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Micropropagation of Upland Native Species for Landscape Restoration©

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INTRODUCTION

The use of horticultural techniques to produce plants used for environmental restoration has been significantly overlooked. It seems that ecologists are generally not aware of the horticultural industry and of what horticulture may have to offer to assist in restoration projects. In this sense, such projects could offer a valuable new potential market for IPPS members.

This paper looks at two projects in which the author became involved and at some of the propagation and plant production challenges that had to be overcome.

BRECON BEACONS PROJECT

The first large-scale project that Micropropagation Services became involved in was the restoration of a designated Site of Special Scientific Interest (SSSI) on the Brecon Beacons mountains in Wales, where the gas supply company TransCo was installing one of its large "national grid" gas mains (Fig. 1). The possibility of propagating plants to re-plant on the site seemed to have been totally overlooked until a nurseryman, Mark Earle from Specimen Trees, became involved. Methods such as "turfing" and "transplanting" had been tried, but for many well-established wild plants these techniques are not very satisfactory. Mature plants, particularly of woody nature, do not take kindly to such disturbance. This applied particularly

Figure 1. Brecon Beacons site during pipeline installation.

to the bilberry (*Vaccinium myrtillus*), where virtually all translocated plants had died, and to a slightly lesser extent to crowberry (*Empetrum nigrum*). Growing these two species from seed had been considered but seed was not available, and the viability of such seed is often extremely low. Furthermore the timescale of the operations did not allow this option to be pursued. As these were the two species of particular importance to the ecology of this site, this presented the contractors with a very particular problem to be overcome.

The damage to the site during construction was extensive. A high-pressure steel gas main of approximately 1-m diameter was being buried in a trench up to 3 m deep in rocky ground. This required some extremely large, heavy, machines and considerable space to be made for access — the topsoil was removed and stacked from a 40-m wide strip over a length of 30 km. This topsoil was to be returned to its original location, but by that time most of the vegetation within it would be dead. The construction work had to be done in the dry summer period.

Fortunately for the contractors, Mark Earle was familiar with at least the concepts of micropropagation and approached Micropropagation Services to see if we could help. The task was to propagate 120,000 plants of two species, where conventional methods had failed; species of which we had virtually no knowledge. The propagules had to be grown into a plant tough enough to plant out into an exposed building site on the mountains — and the project had to be completed within 18 months.

Propagation and Planting. One of the restrictions placed on the contractors was that only a small quantity of plant material could be removed from the site so the use of micropropagation was very appropriate, as cultures could be started from just a small number of plants. It was important to also remember that we were dealing with a natural environment, so there was a need to ensure genetic variability was maintained for the future. Plants were therefore taken from as diverse a number of sites as possible and each collected clone was kept separate.

As bilberry is a *Vaccinium*, we were able to draw on quite a lot of research already done on the micropropagtion of blueberries. This at least gave us a starting point. Unfortunately, although we found that bilberry would initiate onto media developed for blueberry, multiplication rates were very slow. Fortunately after a little further research, we were able to deduce that there were certain ions in the medium which bilberry did not like, and once these were removed they multiplied reasonably quickly.

Crowberry fortunately proved to be a subject that we could culture relatively well and so we were then in the bulk-up phase in the lab. Meanwhile, initial trials on weaning and growing were established, leading us to develop suitable low pH, low nutrient, free-draining paper-pot plugs to wean into; and also to develop an improved water-holding medium in peat pots for potting on. These wetland plants would require a good water-holding capacity to survive their transplanting. Mycorrhizae were incorporated into the compost to assist in establishment.

During the bulk-up period we were able to carry out planting and establishment trials to assess the best size and type of plant, compost, etc., to use for the project. Alongside finding the best transportation and planting techniques, the trays used to hold the plants needed to be flimsy to ensure a minimum volume of waste to remove from the site, but specific handling forks had to be developed to carry the trays on site.

The successful regeneration of this pipeline site by propagation and planting of *V. myrtillus* and *E. nigrum* will, we hope, help prevent the long-term scarring of the landscape, such as can still be seen in other areas 25 years after similar construction projects.

