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“Yield Gap Analysis Extended to Marketable Grain Reveals the Profitability of Organic Lentil-Spring Wheat Intercrops”

Viguiet L, Bedoussac L, Journet E-P, Justes E



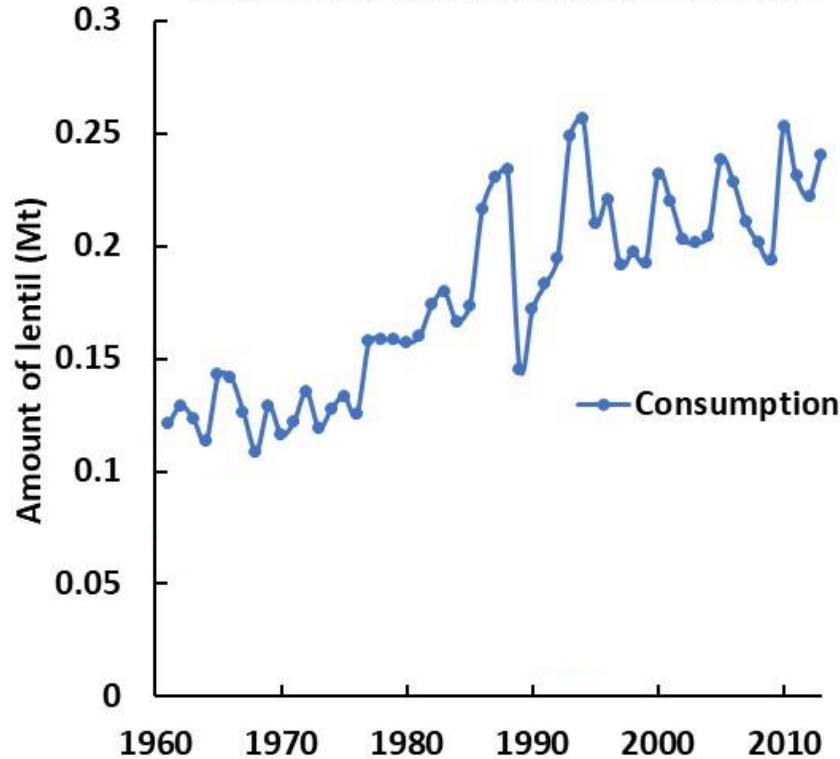
VASCO Team

Varieties and cropping systems for an agroecological production

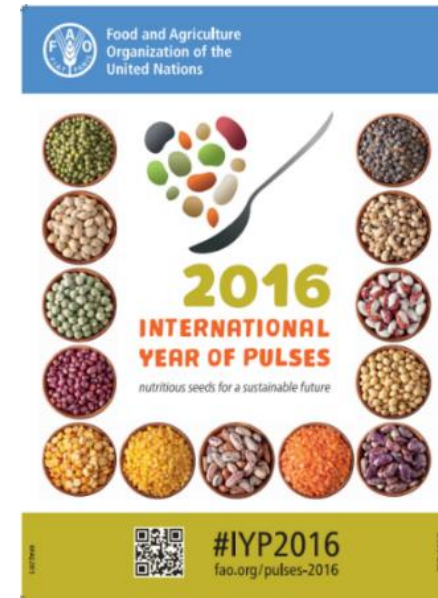
Lentil in Europe

- [1] FAO, 2018
- [2] Nguyen, 2018
- [3] Watson et al. 2018
- [4] Ansari et al. 2015
- [5] Erskine et al. 2016
- [6] Magrini et al. 2016

