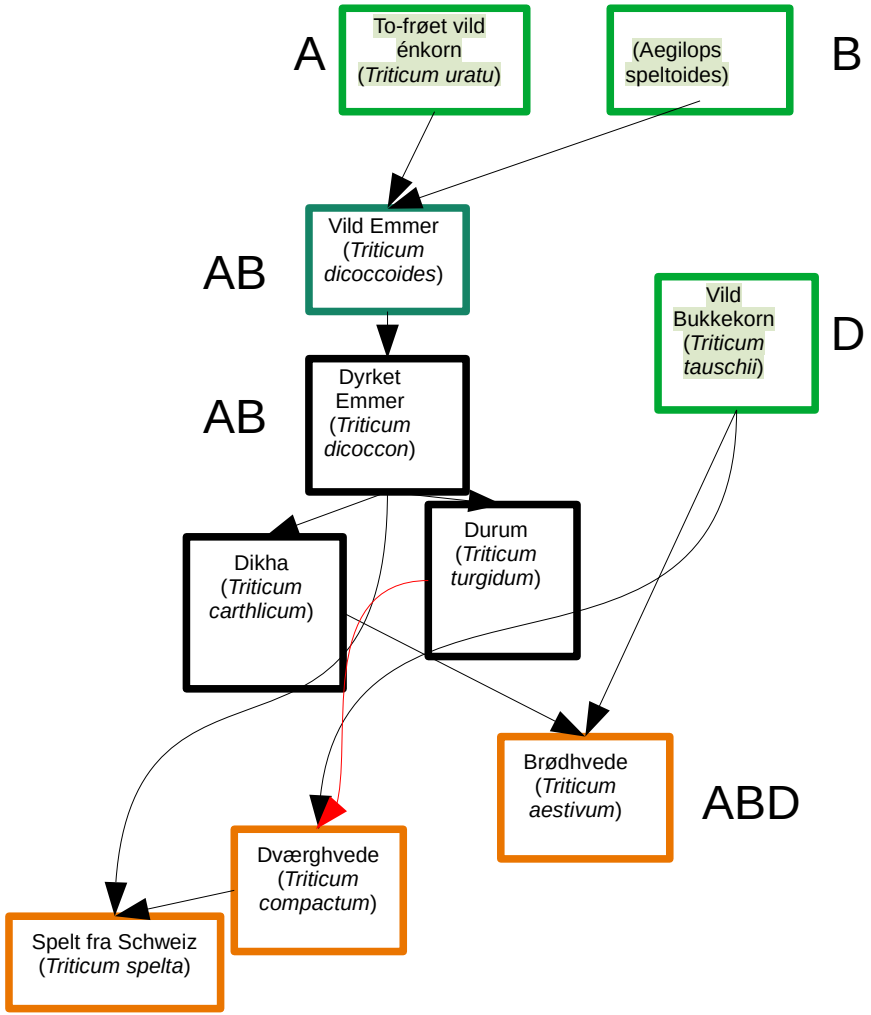




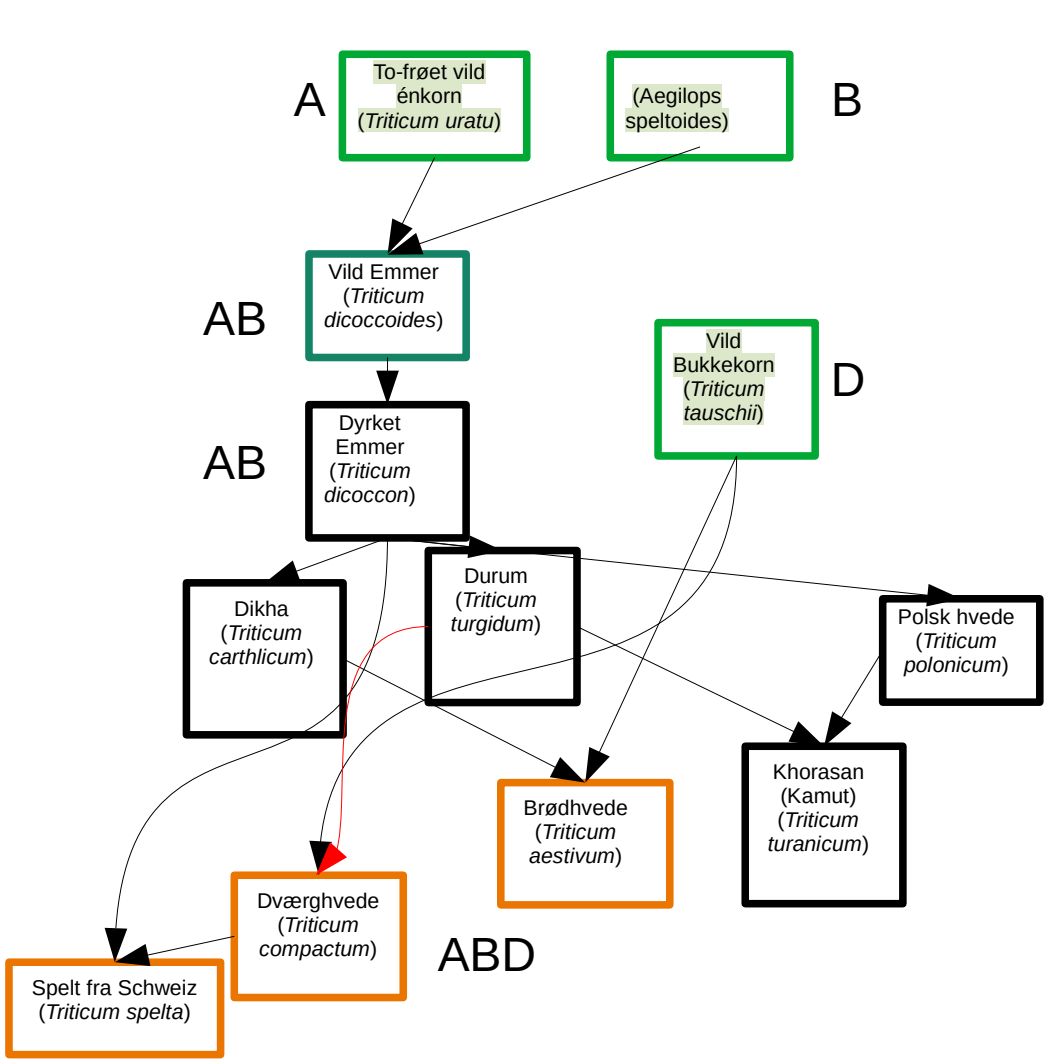


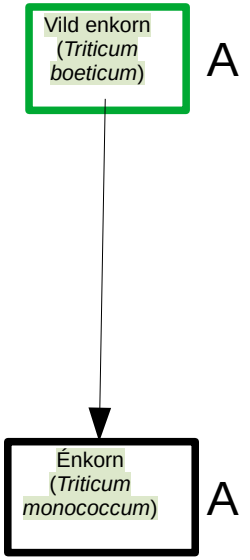


