Carrefours de l'innovation agronomique 2012

HEALTH GRAIN

Du champ à l'assiette

Nouveaux enjeux pour la filière blé

Jeudi 29 mars 2012

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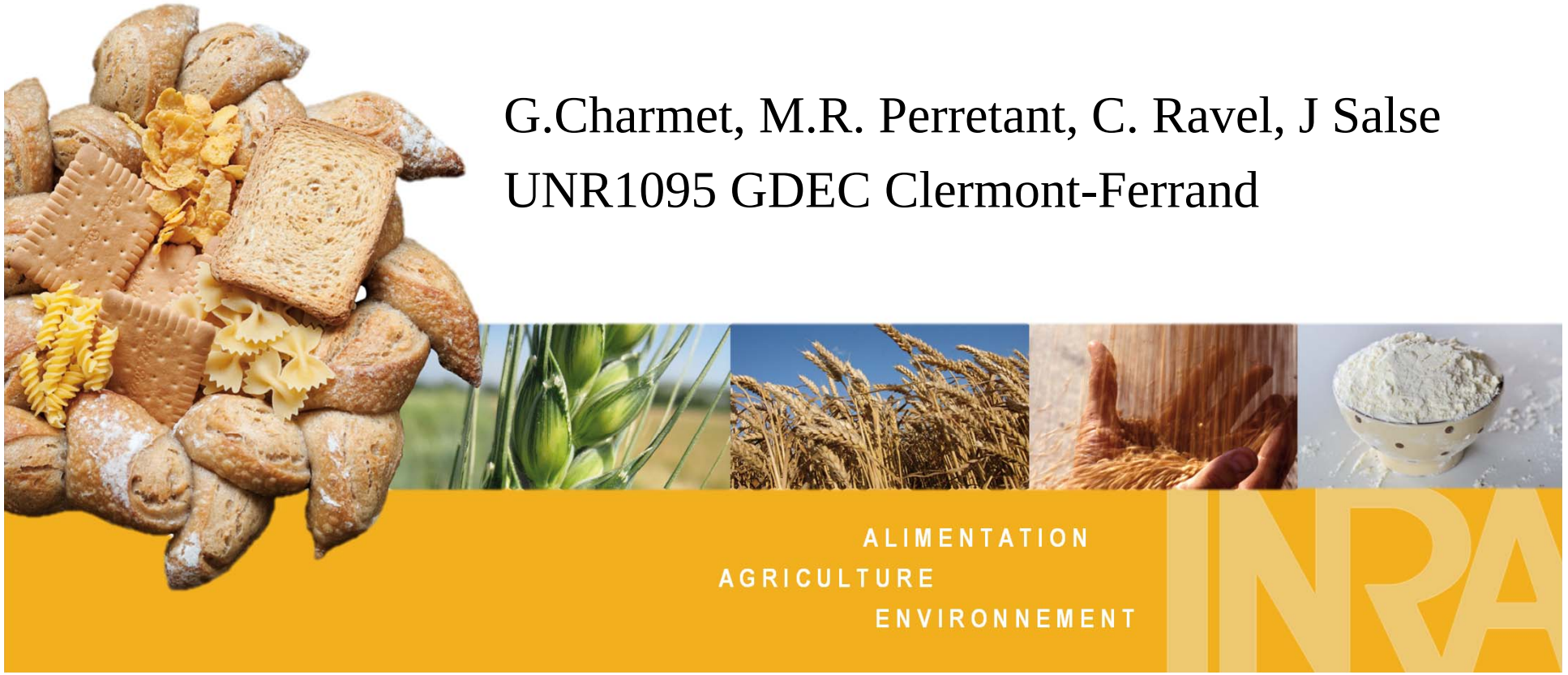
HEALTH·GRAIN

VARIABILITÉ GÉNÉTIQUE ET ENVIRONNEMENTALE DE LA TENEUR DES BLÉS EN NUTRIMENTS

G.Charmet, M.R. Perretant, C. Ravel, J Salse

UNR1095 GDEC Clermont-Ferrand



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HEALTHGRAIN:
IMPROVING CONSUMER HEALTH BY BETTER USE OF WHOLE GRAIN

HEALTH·GRAIN

EU FP 6 INTEGRATED PROJECT 2005-2010

Aiming at:

- Tailoring healthy grain foods
- Better use of European grain

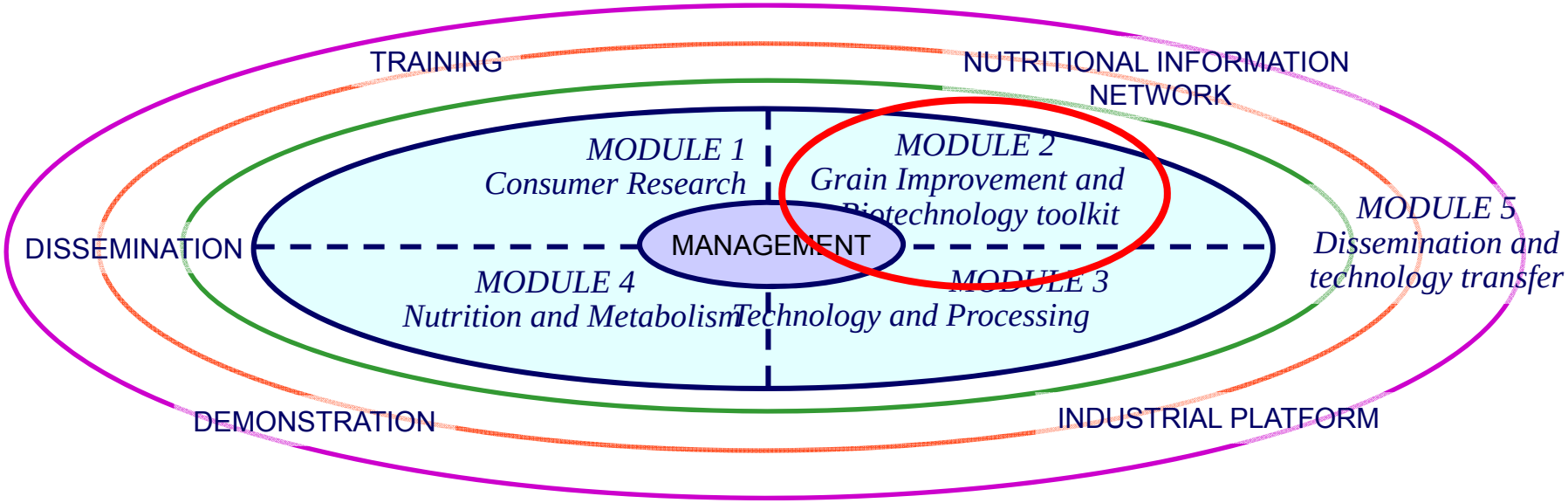
Countries Involved:
FIN, BG, BE, AT, IT, DE, UK, HU, SZ, DK, PL, FR, SE, NL, IE

43 partners, *11 of them being companies, whereof 7 SMEs*

Deliverables:

- Consumer expectations
- Biotechnology toolkit for breeders
- Enabling process technologies
- Mechanisms of health benefits
- Awareness of health benefits

