A willow breeding programme for the UK, part of the Biomass for Energy Genetic Improvement Network (BEGIN)

Ian Shield and William Macalpine

ROTHAMSTED RESEARCH

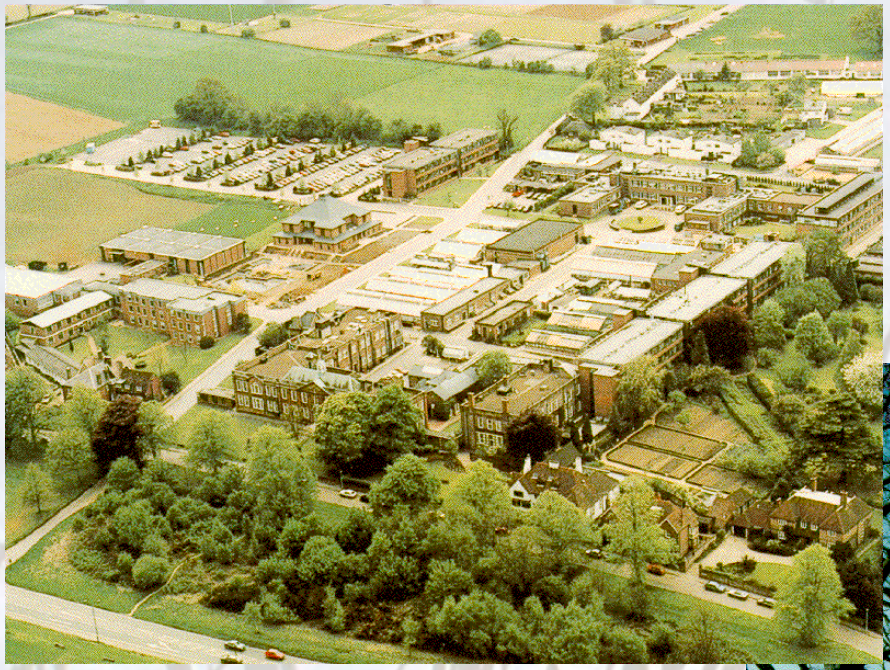
Breeding & Agronomy – Ian Shield & William Macalpine

Pathology – Ming Pei

Molecular Genetics – Steve Hanley & Angela Karp

The National Willows Collection – Sviatlana Trybush

Rothamsted Research



Harpenden

Hertfordshire

~ 40 miles North of London, UK

The National Willow Collection

Very few willow baskets were re-used during World War I and the UK resources were seriously denuded.

In 1920 the National Willow Collection was started at Long Ashton Research Station to act as a repository for disappearing basket willows.

The National Willow Collection today….

- Transferred from Long Ashton to Rothamsted during 2002
- The most comprehensive collection in the UK
- 1,300 accessions representing more than 100 species and hybrids from across the world and still collecting !
- Repository for many cultivars used in the basket & hurdle making industries.
- Recently joined the NCCPG collection scheme.

European Willow Breeding Partnership

IACR-Long Ashton
Integrated Approach to Crop Research

MURRAY CARTER

SW
Svalöf Weibull

A commercial activity building on, and feeding back to, Long Ashton science.

Breeding SRC willows as an energy crop, 1996 -2002.

Released 3 varieties, Ashton Stott, Beagle and Quest, at least 4 more to follow.

Yield Results, yield trial

Variety / genotype	Breeder	Yield odt ha^{-1} yr^{-1}
Resolution	EWBP	13.89
Discovery	EWBP	12.16
Sherwood	SW	11.33
Tora	SW	11.06
LA940052	LA / EWBP	9.61
78183	-	9.39
LA980289	EWBP	7.38

s.e.d. = 0.902 12 d.f.

Yield Results, Obs II

Variety / genotype	Yield odt ha^{-1} yr^{-1}
LA 970282	16.98
LA 980279	16.18
LA 970217	16.04
LA 970395	15.96
LA 970412	15.16
LA 960226	15.08
Tora	10.04

unreplicated

Willow breeding at Rothamsted 2003 on

- Making intelligent use of the genetic resources contained in the National Willow Collection.
- DEFRA funded to provide underpinning support of genetic crop improvement.
- Exploitation of cultivars will be via the private sector.

