Is 'durum wheat - winter pea intercropping' efficient to improve the use of light and N resources in low-input farming?

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Laurent BEDOUSSAC and Eric JUSTES

INRA, UMR ARCHE, Auzeville, BP 52627, 31326 Castanet-Tolosan, France

E-mail: *Laurent.Bedoussac@toulouse.inra.fr – Eric.Justes@toulouse.inra.fr*

Background and objectives

- Intercropping (IC) is known as an agricultural practice which can improve the use of environmental resources (light, nutrients and water) **that results in yield advantages and increased yield stability compared to sole cropping** (SC) (e.g. Willey, 1979)
- Corre-Hellou et al. (2006) demonstrated that IC spring barley-pea advantages were mainly based on *i)* a better light use and *ii)* a deeper root growth of spring Barley vs. Pea

→ **More important soil N acquisition** (e.g. Hauggaard-Nielsen and Jensen, 2001)

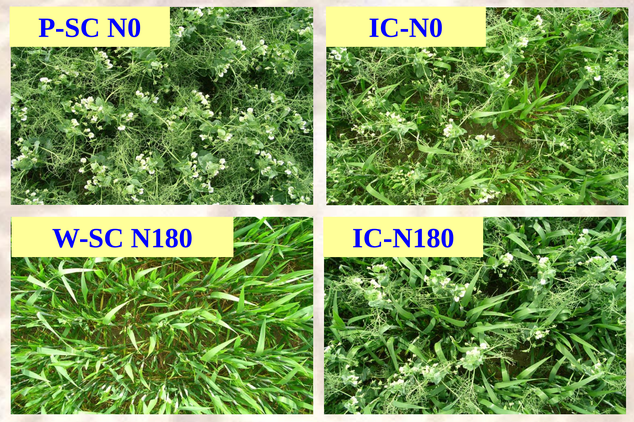
→ **Yield and protein content of barley in IC relatively higher than in SC** (e.g. Hauggaard-Nielsen *et al.*, 2003)

- No reference on winter wheat-grain legume IC was available, despite winter crops seems more adapted to conditions of southern Europe
- **Aim of our study: Evaluate the assumption that IC can improve protein content of durum wheat in low-input system** by focusing on:
  - *i)* **Understanding competition between durum wheat and winter pea for light and N during the early crop stages**
  - *ii)* **Analysing the consequences on shoot growth and N acquisition during the crop cycle and grain protein content at harvest**

Material and Methods

An experiment was carried out in Auzeville (SW France) in a clayed loamy soil. The two species were sown in **row-intercropping** at the same time on Nov. 8, 2005. The experiment was based on a randomized block design with 3 replicates

- **Three main treatments were compared :**
  - *i)* Durum wheat (cv. Nefer) sown at normal density (280 seeds/m²): **W-SC**
  - *ii)* Winter pea (cv. Lucy) sown at normal density (60 seeds/m²): **P-SC**
  - *iii)* Durum wheat-winter pea IC, **each specie sown at half of normal density**: **IC**
- **Three fertiliser-N sub-treatments were carried out on W-SC and IC :**
  - *i)* No fertilizer: **N0** ***(also carried out for P-SC)***
  - *ii)* Low fertilization splitted into 2 applications of 50 kg N/ha: **N100**
  - *iii)* Moderate fertilization in 3 applications 30, 100 and 50 kg N/ha: **N180**
- **Measurements made :**
  - *i)* Fraction of photosynthetically active radiation (PAR) absorbed by the crop (**FPARa**)
  - *ii)* Nitrogen status of SC and IC were evaluated by calculating the nitrogen nutrition index (**NNI**) and the grain protein concentration
  - *iii)* Land Equivalent Ratio (**LER**), which is defined as the relative land area under SC that is required to produce the yields achieved in IC (e.g. Hauggaard-Nielsen and Jensen, 2001) was calculated at key crop stages



Results

- FPARa of IC was greater than for P-SC in early stages but was slightly lower than W-SC (Fig. 1). From 950 DD until wheat flowering, FPARa of IC became equal to P-SC and higher than W-SC

  FPARa of unfertilized IC was the same as the FPARa of the fully fertilized W-SC (Fig. 1)
- LER values of IC were higher than 1 (Tab. 1)

→ **Light and nutrients resources were used 8 to 23% more efficiently in IC than SC**

Partial LER (LERp) of wheat were always greater than pea and always higher than 0.5

→ **Wheat took advantage of IC by using available resources more efficiently than pea**

- Grain Protein content (GPC) of durum wheat was significantly greater in IC (Tab. 2)
- GPC of winter pea was the same in SC and IC and increased with fertilizer-N increasing

Figure 1: Change in PAR absorption vs. time

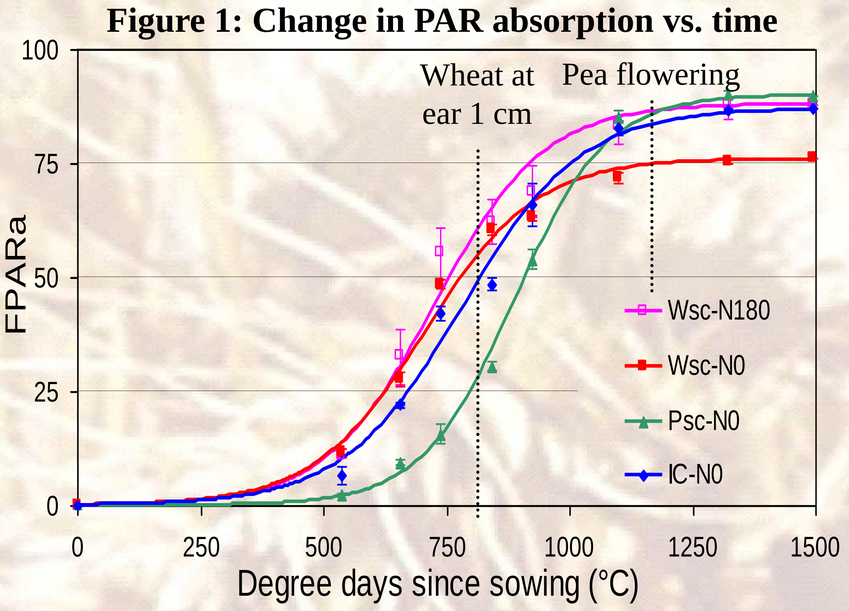


Table 1: Land Equivalent Ratio at harvest

	LERp P	LERp W	LERtotal
N0	0,51 (0,09)	0,72 (0,10)	1,23 (0,18)
N100	0,59 (0,03)	0,60 (0,10)	1,19 (0,11)
N180	0,38 (0,00)	0,70 (0,13)	1,08 (0,13)

Table 2: Grain Protein Concentration (%)

	W-SC	W-IC	P-SC	P-IC
N0	8.1 (0.1)	9.5 (0.2)	18.4 (0.3)	17.6 (0.6)
N100	13.1 (0.2)	14.7 (0.4)		20.6 (0.7)
N180	12.8 (0.4)	13.7 (0.6)		22.4 (0.5)

Conclusions

- The 'durum wheat - winter pea intercropping' seems well adapted to the conditions of Southern France because it allowed *i)* a **better use of light and nitrogen resources during winter and early spring and** *ii)* **a higher grain protein concentration of durum wheat at harvest**
- The PAR absorption of intercrop and the wheat grain protein concentration was greater in IC, in particular for the unfertilized treatment, **confirming the interest of intercropping in low-input systems**

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