

Year in Industry Proposal for 2027/28

Title of Project	Genetics of Elm, Including Resistance to Dutch Elm Disease
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Project on Offer

Elms were once the dominant trees in the landscape of southern England (Figure 1) but during the 20th Century, they were devastated by Dutch elm disease (DED), which left fewer than one in 100,000 trees alive (Figure 2). But if these survivors have resistance to DED, they may form the foundation for breeding a new, disease-resistant population of elm. At JIC, we have recently gained experimental evidence that there is indeed genetic variation for DED resistance. This implies there is a realistic possibility of breeding resistant elms, which will help to reverse the damage caused by the accidental introduction of the DED fungus, *Ophiostoma novo-ulmi*.



Figure 1. Part of 'The Hay Wain' by John Constable (1821), showing the River Stour in Suffolk with smooth-leaved elms in the background. The river and the cottage are still there but the elms died of Dutch elm disease in the 1970s.

The Year in Industry student will study genetic variation in elms and its relationship to DED resistance. There are broadly three types of elm in Great Britain: native wych or Scotch elm, especially in the North and West; field elm, introduced from 3000 BC onwards to the South and Midlands of England; and hybrids of wych and field elm, found across the Midlands and into East Anglia. The taxonomy of British elms is poorly resolved, although they probably all form a single biological species, *Ulmus glabra*, but many large elms which might have high DED resistance have not yet been studied in detail. The student will use a combination of DNA markers and botanical taxonomy to identify how these potentially DED-resistant trees are related to the British elm population as a whole. This will guide strategies for selecting breeding stock and selecting progeny trees. The marker work will involve some 'wet bench' work and a significant amount of computational molecular genetics. The taxonomy will make use of a detailed key for over 60 British elm genotypes but the student will need to determine if elms of special interest fit into this key.

Wych elm reproduces sexually by seed whereas most field elm is clonal. Although most clones propagate by suckering, many of them produce seed but it is not known if they self-pollinate or outcross. We now have a large collection of progeny from elms across England and Southern Scotland at JIC. The student will use DNA markers to do paternity tests on progeny of selected elms, to determine if they were produced by selfing or outcrossing.

As the goal of our work is to understand the genetics of DED resistance and the potential for breeding to improve resistance, we test elm saplings for their response to DED each year by inoculating them with *O. novo-ulmi*. The student will take part in these trials and will help to analyse the data produced from them.

This will be a multidisciplinary project, involving molecular genetics, genomics, bioinformatics, taxonomy, plant pathology and statistics. The research will involve work in the lab, with a computer, in a polytunnel and in the field. It will involve working with colleagues at JIC but also with collaborators elsewhere who study molecular phylogeny and taxonomy of elm. There is huge interest in reviving elm in Great Britain and Ireland and the student will have the opportunity to interact with some of the knowledgeable members of the public who are contributing to our research.

Further reading

Richens RH (1983) *Elm*. Cambridge University Press.

Pinchot Wilson CC *et al.* (2026) Improved methods to streamline Dutch elm disease resistance screening in American elm. *Forest Pathology* 56, e70099. <https://doi.org/10.1111/efp.70099>

Domínguez J *et al.* (2022) Excelling the progenitors: Breeding for resistance to Dutch elm disease from moderately resistant and susceptible native stock. *Forest Ecology and Management* 511, 120113. <https://doi.org/10.1016/j.foreco.2022.120113>



Figure 2. Two elms at Ilam, Staffordshire. The one in front died of Dutch elm disease, probably a few years before this photo was taken. The one behind it may be resistant. The person acting as a size marker is 1m85 / 6'2" tall.

PERSON PROFILE <i>2 bullets max per box</i>	Essential	Desirable
Education <i>e.g. degree subject</i>	Plant biology, Genetics	Molecular evolution, Plant pathology
Specialist knowledge and skills <i>e.g. course module</i>		Bioinformatics, Microbiology
Relevant experience <i>e.g. lab/research work</i>		Previous experience of molecular genetics, microbiology, or work in greenhouses or polytunnels
Interpersonal and communication skills <i>e.g. teamwork and record-keeping</i>	Able to work productively with a small team, including external collaborators Meticulous record-keeping	Good time management Ability to explain science to non-specialists
Additional requirements <i>e.g. outdoor working</i>		Willing to travel within England Willing to work outdoors