Wheat pedigree

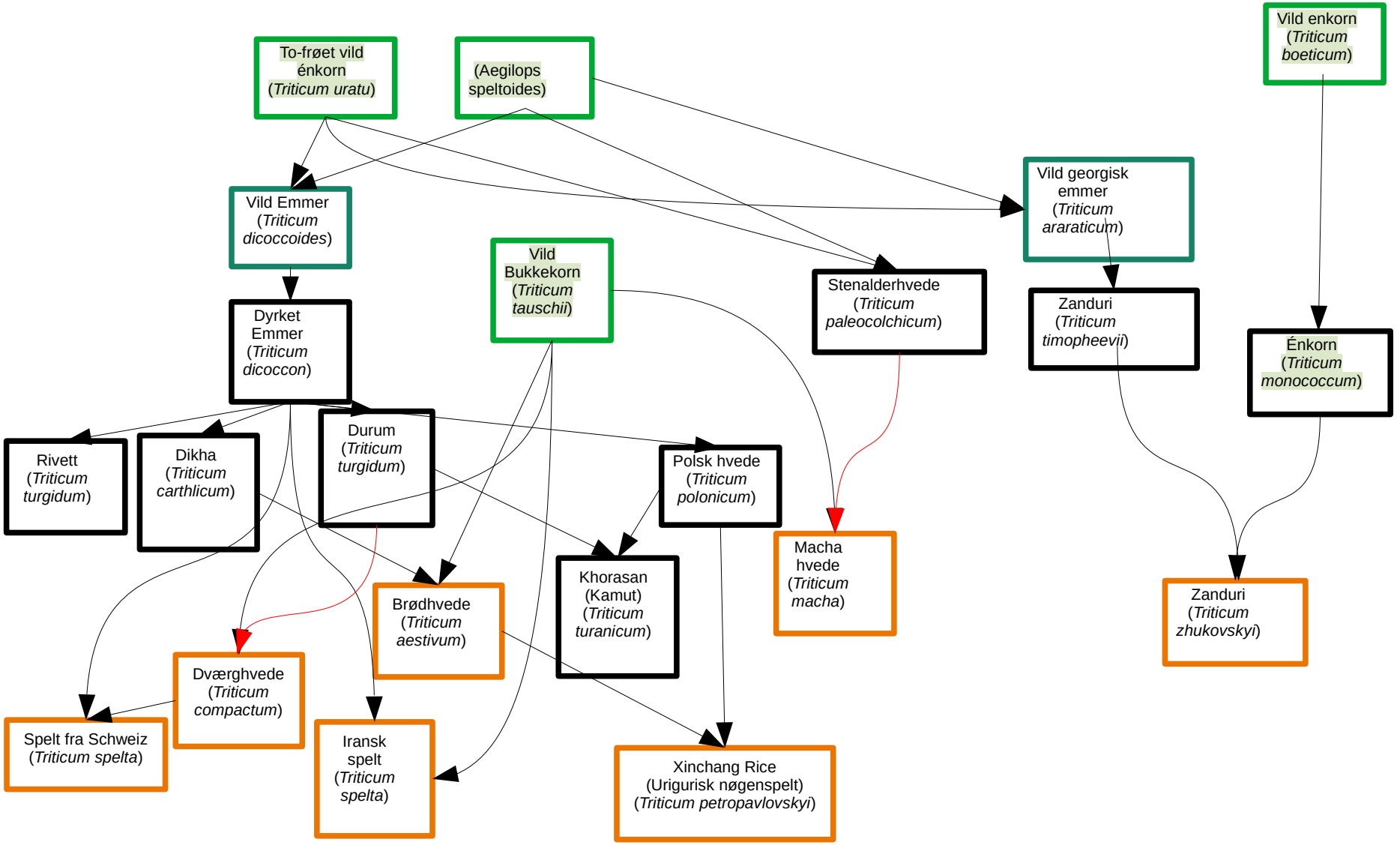


Wheat pedigree





Wheat pedigree



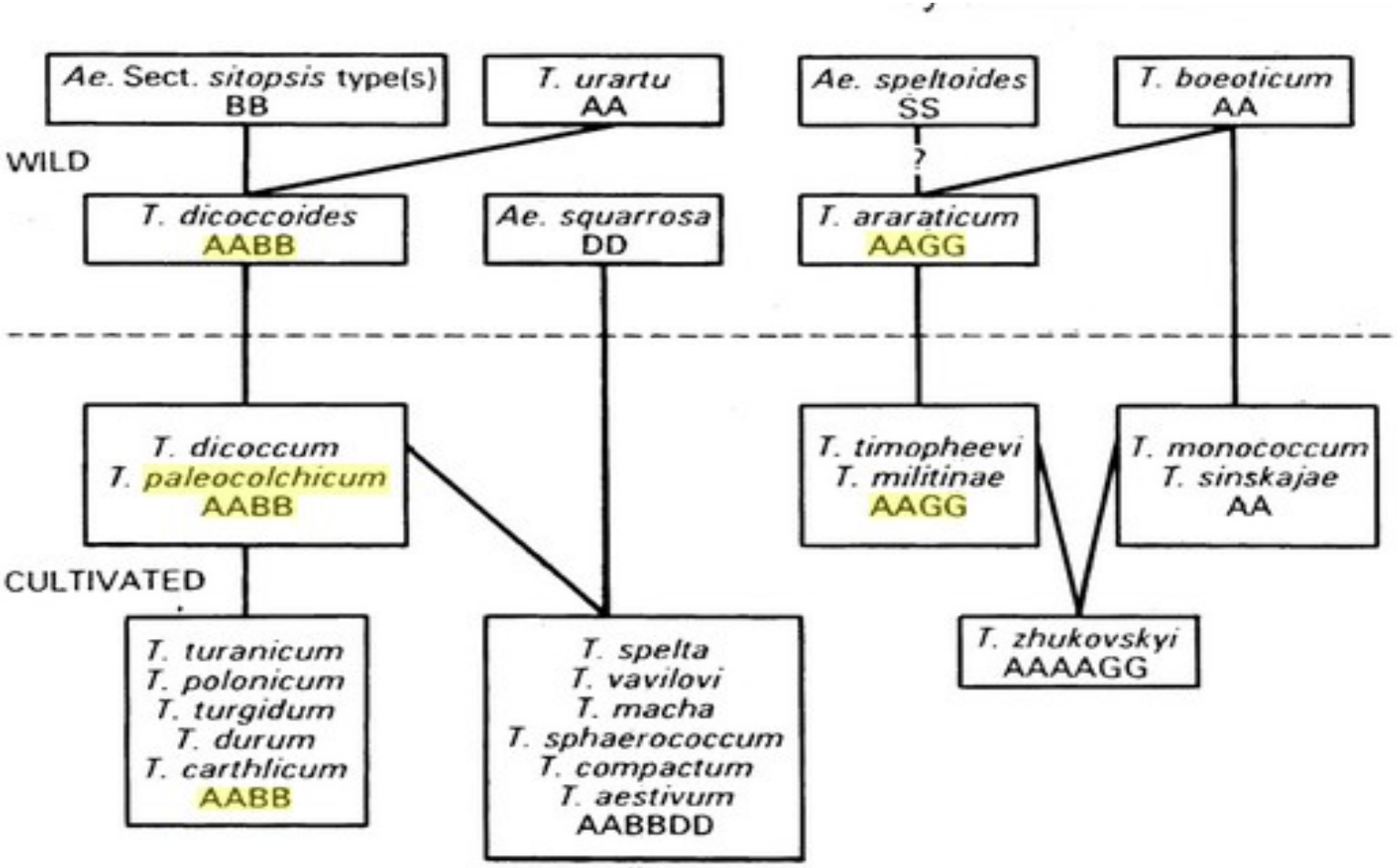
