Accelerating Willow Breeding and Deployment (AWBD)

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Accelerating Willow Breeding and Deployment (AWBD) objectives

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1. Precision deployment of optimal varieties for different growing environments to maximize feedstock production

2. Implementation of a Genomic Selection (GS) strategy that will accelerate the production, performance and security of UK SRC willow varieties for the bioenergy market

3. Acceleration of access to new varieties by micropropagation coupled with GS for rapid multiplication of optimal genotypes

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AWBD Precision deployment

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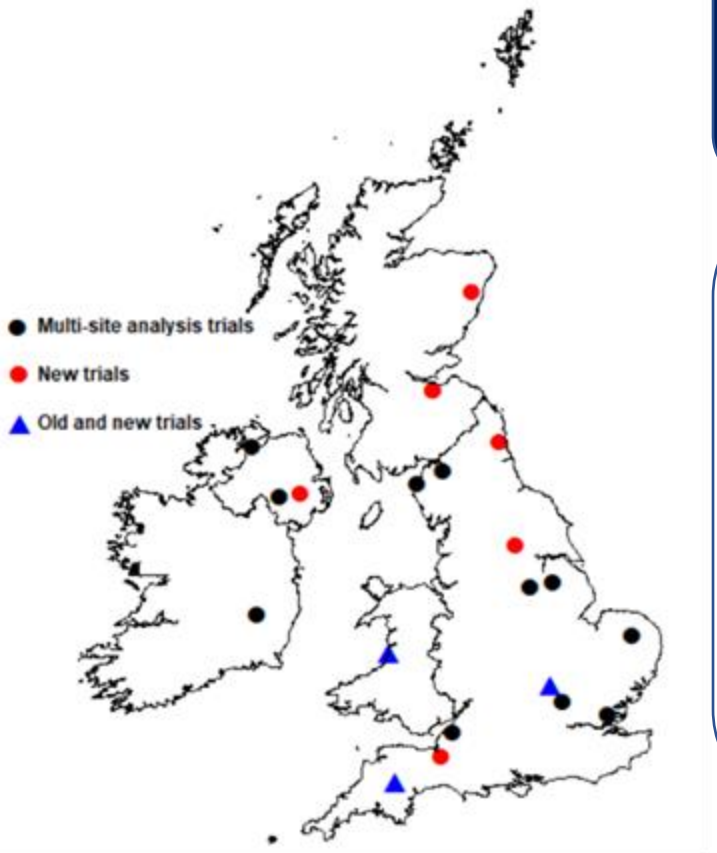

Aim: help growers minimise risk by making informed choices and when choosing to grow short rotation coppice willow (SRCw) for biomass

- Multi-site statistical analysis
- Trials planted between 1997 and 2016
- 71 distinct harvest events
- Biomass yield (t ha^{-1} yr^{-1} DW)
- Dry matter content (%DM) of the wood at harvest (%DM) data, from trials planted between 1997 & 2016
- Weather effects upon SRCw biomass yield were quantified

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Diversity within current varieties