THE PEAK DISTRICT PROJECT

The success with bilberry and crowberry on the Brecon Beacons project was followed by a much larger project in the Peak District, an upland area of central England. Here the organization Moors for the Future had been set up to revegetate huge areas of moorland, which had become damaged over the last century through a combination of the effects of pollution, too many hikers, sheep grazing, and wild fires (Fig. 2).

Moors for the Future had found it possible to re-seed areas with heather and heath (*Erica* and *Calluna* species), but when used alone these species did not restore the habitat's original plant diversity. The five other major species identified as important to this area were bilberry, crowberry, common cotton grass (*Eriophorum angustifolium*), hare's tail (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*). Much initial work had been done to prevent the further rapid loss of the peat from denuded areas by the application of geotextile (Geojute) material and by use of grass seed. The grass is a "temporary holding measure" and can only survive if lime and fertiliser are applied regularly. Moors for the Future realised there was a need to re-establish the full natural vegetation to ensure long-term viability and retention of the peat.

Propagation. Again we were only allowed to remove a very limited amount of plant material from the moors so micropropagation was essential to propagate all the species required. Although we had already worked with, and had cultures of, bilberry and crowberry, it was essential to start with fresh material of local origin. Collections were made from widely diverse areas of the High Peaks to ensure a sufficient diversity of genetic material was gathered and propagated.

Micropropagation protocols for cotton grass, hare's tail, and cloudberry (Fig. 3) were developed—helped by Scandinavian research on *R. chamaemorus*, which is grown commercially for its fruit. This is a very interesting plant, with rhizomes

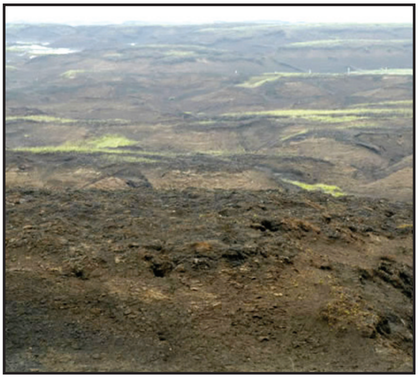

Figure 2. Erosion after fire damage in the Peak District.

Figure 3. Rhizome formation in propagules of cloudberry.

growing up to 2.4 m in a season and is well suited to holding the peat in place. Common cotton grass (*E. angustifolium*) has also proved to be an extremely good erosion-prevention plant, again because of its rhizome forming nature. It is now being used along footpaths to prevent loss of peat by erosion.

The National Trust (a U.K. buildings and landscapes conservation charity) is one of the partners in Moors for the Future and has a policy of peat-free plant production — and this was a specification in the tender for this project. This presented us with a problem: how do you get a low pH peat-free medium? We tried a bark and wood fibre mix, which worked reasonably well for potting rooted plants into, but for weaning it was very poor, particularly for bilberry. Bilberry and other ericaceous plants need peat to root well and finally, having killed 50,000 bilberry plants, we were able to convince the National Trust that some peat incorporation was essential. With help from growing media suppliers Melcourt and Vapogro we adopted a peat, bark, and wood fibre (2 : 1 : 1, by vol) mix.

Transplanting. The next challenge was to find the optimum size of plant for transplanting back into the site. These had to be big enough to establish quickly, but small enough to get on to the planting sites. Some sites were very remote, only accessible on foot after a 1- or 2-h walk. Plants therefore needed to be flown up by helicopter and so every kg incurred costs. After various trials, we opted for a 4 cm diameter × 6 cm deep Ellepot (specially made to measure).

The work we had done at Brecon indicated the benefit of mycorrhizae on establishment in that hostile environment. So when considering the completely denuded, exposed, environments we were planning to plant into within the Peak District, we were sure colonisation would be essential before planting. The soil we were planting in would have no residual inoculum but mycorrhizae would be essential to establishment, as there would be no nutrient available and water supply could be limiting. Discovering that we needed specific ericoidal mycorrhizae for the ericaceous plants we were able to inoculate with local origin mycorrhizae. We were also able to prove colonisation had occurred to a sufficient extent before planting, by assessing roots under a microscope.

The ultimate aim is to establish a functional blanket bog again, but this is likely to take a few more years and a lot more work.

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