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INTERCROPPING LEGUME AND NON- LEGUME, AN INNOVATIVE WAY TO VALORIZE N₂ FIXATION AND SOIL MINERAL N SOURCES IN LOW INPUTS CROPPING SYSTEMS

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Intercrops (or mixed crops)

Simultaneous growth of two or more species in the same field for a significant period without necessarily sowing and harvesting them together (Willey 1979)

- Application of ecology principles like biodiversity and species interactions (e.g. Vendermeer, 1989)
- Better use of natural resources in time and space

The diagram illustrates the benefits of intercropping. It shows a sunflower and a smaller plant (likely a legume) growing together. Light radiation (orange arrows) is shown hitting both plants. Nitrogen (N_2) from the air (red arrow) is shown entering the soil. The sunflower's roots (blue arrows) take up water and other nutrients, while the smaller plant's roots (green arrows) take up mineral soil nitrogen (NH_4^+ , NO_3^-).

Two photos show different intercropping patterns: "Separated rows" (alternating rows of sunflowers and green crops) and "Mixed on the row" (sunflowers and green crops mixed together in the same row).



Material and objectives

- 48 organic experiments from 2001 to 2010
- 3 pedoclimatic situations
- Spring and Winter crops



- **Large range of practices** : cultivars, densities, organic fertilization

- **Aim :**

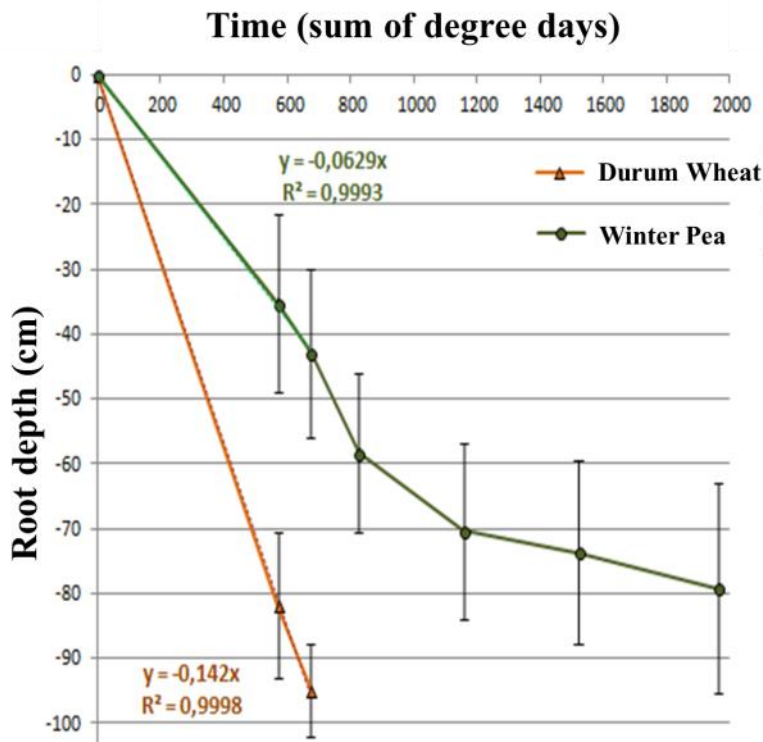
- Evaluate the potential advantages of intercrops for grain yield, grain protein concentration and weed control
- Analyze the functioning of cereal-grain legume intercrops to further propose optimized intercropped systems.



