ORNATE

Optimisation of Reed Canary Grass as a native European Energy Crop

What and why?

- Reed canary grass is a native grass of Europe which has a number of features including it's tolerance of abiotic stresses which could help make it a productive energy crop on marginal land with economic benefits to farmers and environmental benefits for wider society.
- The Challenge is that it is undomesticated and needs a plant breeding programme

Who?

Prifysgol Aberystwyth University	UK	Lead, Germplasm, trials, breeding
SLU Lantbruksuniversitet	Sweden	Germplasm, Trials, agronomy
Teagasc Agriculture and Food Development Authority	Ireland	Trials, conversion,
senova	UK	Economic value chains
W	USA	Expertise: Trials, breeding

Reed canary grass exhibits a unique combination of characteristics:

- Native species of Europe and very cold tolerant
- Able to grow on marginal land (including brownfield sites), drought and flooding tolerant
- Low cost of establishment and faster rates of return on financial investment
- Able to produce harvested biomass from late summer until early spring
- Carbon sink and biodiversity benefits
- Dual use with flexibility to use as an animal feed as well as a fuel (brown for heat & power or green for AD)

Objectives of the ORNATE project

- Develop a trial network of genetically diverse reed canary grass to help define optimum ideotypes matched to differing environments and end uses.
- Use state of the art genomics and phenomics to establish tools for 21st Century precision breeding.
- Set up broad pre-breeding populations using native collected accessions and hybrid populations from which to initiate recurrent selection

Challenges

- Largely undomesticated
- Scandanavian varieties are short season for lower latitudes
- Need to understand how genotypes can be matched to diverse environments and uses
- Need to develop high yielding genotypes that require low inputs, exhibit minimum inter-annual variation, and low moisture content
- Increase persistence