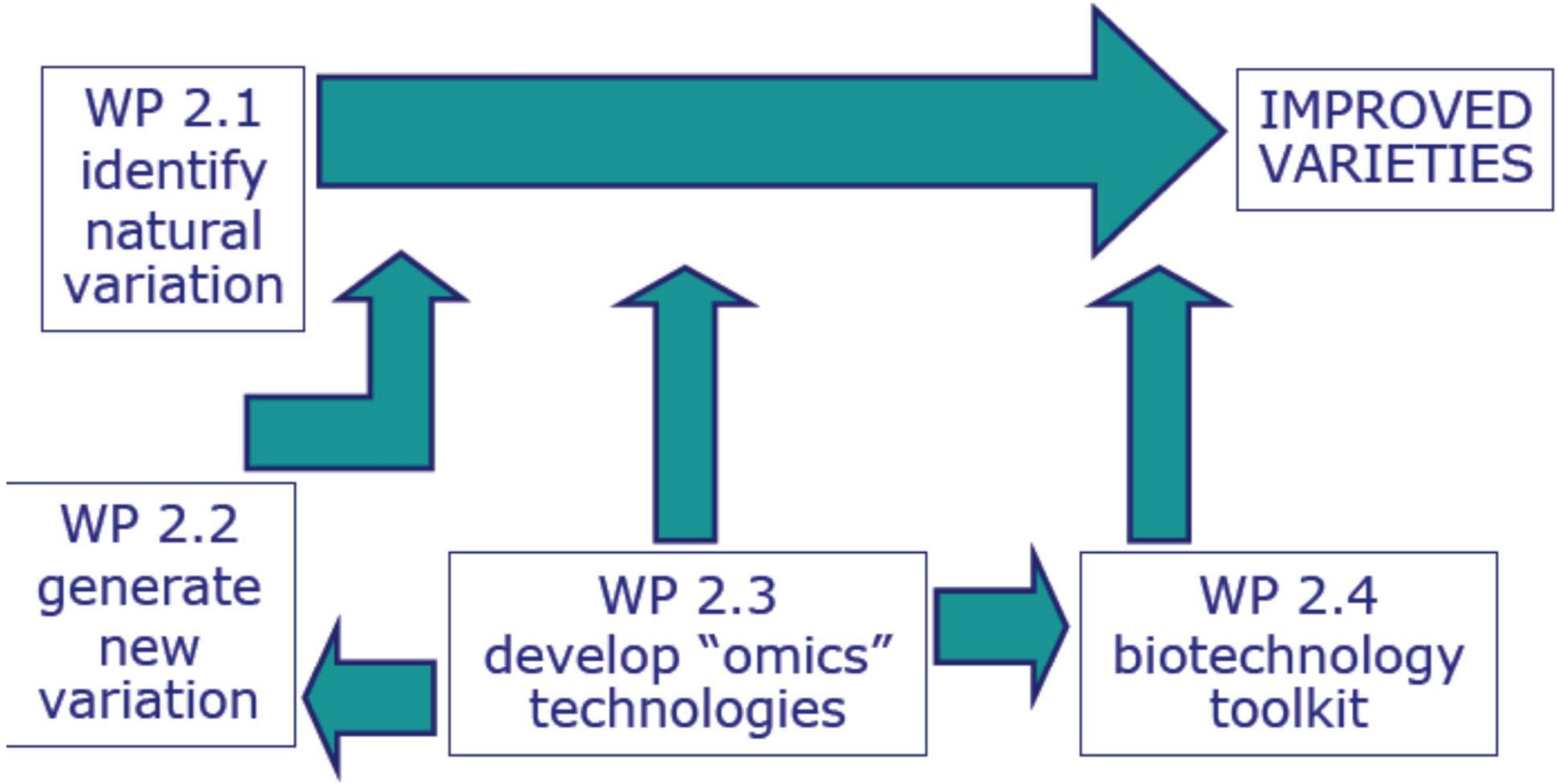
Budget: *16 M €, subvention 10.5 M€*



HEALTH•GRAIN MODULE 2

CROP IMPROVEMENT AND BIOTECHNOLOGY TOOL KIT

Leader: Peter Shewry, Rothamsted Research, UK



I. Screening natural variation

The HEALTHGRAIN Diversity Screen

Grow in Hungary in 2005–6
Grow on four sites in 2006–7
UK, France, Hungary and Poland

Determine compositions of phytochemicals and fibre components

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Le grain de blé est source de nombreux micro nutriments

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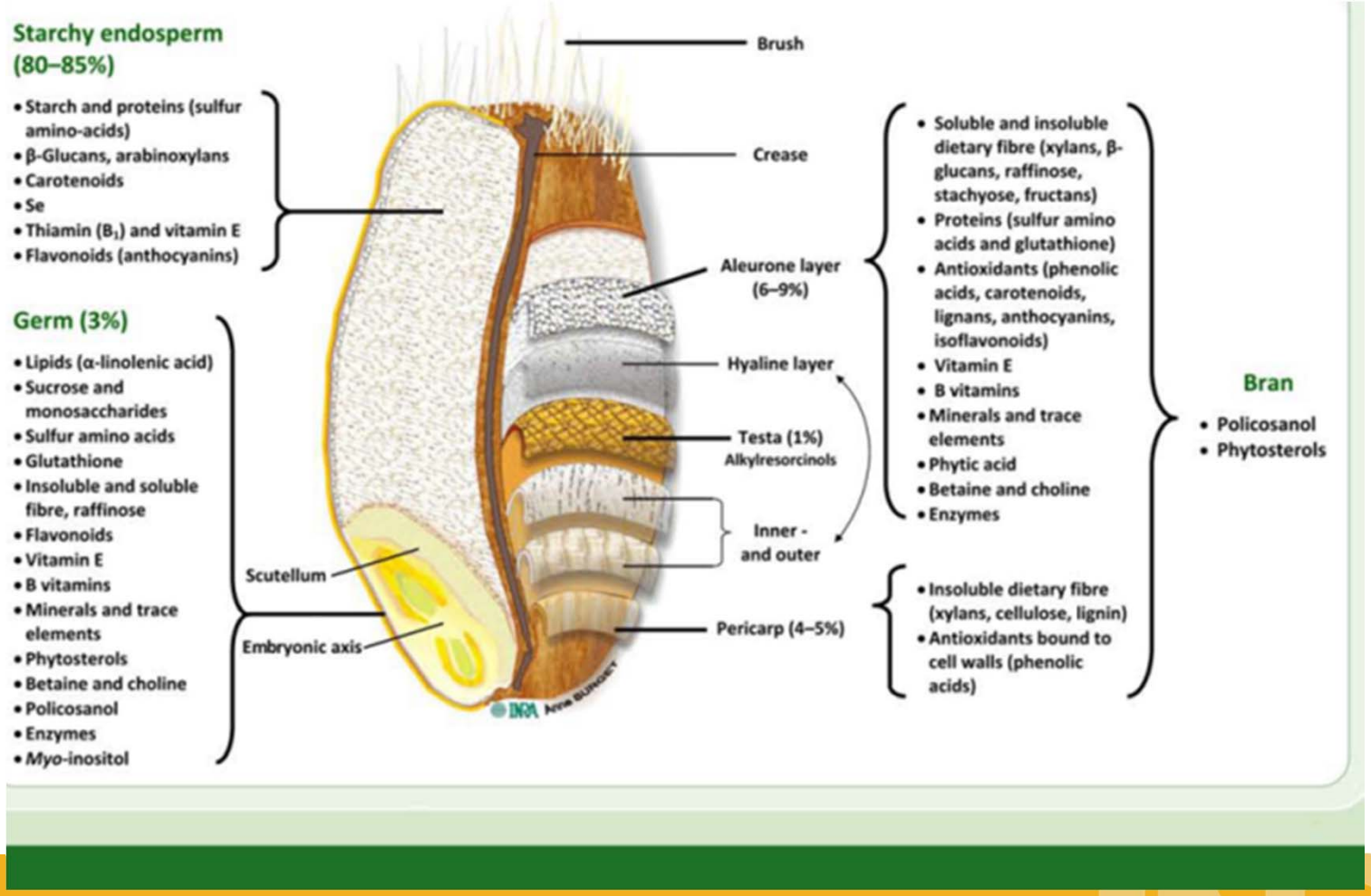
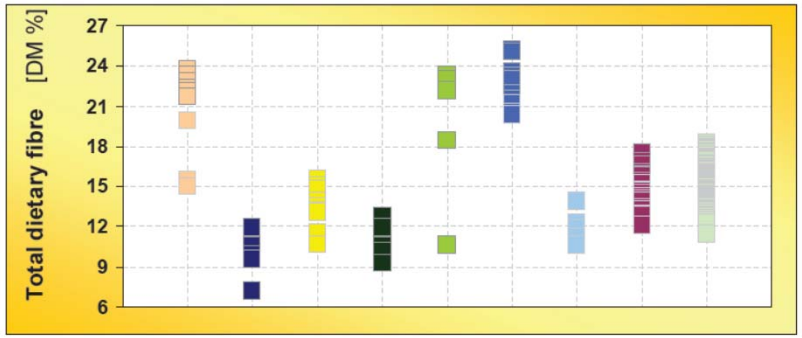


