SHORT ROTATION FORESTRY IN IRELAND
NEW RESEARCH TRIALS

With increasing interest in Short Rotation Forestry (SRF), this research will review best practice in growing, harvesting and stump removal practices employed, writes Brian Tobin (UCD), Susie Foreman (Teagasc Ashtown Food Research Centre) and Conor O'Reilly (UCD).

Image 1: The first ShortFor Trial was established at a site in Johnstowncastle Co. Wexford in 2014.

ShortFor is a research project that was established to investigate the potential of short rotation forestry (SRF) to contribute to biomass and fiber production and renewable energy targets in Ireland. From the outset, SRF topics of relevance to Ireland are being reviewed, covering species/ genotype selection to carbon sequestration and environmental issues. The review will provide best-practice information for most SRF approaches and inform decision-making in other aspects of the project.

Specifically, the project will review current genotypes used in SRF, the impact of harvesting operations on nutrient release and the sustainability of residue and stump removal. In addition, the project aims to evaluate optimum establishment and silvicultural practices through field trials and to investigate a greenhouse gas balance in single and multiple SRF rotations. This area of research is new in Ireland and the project brings together five research performing organisations (UCD, Teagasc, Waterford Institute of Technology, the University of Limerick and Trinity College Dublin) and Coillte (Image 2), is led by University College Dublin, and is funded by the Department of Agriculture, Food and the Marine. This article will describe some of the projects aims as well as some limited experience to date.

BACKGROUND

Ireland's renewable energy targets are set to increase to 16% by 2020 and are very likely to increase further afterward. While currently a challenge, such a reduction in dependence on imported energy (or resources for its generation) may prove economically attractive and will increase sustainability. This is particularly true for Ireland where the climate supports some of the highest productivity forest in Europe. Ireland has a growing and vibrant forestry industry, with a modern wood-processing sector which continues to demonstrate its capacity to develop new opportunities and forests are increasingly seen as an important source of renewable energy. Increasingly however, the supply of biomass for energy is seen as another competing market for forest produce.

SRF occupies a niche between the highly productive short rotation coppice (SRC) systems and conventional forestry. While the entire

Image 2: The ShortFor project team in 2014.

Image 3: Eucalyptus nitens after two growing seasons at the Johnstowncastle trial in Co. Wexford. Some of the plants have begun to suffer windblow.

growth potential of a tree species is not fully utilized in conventional forestry for various reasons, SRF should better optimize the use of natural resources, environmentally and economically, through the application of evidence-based research information.

Factors such as reliable sustainability of supply, production spread countrywide to provide localised supply, economically feasible and environmentally friendly managements systems are all vital to build a viable supply of domestic energy.

ShortFor seeks to address the issue, with the aim of exploiting an intensive short rotation system, making innovative use of new species combinations and management, and to develop an SRF biomass production system suitable for deployment in Ireland.

Carbon storage and sequestration are among the principal environmental services provided by forest ecosystems. Worldwide, SRF systems generate strong carbon sequestration rates, however, in common with conventional systems, extraction and haulage systems play a significant role in determining whether the overall effect of the system is to sequester or release greenhouse gasses. The project will consider the net carbon effect of any potential system and will investigate both production effects as well as loses from haulage and other transportation using a life cycle analysis approach.

The implementation of best practice measures has improved field survival and early growth of several tree species in Ireland. However, more information is needed on planting stock quality attributes specifically for SRF species in Ireland. Furthermore, there is relatively little information available on the optimum growing density and early growth rates of SRF forestry crops.

To fully occupy and maximise production, the trees must grow quickly and fully "occupy" all growing space. ShortFor will examine how some fast growing species allocate resources to optimise growth rates and to deal successfully with competition.

FIELD TRIALS

The project has begun to establish field trials which will be used to determine best establishment practices specific to SRF conditions. It is planned that data from up to three trials will be used, thus ensuring that a system can be developed that quickly maximises productivity potential from a given set of site-specific conditions. From such information new practices for managing crops to optimise harvest times/rotation length, can be developed and coppicing opportunities can be evaluated. In particular, the growth dynamics of key species will be evaluated in response to different spacings. Some information to this end will be obtained from existing stands (mostly broadleaf stands that have not been thinned) to estimate growth responses to competition, with some of the information being obtained from wood core samples.

"SRF occupies a niche between the highly productive short rotation coppice (SRC) systems and conventional forestry"

Emphasis has been placed on establishing field trials on sites with wet or exposed soils where, although fertility should be high, the excess moisture or other factors makes them less suitable for agricultural use.

So far trials have been established at a Teagasc-owned afforestation site at Johnstown Castle, Co. Wexford in 2014 (Image 1) and at a Coillte-owned reforestation site near Portlaw in Co. Waterford in 2015.

