

OLIVE GROVES INTERCROPPED IN MOLOS, CENTRAL GREECE

Pantera A¹, Papadopoulos A¹, Kitsikopoulos D¹, Mantzanas K², Papanastasis V², Fotiadis G¹, Burgess P³

* Correspondence author: pantera@teiste.gr

(1) Department of Forestry & NEM, TEI of Central Greece, Hellas (2) Department of Forestry & NE, Aristotle University, Thessaloniki, Greece (3) Cranfield University, Cranfield, U.K.

Introduction

It is estimated that olive groves cover an area of 705,961 ha in Greece (EUROSTAT 2012) while a great part of them (124,311 ha) forms typical agroforestry systems with various crops or pasture established in the understory of olive trees (Papanastasis et al., 2009).

Olive (*Olea europaea*) is probably the most widespread cultivated tree in Greece. Olive trees alone or in orchards are found in all parts of the country that have a mild Mediterranean climate. The olive tree is considered one of the least demanding in soil nutrients among the cultivated trees. This is why it is grown in poor, rocky areas with soils mostly derived from hard limestone (eg. Gomez *et al.*, 2003; Vossen 2007; Duarte *et al.*, 2008). A large part of the olive groves are found on steep mountain slopes that have been terraced with stonewalls to hold the soil. Olive trees are the only tree component in the typical olive culture. Quite often, however, other trees are found as well almonds, walnuts, apricots, fig, poplars, plums etc. (almost everywhere), either together with the olive trees or along the boundaries of the olive orchards. In the traditional systems, practically all olive trees have come from wild plants that were grafted. Edible olives and olive oil are the main products of olive trees, while secondary products include fodder for animals and firewood. In some places, exquisite furniture and handicrafts are made of olive wood. Under the olive trees they may be found: (a) grazing animals (sheep, cattle, goats, even honey bees, pigs or chickens), (b) wheat or other cereals, corn, alfalfa, or grape vines, (c) vegetable crops, i.e. potatoes, melons, tomatoes, beans, onions, or fava beans, or (d) wild herbaceous vegetation, some species of which are edible (eg. common purslane - *Portulaca oleracea*) or medicinal (eg. devil's thorn – *Tribulus terrestris*). Animals may graze spontaneous vegetation or planted crops (ex. wheat or barley) (Papanastasis et al. 2009).

In the Fthiotida prefecture of Greece, agroforestry is a traditional land use system in which farmers used to combine olive production with grazing animals and arable crops (vegetables) in the same plot. In this way they ensured a steady economic return every year irrespectively of weather conditions or other type of hazards. The area is covered by forests (72%), arable land (18.3% cover), and pastures (8.1%) (ELSTAT 2000). Settlements and traffic infrastructure cover around 1.3% of the land area (ELSTAT 2000). Agricultural systems mostly involve field crop production (58%) but also include vegetables (3%), vines (1%), and tree plantations (27%), operating on small plot units (ELSTAT 2013). Typically, farms are small (average size: <3 ha) and managed as private enterprises. Land is usually owned or rented by farmers. Olive trees in the prefecture are estimated to be more than 200 years old. They amount to almost 7,000,000 trees with the prefecture holding a leading role in edible olives production in the country.

This research is conducted under the framework of the AGFORWARD research project (January 2014 - December 2017), funded by the European Commission, with the general aim to promote agroforestry practices in Europe that will advance sustainable rural development. The combination of olive orchards with arable crops (cereals) in the same field used to be a traditional land use system in Central Greece and is nowadays regaining interest. A stakeholders' group meeting on 'Intercropping in olive groves of Greece' was held on 27 June 2014. This meeting identified examples of interesting or best practices that involved trees intercropped with aromatic/medicinal herbs, leguminous plants for soil amelioration, and higher quality products for human consumption or for feed.

Material and methods

Description of the specific case study system in Molos, Fthiotida, C. Greece

The system investigated occupies an area of 2 ha with co-ordinates 38°49'22.58" N & 22°37'22.73" E, 11 m asl. The climate is Mediterranean-type with a mean monthly temperature 16.5 °C and a mean annual precipitation 573.8 mm (Hellenic National Meteorological Station, 1999). Soil type belongs to "Luvisols" and has more than one meter depth, SCL (sandy-clay-silt) texture, pH 7.97 and an eastern aspect. The system is composed of two varieties ("Kalamon" and "Amfissa") of olive tree (*Olea europaea*). Trees were planted in 1950 at a spacemen of 10 x 10 m. Chickpeas were planted in March 2015. Copper (Cu) was sprayed as a pesticide.

