Research and Development Protocol for Silvoarable Agroforestry Group in Greece

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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 use of agroforestry in arable systems.

2 Background

Agroforestry is a traditional land use system in Voio, north-western Greece, in which farmers integrate agricultural production with high value tree species on the same plot. In this way they ensured a steady economic return each year irrespective of weather conditions. The area is characterized by fast growing species (poplars) and walnuts planted inside or at the edges of small farms where dry beans and cereals are cultivated or pastures are established for grazing.

Poplars (black or hybrids) are widely spaced in arable lands with good soils, irrigated with water from artificial canals coming from a local river. However the most common practice is the establishment of poplars along watercourses or around arable fields, cultivated with vegetables or other crops resulting in traditional silvoarable systems. Poplars are used for timber production but also serve as boundary markers and wind breaks (Papanastasis et al. 2009). Another silvoarable practice, well adapted to irrigated farms and river bank areas, is the use of black poplar growing along the boundaries of the vegetable gardens. In addition to diversifying the income of the farmer, black poplars serve for soil conservation, create wildlife habitats and enhance the landscape. Any decrease in vegetable production due to the shade is compensated by increased protection from the winds. Schultz et al. (1987) argues that this practice should be promoted because it provides timber, which is in short supply in Greece.

Walnut is combined with grapevines, cereals, lucerne, vegetables or dry beans resulting in traditional silvoarable systems (Mantzanas et al. 2006). The species is widely used in Greece. According to Papanastasis et al. (2009) walnut is a commonly cultivated tree species in the sub-Mediterranean and mountainous Mediterranean zones of the country. It is planted in arable lands either in pure stands or more commonly within arable fields or in their borders, alone or in mixture with other trees. It is usually combined with several crops, especially vines and cereals. In the former case it makes typical silvoarable; in the latter typical agrosilvopastoral systems are created that include livestock grazing after the harvest of the cereals. It is rarely used to establish pure silvopastoral systems. Walnut trees are used for nut production, high quality timber, and fuelwood.

A stakeholders meeting on the intercropping of trees with arable crops was held on July 11, 2014 (Pantera 2014). During this meeting the following list of possible innovations was developed:

- Do we want trees inside the agricultural area or not?
- If we decide to intercrop, which tree species should we use? And what crop? What about walnuts with vines?
- Does shadow affects crop production?
- Would economic incentives help the introduction of trees in arable crops?
- Improve marketing and branding of agroforestry products.

These innovations will be addressed in the experimental trials to be conducted in the area.

3 Objective of the trials

The aim of the trial is to assess competition between crops and trees for light, water and nutrients in different tree-crop combinations .Key questions include:

- How does agroforestry affect crop yield?
- How does crop affect trees at the establishment phase?
- What is the tree root distribution and how do tree roots interact with crop roots during the vegetation period?
- How does agroforestry affect nutrient cycling?

4 System description

The trial will involve newly established agroforestry systems (covering one hectare) in the village of Sisani, Voio, Western Macedonia, Greece (Table 1). The research site is composed of two agricultural plots (Figure 1). The first one (0.6 ha) will be planted with walnut trees (end of March 2015) and it will be intercropped with common beans (mid-May 2015). The other (0.4 ha) will be planted with cherry trees and it will be intercropped with aromatic plants (autumn period).

