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► To cite this version:

Laurent Bedoussac, Etienne-Pascal Journet, Henrik Hauggaard-Nielsen, Christophe Naudin, Guenaelle Corre - Hellou, et al.. Intercropping legume and non-legume, an innovative way to valorize N₂ fixation and soil mineral sources in low inputs cropping systems.. 18. Nitrogen workshop "The nitrogen challenge: building a blueprint for nitrogen use efficiency and food security", Jun 2014, Lisbonne, Portugal. pp.573, 10.13140/2.1.3836.2249 . hal-02741691

HAL Id: hal-02741691

<https://hal.inrae.fr/hal-02741691>

Submitted on 3 Jun 2020

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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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Nourrir le monde d'intelligences

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

Light radiation

N₂ from air

Water & others nutrient

Mineral soil N (NH₄⁺, NO₃⁻)

Separated rows

OR

Mixed on the row

2



Material and objectives

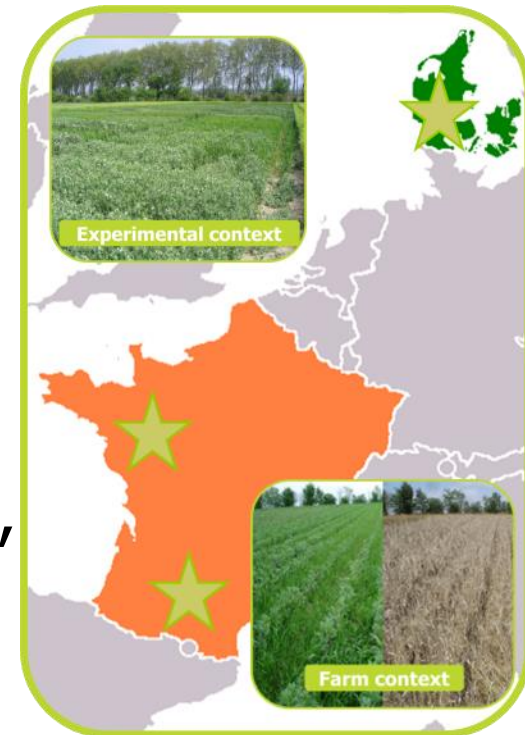
- 48 organic experiments from 2001 to 2010
- 3 pedoclimatic situations
- Spring and Winter crops



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

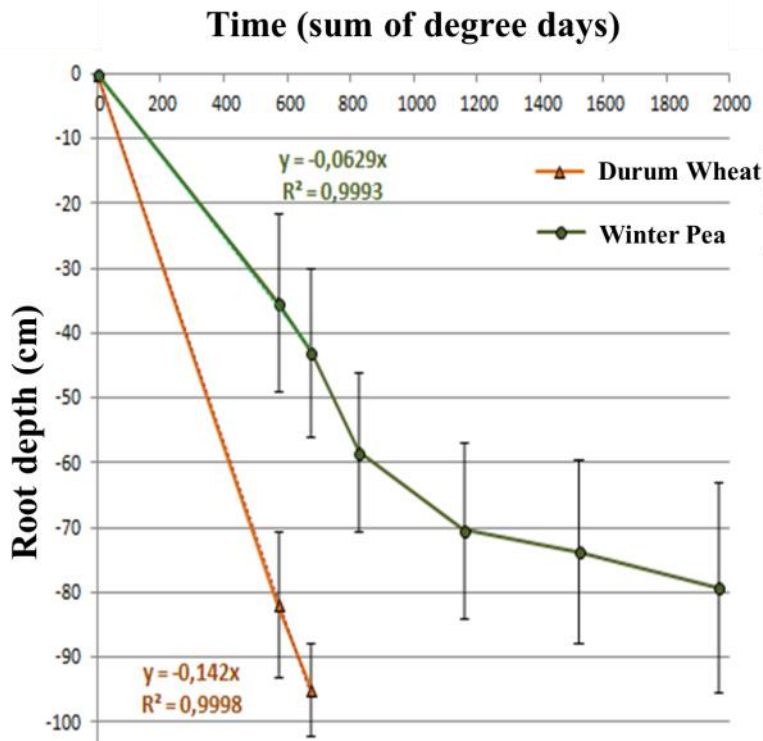
- **Aim :**

- 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.

