OLIVE TREES INTERCROPPED WITH CEREALS AND LEGUMES IN KASSANDRA PENINSULA, NORTHERN GREECE

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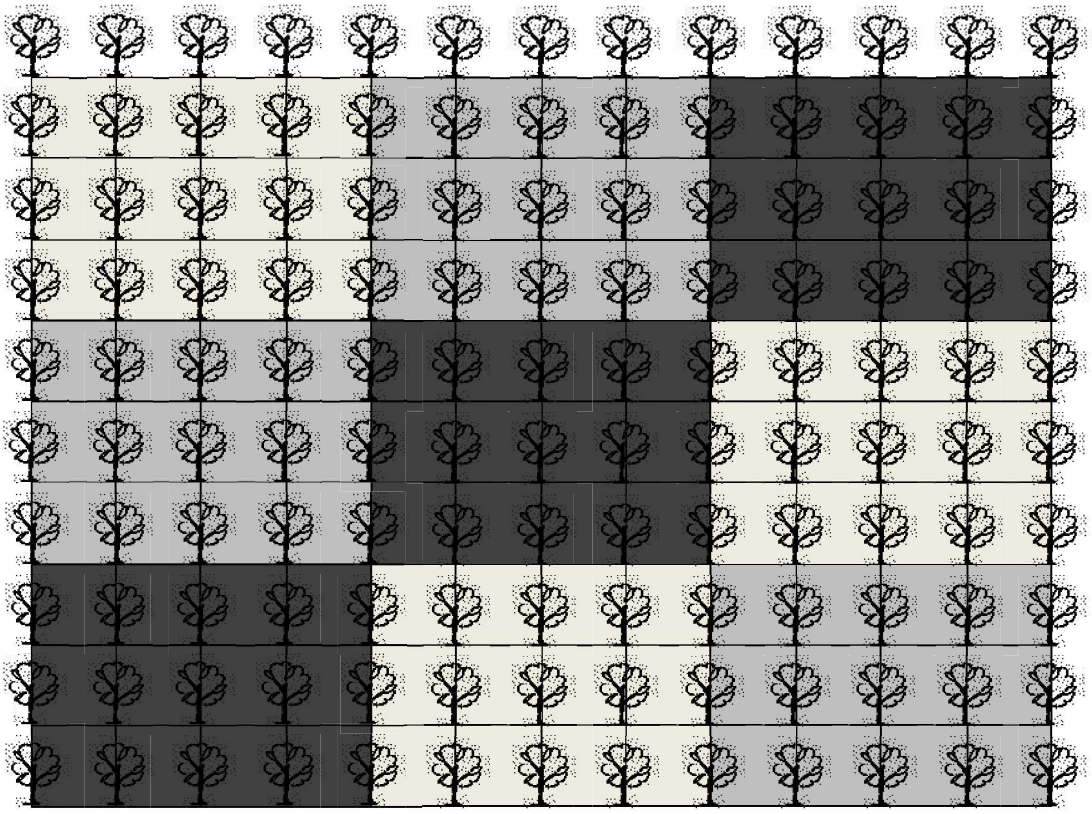
Introduction

It is estimated that olive groves cover an area of 600,000 ha in Greece (Schultz et al., 1986), with a significant part of them (124,311 ha) forming typical agroforestry systems with various crops or pasture established in the understory of olive trees (Papanastasis et al., 2009). According to Schultz et al. (1986) olive (*Olea europea*) is the most widespread cultivated tree in Greece. Olive trees alone or in orchards are found in all parts of the country which have a mild Mediterranean climate. The olive tree is considered as one of the least demanding in soil nutrients among the cultivated trees. This is why it is planted in poor, rocky areas with soils mostly derived from hard limestone. A large part of the olive groves are found on steep hill slopes in the lowlands and islands which have been terraced with stone walls 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, including carobs (mainly in Crete), 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 came from wild plants which 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 may be found: (a) grazing animals (sheep, cattle, goats, even honey bees, pigs or chickens), (b) wheat or other cereals, corn, alfalfa, or grapevines, (c) vegetable crops, i.e. potatoes, melons, tomatoes, beans, onions, or fava beans, or (d) wild herbaceous vegetation, some plants of which are edible. Animals may graze on the spontaneous vegetation or on planted crops (ex. wheat or barley). The aim of the study was to produce quantitative information about the intercropping of olive trees and leguminous crops or cereals.

