





A revolution is taking place in turfgrass genetics. Exciting new molecular techniques are being developed that will accelerate conventional plant breeding. Scott MacCallum finds out more ...

Gene. genie

Mapping out the future

Golf courses have taken a battering over the winter and many may have to come to terms with more frequent winter flooding and summer drought conditions if the global warming prophets are proved correct. But help is at hand, scientists are already able to develop grass varieties more tolerant to climatic and environmental stresses and the pace of innovation is accelerating.

A revolution is taking place in turfgrass genetics. Exciting new molecular techniques are being developed that will accelerate conventional plant breeding. And most of the progress is being made in this country at the Institute of Grassland & Environmental Research (IGER) – the site of the only UK-based turfgrass breeding programme.

Funded by British Seed Houses since 1988, the IGER turfgrass breeding programme – recognised for the development of AberElf and AberImp – is now benefiting from the latest advances in molecular biology, as well as an internationally-recognised grass genetic database and seed bank – all on site just outside Aberystwyth.

According to IGER senior research scientist and cell biologist, Dr Mike Humphreys, it is now possible to track precisely the transfer of genes for stress resistance from fescue grasses into ryegrass in conventional breeding programmes. A number of novel techniques are being developed which will allow the geneticist to test whether the fescue genes have been transferred successfully and are functioning normally in the genome of the ryegrass.

“Our objective is to identify molecular gene markers closely linked to particular desirable turfgrass traits such as drought and/or wear tolerance and fineness of leaf. These markers – or ‘genetic fingerprints’ – can then be used to identify potential grasses that possess the trait without expensive, laborious, and time-based testing over successive plant generations,” he explained.

What’s more, as they try to develop better cultivars, IGER turfgrass breeders have no shortage of natural grass plant material to choose from. IGER scientists have been collecting grass plants since 1974 and now have priority access to a genetic database

representing over 10,000 individual plant populations from all over the world.

“Each population has been catalogued together with details on its habitat, abundance, soil situation and growing environment. Habitats as diverse as quarries, monastery courtyards, football pitches, scrublands and mountain-tops have all been sampled so that we can identify novel, natural genetic material which turfgrass breeders can utilise,” said Mike.

Once material has been catalogued, there is now no barrier to better genetic understanding even though most of the traits that interest turfgrass breeders are complex and governed by a combination of genes of varying importance. Grass chromosomes can be viewed under the microscope and IGER has developed a technique that allows the observer to locate different suites of genes – relevant to a range of important traits – to specific regions of the chromosome. Once their presence has been confirmed, their effect may be determined.

Genomic In Situ Hybridisation



Above and previous page: A party of greenkeepers listen intently to IGER staff

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IGER senior research scientist/cell biologist, Dr Mike Humphreys

(GISH) may be a mouthful, but this exciting new ‘gene painting’ technique is currently being used to distinguish between chromosomes from ryegrass and those from fescues in a hybrid plant. In effect, DNA from the two species is labelled in

different colours.

“Access to this technology means that by using a combination of genetic markers and GISH, we can develop models which will allow our turfgrass breeders to more quickly assess the feasibility of transferring desirable genes to and from ryegrass and fescue in the future,” explained Dr Humphreys.

IGER – in collaboration with partners in France, Poland and Norway – is currently working on an EU funded project (SAGES)† looking at how grasses withstand environmental stresses. A major effort is being made

to identify the genes involved in traits such as cold and drought resistance in the fescues with a view to their transfer into ryegrass. IGER scientists are also aware of potential ‘flood tolerant’ genes in rice that may, theoretically, eventually offer benefits for amenity grass areas prone to flooding.

According to IGER turfgrass breeder Danny Thorogood, working in partnership with his Institute colleagues working in molecular biology means greenkeepers can expect to see an increase in the number of new, adaptable turfgrass varieties coming to the market.

“Over the last 20 years, traditional plant breeding has made an enormous difference to the quality of turfgrass cultivars available to greenkeepers and groundsmen. But just as the advances in molecular genetics have helped map human genes to help accelerate the development of new healthcare treatments, the new technology will do the same for turfgrass breeding over the next decade. “For example, thanks to this

progress, traditional breeding objectives on the IGER ryegrass, fescue and bent grass development programmes are now being more easily combined with aesthetic and sustainability issues such as disease resistance, colour retention, and metal, salt and herbicide tolerance (eg. chemical control of *Poa annua* on golf greens).

“Until recently, the use of molecular tools in plant breeding was at the experimental stage, but now by utilising the gene identification capabilities of modern molecular genetics much of the ‘trial and error’ of conventional plant breeding is being removed. The future is bright,” he predicts.

† Further SAGES project information can be found on the following website; <http://www.iger.bbsrc.ac.uk/igerweb/SAGES/welcome.html>

Further information on the IGER turfgrass breeding programme is available in a technical publication. Free copies of ‘The IGER Advantage’ are available from British Seed Houses on 01522 868714