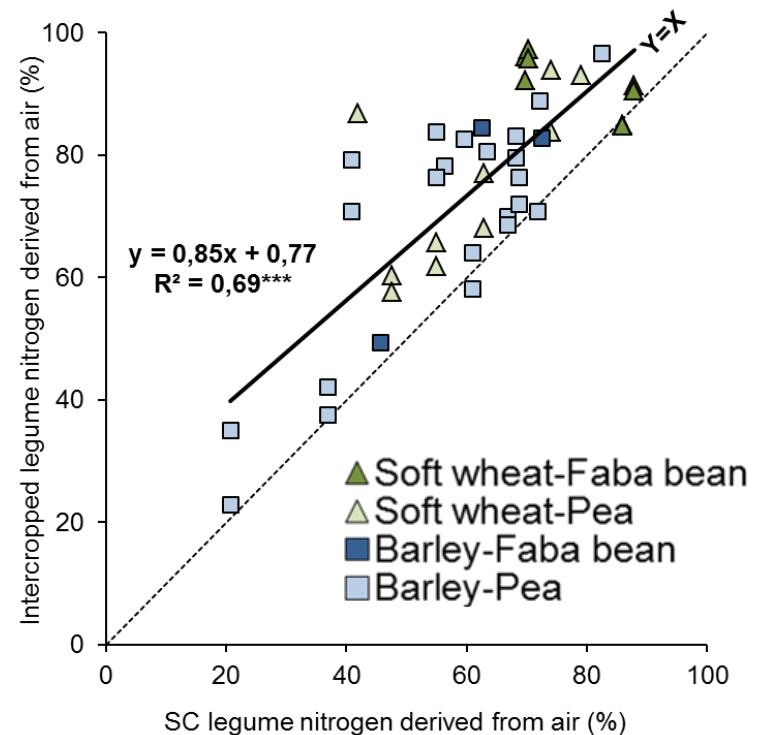


Species complementarity

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**

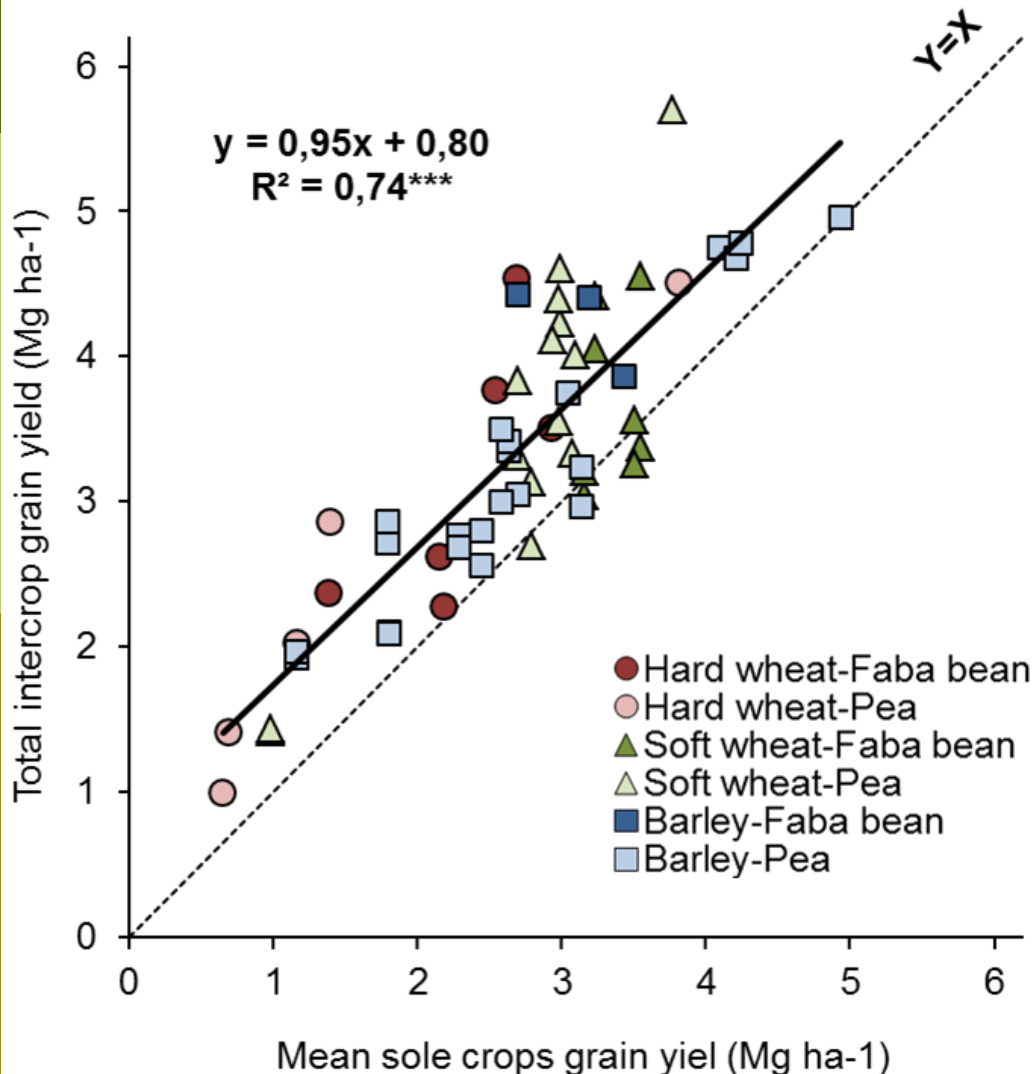


- Higher legume N₂ fixation rate in IC (75% vs. 62%)
→ **Most of soil N mineral available for the cereal**



IC improve yield (compared to low N sole crops)