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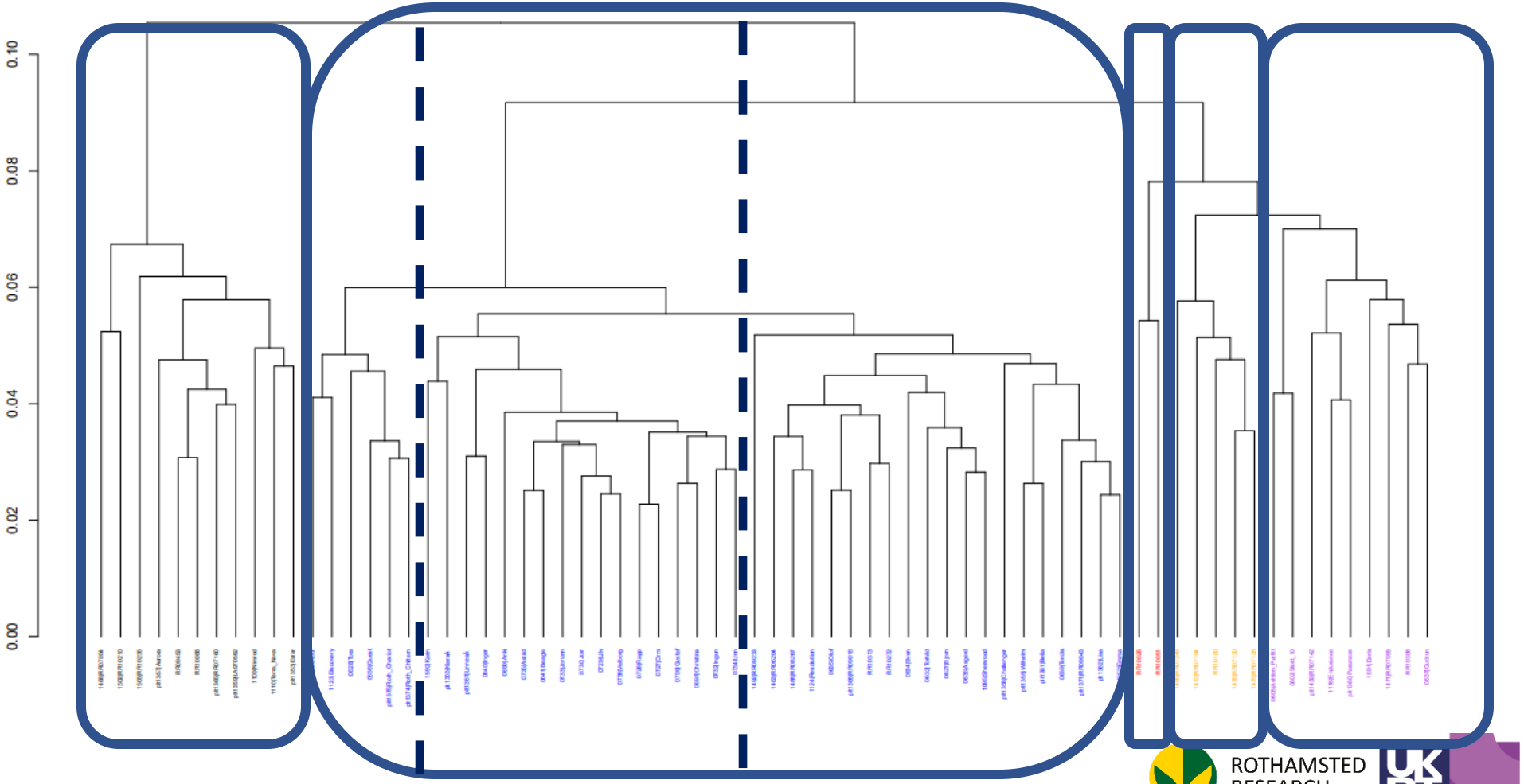

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AWBD Advisory Leaflet for Growers

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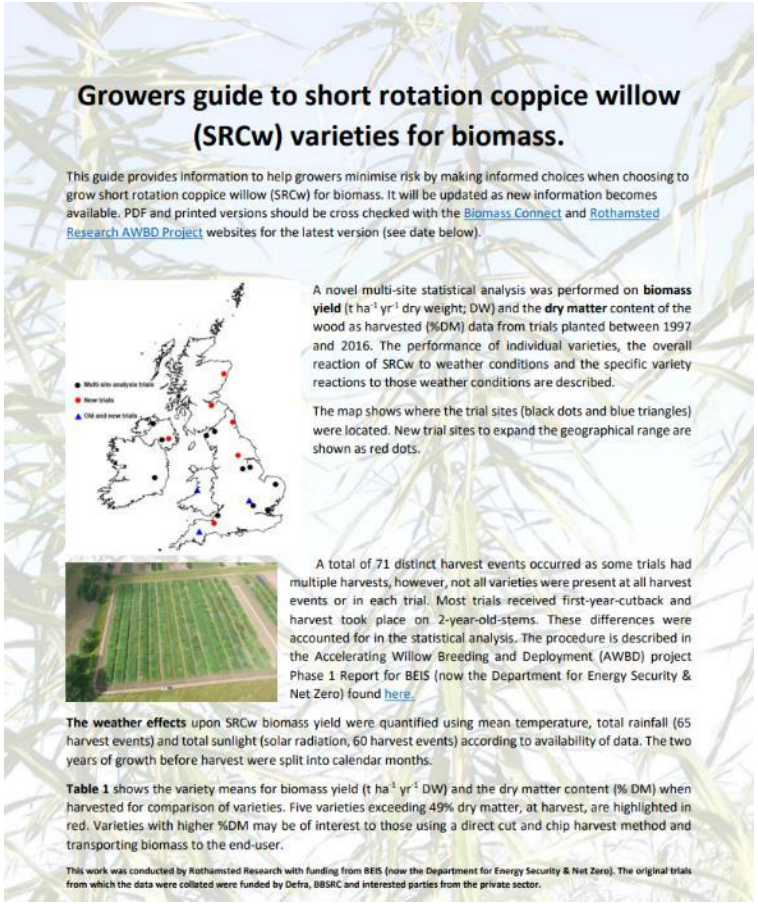

