Research and Development Protocol for Agroforestry for Arable Farmers in Northern France

Project name	AGFORWARD (613520)
Work-package	4: Agroforestry for Arable Systems
Specific group	Agroforestry for arable farmers in Northern France
Milestone	Milestone 16 (4.3) Part of experimental protocol for WP4
Date of report	17 August 2015
Authors	Régis Wartelle (Chamber of agriculture), Delphine Meziere (INRA)
Contact	r.wartelle@picardie.chambagri.fr
Edited	Paul Burgess (18 August 2015), Jaconette Mirck (28 August 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 16 (4.3)) for the participative research and development network focused on the integration of trees on arable land.

2 Background

An initial stakeholder meeting was held with arable farmers in the Picardie region of Northern France in September 2014 (Wartelle, 2014). The participants expressed a need for technical and economic demonstrations of agroforestry on farms. There is a need to develop safe technical routes by which hesitant farmers can develop agroforestry practices. Much of the existing “monitoring work” in Picardie has focused on environmental services in response to the requirements of policy makers and funders. However the stakeholder group considers that these issues are "obvious" to those already committed to agroforestry. In contrast, there has been minimal monitoring in Picardie of the management and socio-economic aspects which are of concern to hesitant farmers.

Farmers mentioned weed management as an issue in silvoarable systems (Gosme 2014). To our knowledge there are only a limited number of studies characterize weed composition and abundance in alley cropping systems, both in the understorey vegetation and the arable crop (Burgess et al. 2003). Thus there is a need for research to assess the impact of trees on weed communities and their effect on arable crops in alleyways. It is expected that the weed community in silvoarable systems are modified because of i) the tree understorey to the sides of cropped alleys, and ii) competition for light and water from the trees. Consequently the effects of weeds on crops may be different compared to a weed community of arable crops without trees.

3 Objective of trial

The first objective of the trial is to assess the effect of tree rows on weed community of the crop alleyways and in alley cropping. Key questions include:

- Is the weed community of arable crops different (species, abundance, distribution) in silvoarable systems compared to conventional arable systems?
- Is the understorey vegetation responsible for increasing weed infestation in crops of the alleyways?
- Does weed pressure for crops change in silvoarable systems compared to arable systems?

The second objective is to assess the yield of agroforestry plots to know the impact of tree rows on crops.

4 System description

The trials will make use of a range of existing silvoarable systems in the Picardie area (Table 1).

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

Site characteristics	
Area:	5 ha to 30 ha
Co-ordinates:	Seven study sites (each farmer has requested to keep the exact location private)
Site contact:	Regis Wartelle
Site contact email address	r.wartelle@picardie.chambagri.fr

Soil characteristics	
Soil type	To be determined
Soil depth	To be determined
Soil texture	To be determined

Tree characteristics	
System	Silvoarable systems
Date of planting	At various dates between 2008 and 2014
Tree species	Between 6 and 12 species per plot including walnuts, maples, wild cherry, *Sorbus torminalis, Sorbus domestica,* wild apple tree, and wild pear tree.
Tree density (spacing)	28 to 110 trees ha^{-1} (26 to 50 m between rows)

Crop characteristics	
Rotation	Rotations with and without legumes
Crop species	Various including wheat, barley, potatoes, sugar beet, and oilseed rape
Cultivation	Various: both ploughing and zero-tillage
Agro-chemical use	Various: organic and conventional systems

Farmer characteristics	
Motivation of farmer	Various: hunting, environment, agronomic, landscape

Climate data	
Mean annual temperature	
Mean annual precipitation	768 mm (mean for Picardie in 2014)
Details of data	

5 Weed measurements

Beginning in spring 2015, the Picardie Chamber of Agriculture is studying the impact of agroforestry on colonization of weeds in crops. Surveys, using 1 m^2 quadrants, will be taken within each trial. To measure the impact of the tree row, the first sample will be measured 1 m from the tree row (2015-2016). The third sample will be placed in the centre of the arable crop, and the second sample will be taken at the mid-point between these two values (Figure 1).

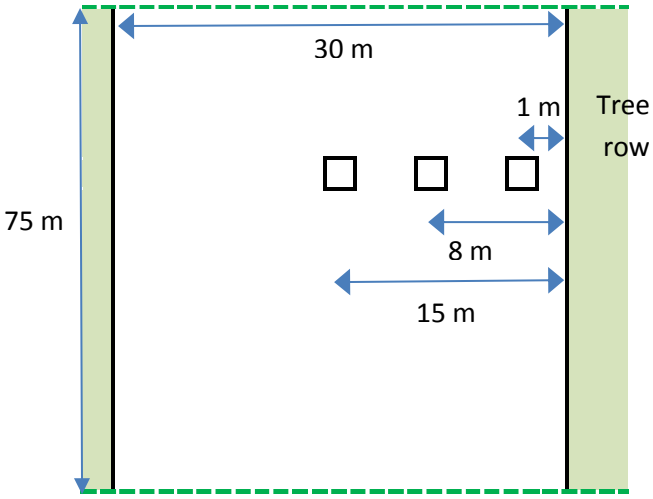
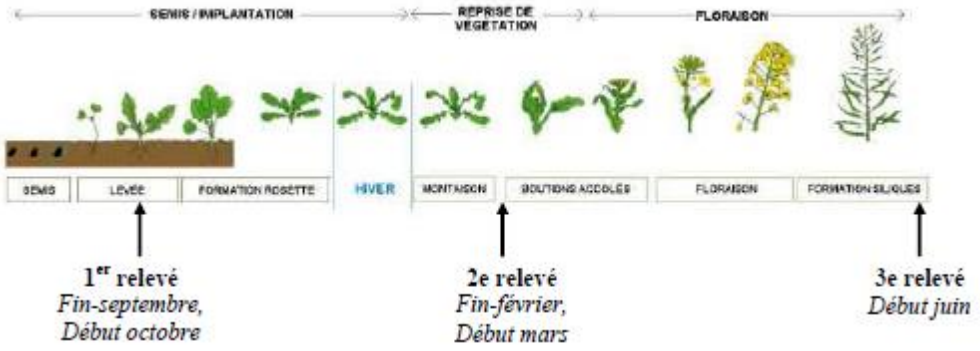