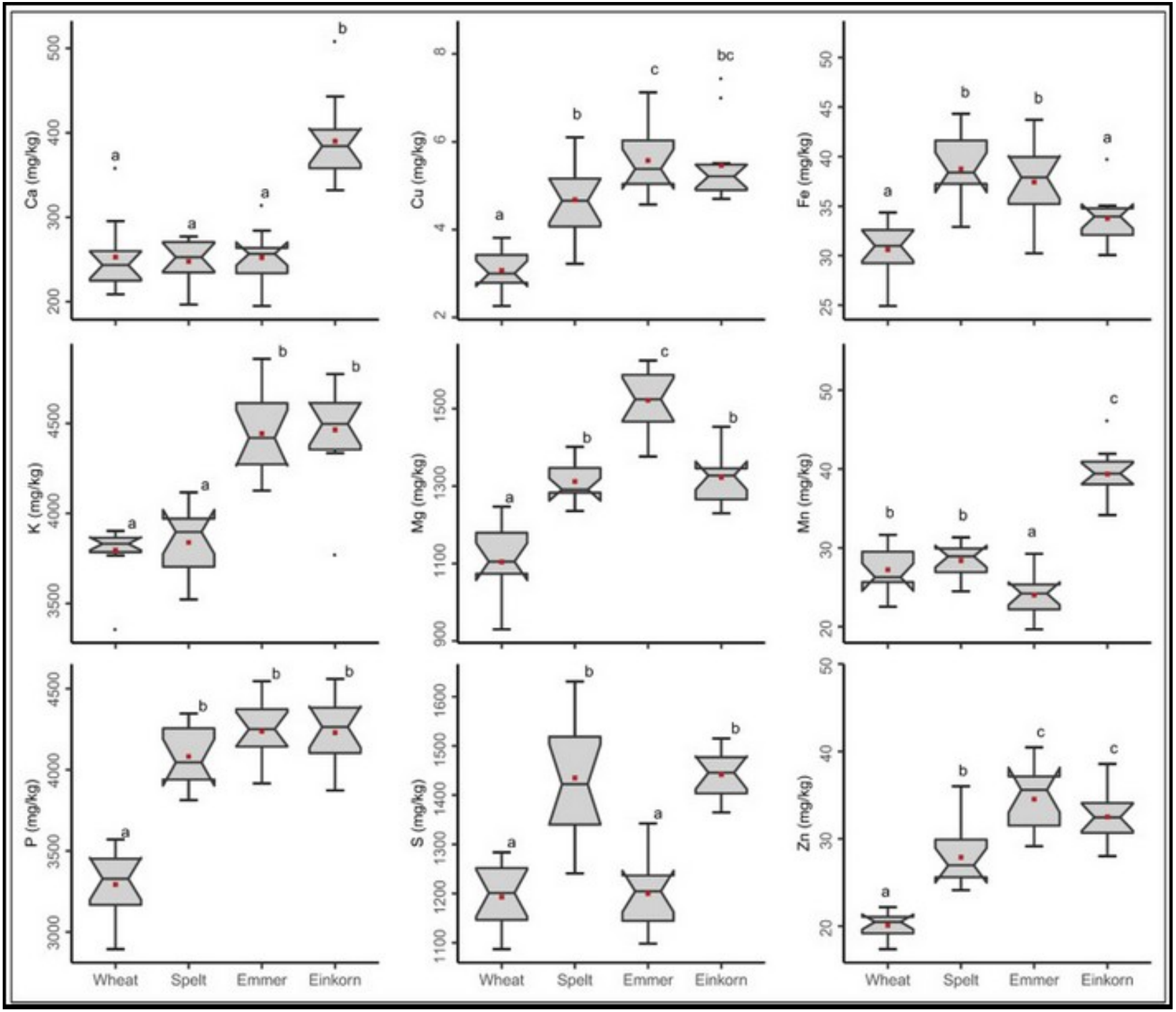


Fig. 1.2. Evolution of the polyploid wheats from current evidence. (Miller 1987)


Ca (mg/kg)
Cu (mg/kg)
Fe (mg/kg)
K (mg/kg)
Mg (mg/kg)
Mn (mg/kg)
P (mg/kg)
S (mg/kg)
Zn (mg/kg)
Wheat
Spelt
Emmer
Einkorn

