HFN LINK Proposal

Peter Jack

WGIN Stakeholders Meeting
29/11/04

R·A·G·T SEEDS

Overview

- What is HFN & why is it so important to UK Wheat
- What research has been done before & why has it not helped?
- What is the structure of the current HFN proposal?
- Next Steps

HFN = Hagberg Falling Number

- Name of the Industry assay used to measure starch integrity
- Inappropriate expression alpha amylase > starch breakdown > sticky dough > low value
- “The final results of the HGCA Quality Survey show that in some areas Hagberg falling numbers were the lowest for 10 years”.

Main UK Causes Poor HFN?

- Pre-harvest sprouting
  - Inadequate depth of dormancy or failed maintenance of dormancy
  - Promoted by damp harvest conditions
- Pre-Maturity Alpha amylase (PMA or LMA)
  - Elevated alpha amylase in absence of sprouting
  - Temperature stress during development can promote it; other factors??
- Genetically independent

R·A·G·T SEEDS

Why Can't Breeders Select for it?

- PHS assay eg mist irrigated plots
  - Expensive (in breeding terms) to run,
  - Wrong time of year for labour;
  - Inconsistent results;
  - Not high throughput
- PMA Assay
  - Environmental triggers poorly understood
  - No validated assay for UK
  - If phenotype-based, would suffer same problems as PHS in terms of cost, throughput *etc*

R·A·G·T SEEDS

Variation for PHS & PMA

- Some UK elites do perform well even in poor years
- Thus adequate levels of genetic resistance in elite pool
  - Cultivars well characterised and genes are already dispersed in elite pool
  - Just need a high throughput, cheap, reliable means of selection
  - Probably a DNA marker
- What about utilising Exotic sources?
  - Discovery cost
  - Very high introgression cost
  - Uncertain behaviour once introgressed
- Start with Elites!!

R·A·G·T SEEDS

QTL Analysis

- Studies in US; Aus; Jap; Fra; Can *etc*
  - **27** chromosome arms implicated!
  - Statistical Noise; Environment; Germplasm
  - Some particularly interesting regions
    - Independent studies > same region
    - Some QTLs line up on/near known genes
    - Amy 1; Amy2; Rht; Red genes
- How about UK germplasm/environment?
- Only 1 published QTL study…..

R·A·G·T SEEDS

UK Study – Flintham et al (JI)

- Soleil x Boxer (both triple red)
  - ’98 artificial sprouting conditions > major QTL on 4AL
  - 2 other wheat QTL studies > 4AL (& rice Dor gene)
  - GA biosynthesis gene maps in similar region
- QTL Validation
  - Introgressed into range white backgrounds > no effect
  - ’99 **field** conditions > no 4AL QTL!
- Stresses need to use validated phenotyping methods
- Also demonstrates difficulty of utilising Global QTL data (very different environments/germplasm)

R·A·G·T SEEDS

Conclusions on Previous Work

- None of this has provided UK breeders with something they can use – even indirectly!
- Need properly coordinated UK programme to look at both PMA & PHS
- Phenotyping screens MUST be validated against actual field conditions
- This is a not a 3 year x 1 scientist project!!

Research Discussions

- WGIN Stakeholders Meeting Nov 03
  - Breeders & end users identified HFN as major problem
  - No WGIN core projects relate to HFN specifically – would require specific initiative
- Many Subsequent Meetings including:
  - Cambridge Oct 04 – JI/Rothamsted/Nottingham/HAdams/ Advanta/Nickerson/RAGT
  - Agreement of outline research programme as follows