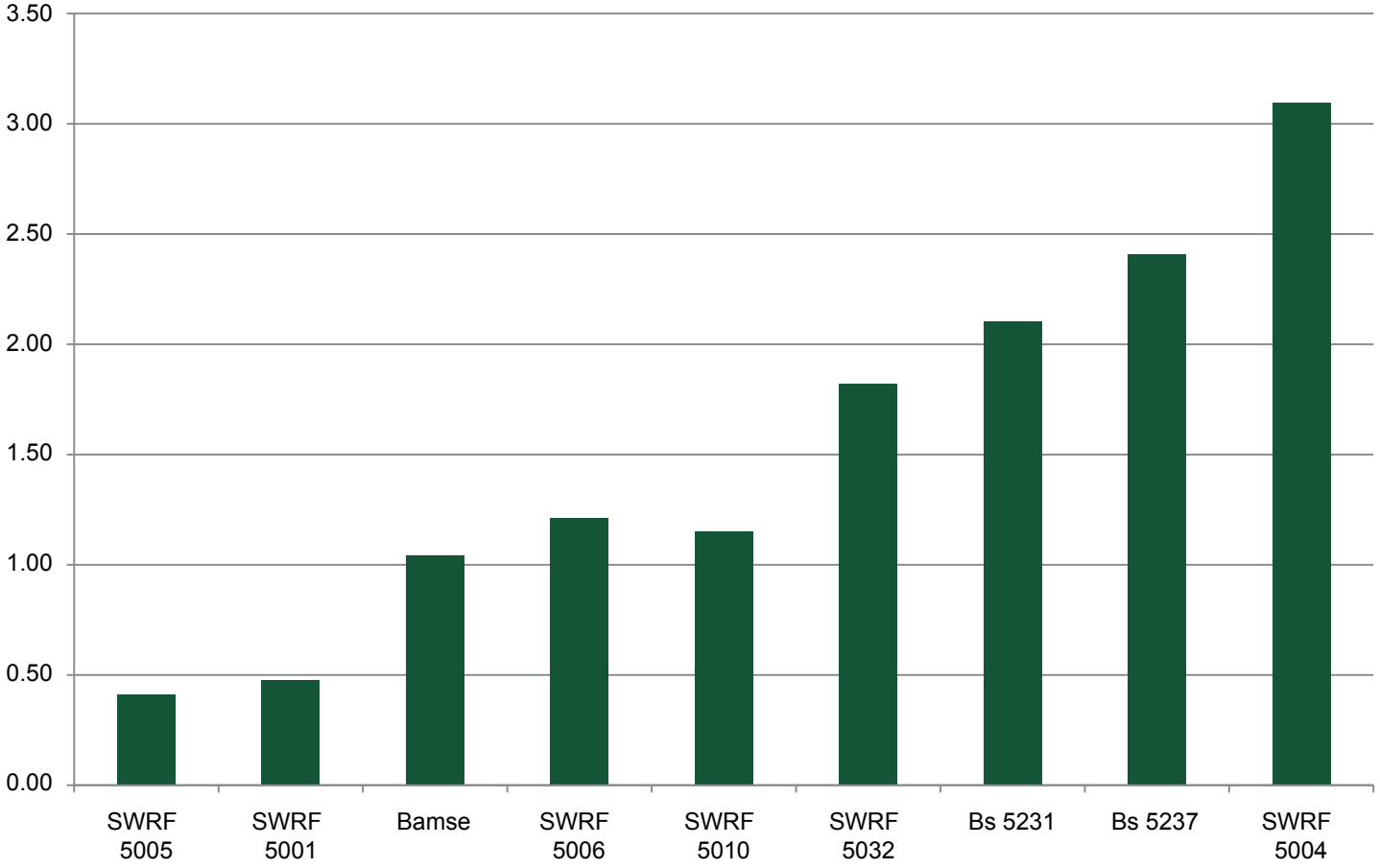
Evaluation of genotypes in plots

IBERS, Aberystwyth, UK

SLU, Umea, Sweden

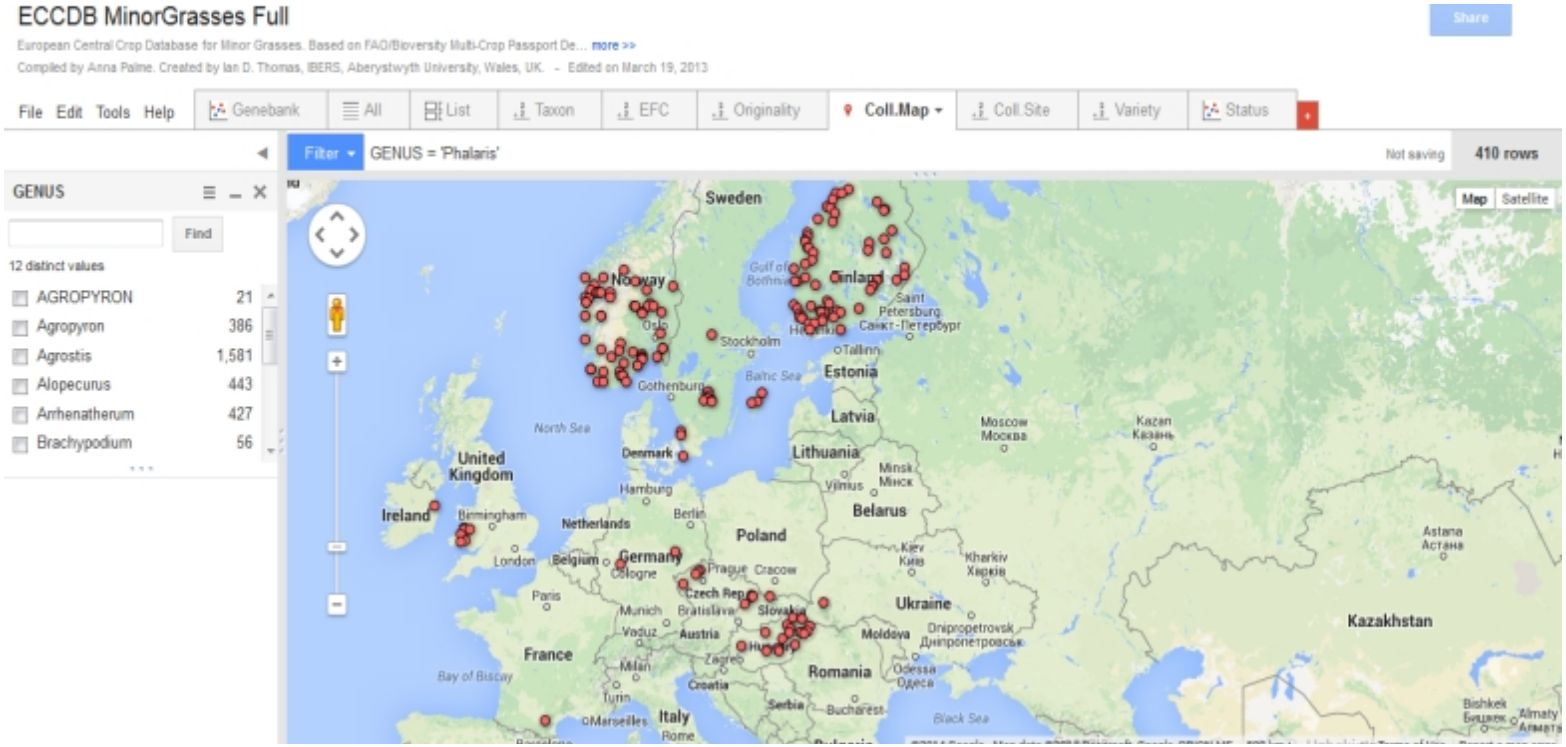
Plot harvesting (green cuts)