One of the objectives of the trials should be a demonstration of the potential for using these site types for SRF, site types that are expected to become increasingly available in the future for SRF.

Since the expected rotation time for a SRF system falls between 8 and 20 years, it is too early to provide any reliable results at this stage. However, it is becoming apparent that eucalyptus, as it is supplied as seedlings in growing media plugs (rather than as bare-rooted plants like the alder and spruce), needs to be planted deeper and with more care than much of the planting associated with conventional forestry species.

The eucalyptus grew extensively above ground very quickly after establishment and placed considerable pressure on their developing root systems. When the species is planted into a wet or moist soil the conditions are exacerbated. This necessitates a deeper –than–usual planting position if very early windblow is to be avoided (Image 3).

COMPETITION EXPERIMENT

Forest tree responses to competition can be extremely complex and difficult to attribute to individual factors such as light or below ground availability of moisture or fertility etc.

Consequently, the measurement of physiological responses to competition is challenging. In order to resolve some of the methodological issues involved, an experiment was designed to examine the growth and competition interactions of three species growing at three densities in pots in a polytunnel.

Trees were planted 1, 4 and 7 plants to a pot, respectively (Image 4, Figure 1). While still at an early stage in the experiment, it is no surprise that the eucalyptus has produced the greatest increment in height at each density.

Nor is it surprising that increment appears to reduce with increasing competition.

Equally, Sitka spruce is well–known to be slow to establish, consistent with the early findings in the pollytunnel experiment.

However, the ability of the Italian alder to almost keep pace with the eucalyptus was perhaps the most surprising outcome. Certainly these two species appear suited to the requirements of a SRF system where the initial goal is to quickly occupy the available growing space.

Image 4: Potted experiment with varying planting densities of species (Italian alder pictured) in a polytunnel.

Another interesting, though not entirely unexpected aspect of the potted experiment, has been the prevalence of pests. The 2015 growing season was noted generally for the high incidence of green spruce aphid (*Elatobium abietinum*) damage throughout the country. While this pest did not feature inside the polytunnel, tortrix moth larvae (*Celypha* spp.) caused extensive damage to growing tips of the spruce plants while a psyllid species was very much in evidence on the foliage of the eucalyptus plants (Image 5).

The latter began to cause some damage to trees towards the end of the season even apparently causing some degree of mortality. While the conditions for pests within a polytunnel are ideal, the extent of damage was surprising.

It is planned that a further trial will be established in 2016. Measurements of competition interactions at the Johnstowncastle trial should begin to inform about suitable establishment densities, later management and rotation length.

This, along with data describing species' productivity rates, will be combined with lifecycle analyses and other environmental modelling to describe in detail the potential effect of biomass production using a SRF system in Ireland.

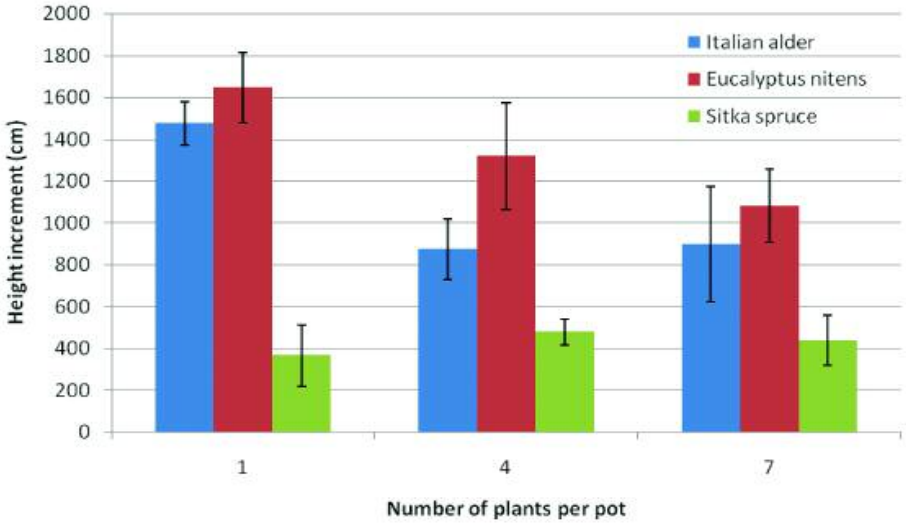

Figure 1: Height increment of Italian alder, Eucalyptus nitens and Sitka spruce, planted in three densities (1, 4, and 7 plants per plot, respectively) in pots in a polytunnel. The trees were planted in June 2015 and final heights were measured in the following December.

Image 5: Stems and leaves were covered with a white sticky waxy flocculence produced by an infestation of psyllid nymphs.