ANATOMY OF A GRAIN

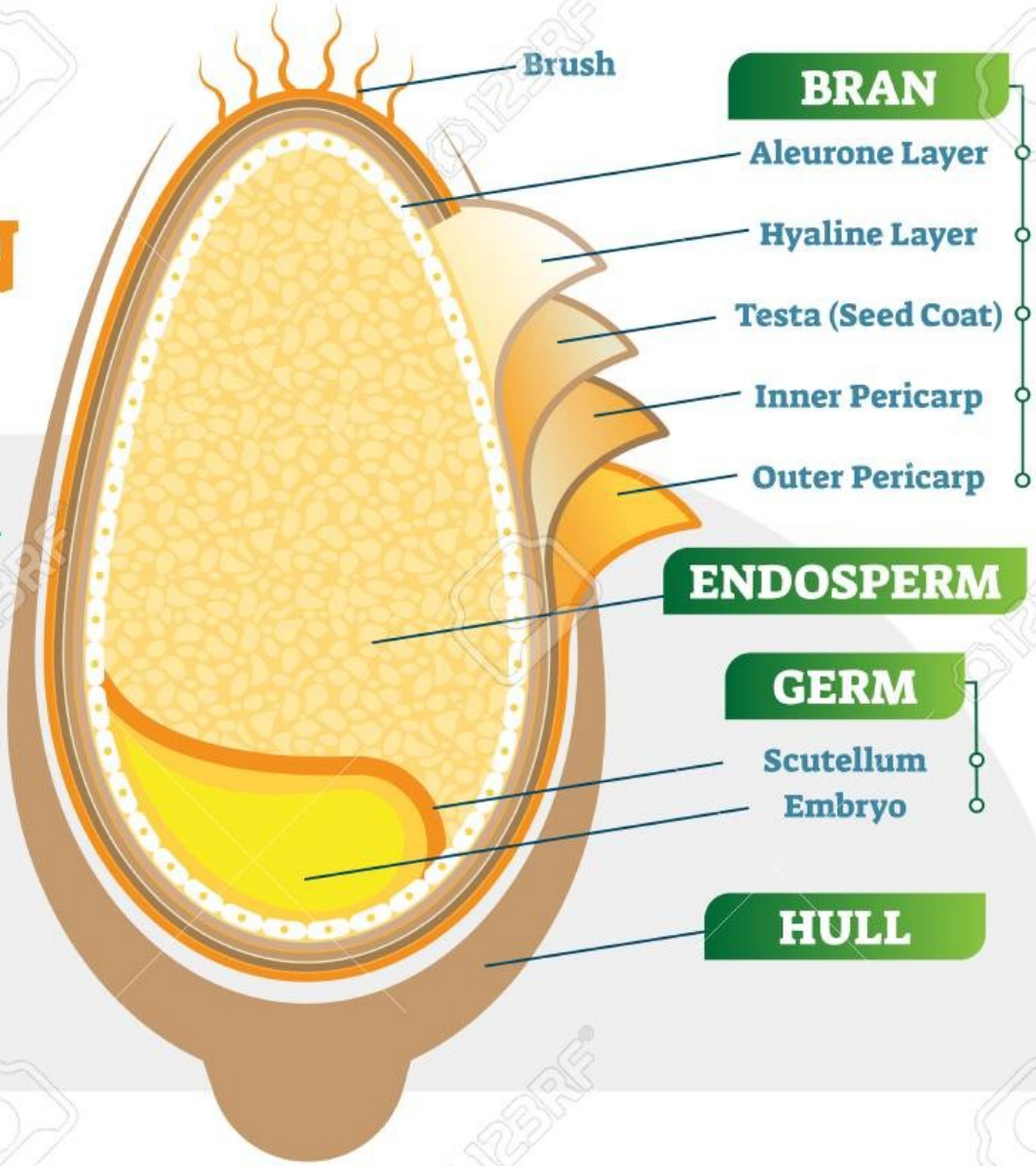


Figure 1

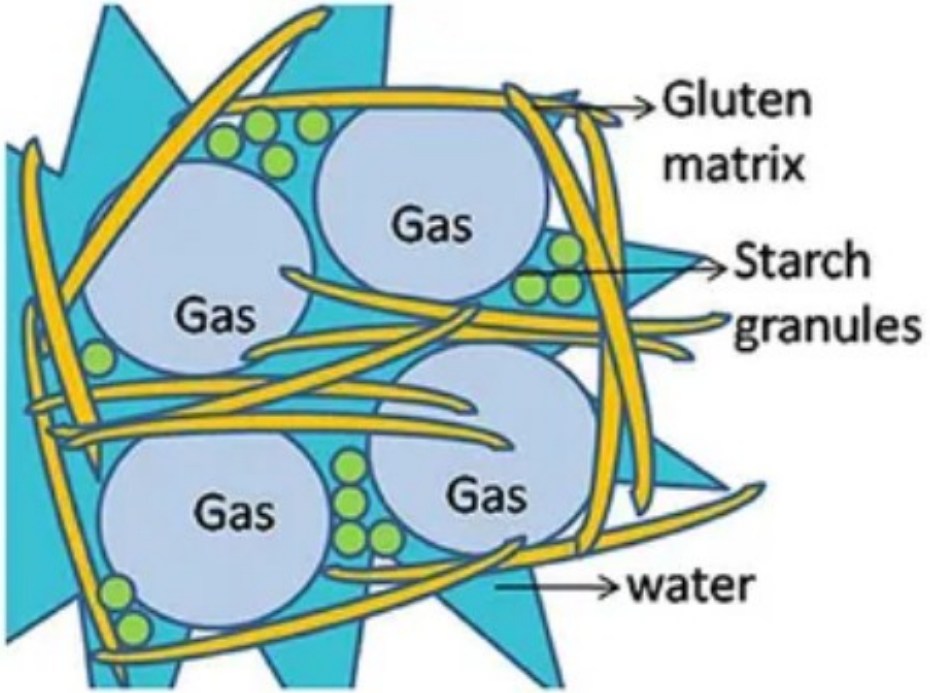


Figure 1. Illustration of gas molecules entrapped in the gluten matrix of wheat dough.

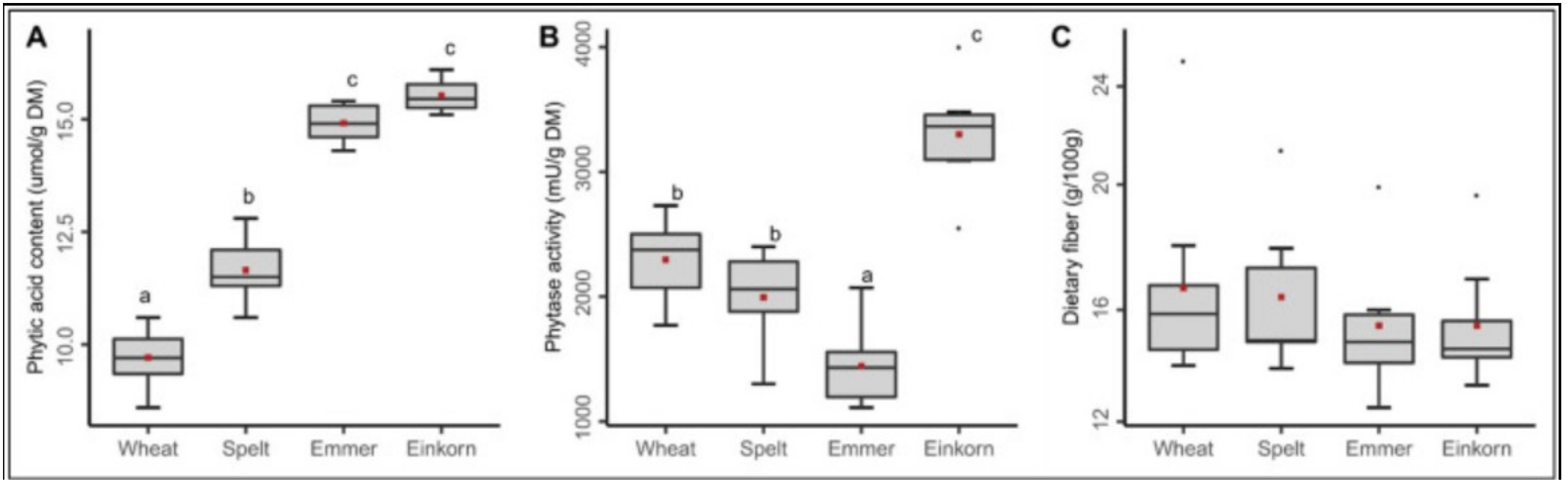

A
Phytic acid content (umol/g DM)
10.0
12.5
15.0
a
b
c
c
Wheat
Spelt
Emmer
Einkorn
B
Phytase activity (mU/g DM)
1000
2000
3000
4000
b
b
a
c
Wheat
Spelt
Emmer
Einkorn
C
Dietary fiber (g/100g)
12
16
20
24
Wheat
Spelt
Emmer
Einkorn

Table 1. Kernel quality traits of einkorn, emmer, spelt and hard red spring wheat.