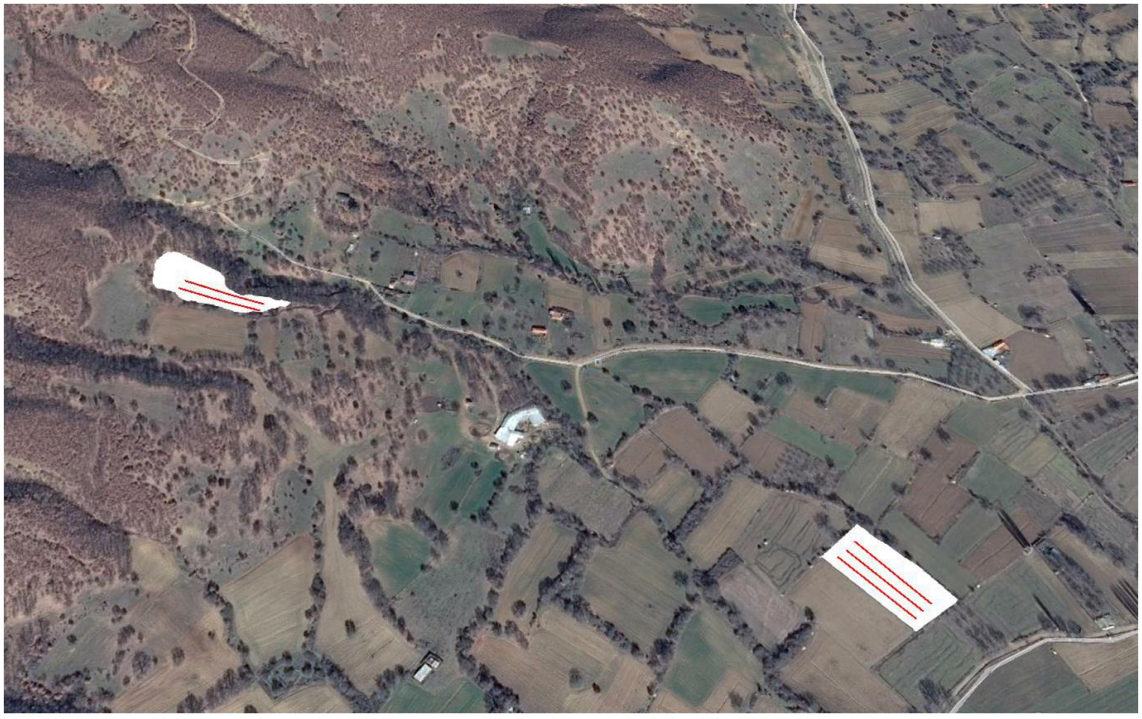

Figure 1. A view of the two trial plots near Sisani, Voio, Greece

In the first plot, three tree rows will be established with a distance between them of 15 m. The tree distance in the same row will be 5 m. In total, 54 walnut trees will be planted. Two tree rows of cherry trees will be established in the second plot with the same tree distances (40 trees). These plots will be compared with a plot with beans and no trees (for the first plot) and some aromatic plants without trees (for the second plot).

Table 1. Description of the first and second trial sites, with soil, tree, understorey, livestock, and climate characteristics

Site characteristics	
Area (ha):	1 ha (trees will be established in March 2015)
Co-ordinates:	40°26'10.56''N and 21°29'39.56''E
Site contact:	Markos Tsiblinas
Site contact email address	mtsimplinas@yahoo.gr

Soil characteristics	
Soil type (WRB classification)	Lithosols – Campisols
Soil depth	>1 m

Tree characteristics		
System	Agroforestry system	Reference system*
Tree species	Walnut trees (*Juglans regia*) and Cherry trees (*Prunus avium*)	None
Variety/rootstock		None
Tree density (spacing)	100 trees/ha	None
Tree protection	Tubex shelters	None

Crop characteristics		
System	Agroforestry system	Reference system*
Species	Common beans (*Phaseolous vulgaris*)	Common beans (*Phaseolous vulgaris*)
Coverage	Complete	Complete

Climate data	
Mean monthly temperature	12.9 °C
Mean annual precipitation	507.6 mm
Details of weather station (and data)	Hellenic National Meteorological Service, Station of Kozani, Data from 1955-1997

* To which the agroforestry system is compared

5 Trial design

5.1 Conceptual design

The primary goal of the research study is to measure yield differences between silvoarable systems and conventional agricultural systems. The treatments are described in Table 2. A view of the first trial site is shown in Figure 2.