Recurrent selection for yield

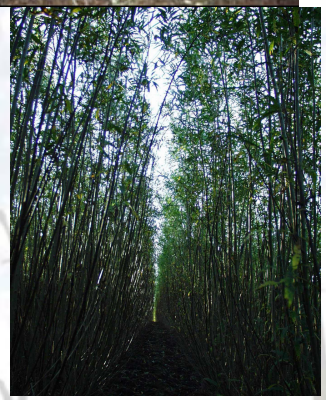
Tolerance to drought stress

Pest resistance

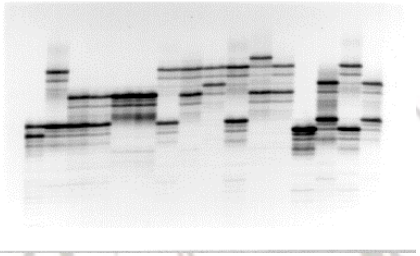
Fungal pathogen (rust) resistance

Polycross

Leaf & canopy characters



Marker Assisted Selection (MAS) Test



New Mapping Families

Willow breeding at Rothamsted

Ultimately < 0.1% (<5) may be expected to become a new variety

Tackling barriers to crossing and increasing genetic diversity

Many willows hybridise freely, but not all.

Ploidy differences - colchicine treatment

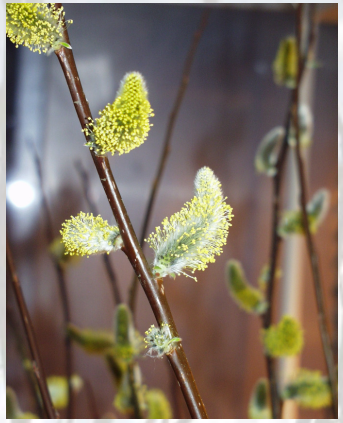
Non synchrony of flowering - pollen storage

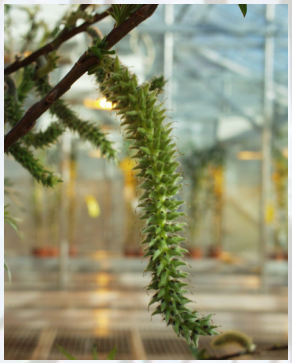
Embryo rescue

Anther culture

Willow breeding at Rothamsted

Approx. 35 crosses made each winter





Dominated by *Salix viminalis*, the main source of biomass for energy traits.

But also including;

S. schwerinii, *S. dasyclados / burjatica*, *S. eriocephela*, *S. sacchalinensis*, *S. cordata*, *S. rossica*, *S. rehderiana*, and a growing list of novel germplasm

Willow breeding at Rothamsted

Approx. 5,000 seedlings raised on the nursery each summer

Willow breeding at Rothamsted

Approx. 10% (500) selected and moved to field trials in the following spring. All vegetatively propagated by stem cuttings.

Willow breeding time frame

Jan-Feb 2000

Cross parents

x

May 2000

Seedlings under glass

June 2000

Seedlings in Nursery

Yr 2000
Crosses

Establish from cuttings (2001)
Cut back end yr 1(winter 2001/2)
Second year no cutback (winter 2002/3)
FIRST BIOMASS HARVEST (2003/4)

5-10%

2001-3/4

Observation I trial
(0 replication)

Establish from cuttings (2004)
Cut back end yr 1(winter 2004/5)
Second year no cutback (winter 2005/6)
SECOND BIOMASS HARVEST (2006/7)

5-10%

2004-6/7

Observation II trial (2
replicates)

~ 5-10%

Yield trial (4 replicates)

2007-11

Varieties

Willow breeding at Rothamsted

Today we have 5 genotypes looking promising for commercial development in the near future

Thanks you for your time

Any questions ? We'll do our best to answer them !

ROTHAMSTED RESEARCH