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

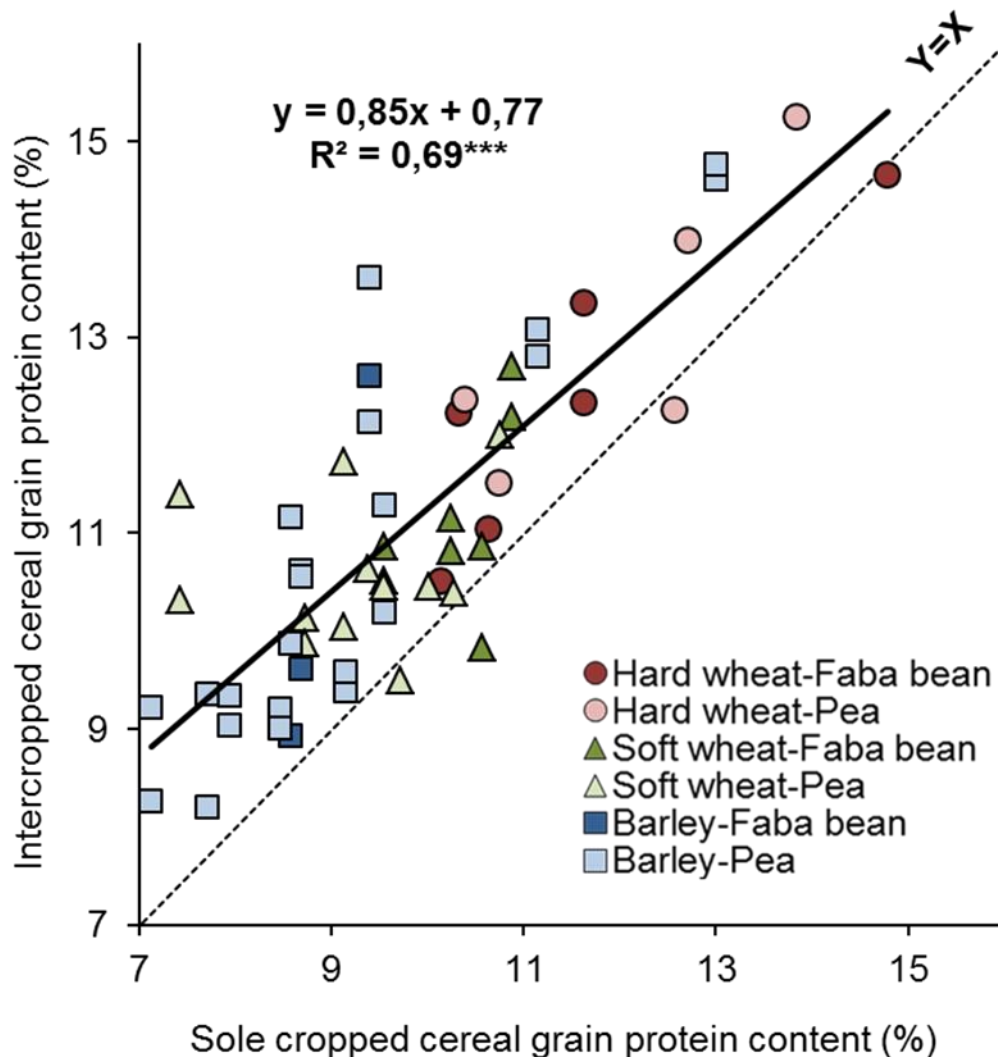


- Total intercrop grain yield higher than the mean sole crops (3.3 vs 2.7 Mg ha⁻¹)
→ **Highest efficiency for low N**
- Total IC grain yield more stable compared to each sole crop
→ **Higher resiliency**
- Proportion of cereal > 50%
→ **Cereal more competitive**



