'Micropropagation saves the planet?'
From Roses to Sphagnum a 30year journey
Neal Wright , Micropropagation Services , Kirk Ley Rd, East Leake, Loughborough, Leicestershire, LE12 6PE, UK. +44 1509 856295, neal@microprop.co.uk.

Background
Neal is one of an apparently dying breed of UK micropropagators: he has been involved in micropropagation since being introduced to it in 1976 whilst still studying Physics. So enthusiastic about it he did a PhD in it at Nottingham University and then started his own Lab/Nursery and with his wife Barbara. Together they have (30+ years on) made it is a thriving business. An IPPS member for all that time, perhaps one of the few micropropagators sharing most of the supposed 'secrets' of microprop.

Micropropagation is labour intensive and has largely moved to cheaper labour areas such as Eastern Europe, India and China. However, with very careful management and integration into niche markets, there is still a place in the UK. The basics of micropropagation have not changed much over the 30 years that Micropropagation Services has been going, but there has always been a need to control costs, and in the traditional IPPS manner low investment innovations have been developed in the lab and nursery. Starting with home-made sterile air cabinets and alternatives to scientific apparatus wherever possible, to the use of gantry mounted mowers for trimming plug plants to improve bushiness and uniformity. Early adoption of innovations, such as the Evaposensor for mist control in weaning has also proved essential to maintain 'the edge'.

Many different species of woody, herbaceous, houseplant, horticultural crops and forest trees have been and are propagated. These are always with very careful management of production, order processing, stock and cost control, achieved by the use and development of an in-house database program. This unique system also allows complete traceability from original stockplant to delivery. Niche markets have been developed and any very large scale production has been passed to labs overseas, so competition with cheap labour producers is minimised. One niche market; the production of native species for vegetation restoration in The Peak District has lead us to develop a unique product: We are now propagating *Sphagnum* moss on a large scale to re-establish it on peat bogs and return them to the full-functioning carbon sequestering stores that they should be. Below is more of the science of this.

Introduction
Re-establishment of *Sphagnum* species is key to returning degraded ombrotrophic bogs to functioning ecosystems. In the South Pennine bogs of England where *Sphagnum* was almost wiped out after the Industrial Revolution, recovery of peatlands is limited by availability of local *Sphagnum* for any restoration operation. Novel propagules produced using *in vitro* techniques and encapsulated in a gel (BeadaMoss™) provided the opportunity to 're-seed' large areas economically.

Propagation of Sphagnum species
In the South Pennines and many other areas where restoration of *Sphagnum* is desirable there is very little material available as a source, either because it has been degraded or is protected. A successful rapid propagation method, suitable for all species tested (currently 12) was developed and large quantities can now be routinely produced. Methods to 'toughen' beads to make them more tolerant of tough *in vivo* conditions were also developed and applied.

Figure 1 BeadaMoss™ Inside each bead are numerous tiny propagules, each with the potential to grow into a *Sphagnum* plant.

Distribution of Sphagnum onto the bog

Sphagnum is very difficult to handle and distribute, when removed from the growing medium surface it acts like a wet blanket and is difficult to separate individual plantlets. A method has been developed to encapsulate *Sphagnum* plantlets, a few millimetres in size (termed 'BeadaMoss™') allowing easy separation and planting onto the bog surface. The beads produced by this system have enabled handling with air-seeding machines and distribution from a helicopter (Fig 2), thus making large scale planting viable and achievable. They can equally be handled and planted by ground based machines on suitable surfaces, such as cut-over peat bog surface.

Figure 2 Helicopter mounted seeder applying BeadaMoss™

Testing growth' in vivo'

Sphagnum plantlets in beads (BeadaMoss™) produced recognisable *Sphagnum* growth within 2-3 weeks of being placed onto commercial peat in a glasshouse at ~20 deg C. Within 8-10 weeks these had grown to approx 1 cm in diameter.

Figure 3

Sphagnum beads were tested for their ability to grow if buried in substrate and were found to be able to grow to the surface within 8-10 weeks even if buried to 30mm. Cold tolerance was also tested: at temperatures down to 0 deg C there was no deterioration in growth rate or survival, at -5 deg C after 10 weeks growing, 70% of beads grew, but growth was delayed by 2-3weeks compared to controls.

Figure 3 BeadaMoss™ after 8-10 weeks in glasshouse

Field trials: Trials on degraded bog
A series of permanent 0.5 x 0.5 m quadrats containing *Sphagnum* beads were
set up on two sites in the Southern Pennines (Black Hill & Holme Moss Mast) Quadrats were placed at random in three blocks within the Mast (bare) and Black Hill (restored) sites,

Results
Plots were examined in detail in autumn 2011. All growing pieces were marked with thin canes for future monitoring and counted.
Survival on bare sites was lower than for restored sites, where the surface was stabilised

Figure 4: A forest of canes marking 62 visible *Sphagnum* plants of the original 90 propagules planted.

Conclusions/Discussion
Monitoring has shown that sphagnum beads can establish and grow into significant robust pieces (Fig 5) that can survive harsh winters and even the moderately severe drought in spring 2010. Given sufficient time a very large percentage of beads (BeadaMoss™) can become apparent over 2 years after planting.
It is presumed now, that they have grown but had been buried or covered with wind blow black peat and obscured from view.
Sphagnum establishment from beads on vegetation stabilized surfaces, like Black Hill, was evident more quickly than on the bare peat (Mast site). However, even on bare peat in areas/ground conditions previously thought too severe, *Sphagnum* beads can colonise with a good degree of success, given time.

Figure 5: Established *Sphagnum* from bead

Further field trials:

Cut-over bog – Peat harvested bog

The best results were produced in areas with a stabilised peat surface (with brash, grass seed or cotton grass plugs).
Plots of 'bare peat' & 'brashed' plots had BeadaMoss™ applied in spring. Cotton grass (*Eriophorum angustifolium*)
plugs were planted in spring and beads were applied 4 months later. Small *Sphagnum* plants establish in Cotton grass, as it acted as an effective 'nurse crop'. (Fig8) *Sphagnum* plants growing through brash if coarse chopped brash is used and support growth, but finely chopped can crust & inhibit growth. Without anything to prevent frost heave and surface movement (bare plots) no *Sphagnum* could establish.

Figure 6 Harvested bog: Early stages of *Sphagnum* growth in Cotton grass restored area

The survival rate of beads even in fairly severe conditions means that a good *Sphagnum* cover can be achieved over large areas, by seeding with BeadaMoss™. The real possibility of restoring a fully functioning *Sphagnum* bog back to the Peak District and other degraded cut-over bogs etc. is therefore becoming a reality.

I hope the above shows that there is a place, even in the UK for micropropagation to thrive in niche markets. It does require careful attention to detail and considerable innovation, some hard work and a bit of luck – but that's nothing new for many IPPS members. Hopefully it may even assist in saving the planet.

Ends…