Topic 2.1
Enhanced
Health
Benefits

DIETARY FIBRE AND STARCH.

Aim: To manipulate **amount**, **composition** and **properties**, by dissecting the **genetic and biochemical mechanisms determining their beneficial properties** in material produced by the **exploitation of natural and induced genetic variation.**

Working with **breeders** and **food processors** to develop wheat products with improved quality for human health.
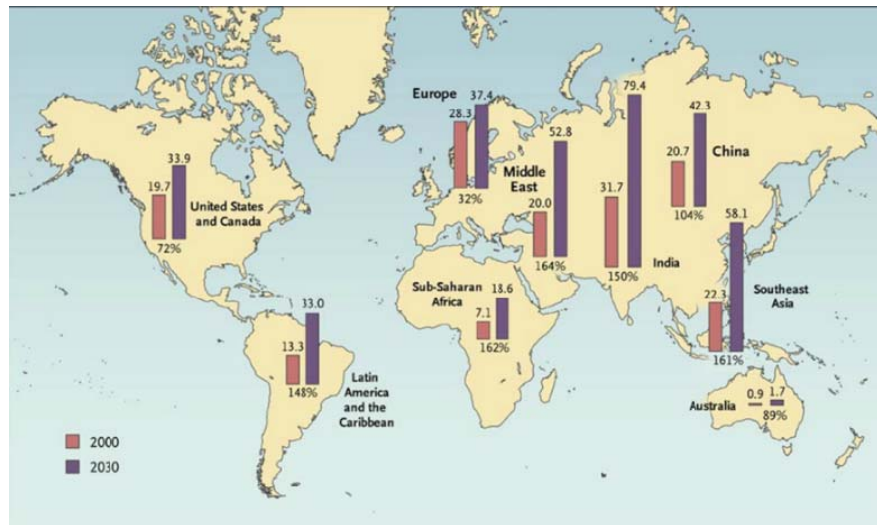
Why Dietary fibre?

NON-COMMUNICABLE DISEASES

NCDs kill 40 million people each year, equivalent to 70% of all deaths globally

- Rapid urbanisation and economic development
- Adoption of unhealthy western diet
- Sedentary lifestyle
- Change from traditional crops and foods to 'white' grains
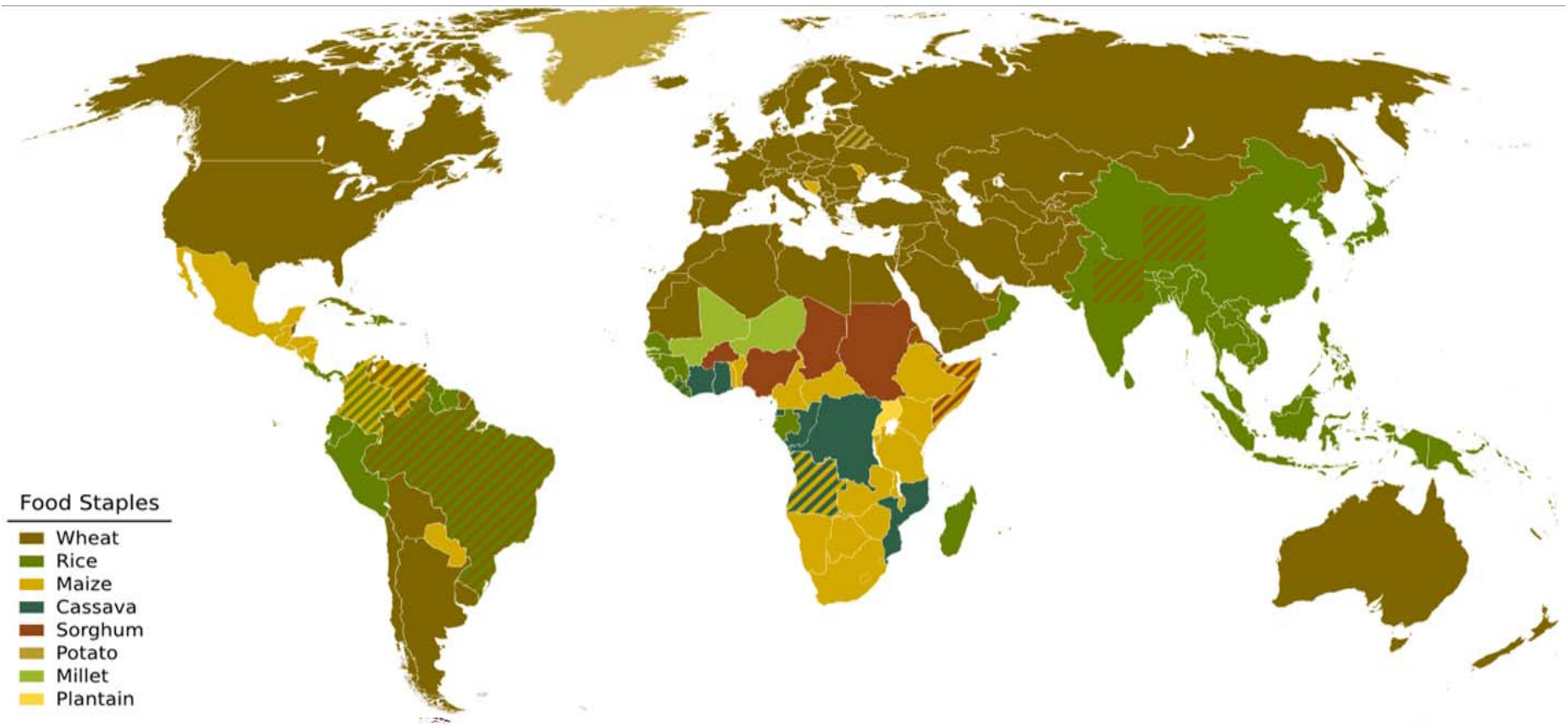
CVD