Figure 1. Schematic diagram showing the position of the quadrats 5 m from the tree line, at the mid-point of the alley, and at a mid-point. The diagram shows the example for a 30 m alley

The species within each quadrat will be identified at specific points in the development of the crop (Figure 2). The proportion of the area covered by each species and the proportion occupied by bare earth and leaf litter will also be recorded at each measurement.

a) Development periods for oilseed rape



b) Development periods for wheat

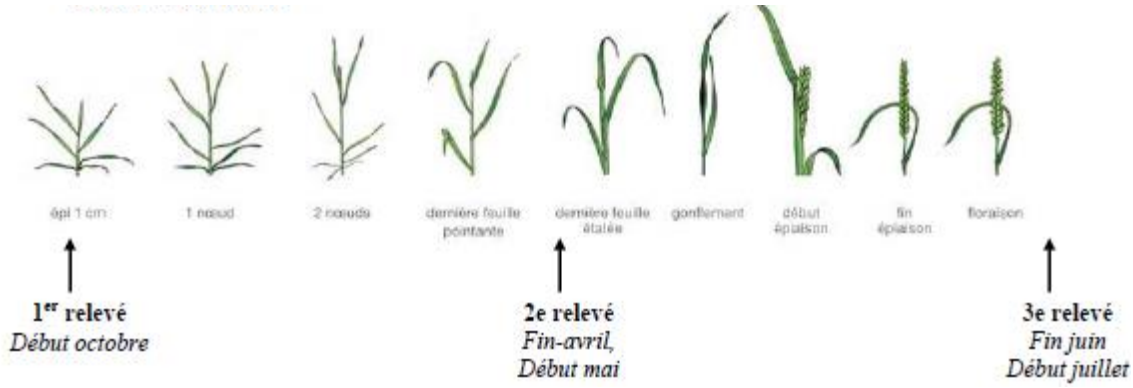


Figure 2. The weed measurements will be alligned with the development periods of either a) the oilseed rape or b) the cereal crop

6 Yield measurements

At the selected sites, crop yield measurements will also be taken using 1 m² sample plots at three distances from the tree lines. For 2015-2016, the first will be taken 1 m from the tree line, midway between the tree rows, and a third midway distance between the two in a similar way to Figure 1.

At each plot with a wheat or barley crop, the measurements will include the number of plants per square metre, the number of tillers per plant, the number of grain per ear and the thousand grain weight (Table 2). The yield (with some corrections due to the units) can be determined from the product of these data. These measurements will occur just before harvest, typically in mid or late July.

Table 2. Description of yield measurements

Crop measurements	Units
Plant density	Plants m^{-2}
Mean tillers per plant	Tillers $plant^{-1}$
Grains per ear	Grains ear^{-1}
Thousand grain weight	g per 1000 grains

On plots planted to crops other than wheat or barley, a more simplified yield measure will be used. In some cases, spatially explicit yield can be determined from the combine harvester. In case harvesters are unreliable or do not show performance, an approach similar to that described for wheat and barley will be applied.

7 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.

8 References

Burgess PJ, Incoll LD, Hart BJ, Beaton A, Piper RW, Seymour I, Reynolds FH, Wright C, Pilbeam DJ, Graves AR (2003). The impact of silvoarable agroforestry with poplar on farm profitability and biological diversity. Final report to DEFRA, Cranfield University, UK.

Gosme M, Desclaux D (2015). Research and Development Protocol for the Participatory Plant Breeding of Durum Wheat for Mediterranean Agroforestry Group. http://www.agforward.eu/index.php/en/mediterranean-silvoarable-systems-in-france.html

Gosme M (2014). Initial Stakeholder Meeting Report: Mediterranean Silvoarable Systems in France. 8 October 2014. 12 pp. Available online: http://www.agforward.eu/index.php/en/mediterranean-silvoarable-systems-in-france.html

Wartelle R (2014). Initial Stakeholder Meeting Report Agroforestry for Arable Farmers in Northern France. (Ed PJ Burgess). 16 December 2014. 10 pp. Available online: http://www.agforward.eu/index.php/en/agroforestry-for-arable-farmers-in-northern-france.html