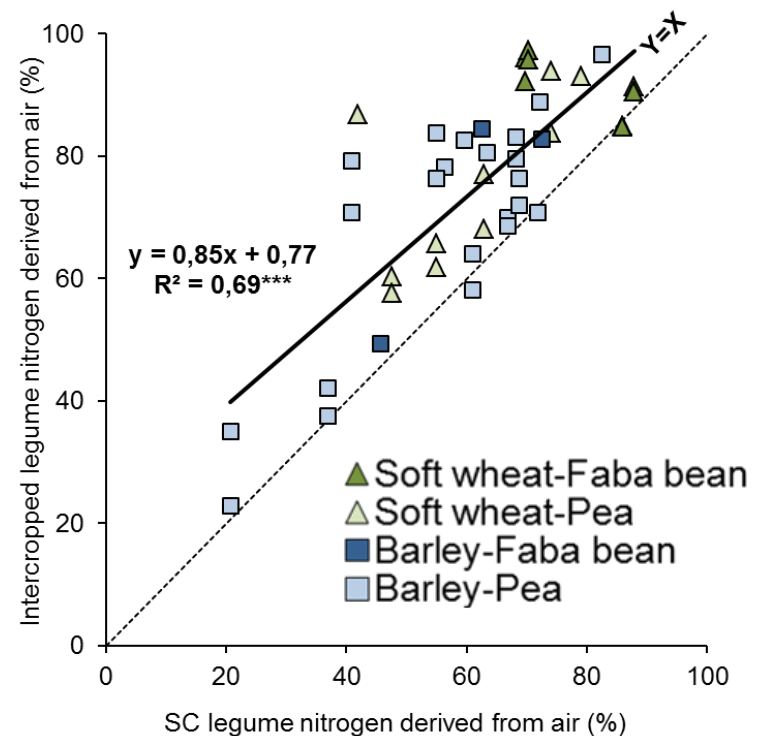


Species complementarity

for N sources (soil mineral N and N₂ from air)



- Wheat roots deeper than those of the legume
→ **Deep nutrients only available for the cereal**

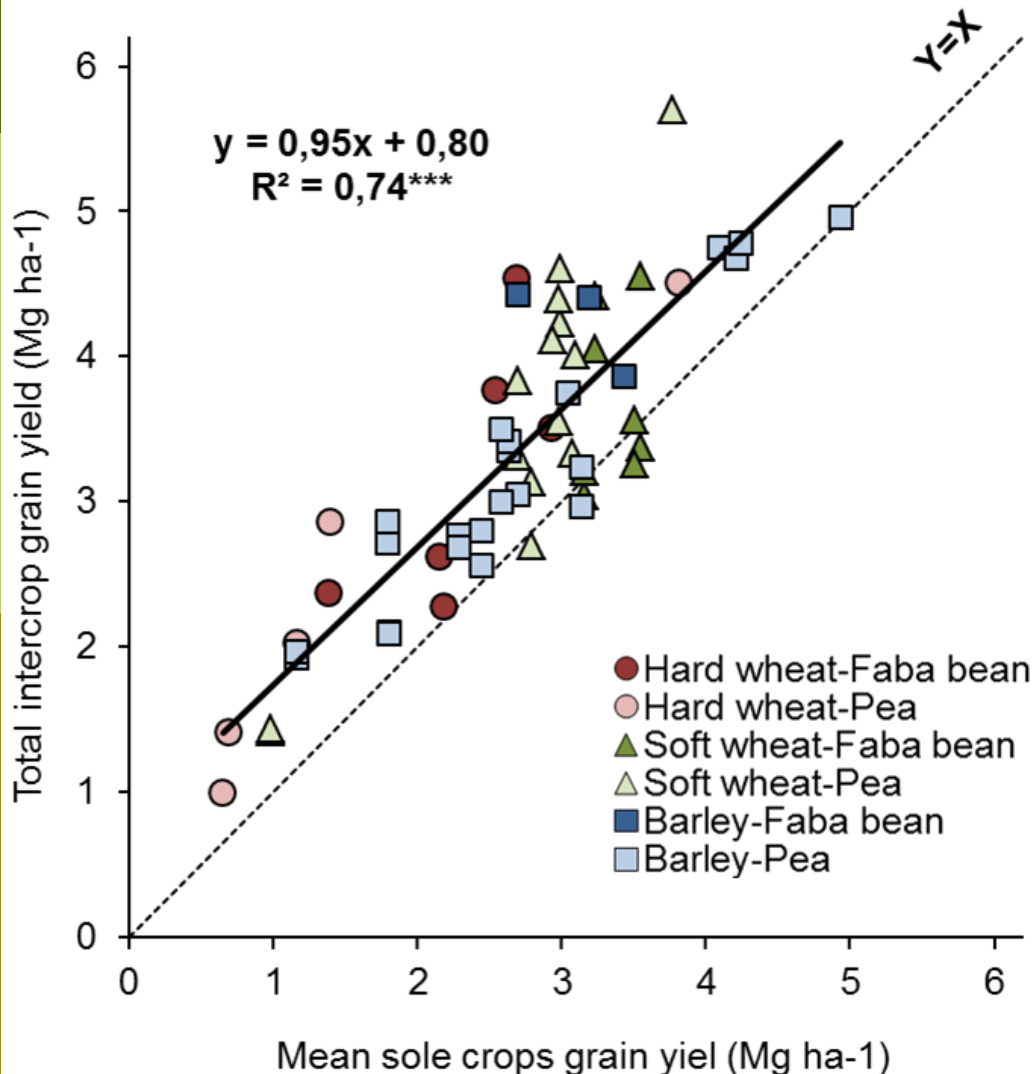


- Higher legume N₂ fixation rate in IC (75% vs. 62%)
→ **Most of soil N mineral available for the cereal**



