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

Laurent BEDOUSSAC and Eric JUSTES

INRA, UMR 1248 AGIR, Auzeville, BP 52627, 31326 Castanet-Tolosan, France

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

Background and objectives

- Intercropping (IC) can improve the use of environmental resources (light, nutrients and water) resulting **in yield advantages and increasing yield stability compared to sole cropping** (SC) (e.g. Willey, 1979).
- Corre-Hellou et al. (2006) demonstrated that spring barley-pea IC advantages were mainly based on:

  ***i)* a better light use and *ii)* a deeper root growth of spring Barley vs. Pea** leading to a **more important soil N acquisition.**

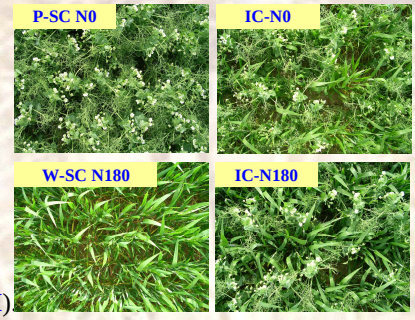
  → **Yield and protein content of barley in IC relatively higher than in SC** (e.g. Hauggaard-Nielsen *et al*., 2001 and 2003).
- No reference on winter crops IC was available, despite winter crops seems more adapted to conditions of southern Europe.
- *Aim of our study:* **Evaluate the assumption that IC can improve protein content of durum wheat in low-input farming.**

  ***i)* Understanding competition between durum wheat and winter pea for N.**

  ***ii)* Analysing the consequences on shoot growth, N acquisition and grain protein content of durum wheat.**

Material and Methods

- An experiment was carried out in Auzeville (SW France) in a clayed loamy soil. The two species were sown the Nov. 8, 2005 in **row-intercropping**. The experiment was based on a split-splot design with 3 replicates.
- **Three main treatments were compared:**
  i) **W-SC:** Durum wheat (cv. Nefer) sown at normal density (280 seeds/m²).
  ii) **P-SC:** Winter pea (cv. Lucy) sown at normal density (60 seeds/m²).
  iii) **IC:** Durum wheat-winter pea IC, **each specie sown at half of normal density.**
- **Three fertiliser-N sub-treatments were carried out:**
  i) **N0:** No fertilizer; *ii)* **N100:** 2 applications of 50 kg N/ha;
  iii) **N180:** 3 applications of 30, 100 and 50 kg N/ha.
- **Measurements made:**
  i) Nitrogen status of SC and IC were evaluated by the Nitrogen Nutrition Index (**NNI**)
  ii) Nitrogen acquisition at harvest (**N uptake**) and the Grain Protein Concentration (**GPC**).
  iii) Land Equivalent Ratio (**LER**), defined as the relative land area under SC required to produce the yields achieved in IC and decomposed in partial LER (**LERp**) corresponding to each specie (e.g. Hauggaard-Nielsen and Jensen, 2001).



Results

- **NNI** of durum wheat was significantly increased in IC than SC (Tab. 1).
- **N uptake** of durum wheat per m² was higher in SC but lower than the whole N acquisition of IC for N0 and N100 treatments (Fig. 1).
- **GPC** of durum wheat was greater in IC for N0 and N100 (Tab. 2).

→ **Greater wheat N uptake coming from soil mineral N.**

→ **Complementary use of soil N and symbiotic N2 fixation sources in IC.**

- **LER** values were always higher than 1 (Tab. 3).

→ **Environmental resources were used 8 to 23% more efficiently in IC: the less N availability, the highest LER.**

- **LERp** of wheat were always greater than pea and higher than 0.5 (Tab. 3).

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

Table 1: Durum wheat NNI

Stage	N	W-SC	W-IC
142 DAS	N0/N100	0.49 (0.05)	0.56 (0.04)
Ear 1 cm of Wheat	N180	0.63 (0.04)	0.74 (0.03)
169 DAS	N0	0.40 (0.02)	0.50 (0.03)
Begining of Pea	N100	0.54 (0.04)	0.63 (0.08)
Flowering	N180	0.82 (0.04)	0.82 (0.04)
189 DAS	N0	0.35 (0.02)	0.45 (0.04)
Wheat Flowering	N100	0.58 (0.04)	0.71 (0.08)
	N180	0.74 (0.01)	0.76 (0.02)

Figure 1: N acquisition at harvest (Kg N.ha-1)

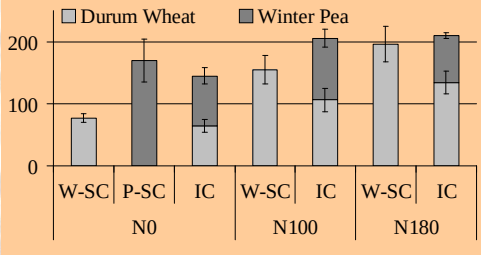


Table 2: Grain Protein (% of DM)

N	W-SC	W-IC
N0	8.1 (0.3)	10.7 (1.4)
N100	13.1 (0.3)	14.0 (0.7)
N180	13.6 (0.9)	13.4 (0.8)

Table 3: Land Equivalent Ratio

N	LERp P	LERp W	LER
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)

*: In comparison to N0 treatment

Conclusions

- The 'durum wheat - winter pea intercropping' seems well adapted to the conditions of Southern France because it allowed
  i) **a better use of N resources (and light) during winter and early spring period of growing season**
  ii) **a higher grain protein concentration of durum wheat at harvest**
- IC advantages were greater for the unfertilized treatment **confirming the interest of intercropping in low-input farming**