Cancer

Respiratory disorders

Type-2 diabetes

Millions of Cases of Diabetes in 2000 and Projections for 2030, with Projected Percent Changes.

A Sedentary Lifestyle
= Sitting Is The New Smoking =

77%

heart disease, stroke, **cancer**, chronic respiratory diseases and **diabetes**, **are the leading causes of mortality in the world**

ACCEPTED HEALTH CLAIMS FOR **CEREAL** FIBRE

FDA

Whole grains

- Risk of **heart disease** and **some cancers**
- Qualified claim for risk of **type 2 diabetes**
- Soluble fibre (β-glucan), **serum cholesterol** and **Coronary Heart Disease**

EFSA

1. Wheat

- **Arabinoxylan and reduced post-prandial glycaemic response**
- Bran fibre and reduced intestinal transit time
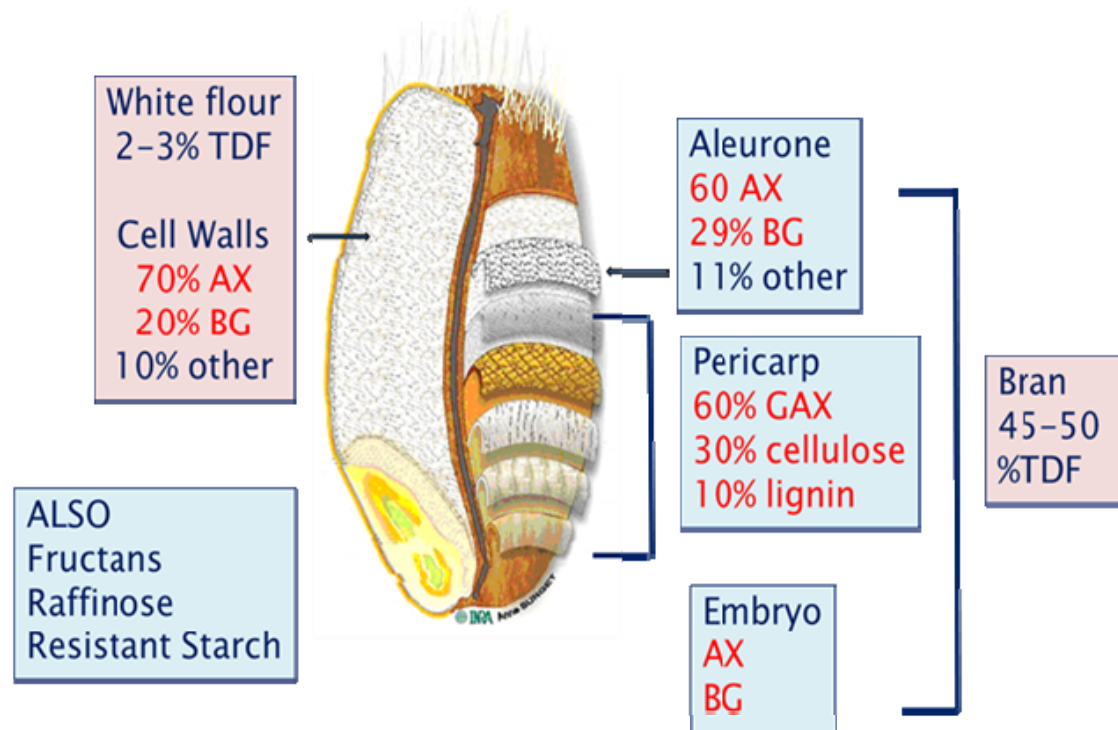- Bran fibre and increased faecal bulk

