Exploiting Crop Genetics

Soft Fruit Potato Barley



Scottish Government Riaghaltas na h-Alba gov.scot SEFARI

Variety development is key to SEFARI





Improving Sustainability: biological and environmental stress

- Disease and pest burdens
- Winter chill requirements
- Water use efficiency
- Heat stress
- Within and between season variability



Development of a new genotyping platform for barley breeding . Genotyping



• Genotyping = genetic profiling

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- Genotypic data used in breeding and research
- SNP (Single Nucleotide Polymorphism) -> high density in most genomes
- High-throughput assays can screen thousands of SNPs at same time (SNP chips)
- Requires initial discovery of SNPs in genome first

Development of the barley 50k chip





Impact / Uptake





- International consortium formed and 13,000 50k assays preordered -> big discount from Illumina
- Includes academic partners and all major European barley breeding companies
- To date 4,500 samples processed for Hutton (core WP, externally funded projects, PhD projects, collaborations)
- Now used worldwide by breeders and researchers
- Puts Hutton at forefront of barley diversity research internationally



Understanding the mechanism of resistance

10th Apr 5th Apr 30th Mar 16th Mar 2 1st Mar 17th Feb Moy 2nd Feb 20th Jan Latham 50 100 150 200 250 300 Wavelength or ratio No.

VNIR (water/pest/disease treatment)

Significant external funding



q=0.0300

0.001 0.01

0.05

0.1 0.2

0.5



- Disease resistance genes
- Auxin pathway genes
- Root growth



Environmental resilience in woody species

- Trend towards milder winters projected to continue into future
- Reduced levels of winter chilling cause problems in development in woody species eg. uneven bud break, yield
- Screening breeding lines for chill requirement
 - Differing response between varieties identified, outline models for bud break developed
 - Further work in progress on Innovatefunded project
 - New variety released (Ben Lawers)



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Mechanisms of resilience in perennials

- Genes differentially expressed at budbreak in high- and low-chill varieties of blackcurrant
- Mapping of genes onto GbS linkage map alongside phenological data from high x low chill mapping population
- Linking of blackcurrant work to other potentially vulnerable crop and non-crop perennial species
 - Pilot study on *Vaccinium myrtillus* (blaeberry) as ecological keystone species funded by Climate X Change
 - Further work required to identify generic mechanisms and resilient genotypes





Developing Potatoes Resilient to SEFARI **Environmental Stresses**

- The Problem and Rationale •
- Major stresses ٠
- Elevated temperature ٠
- Water stress ٠
- Salinity ٠
- Frost ٠







Approaches to understanding heat tolerance in potato



- 75% of Scottish seed exports are to warm countries
- High temperature is a major abiotic stress that impacts on yield in potato and constrains production in Asia and Sub-Saharan Africa
- Potato markets are growing in these regions and so it is important to have varieties adapted the target environments.
- Within Europe, hot summers can impact negatively on yield
- Tuber yield falls sharply above optimum temperatures
- Used a full range of genetic, genomic and molecular physiology approaches
- Drought/heat combinations
- Avoidance of stress by developing an early maturing potato

Temperature Effects on Tuberisation





Heat sprouting

Chain tubers

Misshaped tubers







- New genomic approaches are being used to develop breeding tools (genes and markers)
- These will be deployed to develop enhanced heat tolerance and early maturing potatoes
- Similar approaches will be used to look at more complex combinations of heat and drought

RESAS funding leads to significant external funding eg. Innovate UK, AHDB, EU supporting Scottish and UK agriculture/horticulture



Thanks





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