

The Clover Innovation Community

Boosting innovation in breeding for the next generation of legume crops for Europe

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Figure 1. Red clover field

Introduction: Red and white clover are out-crossing perennial forage species. They are used in agriculture as they are highly digestible and palatable; they contain high levels of protein and minerals reducing the need for expensive feed substitutes. Their root structures are able to ameliorate drainage problems and improve fertiliser uptake from the soil. As legumes, they reduce the need for synthetic nitrogen fertiliser thanks to their ability to bind nitrogen. They are also high in nectar and pollen and are therefore good for pollinator diversity on the farm (Figure 1).

Goal: Our goal is to improve the breeding of red and white clover. Our strategy is to create a lasting framework for much-needed pre-competitive investment in pre-breeding.

Challenges in clover breeding: in Legume Generation we will address the following challenges faced by clover breeders

1. Low seed yield due to poor pollen viability.
2. Hybrid seed generation with low levels of intrapopulation seed.
3. Little pre-breeding investment due to cost and space requirements.

The **Clover Innovation Community** are a group of breeders and scientists from both commercial and academic organisations from around the globe working together to generate new breeding material that has both economic and environmental benefits for farmers, growers and the general public. Figure 2 illustrates how our work together will bring a change in the breeding of both red and white clover. The work is divided between the partners according to the specialities we bring to the project. Plot field work is carried out in Wales (Germinal (GER), IBERS), Bulgaria (ABI) and in Germany (LfL). Molecular analysis is carried out at Earlham Institute (EI), USDA (USA), Aarhus University (AU; Denmark) and AgResearch (New Zealand).

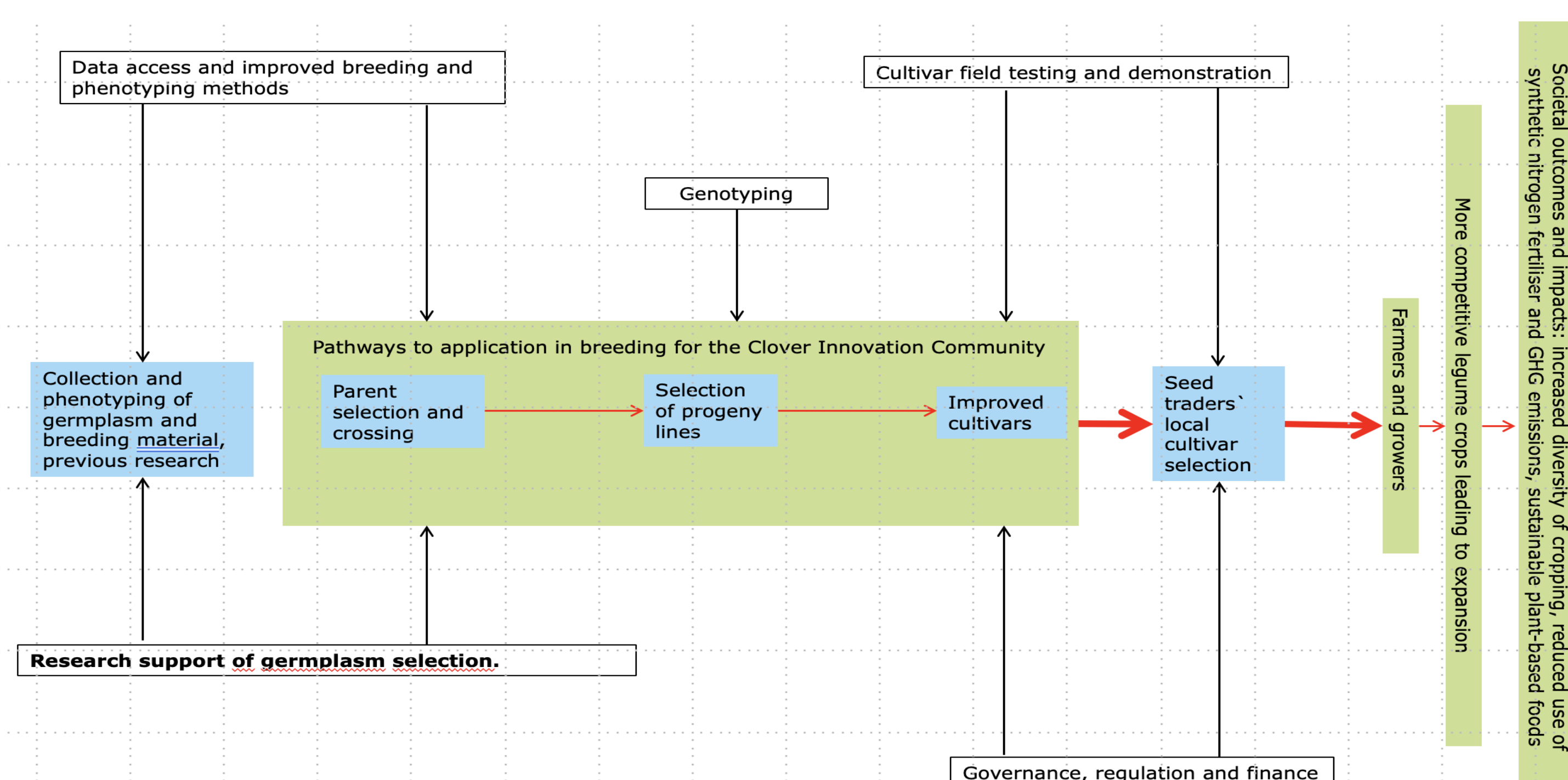


Figure 2. Pathways to application in breeding

Approaches

Low seed yield in red clover: The work is concentrated at ABI and GER/IBERS using varieties of low seed production. Foliar boron application, is carried out at the Agrobiointitute in Bulgaria and Germinal/IBERS (UK). Boron application and analysis of pollen tube growth and seed development. Boron application is performed in glasshouses and in the field (years 1 - 4).

Pre-breeding investment in white clover: In white clover, we are identifying accessions and genotypes that may harbour valuable characters such as persistence and disease tolerance that are not available in modern cultivars. 204 accessions of wild populations and elite cultivars are being assessed in replicated trials in the UK (Germinal and IBERS) and in Germany (LfL) in contrasting environments. We are collecting yield and quality data. The Earlham Institute (UK) is carrying out whole-genome sequencing on populations of 50 genotypes of each accession. We are using a GWAS approach to understand the mechanisms underlying yield and persistency.

Hybrid seed generation in red and white clover: Our other approach is to utilize the already characterised S-allele markers and S-allele frequencies in the same poor seed-yielding varieties. We will use the facilities at IBERS to perform this work. Our IC is also committed to the elucidation of the S-alleles in white clover. This work is being carried out at AgResearch (NZ), and Aarhus University (DK) (years 1 – 4).



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