Wheat Species	Genotype	Test Weight (kg/hL)	Average	1000 Kernel Weight (g)	Average	Large Kernel Content (%)	Average	Medium Kernel Content (%)	Average	Small Kernel Content (%)	Average	Hardness Index	Average
Einkorn	TM 23	72.4	73.2 ± 1.1 b	30.9	29.2 ± 1.5 c	2.8	3.8 ± 2.8 c	92.4	92.9 ± 3.9 a	4.0	3.0 ± 1.1 b	1.8	2.2 ± 0.4 c
	WB Apline	74.5		28.8		1.7		97.0		1.8		2.4	
	PI 538722	72.7		28.0		7.0		89.3		3.1		2.5	
Emmer	Vernal	71.3	70.4 ± 1.3 c	33.8	33.6 ± 0.5 b	3.4	2.7 ± 0.8 c	91.4	91.9 ± 1.2 a	4.9	5.2 ± 2.4 a	73.8	74.4 ± 0.8 a
	Lucille	71.4		34.0		3.1		93.4		3.4		75.6	
	ND common	70.2		32.9		2.8		90.7		6.0		74.4	
	Yaroslav	68.7		33.6		1.6		92.1		6.3		73.8	
Spelt	CDC Zorba	70.5	72.9 ± 2.3 b	35.1	38.3 ± 4.9 a	44.0	52.9 ± 23.3 a	54.2	34.85 ± 22.6 c	1.7	0.9 ± 0.8 c	24.4	32.7 ± 20.4 b
	94-288	75.0		35.8		35.4		64.2		0.8		56.0	
	SK3P	73.2		44.0		79.3		21.0		0.1		17.8	
HRS	Sy Ingmar	79.8	81.0 ± 1.0 a	33.9	33.9 ± 1.5 b	31.9	33.7 ± 2.6 b	67.0	65.2 ± 2.4 b	1.2	1.1 ± 0.4 c	68.3	74.9 ± 5.3 a
	Barlow	81.3		32.8		31.4		67.4		0.9		79.8	
	Elgin-ND	79.4		33.7		33.9		64.4		1.7		75.3	
	Linkert	80.6		36.6		38.4		61.0		0.6		66.1	
	glenn	82.1		34.3		32.7		66.0		1.4		77.4	
	Rollag	81.2		34.3		36.6		62.2		1.2		78.0	
	ND Vitpro	81.9		34.4		33.3		66.2		0.4		73.1	
	Lang-MN	81.8		31.5		31.4		67.1		1.5		80.8	

HRS–Hard Red Spring. Mean values across field replicates are presented in Table 1 ($n = 4$). Means with the same letter in the same column are not significantly different ($p < 0.05$).

Table 2. Chemical composition of whole wheat flour of einkorn, emmer, spelt and hard red spring wheat.

Species	Genotype	Moisture (%)	Average	Ash (%)	Average	Protein (%)	Average	Total Starch (%)	Average	Crude Fat (%)	Average	Total Dietary Fiber Content (%)	Average
Einkorn	TM 23	9.0	9.0 ± 0.1 c	2.2	2.2 ± 0.1 a	15.4	14.6 ± 0.8 c	62.1	62.2 ± 0.6 b	2.3	2.3 ± 0.2 a	13.0	15.1 ± 2.3 c
	WB Apline	9.0		2.2		13.9		62.8		2.5		14.8	
	PI 538722	9.1		2.1		14.5		61.7		2.1		17.5	
Emmer	Vernal	9.4	9.4 ± 0.1 b	2.3	2.2 ± 0.1 a	15.2	14.5 ± 0.7 c	64.3	65.9 ± 1.2 a	2.0	2.1 ± 0.2 a	15.0	19.1 ± 3.1 a
	Lucille	9.5		2.3		15.0		66.9		2.0		20.7	
	ND common	9.5		2.1		14.2		66.6		2.0		18.4	
	Yaroslav	9.3		2.1		13.6		65.8		2.3		22.2	
Spelt	CDC Zorba	8.8	8.9 ± 0.2 c	2.2	2.1 ± 0.1 a	14.6	15.2 ± 0.6 b	61.2	61.6 ± 0.4 b	1.7	1.6 ± 0.3 b	15.6	17.3 ± 1.5 ac
	94-288	9.1		2.0		15.1		61.8		1.3		17.8	
	SK3P	8.9		2.1		15.8		61.9		1.9		18.5	
HRS	Sy Ingmar	10.5	10.4 ± 0.2 a	2.1	2.2 ± 0.1 a	18.4	17.3 ± 0.8 a	61.4	62.3 ± 1.7 b	1.0	1.1 ± 0.3 c	18.8	19.2 ± 1.8 a
	Barlow	10.4		2.1		16.6		65.1		0.7		17.6	
	Elgin-ND	10.3		2.2		16.9		60.5		1.2		20.7	
	Linkert	10.0		2.2		17.5		62.9		1.4		21.3	
	glenn	10.4		2.2		17.3		64.3		1.3		19.1	
	Rollag	10.3		2.1		17.6		61.5		1.4		21.6	
	ND Vitpro	10.4		2.3		17.9		62.0		0.9		17.4	
	Lang-MN	10.8		2.0		15.9		60.5		0.6		17.4	

HRS—Hard Red Spring. Mean values across field replicates are presented in Table 2 ($n = 4$). The ash content, protein content, total starch content, crude fat content, and total dietary fiber content values are expressed on dry weight basis. Mean values with the same letter in the same column are not significantly different ($p < 0.05$).