Growers guide to short rotation coppice willow (SRCw) varieties for biomass.

This guide provides information to help growers minimise risk by making informed choices when choosing to grow short rotation coppice willow (SRCw) for biomass. It will be updated as new information becomes available. PDF and printed versions should be cross checked with the Biomass Connect and Rothamsted Research AWBD Project websites for the latest version (see date below).

A novel multi-site statistical analysis was performed on **biomass yield** (t ha^{-1} yr^{-1} dry weight; DW) and the **dry matter** content of the wood as harvested (%DM) data from trials planted between 1997 and 2016. The performance of individual varieties, the overall reaction of SRCw to weather conditions and the specific variety reactions to those weather conditions are described.

The map shows where the trial sites (black dots and blue triangles) were located. New trial sites to expand the geographical range are shown as red dots.

A total of 71 distinct harvest events occurred as some trials had multiple harvests, however, not all varieties were present at all harvest events or in each trial. Most trials received first-year-cutback and harvest took place on 2-year-old-stems. These differences were accounted for in the statistical analysis. The procedure is described in the Accelerating Willow Breeding and Deployment (AWBD) project Phase 1 Report for BEIS (now the Department for Energy Security & Net Zero) found here.

The weather effects upon SRCw biomass yield were quantified using mean temperature, total rainfall (65 harvest events) and total sunlight (solar radiation, 60 harvest events) according to availability of data. The two years of growth before harvest were split into calendar months.

Table 1 shows the variety means for biomass yield (t ha^{-1} yr^{-1} DW) and the dry matter content (% DM) when harvested for comparison of varieties. Five varieties exceeding 49% dry matter, at harvest, are highlighted in red. Varieties with higher %DM may be of interest to those using a direct cut and chip harvest method and transporting biomass to the end-user.

This work was conducted by Rothamsted Research with funding from BEIS (now the Department for Energy Security & Net Zero). The original trials from which the data were collated were funded by Defra, BBSRC and interested parties from the private sector.

https://www.rothamsted.ac.uk/projects/accelerating-willow-breeding-and-deployment

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Domestication of SRC willows for biomass