IC improve yield (compared to low N sole crops)

(Hauggaard-Nielsen et al. 2001; Bedoussac and Justes 2010)

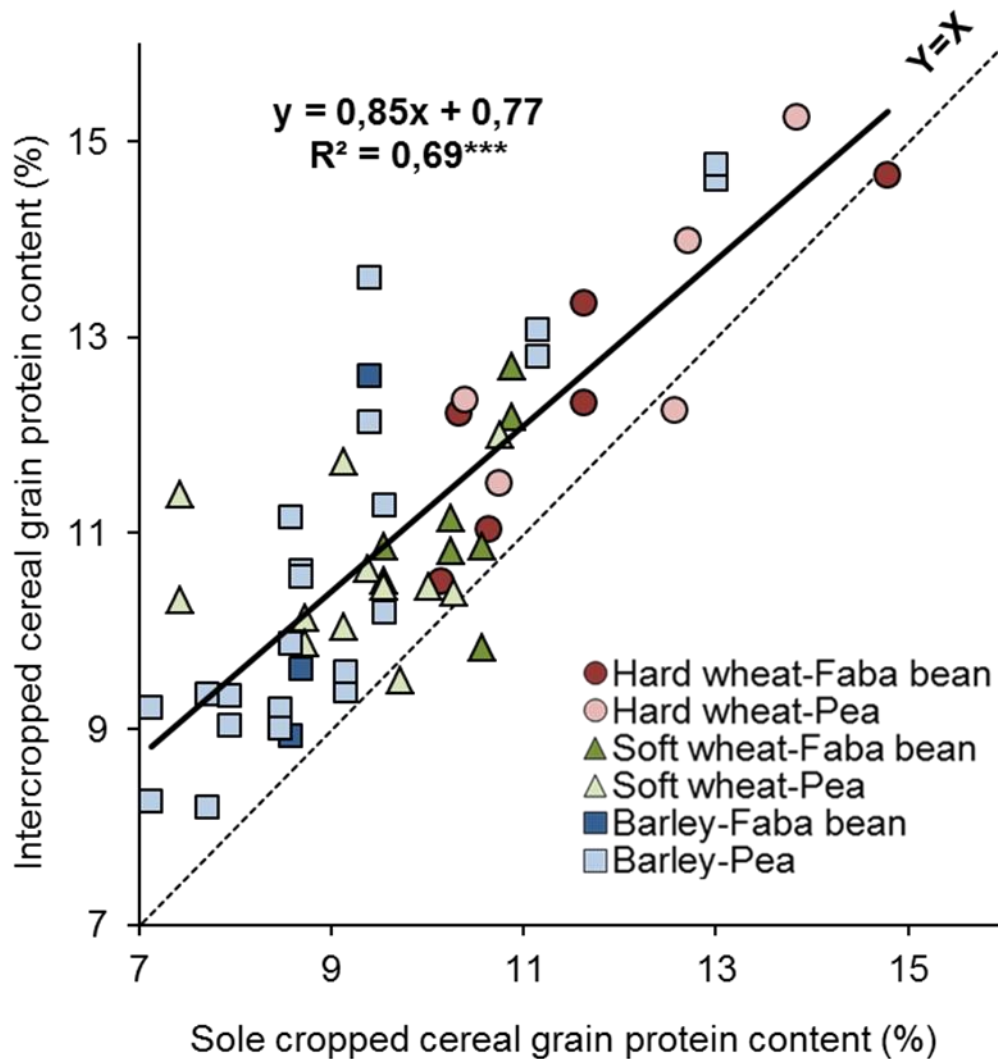


- Total intercrop grain yield higher than the mean sole crops (3.3 vs 2.7 Mg ha⁻¹)
→ **Highest efficiency for low N**
- Total IC grain yield more stable compared to each sole crop
→ **Higher resiliency**
- Proportion of cereal > 50%
→ **Cereal more competitive**



IC improve grain quality

(Jensen 1996; Hauggaard-Nielsen et al. 2001, 2009; Bedoussac and Justes 2010)