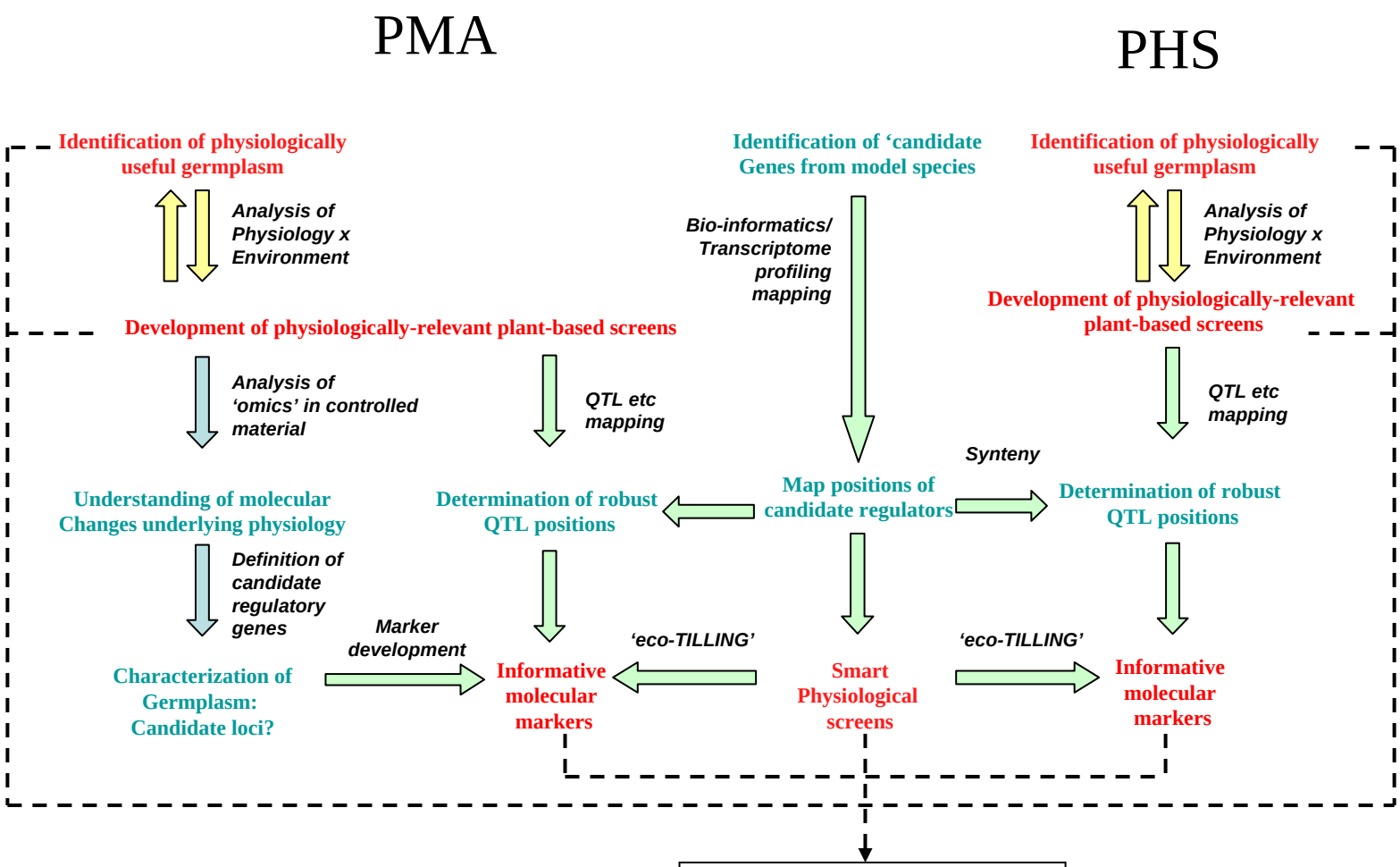
R·A·G·T SEEDS

Convergent Germplasm-based & Gene-based approach

- Germplasm-based (QTLs; Association genetics)
  - Need to develop reliable Phenotyping systems for PHS & PMA using well characterised UK ***elite*** cultivars
  - Phenotype ***elite*** populations (breeders) > QTLs
- Gene-based
  - Candidate genes from literature & from expression studies (PMA)
  - Identify wheat homologues, fine map & look for overlap with elite QTLs
- Validate best candidates using Association Genetics
  - advanced breeding lines & additional cultivars
- End-point = Validated, high throughput marker system

R·A·G·T SEEDS

INTEGRATING A PMA AND PHS RESEARCH PROGRAMME



Courtesy Mike Holdsworth

R·A·G·T SEEDS

Key Components & Coordinators

1. PMA Phenotype Development
   - Peter Kettlewell (Harper Adams)
2. PHS Phenotype Development
   - Mike Holdsworth (Nottingham)
3. Population Phenotyping, Mapping & QTLs
   - John Flintham (JI)
4. PMA Gene Expression
   - Peter Shewry (Rothamsted)
5. Candidate Gene Characterisation
   - Mike Holdsworth (Nottingham)

LINK Proposer:

- Peter Jack (RAGT) representing Breeding Community

RAGT SEEDS

Key Features

- Target is HFN improvement – not basic science
  - but it will involve interesting science along the way!
- Multidisciplinary – good lab-lab coordination vital
- Development of Phenotypic methods is Essential
  - its not sexy but without it all else fails!
- Focus on elite materials & breeder involvement at ALL stages

R·A·G·T SEEDS

Status

- Oct 21st – Agreement Project Outline
- Oct 27th – WGIN Management Meeting
  - Details outlined
  - Coordinating team met for 1st time – main objective = Concept Note
- Nov 21st – Concept Note to DEFRA LINK
  - and breeders; HGCA; CCFRA – others?
- Nov 29th – Funding strategy meeting
  - Peter Street (Sustainable LINK)
- ……..

Outstanding Issue

- How to get end user involvement (millers; baking industry etc)
  - CCFRA
  - HGCA
  - NABIM?
  - Individual Companies – if so who?
  - WGIN Stakeholders

- Ideas & suggestions to: peter.jack@ragt.fr

R·A·G·T SEEDS