Lentil consumption and production in EU



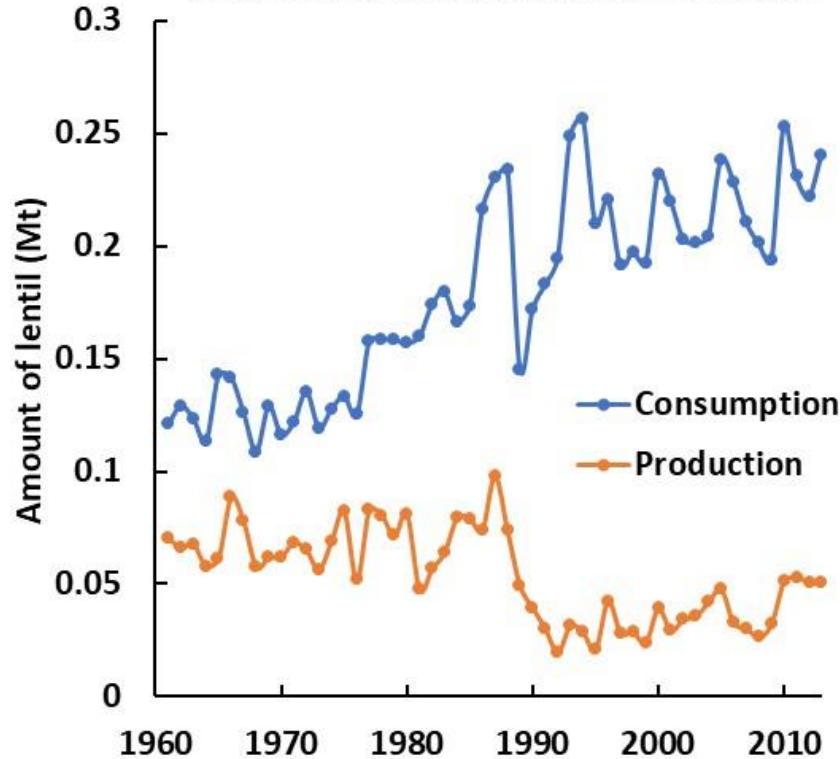
- Growing consumption [1]
- Enhanced communication:
 - Nutritional advantages [2, 3, 4, 5]
 - Environmental benefits [4, 5]
- Dietary transition favorable [6]



Lentil in Europe

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Lentil consumption and production in EU



- Growing consumption [1]
- Enhanced communication:
 - Nutritional advantages [2, 3, 4, 5]
 - Environmental benefits [4, 5]
- Dietary transition favorable [6]
- Consumption > Production
 - ➔ Regional deficit [1]
 - ➔ Market opportunity



Why such a deficit in lentil production ?

- [1] Peoples et al. 2002
- [2] Angus et al. 2015
- [3] Wang et al. 2013
- [4] Laserna-Ruiz et al. 2012
- [5] Carr et al. 1995

- Despite economic and agronomic advantages:
 - High selling price
 - No need for N fertilization [1]
 - Diversification of rotations [2]
- Low and unstable productivity → 3 major yield-reducing factors



Weeds

Up to **100% losses** [3]



Bruchids

Up to **50% losses** [4]



Lodging

Up to **100% losses** [5]



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Can intercrops (IC) lower these reducing factors compared to sole crops (SC) ?



