Genomic Selection for Improved Growth in Sitka Spruce

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Background – Sitka spruce in Ireland

- Sikta (*Picea sitchensis* (Bong). Carr) comprises 51% of all Irish forests (DAFM, 2017)
- Potential for breeding program investigated c. 1980 – 2007, examining juvenile height and width
- Recent revitalisation of the breeding program supported by genomic characterisation

Table 4: *Summary of Sitka spruce progeny tests.*

Test series	Number of locations	Number of plus-trees	First assessment	Second assessment
1	4	33	1986	1995
2	3	32	1986	1995
3	3	29	1990	1999
4	4	54	1993	2002
5	4	40	1993	2002
6	4	42	1993	2002
7	1	17	1994	2003
8	3	45	1994	2003
9	3	44	1994	2003
10	3	44	1994	2003
11	3	43	1998	2007
12	3	46	1998	2007
13	2	36	1998	2007
Total		505		

Thompson, 2013

Data Availability – Genomic Selection

Genomic Selection requires genotypic and phenotypic data:

- **Phenotypic Data** – EBVs for a genotype predicted from measurements on its half-sib progeny (similar to msGBLUP)

- **Genotypic data** - Genotyping-by-Sequencing resulting in a large amount of data, but prone towards loci with many missing data (i.e., Chen et al., 2013)

Methodology – Model Evaluation

Six models evaluated on ~78,000 SNPs at 15% missing data threshold for additive genetic effect on phenotypes:

- **G-BLUP & RKHS** – Using the Genetic Relationship Matrix (GRM) to predict for phenotypic effects

- **rrBLUP, BayesA, BayesCπ & Bayesian Lasso, –** Using all markers as predictors
  - rrBLUP uses ML, Bayesian methods use MCMC
  - Bayesian methods differ in assumptions about marker effects

Results & Conclusions

Model	Predictive Accuracy - Height	Predictive Accuracy – Width (DBH)
G-BLUP	0.2806	0.1963
RKHS	0.2725	0.1806
rrBLUP	0.2712	0.1932
BayesA	0.2427	0.1636
BayesCπ	0.2702	0.1853
Bayesian Lasso	0.2522	0.1646

Model Accuracy similar, though with clearly better models for both traits. Accuracy lower than for other similar GS models in other species

Potential for GS in Sitka spruce could be expanded to other traits i.e., resistance and drought tolerance. Potential for increasing production with land already is use

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