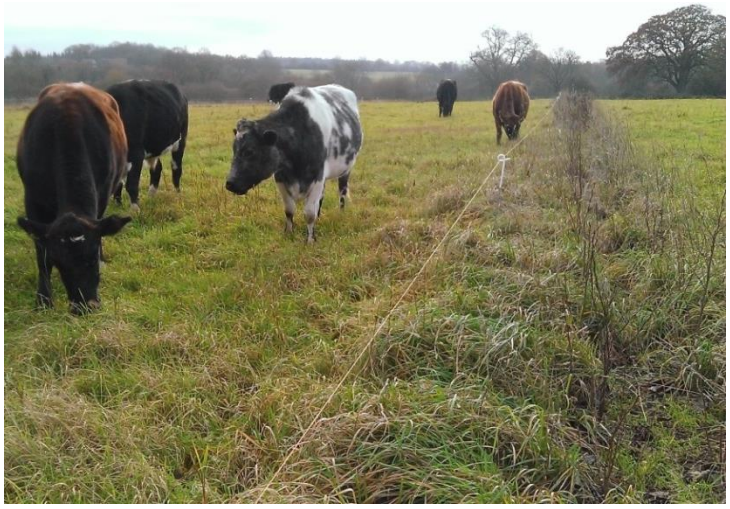

Research and Development Protocol for Agroforestry for Ruminants in England, UK

Project name	AGFORWARD (613520)
Work-package	5: Agroforestry for Livestock farmers
Specific group	Agroforestry for ruminants in England
Milestone	Milestone 22 (5.3) Part of experimental protocol for WP5
Date of report	2 June 2015
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Reviewed	John Hermansen (8 July 2015) Paul Burgess (27 July 2015)

Contents

AGFORWARD (Grant Agreement N° 613520) is co-funded by the European Commission, Directorate General for Research & Innovation, within the 7th Framework Programme of RTD. The views and opinions expressed in this report are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

1 Context

The AGFORWARD research project (January 2014-December 2017), funded by the European Commission, is promoting agroforestry practices in Europe that will advance sustainable rural development. The project has four objectives:

1. to understand the context and extent of agroforestry in Europe,
2. to identify, develop and field-test innovations (through participatory research) to improve the benefits and viability of agroforestry systems in Europe,
3. to evaluate innovative agroforestry designs and practices at a field-, farm- and landscape scale, and
4. to promote the wider adoption of appropriate agroforestry systems in Europe through policy development and dissemination.

This report contributes to the second objective. It contributes to the initial research and development protocol (Milestone 22 (5.3)) for the participative research and development network focused on the use of agroforestry in ruminant production systems.

2 Background and objectives

New agroforestry systems integrating bioenergy crops such as short rotation coppice (SRC) with livestock may be more productive than the separate monoculture systems and thereby they can help reconcile conflicting demands for land use. For example, SRC may provide alternative feed resources for livestock during forage shortages and welfare benefits by providing shelter and shade.

The stakeholder workshops held within WP5 (Hermansen et al 2015) identified that there is a need to get better estimates of the value of the woody vegetation for meeting the nutritional needs of the animals in relation to management of trees (such as pollarding, cutting or grazing period).

In the context of the FP7 project Sustainable Organic and Low-Input Dairy (SOLID; www.solidairy.eu), (2011-2016) a new silvopastoral system combining bioenergy production with cattle has been established at the Organic Research Centre, Newbury, Berkshire, UK. The SOLID project focused on the establishment phase of the silvopastoral system, assessing tree establishment (comparing different weed control treatments), pasture productivity and monitoring the microclimate on a monthly basis. During 2015-2016, cattle will be introduced into the system to assess the interactions between the trees and animals.

3 Description of the site

The site is located at the Organic Research Centre, Newbury, Berkshire, UK. The main treatments are described in Table 1.