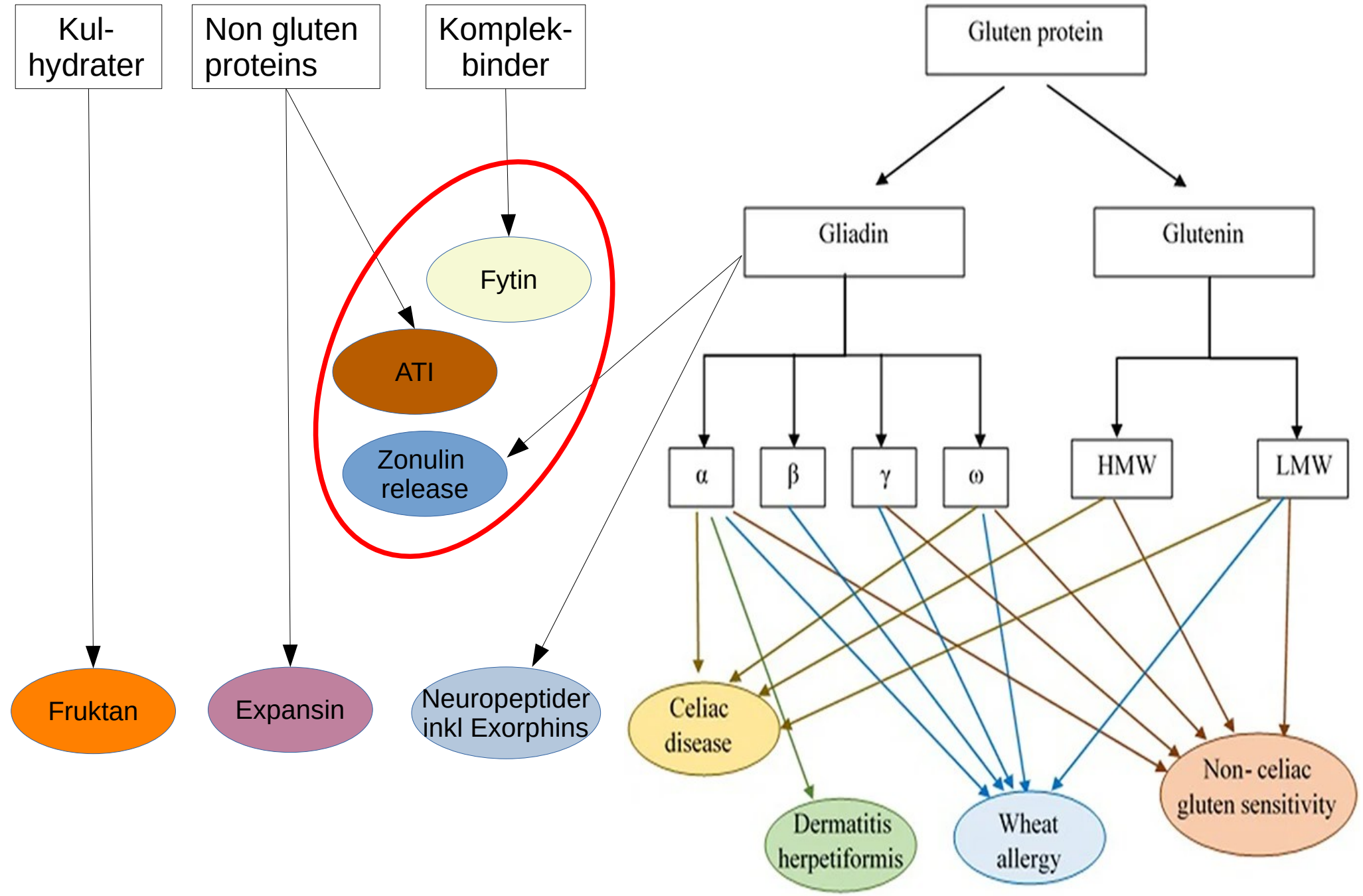
Glutenine sub units in wheat

Score	Chromosome		
	1A	1B	1D
4	-	-	5+10
3	1	-	-
3	2*	-	-
3	-	17+18	-
3	-	7+8	-
3	-	13+16	-
2	-	7+9	-
2	-	-	2+12
1	null	-	-
1	-	7	-
1	-	6+8	-
1	-	20	-

Einkorn

- High in lutein
- High in fat (big germ)
- Good digestibility due to
  - soft kernels
  - high amylase and phytase content
  - low in HMWG
- low in allergenic response
  - low in α-gliadin (most likely low in zonulin response)
  - low in ATI

Anti-nutrients in wheat




A
B
C
D
E
G
H
I
F