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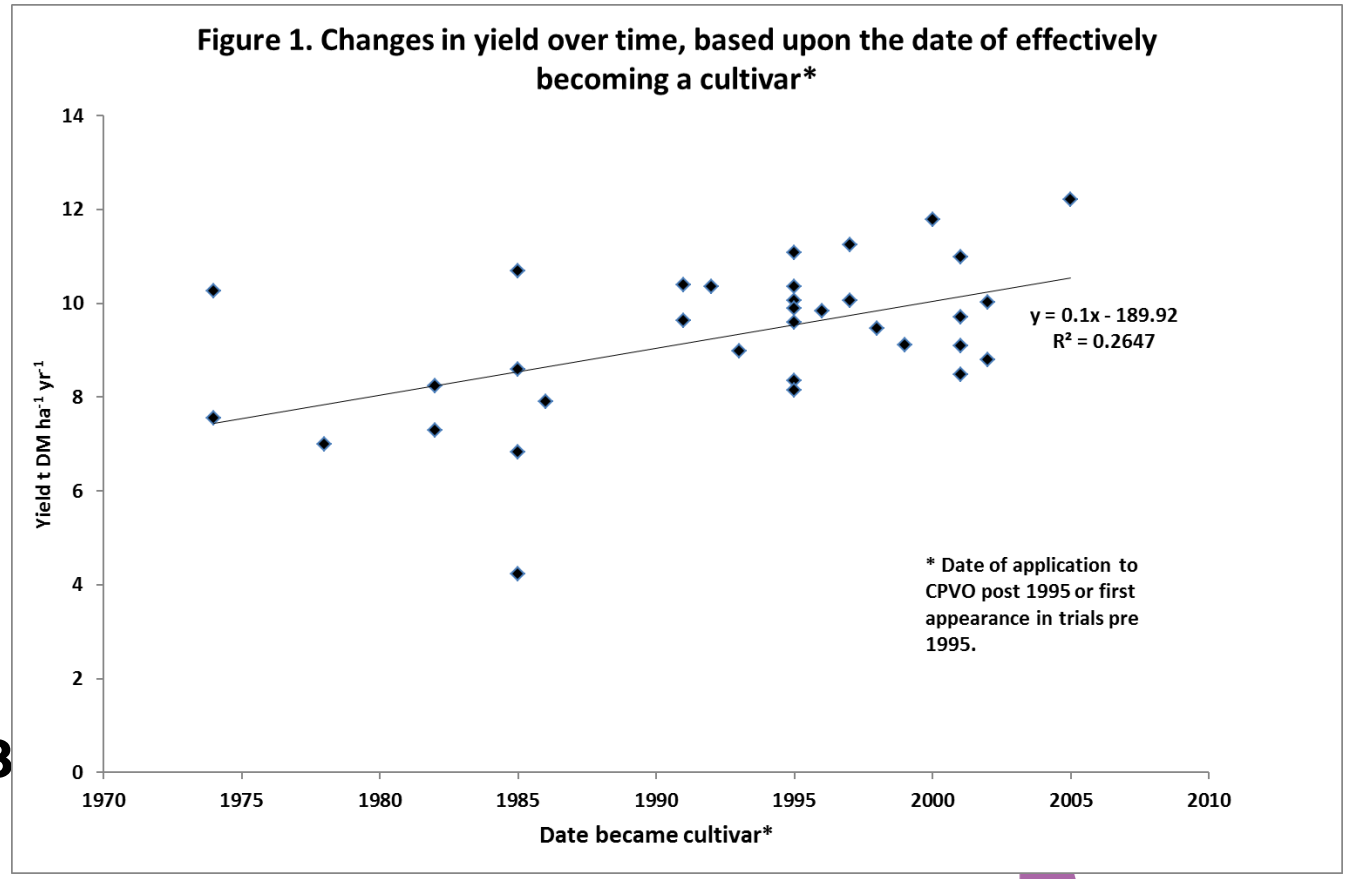
Comparatively recent with breeding programmes being established from the 1980s

- Zsuffa, 1979
- Stott et al., 1981
- Ahman and Larsson, 1994
- Kopp et al., 2001
- Lindegaard and Barker, 1997
- Macalpine et al., 2008
- Poland, Argentina New Zealand & others



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Defining an optimised training population (TP) for GS

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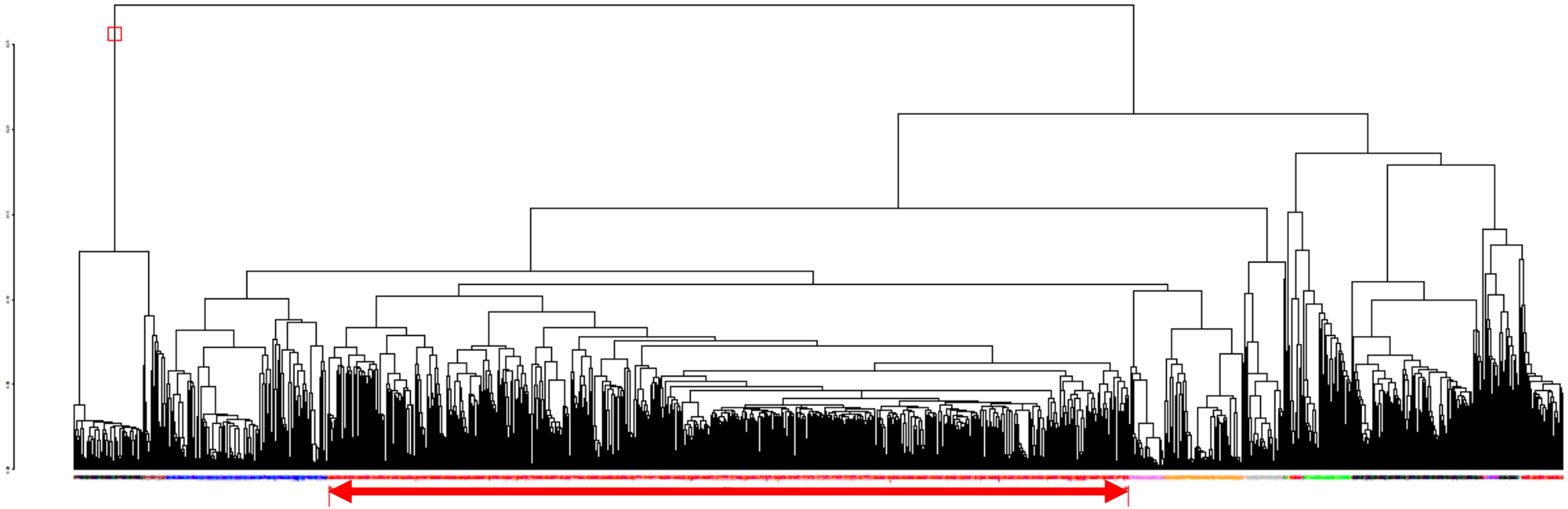

