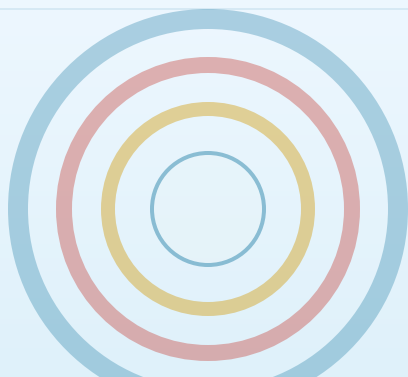


1 CT Phenomics



Fibre -13 → -795 HU

Shell 0 → +202 HU

Endosperm 0 → +37 HU

~1,200 HU Dynamic Range · 5 Varieties × 5 Stages

2 Growth–Defense Axis

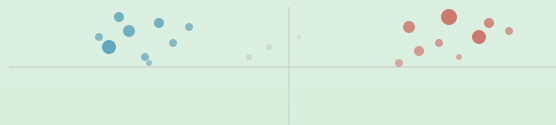
W5 ↑ Growth

- Nucleotides +34.6×
- Amino acids enriched
- Free fatty acids ↑

CK ↑ Defense

- Flavonoids 32.5×
- Tannins 100% in CK
- Phenolic acids ↑

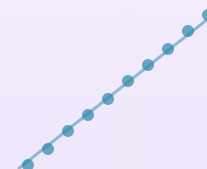
Temporal flip at 6 months (Fig 3)



Volcano plot (624 metabolites, FDR $q < 0.05$)

3 CT–Metabolite Asymmetry

W5 — 55 pairs $|r| > 0.99$



CK — 0 pairs $|r| > 0.95$



3,376 sig. associations (FDR $q < 0.05$)

4 Developmental Canalization

W5 Canalised



Homozygous → buffered trajectories

CK Heterogeneous



Heterogeneous → diluted correlations

↓ CV test ($p = 0.017$) · DNA validation: π , ROH, Fst

5 Germination Prediction

ROC Curve



Shell thickness

Embryo size

n = 75
samples

45/30
germ/non

5-fold CV
AUC=0.691



15-min
screening

2-3 months → 15 min CT scan