Une variabilité intéressante existe pour de nombreux composants bioactifs

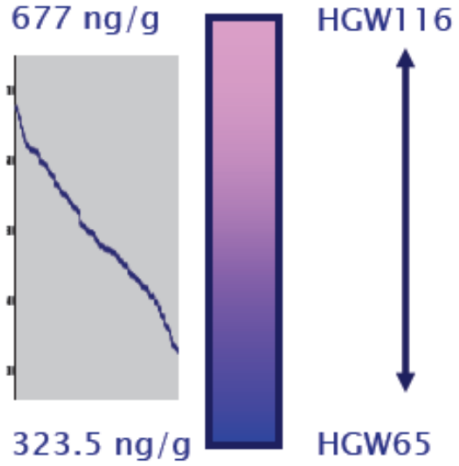
Budapest - 2007

Distribution of TDF levels in different cereals

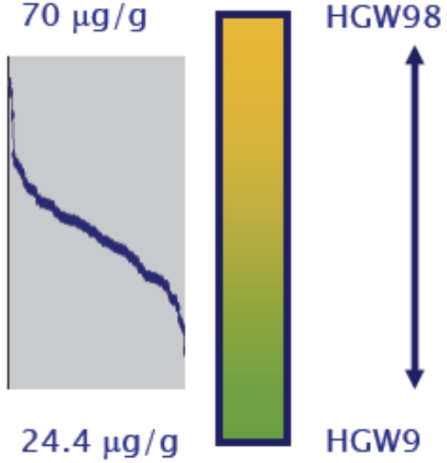


Sample	Barley	Dicoc-cum	Durum	Monococ-cum	Oat	Rye	Spelt	Spring wheat	Winter wheat
n	10	5	10	5	5				
Avg	20,9	9,8	13,4	10,9	19,5				
CV	15	18	11	13	28				