Table 2. Description of treatments

Treatment A	Treatment B	Treatment C	Treatment D
Silvoarable system	Control	Silvoarable system	Control
Walnut – common beans	Common beans	Cherry – aromatic plants	Aromatic plants

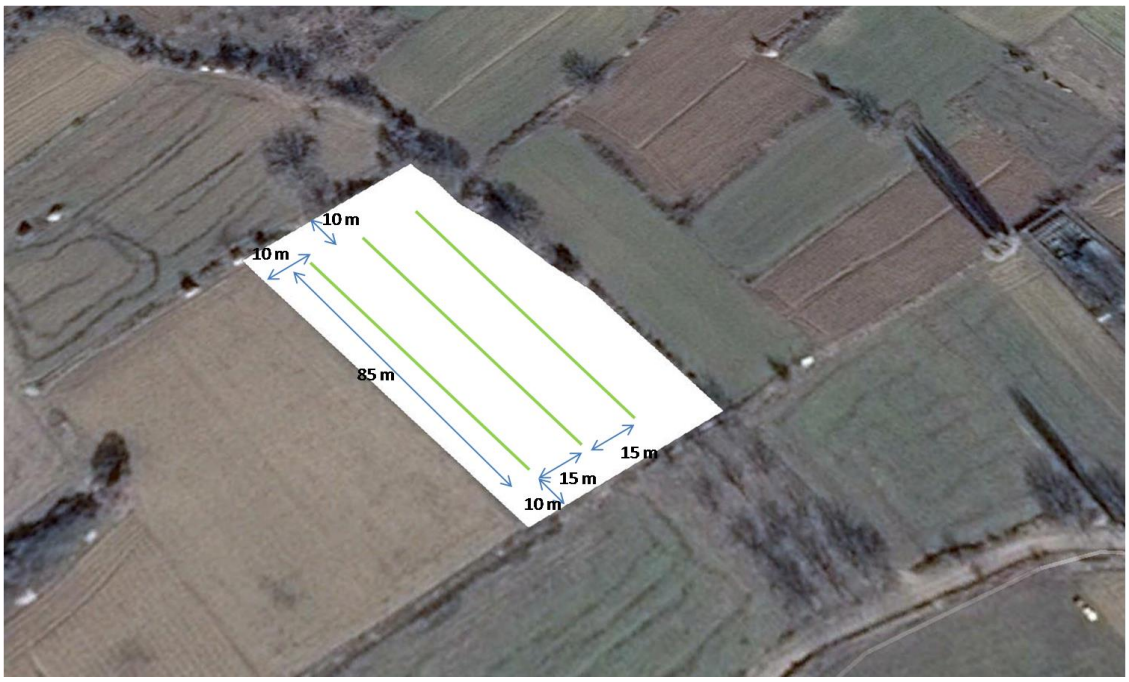

Figure 2. An aerial view of the first trial site near Sisani, Voio, Greece

6 Measurements

The planned measurements to be taken in the four treatments are described in Table 3.

6.1 Tree measurements

Tree height will be measured during the winter period, diameter at breast height will be measured each year, and the growing period will be estimated.

6.2 Crop measurements

The growing period and the labour costs will be estimated, and the yield will be measured.

6.3 Measuring root competition

- Soil cores will be taken both in the tree plots and in reference site in summer of 2016.
- The root cores will be taken to a depth of approximately 75 cm and analysed as 15 cm sections.

- The soil cores will be washed with water, crop, tree coarse and fine roots (<2 mm) will be separated, dried and weighed.

6.4 Nutrient cycling

- Soil samples will be collected from the silvoarable and control plots. These will be analyzed for major nutrients (NPK) and C and if expedient also for lignin and carbohydrate ratios.
- Plant material will be collected from the tree plots. These will be analyzed for major nutrients (NPK) and C and if expedient also for lignin and carbohydrate ratios.

Table 3. List of measurements to be taken in the four treatments

Treatment	Treatment A/C: Silvoarable systems (Walnut and cherry)	Treatment B: Reference Crop	Treatment D: Reference Crop
Tree measurements	Seasonal and yearly tree growth Root cores, root weight		
Crop measurements	Seasonal growth and yield at the harvest period	Seasonal growth and yield at the harvest period	Seasonal growth and yield at the harvest period
Soil measurements	Soil nutrients (NPK and C) and physical properties	Soil nutrients (NPK and C) and physical properties	Soil nutrients (NPK and C) and physical properties

7 Acknowledgements

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8 References

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