The efficiency of durum wheat and winter pea intercropping to increase wheat grain protein content depends on nitrogen availability and wheat cultivar

Laurent Bedoussac, Eric E. Justes

‘Durum wheat - winter pea intercropping’ efficiency depends on nitrogen availabily and wheat cultivar

L. BEDOUSSAC and E. JUSTES

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

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

X^th Congress of the European Society for Agronomy
15-19th September 2008, Bologna, Italy

OBJECTIVES

- **Nitrogen acquisition** is often a major concern, particularly in low input systems where mineral **N is a limited resource**.
- Intercropping (IC) can improve the use of environmental resources (light, nutrients and water) resulting **in yield and quality advantages compared to sole cropping** (SC) (e.g. Willey, 1979).
- No reference on winter crops IC was available, despite winter crops seems more adapted to Southern Europe conditions.
- *Aim of our study:* **Evaluate the assumption that Durum wheat – Winter pea intercropping (IC) is more efficient than sole crops (SC) by:**
  - ***i)*** **Understanding competition between durum wheat and winter pea for different wheat cultivars**
  - ***ii)*** **Analysing the consequences of N availability on the performance of IC (grain protein, yield and species proportion)**

CONCLUSIONS

- The ‘**Durum wheat - Winter pea intercropping**’ seems well adapted to the Southern France conditions because it allows:
  - ***i)*** **A better use of N resources (and light) during early spring growing season due to the complementarities of the 2 species**
  - ***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**
- Choices in N supply and wheat cultivar depend on the target of the intercrop. Two directions are possible:
  - ***i)*** **Increasing N availability and/or choosing a tall wheat cultivar that could increase wheat proportion**
  - ***ii)*** **Reducing N supply and/or choosing a short wheat cultivar that could increase wheat grain protein and pea proportion**

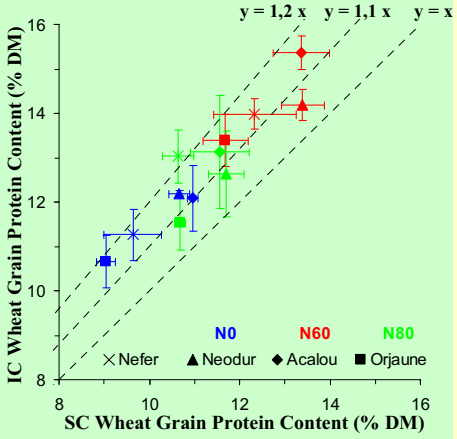
MATERIAL AND METHODS

- An experiment was carried out in Auzeville (SW France) in 2006-2007 on a clay loamy soil. The two species were sown on November 2006 the 9th in **row-intercropping**. The experiment was based on a split-split-plot design with 3 replicates.
- **Three main treatments were compared:**
  - ***i)*** **W-SC:** Durum wheat (sown at 280 seeds/m²) ;
  - ***ii)*** **P-SC:** Winter pea (cv. Lucy sown at 60 seeds/m²) ;
  - ***iii)*** **IC:** Durum wheat-winter pea IC, **each specie sown at half of SC density**

- **Four wheat cultivars of different height:** ***i)*** **Ac:** Acalou (89 cm); ***ii)*** **Nf:** Nefer (98 cm) ; ***iii)*** **Nd:** Neodur (98 cm) and ***iv)*** **Oj:** Orjaune (116 cm)
- **Three fertiliser-N sub-treatments:** ***i)*** **N0:** No fertilizer ; ***ii)*** **N60:** 60 kg N.ha^{-1} (at **FLV** ‘flag leaf visible’ to increase **wheat GPC**) and ***iii)*** **N80:** 80 kg N.ha^{-1} (at ‘ear 1cm’ to increase **wheat yield**)
- **Measurements made:** ***i)*** Wheat grain protein concentration (**GPC**) ; ***ii)*** Grain yield and ***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.

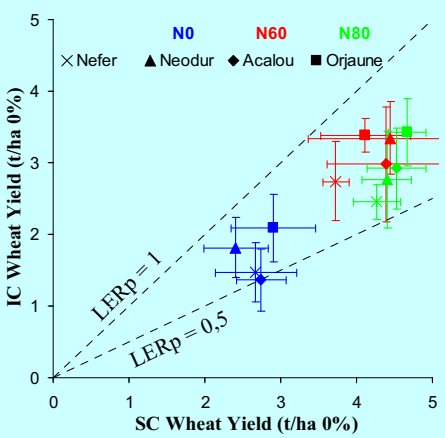
RESULTS

Wheat Grain Protein in IC vs SC



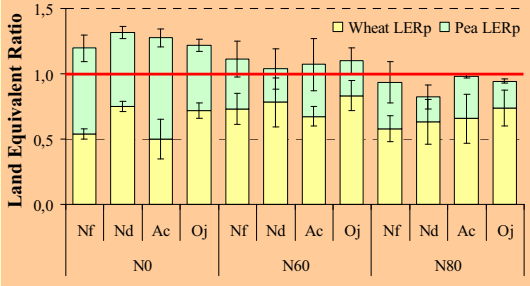
- **IC GPC** was 13% higher than in SC
- Greatest **GPC** for N60 applied at FLV
- **Ac** and **Nd** have greater GPC in SC & IC
- IC reduced the gap in cultivars **GPC**

Wheat Yield in IC vs SC



- **IC Yield** was about 68% of the **SC Yield**
- **IC Yield** greatest with N60
- **SC Yield** greatest with N80
- **Oj/Nd** IC yield 20% greater than **Nf/Ac**

Land Equivalent Ratio



- **LER** greater than 1 for N0 and N60
- **Wheat LERp** always higher than 0,5
- **Nd** & **Oj** Wheat LERp greater than **Nf** & **Ac**
- **Pea LERp** strongly reduced with N supply
- **Pea LERp** lower for **Nd** and **Oj**

→ **IC more efficient than SC in N0 and N60**
→ **Wheat took more advantage of N than pea**
→ **Complementary use of N ressources**
→ **Pea yield is more reduced with tall cultivars**