IC improve grain quality

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

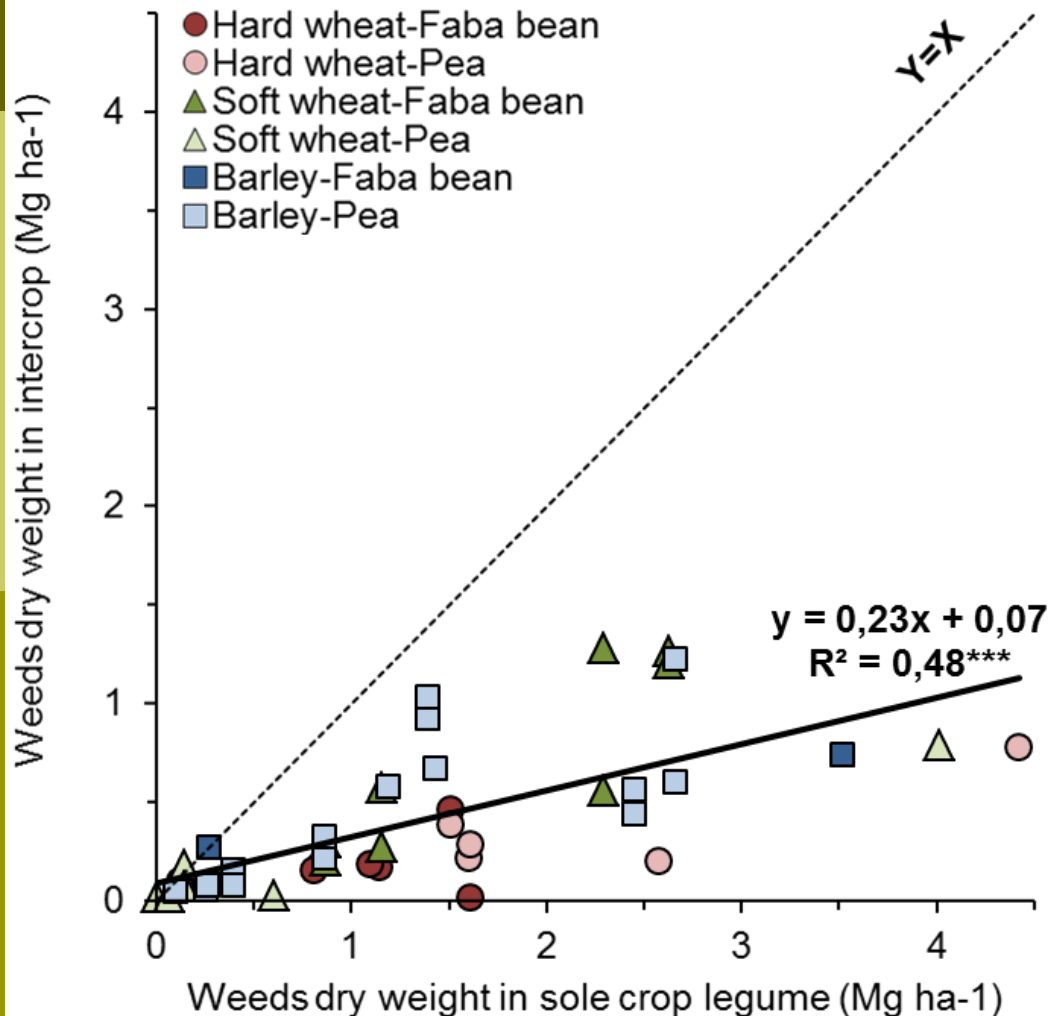


- Cereal grain protein concentration higher in IC (11.1% vs. 9.8% in SC)
- The lowest the SC protein the higher the increase
→ **Highest efficiency for low N**
- Due to :
 - lower cereal grain yield
 - low use of soil mineral N by the legume (75% of Ndfa)
→ **More N available per plant, tiller & grain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

Bedoussac L., Justes E., Journet E.-P., Hauggaard-Nielsen H., Naudin C., Corre-Hellou G., Prieur L., Jensen E. S.

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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