- Significant investment in the Genomic Selection (GS) approach warrants careful selection of genotypes for the TP
- Not as straightforward in willow as it is in some other systems

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AWBD Training Population for Genomic Selection - trial site network

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Site	Organisation	Site conditions
Woburn Experimental Farm	Rothamsted Research	Low rainfall, high ET, sandy soil
Bussex Farm	Somerset Willow Growers Ltd.	Flood inundation, disease pressure
Hillsborough	AFBI NI	Greater risk of rust infection
Cockle Park Farm	Newcastle University	A “control” site
Craibstone	SRUC	Lower growing season temperatures, long summer days

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AWBD - Phenotyping the Training Population

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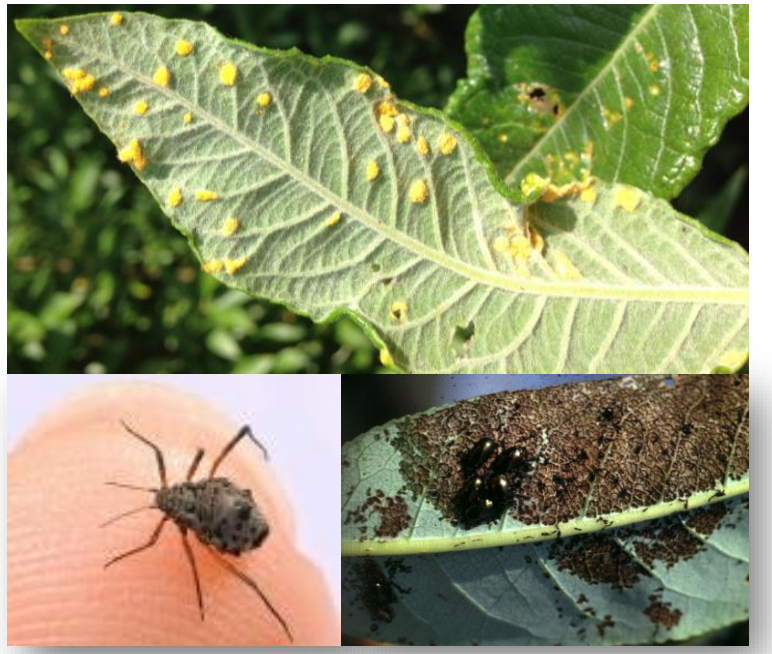
- *Melampsora* spp.
- Pests;
  - Tip damage *Dasyneura* spp.
  - Chrysomelid beetles
  - Sawfly *Nematus oligospilus*
  - Aphids *Tuberolachnus salignus* and *Pterocomma salicis*
- Plant architecture
- Senescence
- Bud burst
- Yield & components, stem number, height and diameter