Materials and methods

For this reason, a controlled experiment (1.08 ha area) was established in the premises of the State Agricultural Prison of Kassandra Chalkidiki, in December of 2014 (40.1106953 and 23.3425052) (Pantera 2014). The mean annual precipitation of the area is 602.5 mm and the mean monthly temperature is 16.2 ^{o}C. Regarding the soil data soils derived from luvisols with poor fertility and soil depth less than 0.5 m, an 8.2 pH and an 8.5 % organic matter. The aspect is south and the slope is 15%. Olive trees are 80 years old and are cultivated for olives and olive oil in a density of 100 trees/ha. The crops were barley (*Hordeum vulgare* L.), and a mixture of barley and common vetch (*Vicia sativa*).

The design involves three treatments in three replications in a latin square design, namely olive trees + barley, olive trees + a mixture of barley and common vetch, and olive trees alone as a control. The experimental design is shown in figure 1. There was also a reference site with barley covering an area of 2 ha out of the system described above; in the reference site barley was sown in mid-November 2014. Tree spacing is 10 x 10 m. Therefore, every treatment covers an area of 0.12 ha and the total area is 1.08 ha. Crops sowing in the agroforestry plots took place on the 23d of December 2014, relative late for the area due to the very rainy autumn period. However, no particular problems phased after a normal spring. The quantities for seed and fertilizer were the following: treatment A (barley): Barley 240 Kg/ha and fertilizer 130 Kg/ha (24-10-0, N-P-K) and treatment B (barley+common vetch): Barley 80 Kg/ha, Common vetch 120 Kg/ha and fertilizer 120 kg/ha (0-46-0, N-P-K).



Barley	Barley + Common vetch	Control

Figure 1. Experimental design of olive intercropped system in the premises of the State Agricultural Prison of Kassandra Chalkidiki.

The crop sampling was concentrated on the area close to 6 sample trees selected inside each experimental plot and on the reference site. Crop sampling plots included plots in close proximity to the tree canopy and in the centre between the tree rows. Above ground biomass in treatment B (barley+common vetch) was harvested using a (0.5X0.5m) square quadrat. Plant density (nr of tillers/m^2), height, heads/ m^2 and grains per head were measured in treatment A at the end of May of 2015.

Results

The preliminary results (Table 1) shown that regarding the treatment B and total biomass according to the relative position to the tree there is no significant difference between the total biomass averages of the samples taken at the edge of the tree or between the trees (p-value=0.0878). It could suggest that according to the relative position to the tree, the accumulation of the biomass is similar. The position of the tree seems to not influence the quantity of biomass of the crops. For the same treatment also found that there is a significant difference (p-value=0.0109*) in the number of seeds according to the distance to the tree. The number of seeds is higher in the samples harvested at the edge of the tree. The tree could have a positive effect on the formation of seeds.

Table 1. Biomass and number of seeds in mix of barley and common vetch treatment according to distance from the olive trees

Category	Edge of trees	Between the tree rows
Dry biomass yield of the mixture (t/ha)	6.53	7.88
Number of barley seeds/head	19	18*

* Means statistical significant differences in the same row

The analysis of variance for treatment A results (Table 2) shown significant difference: for the density of barley (p-value<0.001), for the height (p-value<<0.001), number of heads (p-value=0.007**) and number of tilers (p-value=0.0404).

Table 2. Density, height, number of tillers and number of heads of barley treatment in agroforestry and monoculture plot with barley

Parameters	Type of plots	
	Agroforestry	Monoculture
Density (nr of plants/m^2)	73.48	42.68*
Height (m)	0.72	0.91*
Nr of tillers/m^2	320.28	390.68*
Nr of heads/ m^2	279.12	365.20*

* Means statistical significant differences in the same row

Only the plant density is higher in agroforestry plot, the other parameters are higher in the reference plot with barley. The large difference in density of agroforestry and monoculture plots is probably a result of different seeding time making the latter strongly established with higher plants and greater number of tillers and heads per plant.

Conclusions

Biomass yield of the mixture (barley and common vetch) was similar close to tree canopy and between the tree rows. The parameters for treatment A (barley) had differences in agroforestry and monoculture plot suggesting the latest more productive.

Acknowledgements

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References:

Pantera A (Oct 2014) Initial Stakeholder Report – Intercropping of olive groves in Greece.TEI Stereas Elladas, Greece http://agforward.eu/index.php/en/intercropping-of-olive-groves-in greece.html?file=files/agforward/documents/WP3_GR_olives_Kassandreia.pdf

Papanastasis VP, Mantzanas K, Dini-Papanastasi O, Ispikoudis I (2009) Traditional agroforestry systems and their evolution in Greece. In: Agroforestry in Europe: Current Status and Future Prospects (A. Rigueiro-Rodrigez et al., eds.). Springer Science, pp. 89-109.

Schultz AM, Papanastasis VP, Katelman., Tsiouvaras C, Kandrelis S, Nastis A (1987) Agroforestry in Greece. Aristotle University of Thessaloniki, Thessaloniki, Greece