Field experiments 2015 and 2016

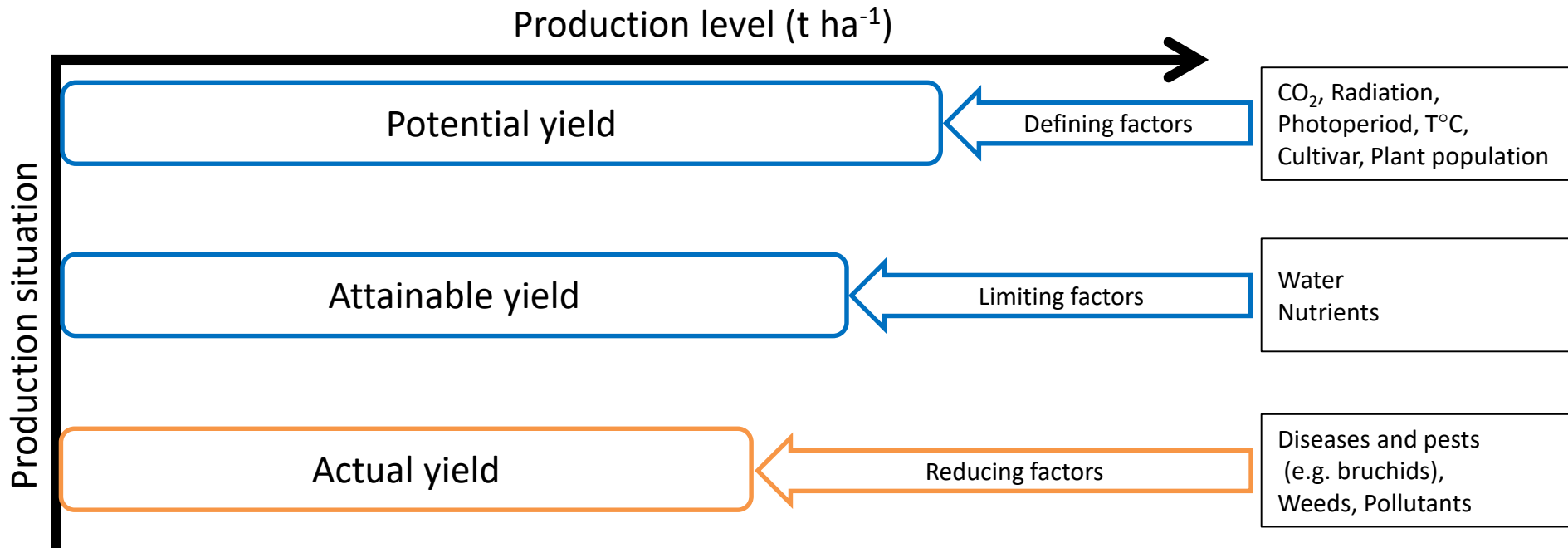


- INRA Auzeville (SW France)
- Experimental plots, no inputs
- Low N mineral content at sowing (30 kg N ha⁻¹)
- 4 lentil and 2 spring-wheat cultivars
- 100% lentil + 17% wheat in intercrop
- Both crops sown and harvested simultaneously

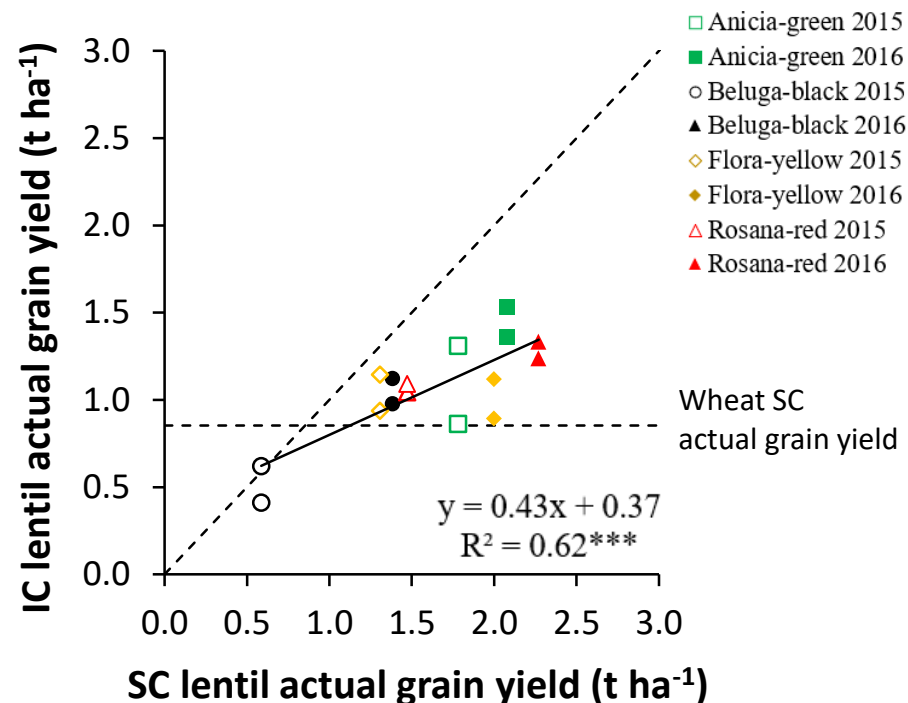
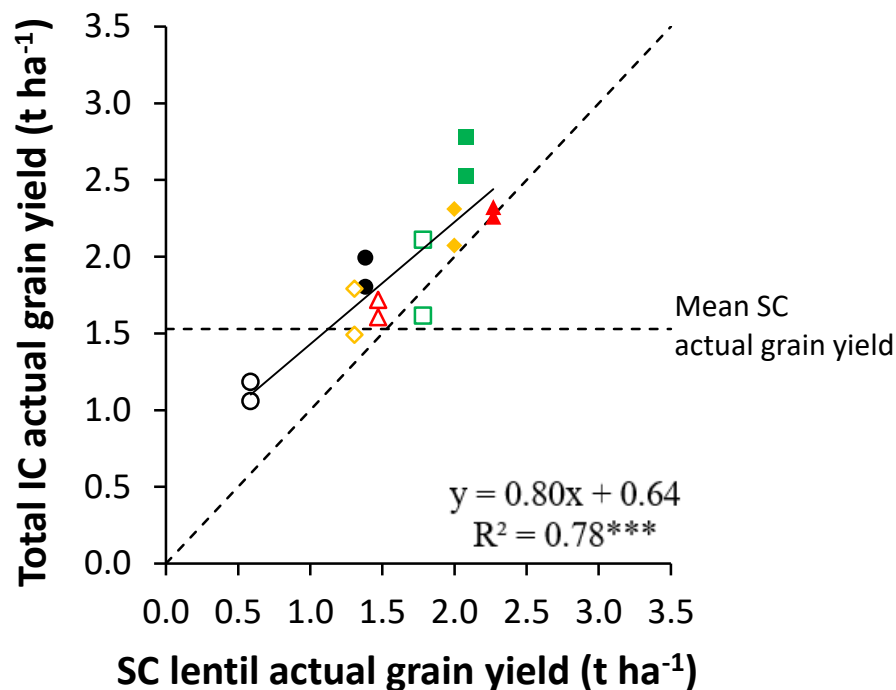