Table 1. Description of the site, with soil, tree, understorey, livestock, and climate characteristics

Site characteristics	
Area:	3.5 ha
Co-ordinates:	51°23'14.19" N; 1°24'08.34"W
Site contact:	Jo Smith
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Soil characteristics	
Soil type:	Wickham series, changing from heavy clay loam at top of slope to sandy loam at bottom
Soil depth	
Soil texture	
Aspect	Southerly

Experimental design				
Three replicate blocks with coppice rows running north/south (Figure 1). Alley width of 24 m between twin rows of trees. Three tree rows of coppice and two pasture alleys per plot. Each plot 50 m north-south and 51 m east-west (2550 m^2 or 0.255 ha).				
System	Pasture only (ref system)	Willow agroforestry	Alder agroforestry	Mixed agroforestry
Tree species	NA	Willow (*Salix viminalis*: mixed varieties)	Common alder (*Alnus glutinosa*)	Willow and common alder
Tree density (spacing)		1175 trees/ha 0.7m between twin rows 1.0m within rows	1175 trees/ha 0.7m between twin rows 1.0m within rows	1175 trees/ha 0.7m between twin rows 1.0m within rows
Tree protection		No protection	No protection	No protection

Livestock characteristics	
Species	Beef cattle (British white x Jersey, a small frame cow).
Stocking density	Adapted to sward height

Climate data	
Mean annual temperature	10.7°C
Mean annual precipitation	672 mm
Details of weather station	See Appendix A

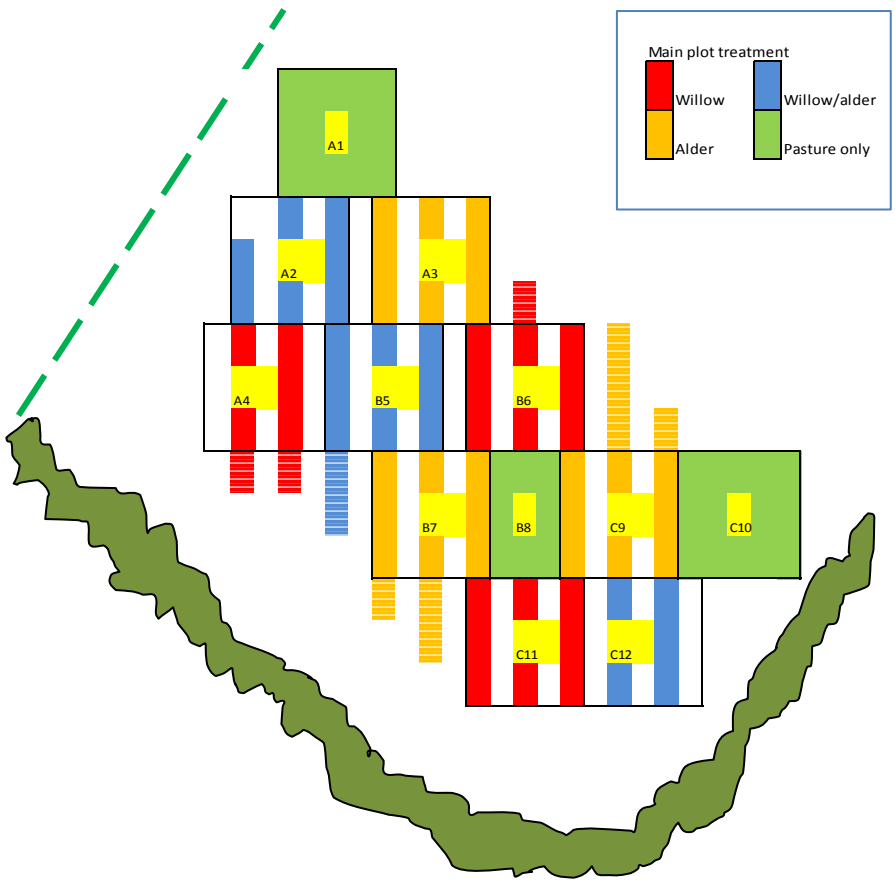

Figure 1. Silvopastoral system design, Flatbottom Field, Elm Farm, Hamstead Marshall (not to scale)

Figure 2. Aerial view of silvopastoral system, Flatbottom Field, Elm Farm, Hamstead Marshall (taken Sept 2014)

Figure 3. Images showing the establishment of the short rotation coppice rows within the grazed pasture

4 Materials and methods

Building on the establishment phase of the silvopastoral system studied within the SOLID project, this protocol will investigate system productivity and the fodder value of the short rotation coppice.