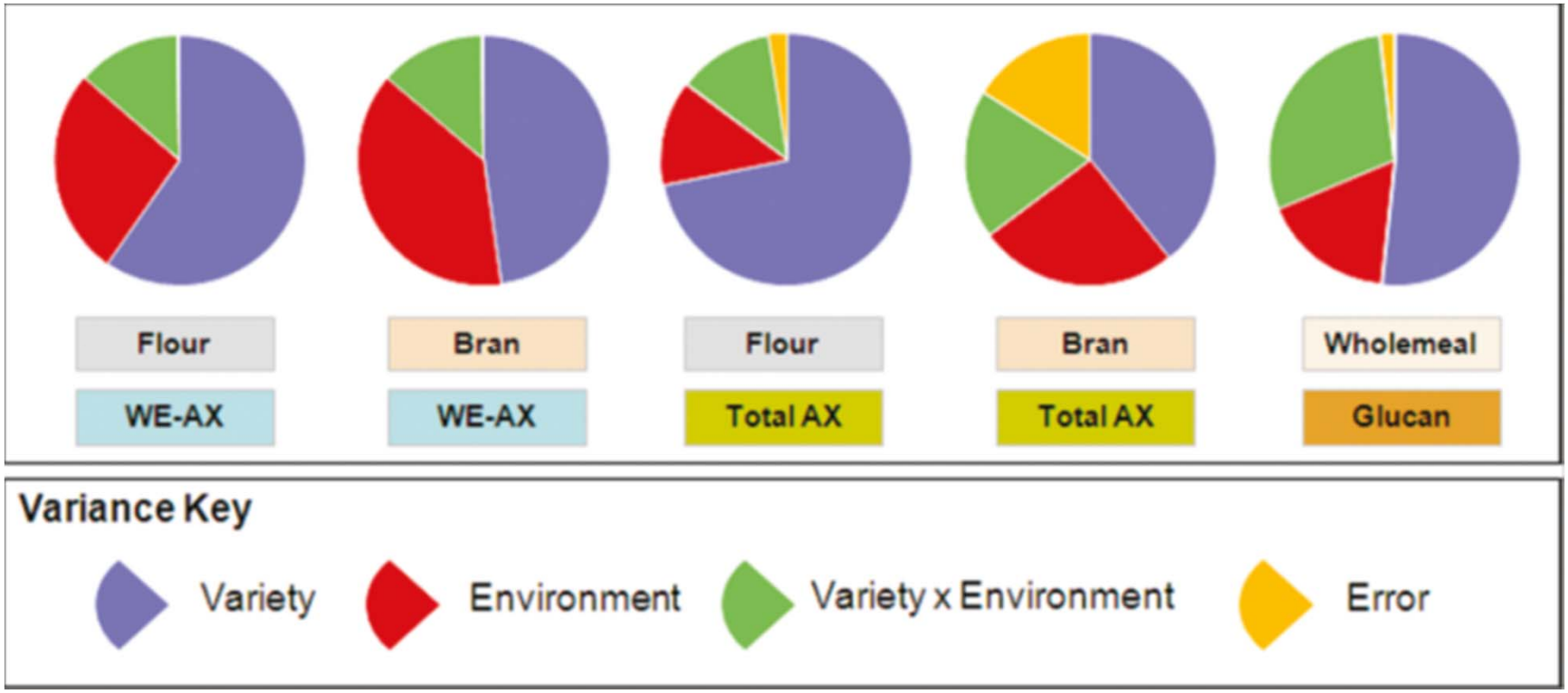
Total Folate in Winter Wheats



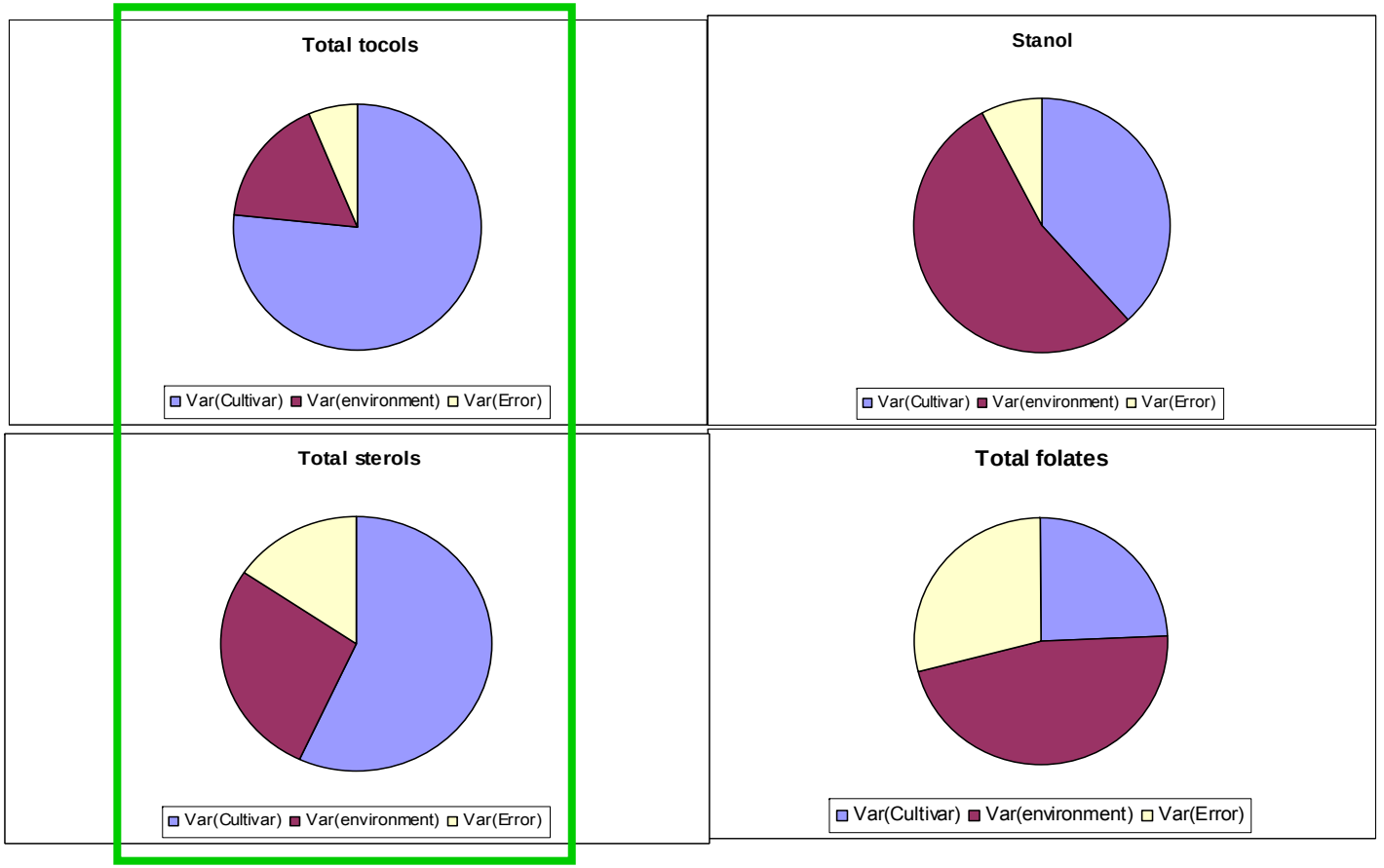
Total Tocols in Winter Wheats



Pour les fibres, la variation est surtout génétique (héritable)



Mais ce n'est pas le cas pour tous les composés



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Analyse métagénomique de la teneur en fibres solubles: des QTL aux gènes