2. Oat and barley

- Fibre and increased faecal bulk
- **β-glucans** and **reduced post-prandial glycaemic response**
- **β-glucans** and reduced blood cholesterol and **risk of heart disease**
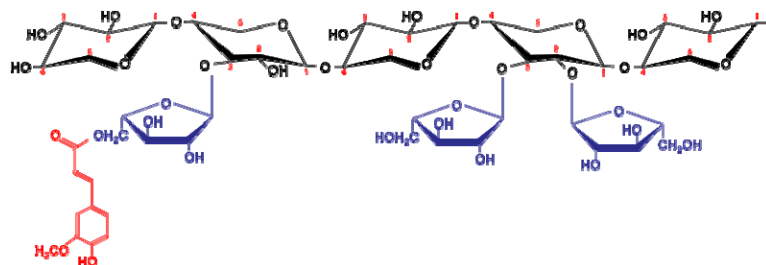
3. Rye

- Fibre and "normal bowel function"

EFSA

- **Pectins** and a reduction of **post-prandial glycaemic responses** and **maintenance of normal blood cholesterol concentration.**
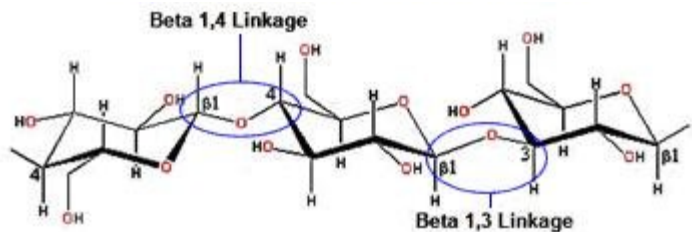
DIETARY FIBRE


White flour
2–3% TDF

Cell Walls
70% AX
20% BG
10% other

ALSO
Fructans
Raffinose
Resistant Starch

Aleurone
60 AX
29% BG
11% other

Pericarp
60% GAX
30% cellulose
10% lignin

Embryo
AX
BG

Bran
45–50
%TDF

NOT TALKING ABOUT FRUIT AND VEG

DIETARY FIBRE

ARABINOXYLAN

↑ Human health

↓ Animal feed
Ethanol

Diabetes (GI)
CVD
Prebiotic

Beta 1,4 Linkage

Beta 1,3 Linkage

Β-GLUCAN

↑ Human health

GI
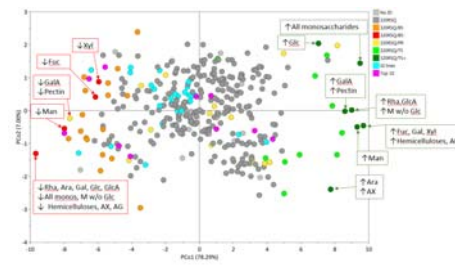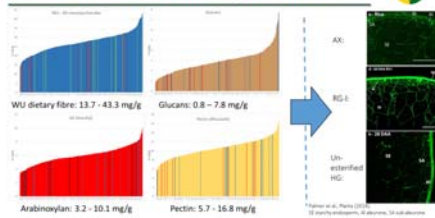CVD
Serum cholesterol
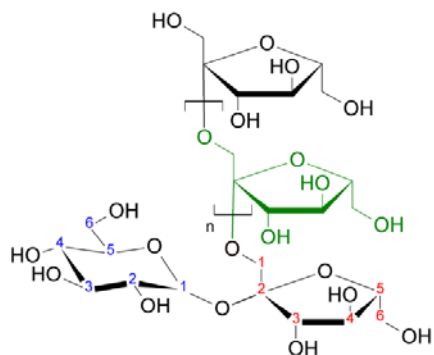
FRUCTANS

↓ Human health

IBS (FODMAPS)

