

# Establishment of a silvopastoral experiment in lowland Ireland with RPM<sup>®</sup> *Quercus* and cattle

A novel fully replicated silvopastoral experiment, incorporating an alley design, cattle, and Root Production Method<sup>®</sup> (RPM) trees, was established in lowland county Wexford, Ireland in 2002. The design of the experiment is described and some results are presented.

## Introduction

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EU agricultural policy over the last 10 years has been increasingly concerned with sustainability, and the maintenance and enhancement of the environment, in conjunction with agricultural production. The advent of decoupling of agricultural subsidies from production in 2005 could increase the uptake of agroforestry systems since agroforestry may be more easily justified for grant aiding. The recently ratified Commission Regulation (EC) No. 796/2004 of 21<sup>st</sup> April 2004 also supports agroforestry systems (EC, 2004a). Article 8 states that:

*A parcel that contains trees shall be considered an agricultural parcel for the purposes of the area-related aid schemes provided that the agricultural activities referred to in Article 51 of Regulation (EC) No 1782/2003 or, where applicable, the production envisaged can be carried out in a similar way as on parcels without trees in the same area.*

In addition, the draft Rural Development Regulation, published 14/7/2004, proposes to support the establishment of agroforestry systems (EC, 2004b). Article 41 states that:

1. *Support provided for [first establishment of agroforestry systems on agricultural land] shall be granted to farmers to create agroforestry systems combining extensive agriculture and forestry systems. It shall cover the establishment costs.*
2. *Agroforestry systems refer to land use systems in which trees are grown in combination with agriculture on the same land.*

The government of the Irish Republic published a strategy in 1996 to increase tree cover from 8% land-area (currently 10%) to 17% by 2030 (Dept. of Agriculture, Food and Forestry, 1996). The ambitious plan entails the afforestation of 20,000 ha per annum, the vast majority of which is to be on private land. Eight years into the plan, planting targets are not being attained. The current

afforestation model is that of plantation forestry: new planting areas are required to be greater than a minimum width, size and have a specified tree density, dependent on species. The introduction of intimate agroforestry systems to the suite of afforestation choices would increase farmer flexibility and, perhaps, aid in the attainment of the government's afforestation goal.

Current UK silvopastoral experiments incorporate sheep into the system and individual tree protection. However, approximately 80% of farms in Ireland have cattle as the main farm enterprise (CSO, 2002). Therefore a silvopastoral experiment was established in 2002 to allow cattle to graze from establishment. The site is located at Teagasc's Johnstown Research Centre, Co. Wexford in the southeast of Ireland (52° 16' latitude, 6° 30' longitude). The site is <100 m a.s.l., receives a mean annual rainfall of 1000mm and has a mean annual temperature of 10° C.

## Objectives

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The objectives of the experiment are:

1. To establish a silvopastoral experiment to be used for future research;
2. To compare agroforestry with conventional land-use systems (pastoral and forestry);
3. To collect baseline data that may be used in future research;
4. To compare tree growth at different planting densities; and
5. To compare growth potential of Root Production Method<sup>®</sup> oak plants with conventional bare-root oak.

## Experimental design

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The experiment has been established with two types of planting stock of identical provenance of *Quercus robur* L.; the standard 1u1 bare-root transplants and 1-year old plants produced using the root production method. The root production method, developed by Forrest Keeling Nurseries, Elsberry, Missouri, is a multistep production system of container tree production that places primary emphasis on the root system (Lovelace, 1999) and involves air-pruning of

the roots in the nursery. A previous Teagasc funded research project produced the RPM trees used in the establishment of the current experiment.

The experimental site has three blocks and five treatments with one treatment replication per block. The treatments are: 1) RPM agroforestry; 2) Bare-root agroforestry; 3) RPM forestry; 4) Bare-root forestry control; and 5) Pasture control. Dimensions are given below (Table 1).