Trial design, treatments and measurements

The design involved two treatments, namely olive trees + chickpea and olive trees alone as a control. An area 0.2 ha of the olive orchard was intercropped with chickpeas in rows 5 m x 60 m while the remaining orchard that contains only olive trees with the exception of 0.2 ha which has other tree species as well is used as control. They were sown 80 kg / ha of chickpea in the first week of April. Field measurements described in the research and development protocol (Pantera *et al.* 2015) began in April of 2015 and will continue until the end of 2016. All measurements have been and will be conducted by researchers from the TEI Stereas Elladas in collaboration with researchers from Aristotle University of Thessaloniki, Greece.

Results

There were no differences in olives production between the two treatments at end of the first year but the cost of production was reduced in the intercropped area since no nitrogen fertilizer was applied compared with the control (**Table 1**). However, and as mentioned before, these are only preliminary results and must be used with caution. The experiment will be repeated again in 2016 in two different locations of the Fthiotida perfection.

Table 1: Result from the experiment: olive production and cost

| | Treatment A (olives + Chickpea) | Treatment B (olives) |
|----------------------------|--|-----------------------------|
| Weight of olive production | 7 kg /tree, 840 kg/ha | 7 kg /tree, 840 kg/ha |
| Fertilizer cost €/tree | 0 | 3.30 |

It should be noted that olives production was relatively low in 2015 due to the unfavourable weather conditions during the tree blossoming period which affected negatively tree fruiting. Chickpeas production was also reduced due to the unfavourable weather conditions in the spring. The experiment will be repeated in 2016.

To conclude, intercropping olive trees with a leguminous crop appears to be a promising practise that may contribute not only to increase economic returns to the farmer but also to the environment by decreasing fertilizers use and soil and water contamination.

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Figure 1: Traditional olive grove intercropped with chickpeas

References:

- Duarte F., Jones N. & Fleskens L. 2008. Traditional olive orchards on sloping land: Sustainability or abandonment? *Journal of Environmental Management* 89(2): 86-98.
- Gomez J.A., Battany M. & Renschler C.S. 2003. Evaluating the impact of soil management on soil loss in olive orchards. *Soil Use and Management* 19(2): 127-134.
- ELSTAT 2000. Land Use / 2000. Hellenic Statistical Authority. <http://www.statistics.gr/el/statistics/-/publication/SPG51/>, visited at 1/-17-2016
- ELSTAT 2013. Holdings and areas / 2013. Hellenic Statistical Authority, <http://www.statistics.gr/el/statistics/-/publication/SPG32/>, visited at 1/-17-2016
- EUROSTAT 2012. Olive trees by age classes (area in ha), <http://appsso.eurostat.ec.europa.eu/nui/show.do>, visited at 23/3/2016
<http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do>, visited at 23/3/2016
- Hellenic National Meteorological Service (1999) *Climatic data from the meteorological stations operated by the Hellenic Meteorological Service (Period 1955-1997)*. Volumes A and B. Published by the Hellenic Meteorological Service, Athens. 260 p. (In Greek).
- Mead R. & Willey R. W. 1980. The Concept of a "Land Equivalent Ratio" and Advantages in Yields from Intercropping. *Experimental Agriculture* 16(3): 217-228.
- Pantera, A. (Oct 2014). Initial Stakeholder Meeting Report: Intercropping of olive groves in Greece
http://agforward.eu/index.php/en/intercropping-of-olive-groves-in-greece.html?file=files/agforward/documents/WP3_GR_olives_Molos.pdf
- Papanastasis, V. P., Mantzanas K., Dini-Papanastasi O. & Ispikoudis I. 2009 Traditional Agroforestry Systems and Their Evolution in Greece. *Agroforestry in Europe. Advances in Agroforestry* 6: 89-109.
- Tutin T.G., Heywood V.H., Burges N.A., Moore D.M., Valentine D.H., Walters S.M. & Webb D.A. (eds.) 1968-1980. *Flora Europaea* vo, II-V. Cambridge.
- Tzouramani E., Navrouzoglou P., Sintori Al., Liontakis Ag., Papaefthimiou M., Karanikolas P. And Alexopoulos G. 2008. Oregano. <http://www.agroepiloges.gr/Files/rigani/Rigani.pdf>, visited at 1/17/2016
- Vossen P. 2007. Olive Oil: History, Production, and Characteristics of the World's Classic Oils. *HortScience* 42(5): 1093-1100.
- Schultz A.M., Papanastasis V.P., Katelman T., Tsiouvaras C., Kandrelis S., Nastis A. 1987. *Agroforestry in Greece*. Aristotle University of Thessaloniki, Thessaloniki, Greece.
- Euro+Med (2006-): Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. Published on the Internet <http://www2.bgbm.org/EuroPlusMed/> [accessed].