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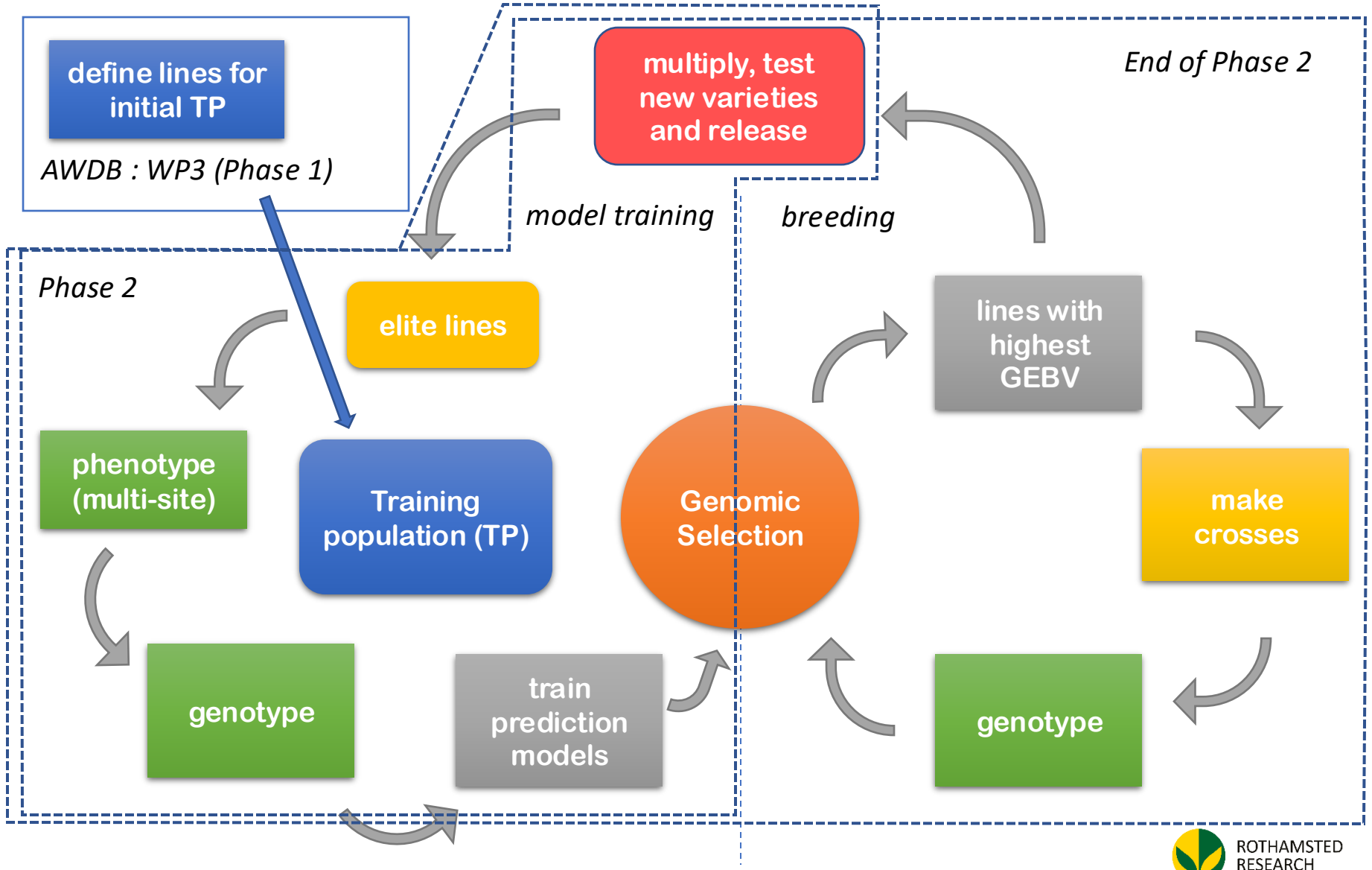
AWBD Genomics and Molecular Breeding



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AWBD - An improved strategy for willow breeding