Green Harvest Mean Dwt Yield (odt/ha)



Prebreeding selections

Aim: 50 accessions x 20 plants per accession
Achieved: 64 accessions and 1470 plants



SLU/ SW germplasm; IBERS collections; Nordic genebank

Prebreeding spaced plant trial

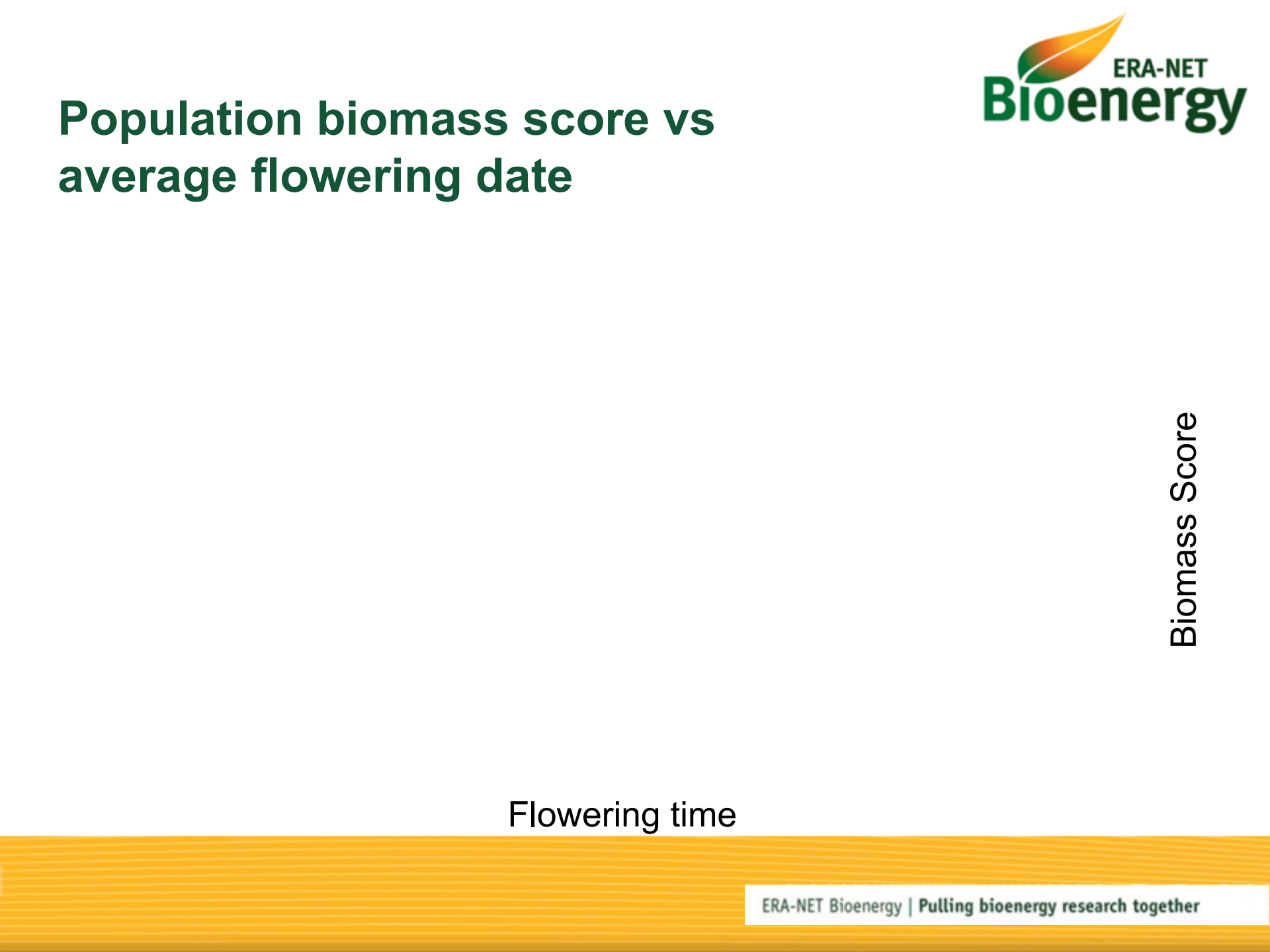
Average biomass score per plant of each accession vs flowering time