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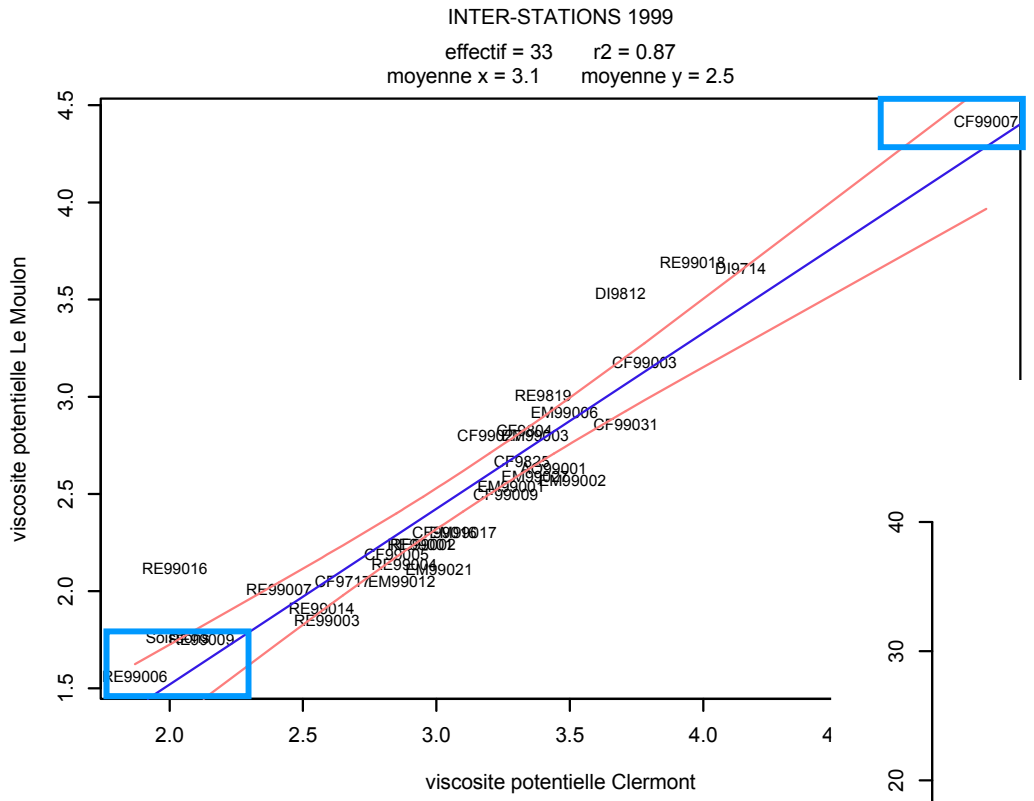
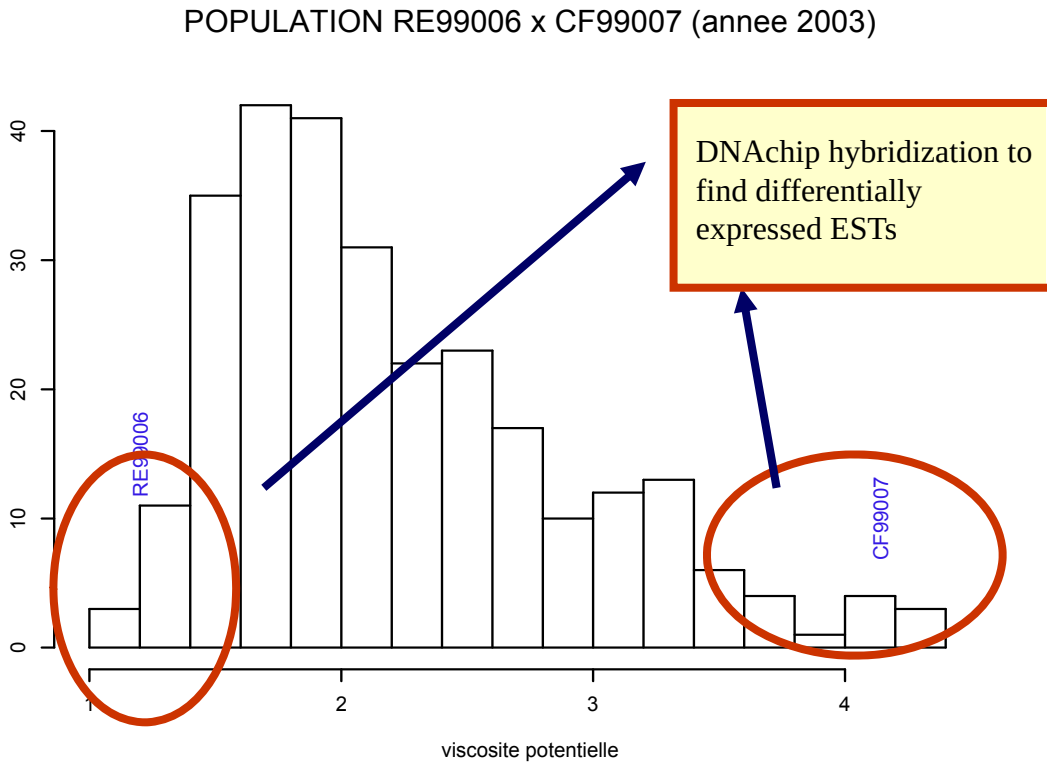
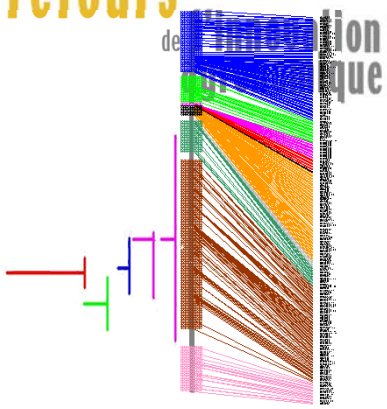
Analyse génétique de la viscosité due aux arabinoxylanes solubles
Développement de lignées recombinantes à partir de parents contrastés

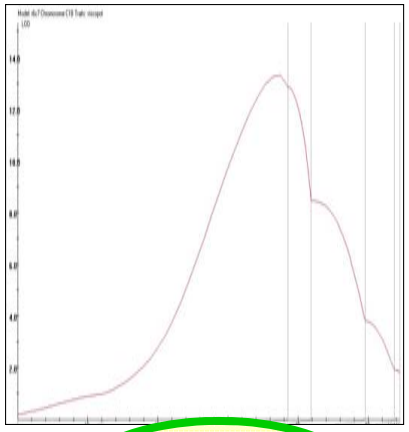




Identification de 3 « meta-QTL » (régions chromosomiques marquées)