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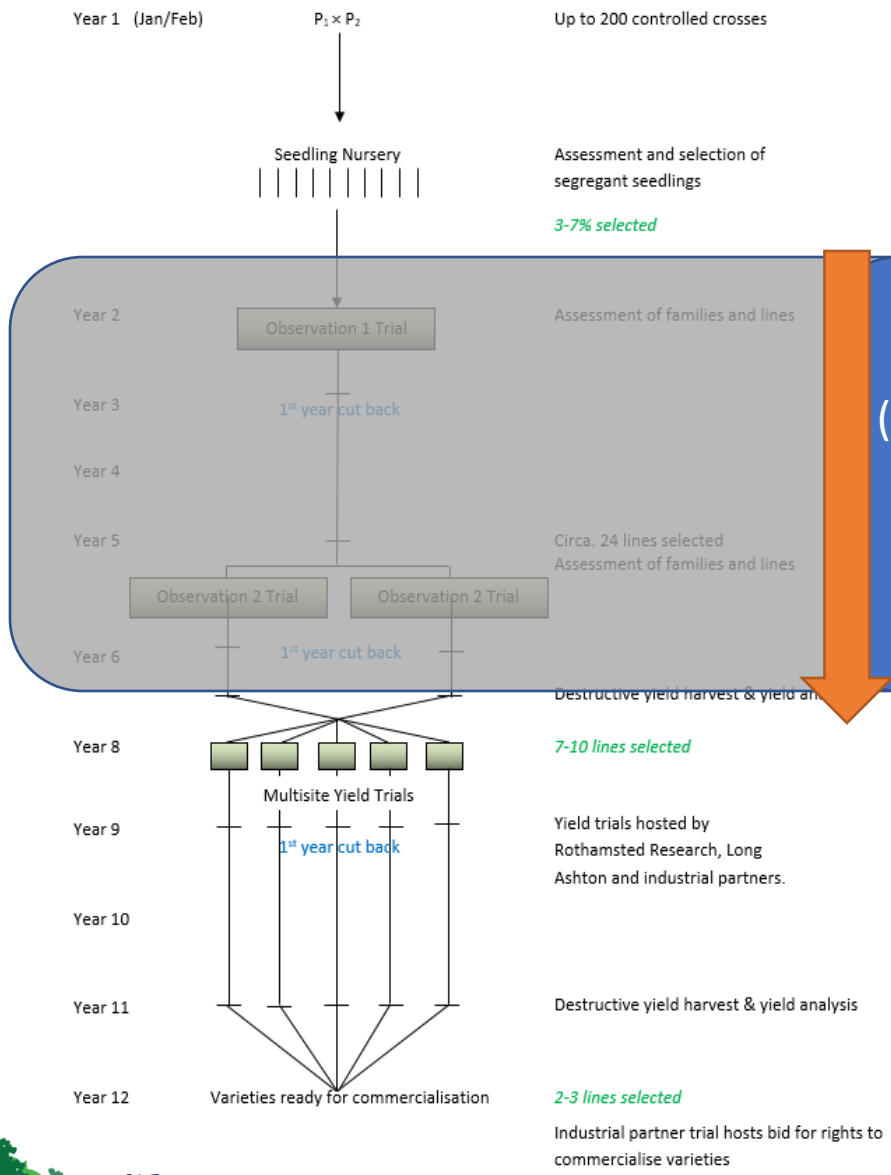

GS would be implemented here (with micropropagation to overcome material bottleneck) – **could remove 6 years from breeding cycle**

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Biotechnology to enable rapid GS-based breeding

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- *In vitro* optimisation and micropropagation for 22 diverse genotypes

Plant growth regulators →  ← Basal formulation

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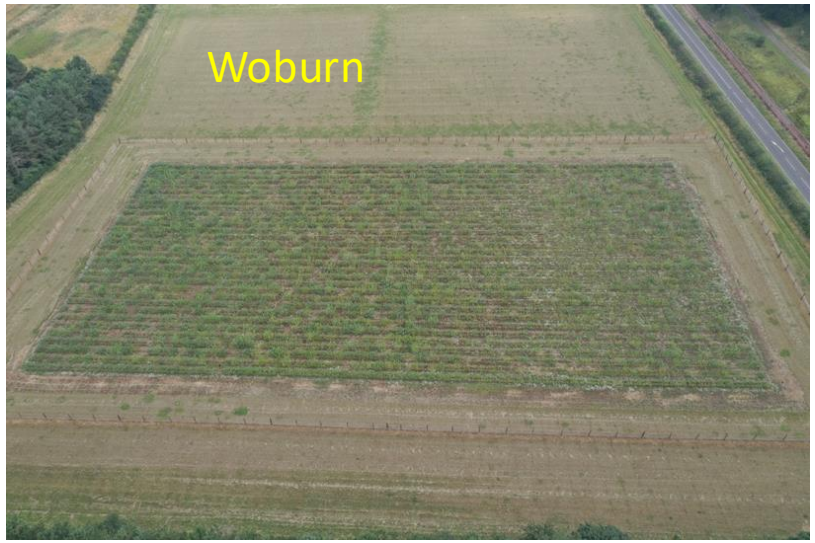

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