4.1 System productivity and pasture management

Tree production and pasture production within each treatment will continue to be monitored, adding to the data already collected since 2011. Following livestock grazing in summer 2015, the pasture alleys will be cultivated and reseeded. Two sward mixtures will be trialled; a standard organic seed mixture with 2-3 varieties of white clover plus three grasses and a diverse mixture with shade-tolerant species. The selection of species for the seed mixes will be informed by a review of literature on the various relevant properties of appropriate species (e.g. shade tolerance, nutritional and biodiversity value), and in consultation with dairy advisors and seed companies.

4.2 Fodder value of short rotation coppice

Observations from the site since 2011 have shown that the willow has been badly damaged by deer while the alder has suffered only minor damage. This suggests that the alder is unpalatable. Browsing trials will identify cattle preferences for the two species. This will be assessed through behavioural studies of the cattle, pre- and post-grazing assessments of the trees to monitor browsing levels, and chemical analyses of the leaf material (in association with USC and contributing to the development of the tree fodder database developed jointly by WP5 partners).

Table 2. List of measurements

Variable	Measurements
Productivity: pasture and trees	Biomass assessments pre-silage cut in June and pre-grazing in July/August Assessments of coppice height and number of stems in October
Sward mixtures for agroforestry	Establishment of sown species and assessments of all plant biodiversity in m^2 quadrats within each treatment. To identify performance of the two sward mixtures in Spring 2016
Fodder value	Behavioural studies of cattle Pre- and post-grazing assessments of trees Nutritional evaluation of tree fodder

5 Acknowledgements

The AGFORWARD project (Grant Agreement N° 613520) is co-funded by the European Commission, Directorate General for Research & Innovation, within the 7th Framework Programme of RTD, Theme 2 - Biotechnologies, Agriculture & Food. The views and opinions expressed in this report are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

6 References

Hermansen JE, Kongsted AG, Bestman M, Bondesan V, Gonzalez P, Luske B, McAdam J, Mosquera-Losada MR, Novak S, Pottier E, Smith J, van Eekeren N, Vonk M, Burgess PJ (2015). Agroforestry Innovations to be evaluated for Livestock Farmners. Milestone 5.2 (MS 21) for EU FP7 Research Project: AGFORWARD 613520. 10 pp.

Appendix A: Climate data 1980-2014 for Oxford

The mean monthly maximum, minimum and mean air temperatures (°C), days of air frost, total rainfall (mm) and total sunshine duration (days) were calculated for the period 1980-2014 from the Met Office weather station at Oxford, accessed from the Met Office website on 25 March 2015 (www.metoffice.gov.uk/public/weather/climate-historic).

Month	Air temperature (°C)			Days of air frost	Total rainfall (mm)	Total sunshine (hours)
	Maximum	Minimum	Mean			
Jan	7.6	2.1	4.9	8.8	58.7	63.4
Feb	8.0	1.9	5.0	8.4	43.1	77.2
Mar	10.8	3.5	7.2	4.2	50.0	112.2
Apr	13.8	5.0	9.4	1.7	49.6	162.6
May	17.1	7.8	12.5	0.1	57.0	194.2
Jun	20.2	10.9	15.5	0.0	51.3	191.8
Jul	22.7	12.9	17.8	0.0	50.2	209.4
Aug	22.2	12.8	17.5	0.0	55.0	194.7
Sep	19.2	10.7	15.0	0.0	53.0	142.7
Oct	14.8	7.9	11.4	0.8	73.2	110.5
Nov	10.5	4.6	7.6	3.7	64.5	70.4
Dec	7.9	2.4	5.2	8.6	66.1	55.3
Mean	14.6	6.9	10.7			14.6
Total					671.8	