The agroforestry plots were planted in an alley design with five pasture alleys, two of which are buffers, per plot. Each of the six tree rows (two are buffer rows) are 50m long and 2.5m wide to allow space for the trees to grow whilst being afforded the protection of the double strand electric fence from the cattle as the trees mature (Figure 1). At each end of the experimental tree rows are buffer trees resulting in 72 trees per plot being monitored. The same number of trees is monitored within the forestry treatments. The forestry treatments have enough extra trees to allow for a nested treatment to be incorporated into the forestry treatments in the future. All pasture within the experiment is managed as per normal except that the cattle graze the grass down to 8 cm height before being moved to the next treatment plot in the next block. The plots are rotationally grazed with an aim of maintaining cattle on each individual plot for 10-day periods, allowing a 20-day rest period between individual grazings. Groups of cattle are randomly assigned to each treatment and remain grazing the same treatment for the duration of the season unless they are required to be taken off the site to reduce

stocking density. The cattle were weighed when entering and leaving the experimental site, and also after each full rotation of the three blocks, in 2003 and 2004.

## Results

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Over 95% of the trees were successfully established after the first year. The electric fencing has been a successful means to protect the trees except for one incursion into a tree row in the first year. The pastures have been successfully managed. Tree rows in the agroforestry plots were sprayed with glyphosate in a band of 2.0 m prior to planting and this resulted in the establishment of willowherbs (*Epilobium* spp.) which gave an unkempt appearance of the inter-tree spaces during the second season.

Weed control by spot treatment around each tree, leaving the remaining area of the tree rows in grass, would have resulted in a better appearance. There was no significant differences last year (2003) in yield of pasture dry matter measured as tonnes per hectare of pasture ( $P < 0.05$ ) between pasture and agroforestry-pasture treatments. There were no significant differences last year in animal liveweight gain per hectare of pasture between treatments.

### *Tree height*

Height growth during the first season was significantly greater for the RPM treatments than the bare-root treatments but there was no significant difference between the forestry and agroforestry treatments ( $P < 0.05$ ). At the end of the second season, the bare-root trees had significantly greater height growth



Figure 1. Silvopasture tree row protection from cattle with a double-strand electric fence.

Table 1. Treatments (systems) plot dimensions, pasture area and tree spacing.

System	Plot dimensions (m)	Plot area (ha)	Pasture area (ha)	Pasture area (%)	Tree spacing [density] (m [ stems ha <sup>-1</sup> ] )
Pasture	21 x 60	0.126	0.126	100	-
Agroforestry	52.5 x 60	0.315	0.24	76	2.5 x 10 [400]
Forestry	21 x 30	0.063	-	-	0.75 x 2 [6,600]

than the RPM trees and the trees grown in agroforestry grew significantly taller than those in the forestry system ( $P < 0.05$ ). After two growing seasons, there are no significant differences in stem height increment between RPM and bare-root treatments, or between the forestry and agroforestry treatments ( $P < 0.05$ ).

#### Tree stem diameter

Stem diameter at 3 cm height was measured in 2003 and 2004. During the 2003 growing season, the stem diameter increment of the bare-root trees was significantly greater than the RPM trees. There was no significant difference between the forestry and agroforestry treatments ( $P < 0.05$ ).

#### Discussion

To the authors' knowledge, this is a unique experiment in Europe being the only silvopastoral alley experiment and the only one that has successfully incorporated cattle grazing since establishment. The experiment has shown that silvopasture incorporating cattle can be successfully established in a lowland site. The experiment is in its early stages and much is to be learned from it in the future. RPM trees are reported to have greater growth rates than bare-root stock (McAdam, J.H., unpublished data) but it would be premature to reach any conclusions from this experiment with that regard until the trees are more mature. The RPM trees, grown in 25 cm pots, were planted with their growing medium. Some of the trees will be excavated later this season to discover whether their roots have begun to explore the mineral soil or are still within the original planting medium.

The liveweight gain of the cattle has not differed per unit area of pasture, therefore the liveweight gain during the early establishment period of the system is relative to the pasture area. The tree rows of the agroforestry treatments have removed 24% of the pasture from production. If this type of system was to be grant-aided in Ireland, the likelihood is that an annual compensation payment would be required for the revenue

foregone due to the loss of 24% of the pasture, in addition to an establishment and maintenance payment that would cover the costs of establishment of the system, for farmers to consider planting. The proposed Rural Development Regulation does not include a compensation payment and would be a deterrent to silvopastoral systems similar to the one described being established.

#### Conclusions

A fully replicated silvopastoral experiment has been established that can be used for future research in Ireland. The RPM trees did not outperform the bare-root trees in terms of stem diameter increment in 2003 and there has been no difference in overall stem height increment growth from establishment until April 2004.

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