1B

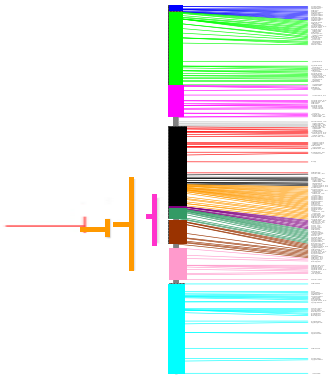


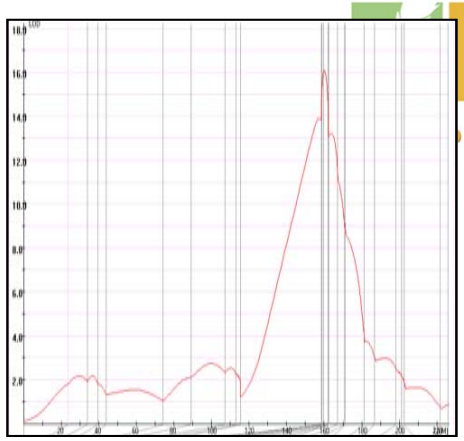


A x Re, Ct x CS, R6 x C7

CI 9.3cM
R2 29.0%

7A

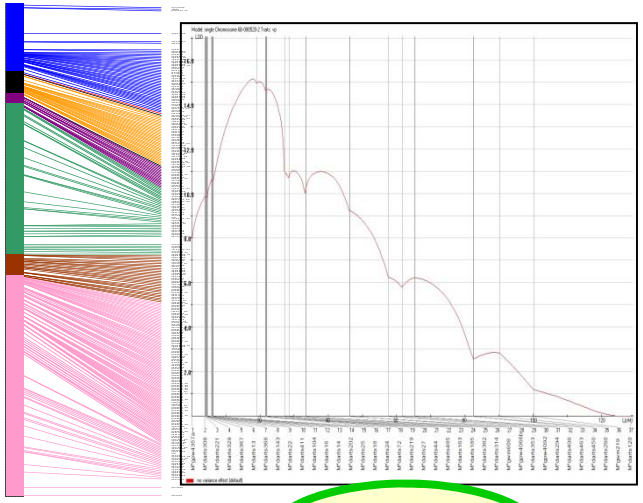




Re x R, Ct x Cs

CI 6.3cM
R2 33.6%

6B



MQTL
RER CtCs VxI
ARE R6C7

V x I, R6 x C7

CI 9.9cM
R2 59.0%

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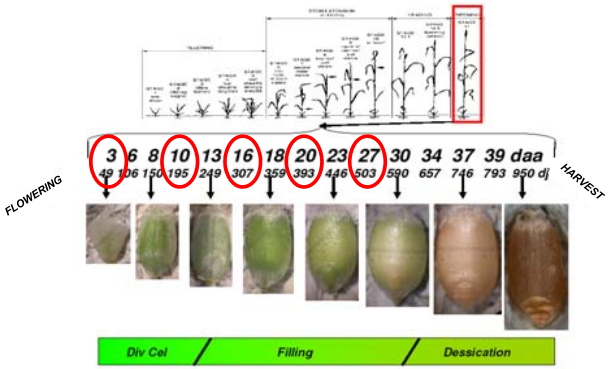
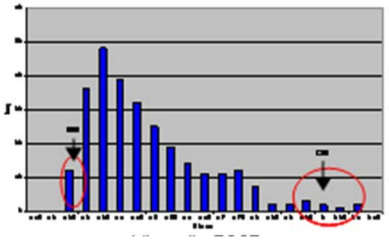
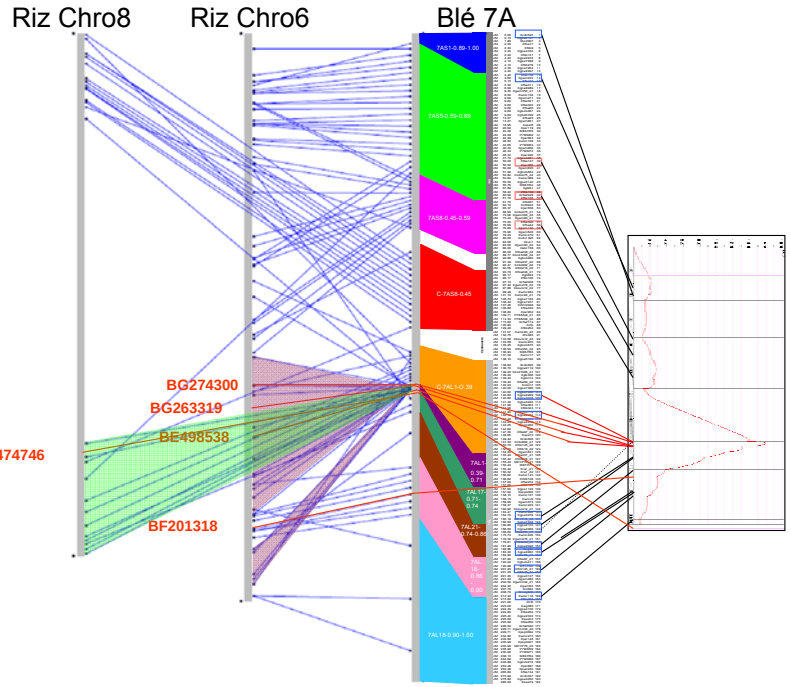
L'approche méta-génomique: combiner la cartographie de QTL avec des donnée d'expression pour trouver des gènes candidats

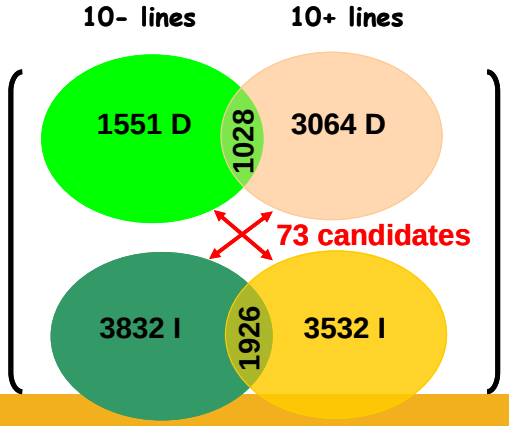




Co-location



Affymetrix wheat chip



5383 genes

6596 genes

Adenylate kinase, chloroplast EC 2.7.4.3) (ATP-AMPtransphosphorylase).	
Caffeic acid O-methyltransferase.	RNAi
Chimeric SDH2-RPS14 protein.	
Cinnamyl alcohol dehydrogenase.	OverExp
Glyceraldehyde 3-phosphate dehydrogenase, cytosolic 3 EC 1.2.1.12).	
Glyoxalase I.	OverExp
H+)/hexose cotransporter.	
OCL5 protein.	
OsNAC6-like protein.	RNAi
Oxalate oxidase-like protein or germin-like protein.	
Putative cinnamoyl-CoA reductase.	OverExp

Résultats d'analyse d'association pour le gène COMT

Carrefours

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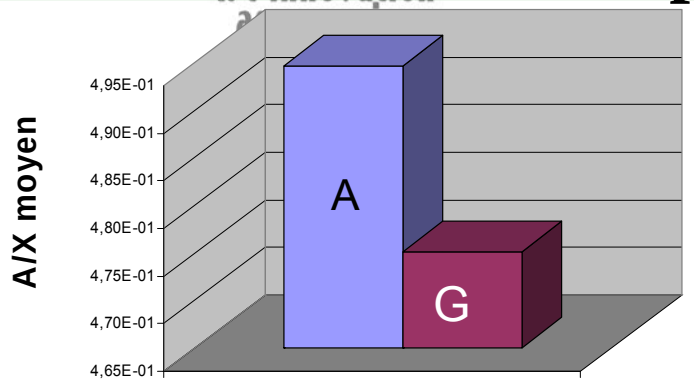
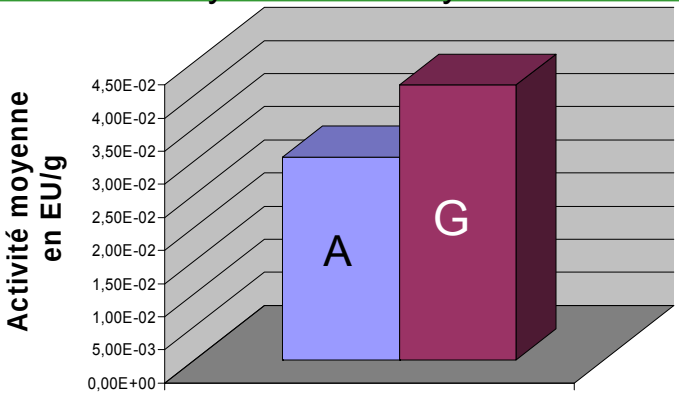
A/X in WE AX in the flour



Allèle A increases the A/X

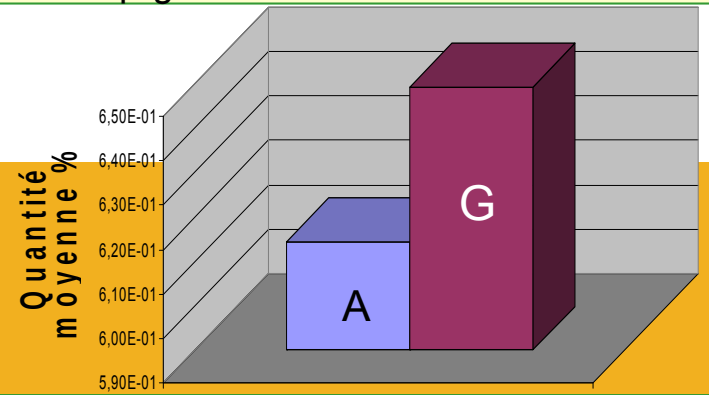
High viscosity (1.97 for A allele/ 1.79 for G allele)

Xylanase activity in the flour



Allèle A : decreases xylanase activity in the flour

β-glucane content in whole meal



Allèle G : increases β-glucans contents

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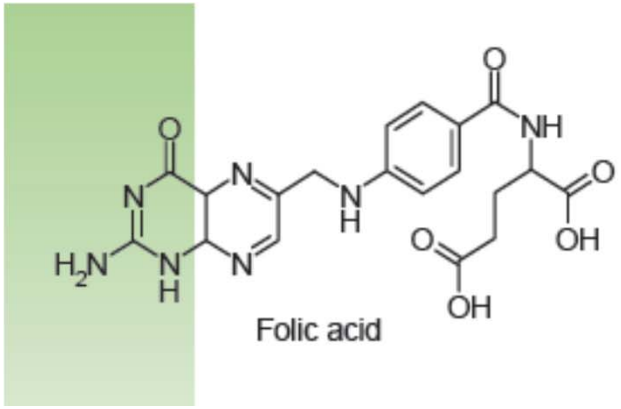
Analyse de gènes candidats du métabolisme: exemple des folates



Folic acid, or its naturally occurring form folate, is considered as a potentially health-protecting compound in the human diet.