ANALYTICAL PLATFORM

High throughput screening for dietary fibre components, specifically AX and β-glucan, fructans in wheat, recently extended to rice
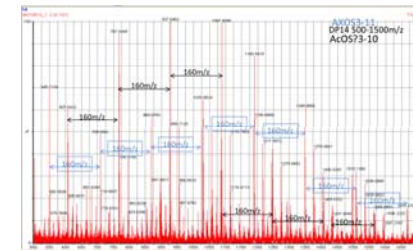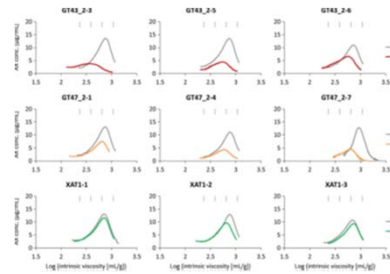

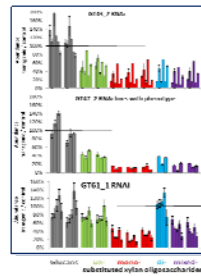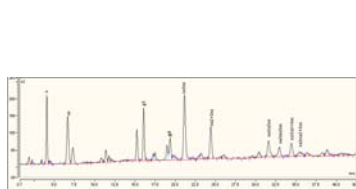- Identification of novel genetic sources of variation through screening large populations

- Amount and composition, polymer size, viscosity

- Phenolic acid amount and composition

AX- A BREEDING TARGET
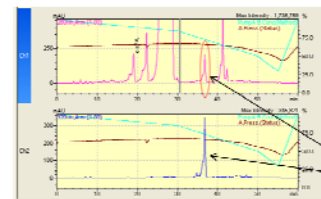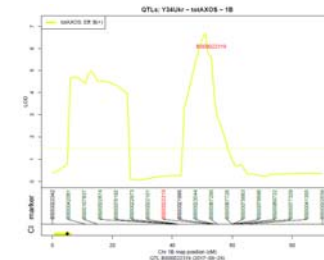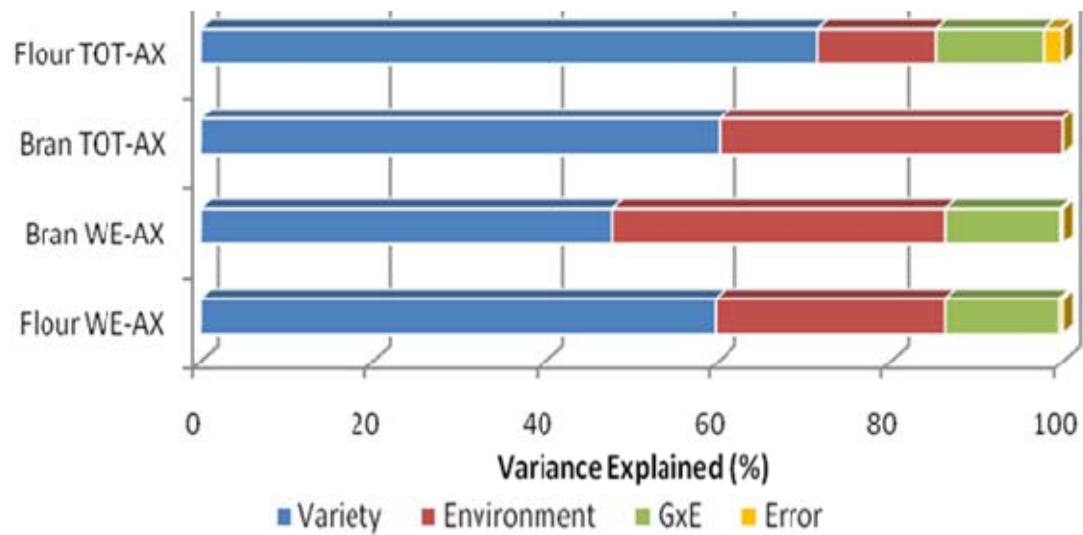
AX content in flour and bran is **highly heritable**.

