Adaptive differences between *Phytophthora ramorum* isolates from Europe and North America: Evidence for separate subspecies?

Clive Brasier, Susan Kirk and Joan Rose, Forest Research, Farnham, Surrey GI10 4LH UK; clive.brasier@forestry.gsi.gov.uk

Samples of European and North American isolates of P. ramorum were compared for their comparative plant health risk, their status as a single cohesive species and their potential for genetic recombination. Growth rates across different environments (g x e tests), developmental stability, host range, pathogenic aggressiveness and sexual behaviour were examined. In multiple tests on the susceptible *Quercus rubra*, samples of EU isolates were on average significantly more aggressive than US isolates (wound inoculation of bark), though the ranges of the two groups always overlapped. The potential host ranges of EU and US isolates (wound inoculation of mature stems of ca 30 European and North American trees) were very similar.

EU isolates grew significantly faster on average than US isolates on carrot agar (CA) at 20^{o}C (35-39 isolates/sample). Often, total separation of EU and US isolates occurred. An EU sample grew faster even when the US sample was fresh from the field. The EU/US growth rate difference was also maintained at 12.5, 15 and 27^{o}, but mean growth curves for the EU and US groups across all the different temperatures were similar. EU isolates were consistently of a uniform 'wild type' colony morphology. US isolates were either wild type or were morphologically variable, often slow growing 'non wild type' colonies. Single hyphal tip subcultures from selected EU and US isolates showed US isolates were more intrinsically developmentally unstable, often changing from wild type to unstable non wild type. No viral dsRNA was detected in selected 'non wild type' isolates.

In sexual compatibility type (mating type) tests on CA using A1 and A2-type testers of other Phytophthora species EU isolates were all of A1-type. US isolates were all of A2-type. However, production of gametangia in these interspecific pairings was unusually slow, sparse and unpredictable, and no gametangia formed in pairings between the putative P. ramorum A1 and A2 types. Subsequently, a method was successfully developed for obtaining gametangia between paired EU A1 x US A2 P. ramorum isolates on CA, but gametangial formation was still unusually sparse. Overall, it is unclear whether P. ramorum is truly A1/A2 outcrossing, or indeed whether its sexual breeding system is functional. The single known European (Belgian) P. ramorum isolate of A2 sexual compatibility type (S. Werres pers. comm.) was a typical EU isolate on the basis of growth rate and colony type.

It is concluded that EU and US isolates are conspecific. However, their differences for continuous variables such as growth rate, aggressiveness and developmental stability are likely to reflect differences in fitness i.e. be adaptive differences. It is suggested that for the present EU and US types be considered as distinct phenotypic populations. Possible causes and possible evolutionary consequences of their differences will be discussed; including the possibility that EU and US population types might at some point need to be viewed as (partially reproductively isolated?) subspecies of P. ramorum: eg. as *P. ramorum* subspecies *europaea* and subspecies *americana*.