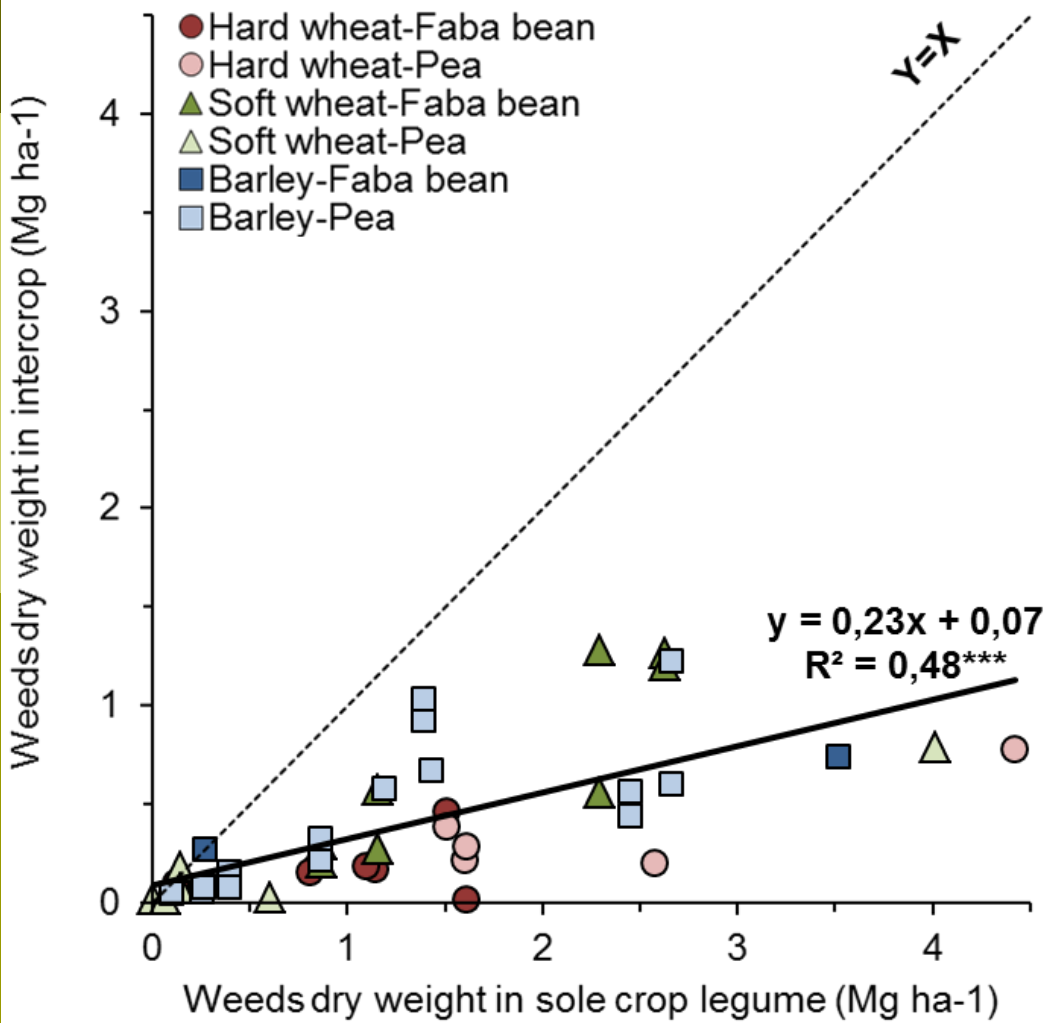


- Cereal grain protein concentration higher in IC (11.1% vs. 9.8% in SC)
- The lowest the SC protein the higher the increase
→ **Highest efficiency for low N**
- Due to :
 - lower cereal grain yield
 - low use of soil mineral N by the legume (75% of Ndfa)
→ **More N available per plant, tiller & grain in IC**



IC reduce weeds (in comparison of legume)

(Hauggaard-Nielsen et al. 2001, Corre-Hellou et al. 2011)



- Less weeds in IC compared to the legume (0.40 vs. 1.38 Mg ha⁻¹)
- No difference compared to the SC cereal

→ **In the IC weeds mostly controlled by the cereal**

→ **Less light and N available for the weeds**



Conclusion and perspectives

- ❑ **Intercropping is an efficient way to improve yield, quality and reduce weeds in low inputs systems**
- ❑ **Intercropping development need the collaboration of all the actors** in the value chain (farmers, collectors, breeders, agribusiness companies...)
- ❑ **Modelling intercropping systems could be helpful** to optimize them and to determine varietal characteristics suited to mixtures





Obrigado pela sua atenção

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Intercropping, an application of ecological principles to improve nitrogen use efficiency in organic farming systems

In: Organic farming, prototype for sustainable agricultures

Bellon S. et Penvern S. (eds), Springer, Berlin (2013)



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