Biomass Score

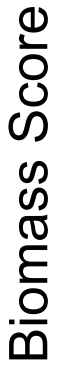
Biomass score per plant for each genotype vs proportion of population flowering

Biomass Score

Population biomass score vs average flowering date

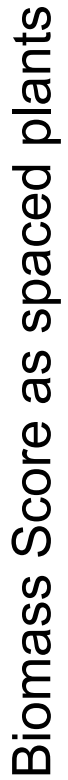


Population biomass score vs proportion of population flowering



Proportion Flowering

Biomass: Performance in yield plot vs spaced plant trial as a population



Biomass yield in plots

Accessions containing plants of high biomass score

Accession	Mean Biomass	Heading date	% of plants heading	no plants 3+	no plants 4+	no plants 5+	Biomass score population
NGB 14515.2	1.69	35	0.3125	2			2
Bs 5119	2.00	42	0.545455	3			3
Bs 5237	3.09	24.14286	0.913043	17	8	3	42
SWRF 5004	3.54	28.05	0.952381	19	14	4	59
NGB 1196.3	1.50	43.95	0.833333	1			1
NGB 4500.3	2.38	29.28571	0.875	11	4		19
SWRF 5032	2.54	26.7	0.833333	14	6	1	29
NGB 4327.2	2.00	34.8	0.769231	3			3
SWRF 5006	2.61	29.83333	0.782609	14	6		26
SWRF 5010	2.13	35.38095	0.875	5	3		11
SWRF 5001	2.54	32.6	0.961538	14	3		20
SWRF 5005	3.00	32	0.958333	17	6	1	30
SWRF 9503	2.00	32.225	0.833333	6			6
SWRF 9903	1.96	34.21053	0.791667	6			6
SWRF 9506	2.26	35	0.95	8	1		10
NRF 9124	1.95	35.70588	0.85	4			4
Bs 5081	0.83	38	0.166667	1			1
SWRF 5037	2.63	27.33333	0.75	6			6
Bs 5121	1.80	33	0.6	4	1		6
NGB 4199.3	1.67	35.53333	0.714286	3			3
NGB 16258.2	0.76	34.33333	0.176471	1			1
SWRF 5035	1.94	28	1	8	5		18
NGB 11140.2	1.60	43.5	0.666667	1			1
SWRF 5007	2.63	32.5	1	4	1		6
Bs 4947-2008	1.79	42.26667	0.625	4			4
SWRF 5035	2.00	34.33333	0.818182	4			4
SWRF 5003	1.44	35.66667	0.666667	2			2
Bs 5081	1.00	43.5	0.285714	2	1		4
NGB 11157.1	1.92	33.75	0.666667	6	2		10

Light blue blocks, accessions not represented in plots

Accessions containing plants of very high biomass score

Accession	Mean Biomass	Heading date	% of plants heading	no plants 3+	no plants 4+	no plants 5+	Biomass score population	Perform well in Sweden
Bs 5237	3.09	24.14285714	0.913043478	17	8	3	42	
SWRF 5004	3.54	28.05	0.952380952	19	14	4	59	Y
NGB 4500.3	2.38	29.28571429	0.875	11	4		19	Y
SWRF 5032	2.54	26.7	0.833333333	14	6	1	29	Y
SWRF 5006	2.61	29.83333333	0.782608696	14	6		26	Y
SWRF 5010	2.13	35.38095238	0.875	5	3		11	Y
SWRF 5001	2.54	32.6	0.961538462	14	3		20	N
SWRF 5005	3.00	32	0.958333333	17	6	1	30	N
SWRF 9506	2.26	35	0.95	8	1		10	Y
Bs 5121	1.80	33	0.6	4	1		6	Y
SWRF 5035	1.94	28	1	8	5		18	Y
SWRF 5007	2.63	32.5	1	4	1		6	
Bs 5081	1.00	43.5	0.285714286	2	1		4	
NGB 11157.1	1.92	33.75	0.666666667	6	2		10	Y

Light blue blocks, accessions not represented in plots

Summary & Future

- Work with industry to bulk up seed and trial leading new varieties
- Create new crossing blocks from best performing plants – between and within populations
- Select genotypes to make wide crosses for mapping populations
- Select genotypes for phenomics