AX-NOVEL DIVERSITY

Exotic bread wheats

Watkins collection

The heritage collection

Turkish wheat lines
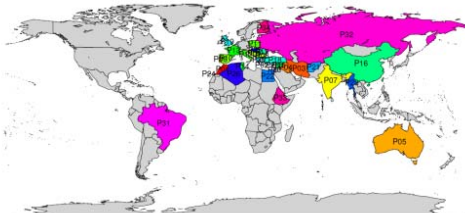
Afghanistan, Algeria, Australia, Brazil, Bulgaria, Burma, China, Cyprus, Egypt, Ethiopia,
Finland, France, Greece, Hungary, India, Iran, Iraq, Italy, Morocco, Palestine, Poland,
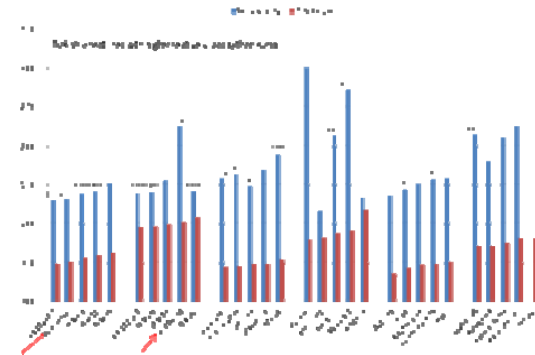Portugal, Romania, Spain, Syria, Tunisia, Turkey, UK, USSR, Yugoslavia
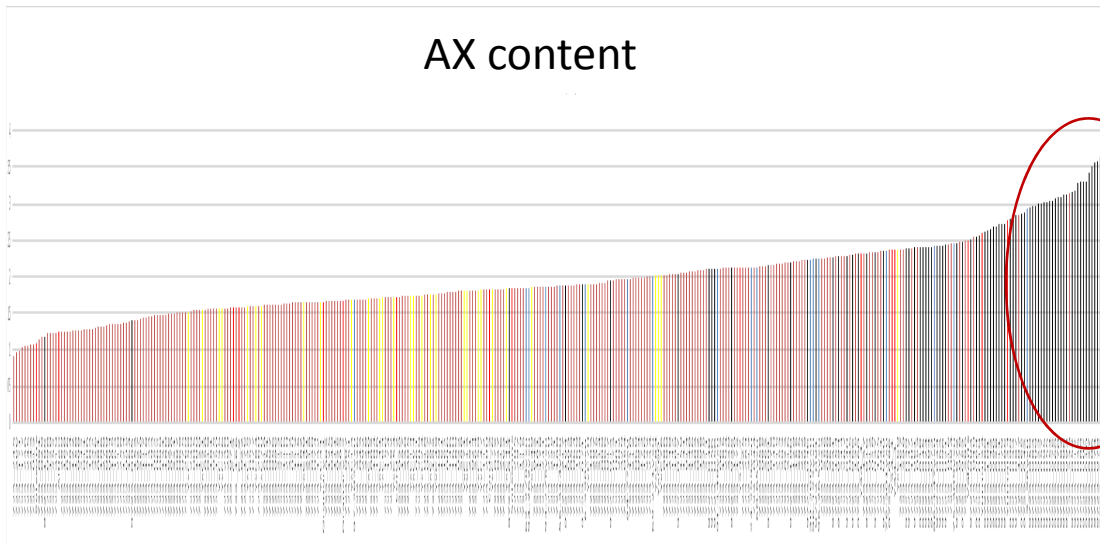
826 landrace cultivars from 32 countries

AX content

Wild relative introgressions

Synthetics

Aegilops tauschi

Aegilops speltoides

Novel diversity

PROGRESS

Identified QTL for AX content

Developing high AX lines in elite background

Developing low AX lines by TILLING

Screening for fructans to determine broadsense heritability

CONCLUSIONS

Cereals are an important source of key components for human health including fibre, minerals and vitamins.

Arabinoxylan, the main DF component of wheat grain
- effects on glycaemic load/index
- pre-biotic
- ferulic acid effects on endothelial function

Wheat is immensely diverse in composition, due to the effects of genotype and environment.

Highly heritable traits, such as fibre content, can be exploited by breeders.

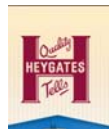Processing may permit enhancement of quality traits

THANKS.... SO FAR

Peter Shewry
Rowan Mitchell
Till Pellny
Suzanne Harris
Jackie Freeman
Mark Wilkinson
Amy Plummer
Abby Wood
Ondrej Kosik (rice)

Simon Griffiths
Luzie Wingen
Simon Orford
Michelle Leverington

Keith Edwards
Sasha Allan

Alison Bentley

Carlos Guzman

Jacob Lage

James Bosnan
Linde Hess

Simon Berry

Mervin Poole

Claire Hughes
Mark Waples

Peter Skeggs