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# The Effect Of Trees On Growth And Yield Of Barley And Soybean In Alley-cropping Systems

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## Introduction

Under intensive agriculture, crop yield stability has been increasingly reduced in the last decades due to the negative impact of natural resources depletion and climate change. Agroforestry farming has high potential to improve crop resilience to climate change and provide a more stable provision of agricultural products (Jose et al., 2009). Intercropping with tree species for timber production was largely practiced in the agricultural lands of Italy until the '70s, but the intensification of agriculture has led to remove trees in order to boost monoculture practices (Paris et al., 2019).

In this study we investigated the impact of row-arranged poplar and oak trees on growth, yield and quality of a winter cereal and a legume crop cultivated in the alley, in order to assess the potential of this alley-cropping system.

## Materials and Methods

The trial was conducted during the 2018-19 growing season at "Casaria" private farm located in Masi (Padova), where an alley-cropping system has been implemented in 2012 with rows of poplars (clone I214) and oaks planted along drainage ditches (40 m apart) and regularly alternated every 5 m. Barley, and soybean as successive crop, were cultivated under organic management in the tree inter-row.

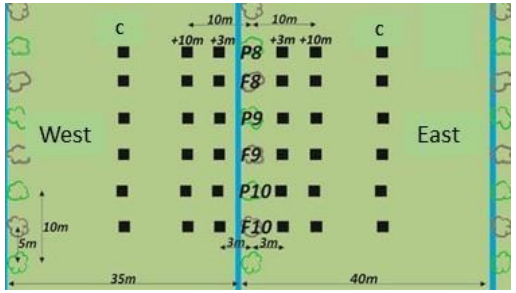



*Figure 1. Sampling points along 6 transects*

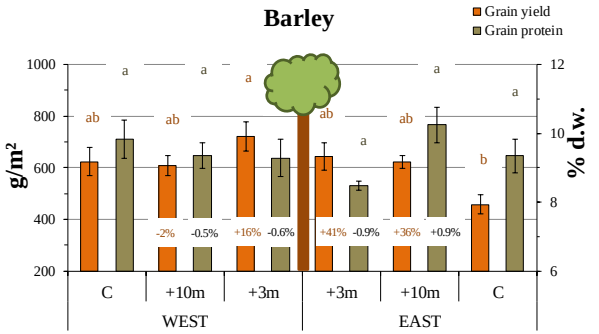
Both crops have been sampled (1-m$^2$ area) at flowering and maturity at 3 distances from the trees, i.e., +3, +10 and +20 m (the latter assumed as controls C), along transects (Fig. 1), to measure LAI, leaf chlorophyll content, and dry biomass. Plants sampled at maturity have been threshed to determine grain yield and quality parameters. Statistical significant differences were detected by R studio software v. 2.7 (Tukey's HSD test, P ≤ 0.05).

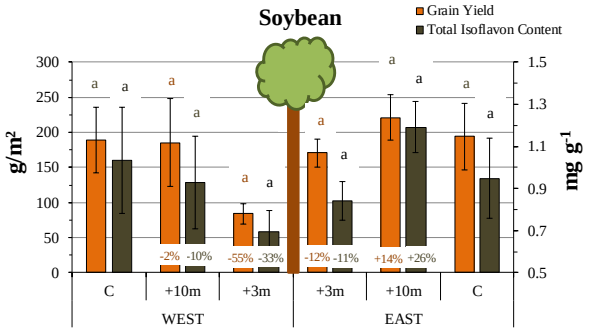
## Results

The grain yield of barley was increased close to the tree row as compared to controls, it being +26% at +3 m and +14% at +10 m, as average of positions East and West. As regards the sampling position, barley plants growing East of the tree row showed higher biomass, LAI and leaf chlorophyll content, that supported higher grain yield (P<0.05) and quality (only at +10 m) close to the trees as compared to controls. On the opposite, growth and yield parameters of barley plants growing West were generally reduced (Figure 2).

In soybean, shoot biomass, LAI and leaf chlorophyll content (at East only) were negatively impacted at +3 m and +10 m, both at East and West positions, leading to stronger yield and quality reductions than barley, as compared to respective controls, particularly at +3 m (-33% of yield vs. C) (Fig. 2). Only in position +10 m at East, soybean showed a small increase of yield and total seed isoflavone content, with the bioactive aglucones being increased by +104% (P<0.05).

*Figure 2. Grain yield and quality (protein content for barley and Total Isoflavone Content for soybean) (average ± S.E.; n=6) of barley and soybean at three distances from the tree row. Values above histograms indicate the percentage variation vs. Controls (C) at East or West. Letters indicate significativity (P ≤ 0,05).*




## Conclusions

Intercropping winter cereals like barley with deciduous trees species seems a successful strategy to implement resilient and high-productive alley-cropping systems. Tree-crop resources competition, especially for solar radiation, is limited in barley, it reaching maximum leaf area index before tree leaf sprouting in April.

Soybean is a relevant intercrop for nutrients cycle improvement in agroforestry but, as summer crop, there is large overlapping with the growing season of trees, and shading causes significant yield losses.

**References**

Jose S. 2009. Agroforestry for ecosystem services and environmental benefits: an overview. Agrofor. Syst. 76: 1-10

Paris P. et al. 2019. What is the future for agroforestry in Italy? Agrofor. Syst. 93: 2243-2256.