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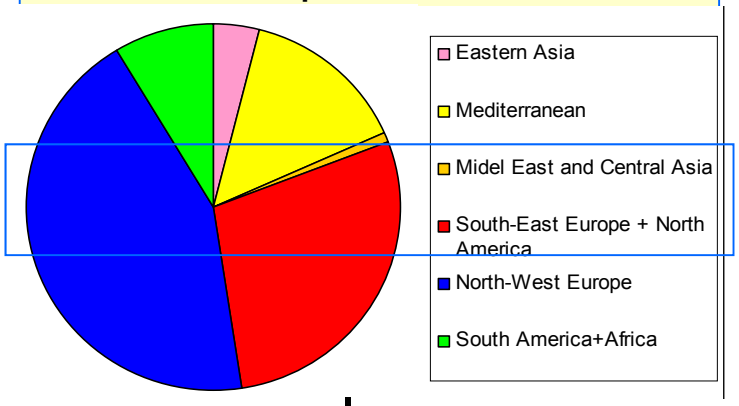
Analyse d'association sur la panel de diversité HEALTHGRAIN

HG collection - 156 lines of hexaploid wheat



Phenotyping (flour, bran, whole meal)

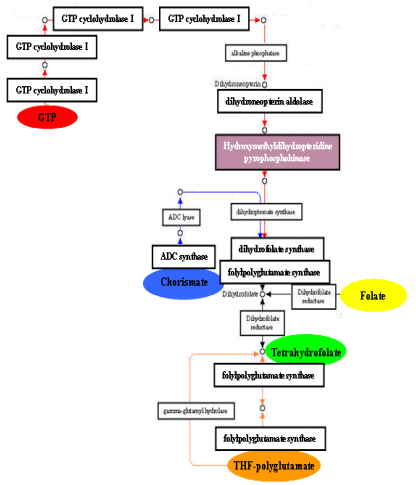
Micronutriment content
Folates
Phenolics
AlkylR
Sterols
...

Phénotype

Genetic Structure (Pritchard et al, 2000)

5 groups used as covariates

Polymorphisms from 12 candidate genes

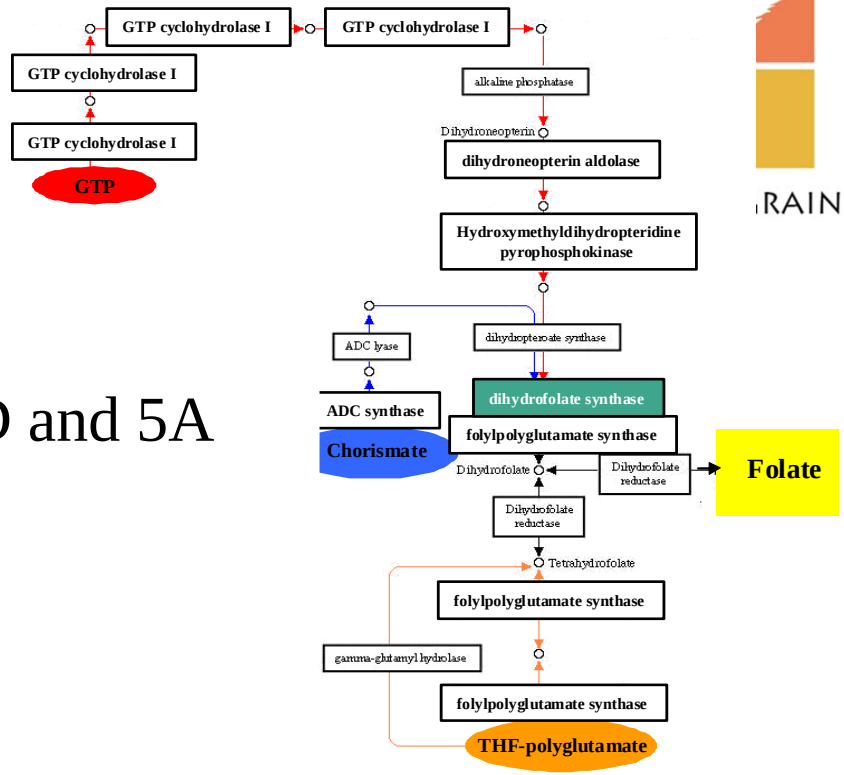


DHPA, GCH1, DHFS, HPPK, ADCS, FPGS

Génotype

Genetic Analysis (Tassel, Buckler et al 2006)

DHFS Genes



- 6 copies expected
- 3 copies assigned on 4B, 4D and 5A chromosomes

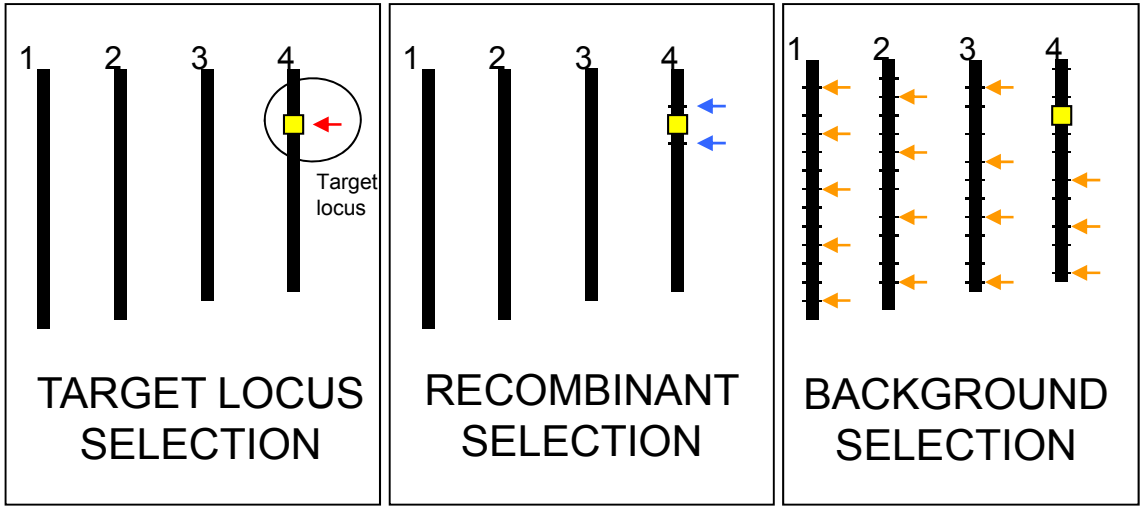
- 4B copy → no SNP
- 4D copy → 10 SNPs unbalanced → 1 SNP
- 5A copy → no SNP

00790 3/31/09
(c) Kanehisa Laboratories

No association with folate content ☹
but association with stanol (P-values = 0,000237) ☺

Marker-assisted backcrossing (MAB)

Utilisation de marqueurs pour le transfert efficace d'allèles favorables d'une source"exotique" dans un fonds adapté



FOREGROUND SELECTION

BACKGROUND SELECTION

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Contributions to this work

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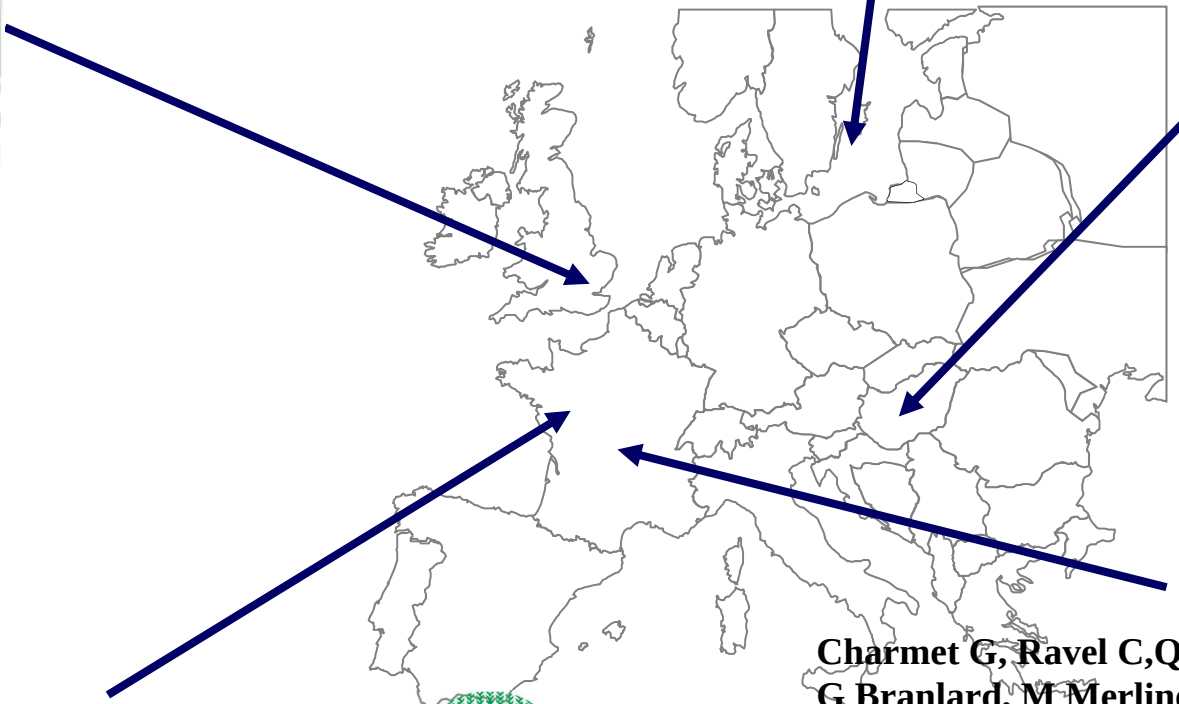

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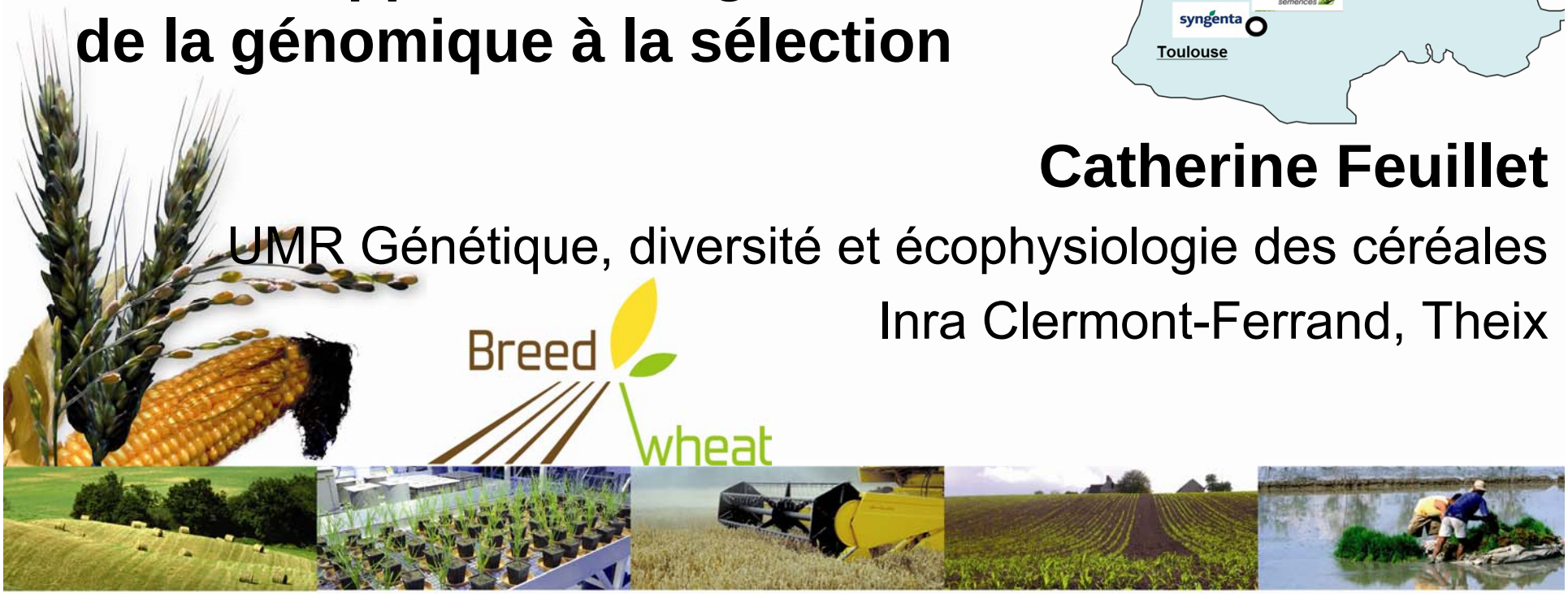
BREEDWHEAT

Développer de nouvelles variétés de blé pour une agriculture durable, une approche intégrée de la génomique à la sélection

Catherine Feuillet

UMR Génétique, diversité et écophysiologie des céréales

Inra Clermont-Ferrand, Theix



INRA

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Des cibles d'amélioration multiples

➢ Potentiel de rendement et stabilité du rendement

✓ Efficience de la photosynthèse

✓Indice de récolte (0,6)

✓ Réduction d'intrants (Ecophyto 2018…)

➢ Adaptation au changement climatique

✓ Evitement (précocité)

✓Tolérance (sécheresse, chaleur, froid…)

✓ Récupération post stress…

➢ Résistances durables aux pathogènes

✓« Les habituels » (virus, fungi)

✓ « Les nouveaux » (UG 99…)

✓ Les espèces invasives

➢ Qualité du grain et des coproduits

✓ Contenu (%) et composition en protéine

✓Amidon, pailles

✓ **Santé (nutriments, contamination, allergenicité…)**

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