Yield gap concept

(adapted from Evans 1993 and Van Ittersum et al. 2013)



Effect of intercrops (IC) on actual grain yields



- Anicia-green 2015
- Anicia-green 2016
- Beluga-black 2015
- ▲ Beluga-black 2016
- ◇ Flora-yellow 2015
- ◆ Flora-yellow 2016
- △ Rosana-red 2015
- ▲ Rosana-red 2016

- Total IC actual grain yield > lentil SC
→ **Complementary use of resources, notably N**
- Lentil IC actual grain yield < lentil SC
→ **Strong competition of wheat over lentil**
- **Effect on actual gross margins ?**



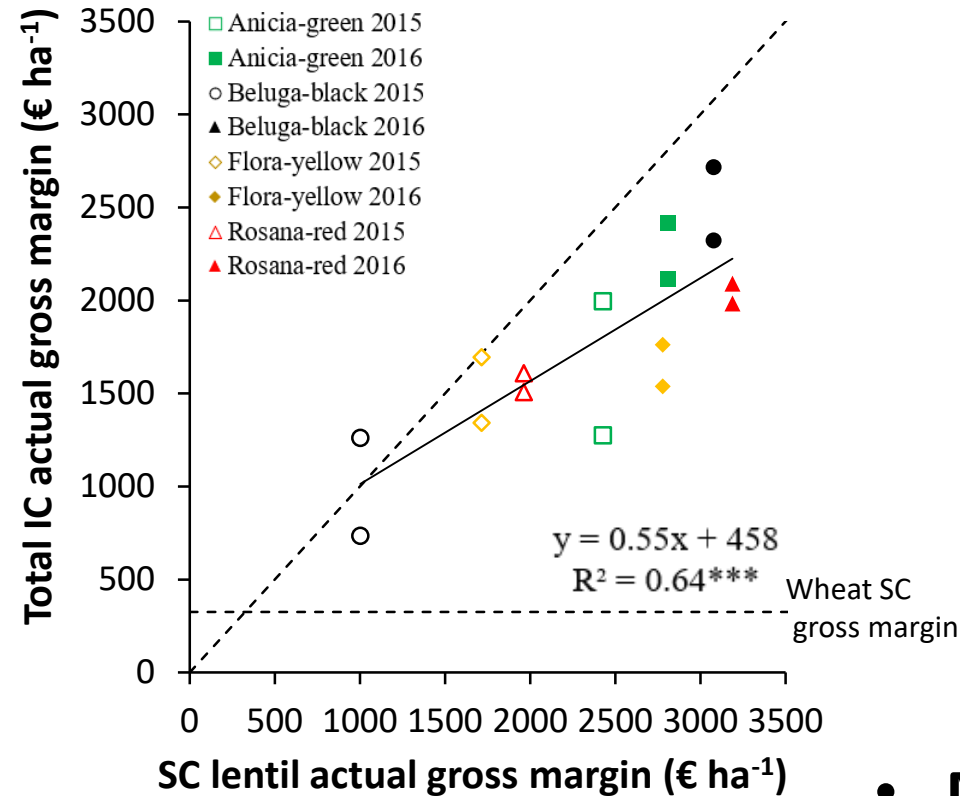
Effect of intercrops (IC) on actual gross margins

- Total IC gross margin < lentil SC

→ IC are less profitable than lentil SC

→ Lentil determines IC gross margins

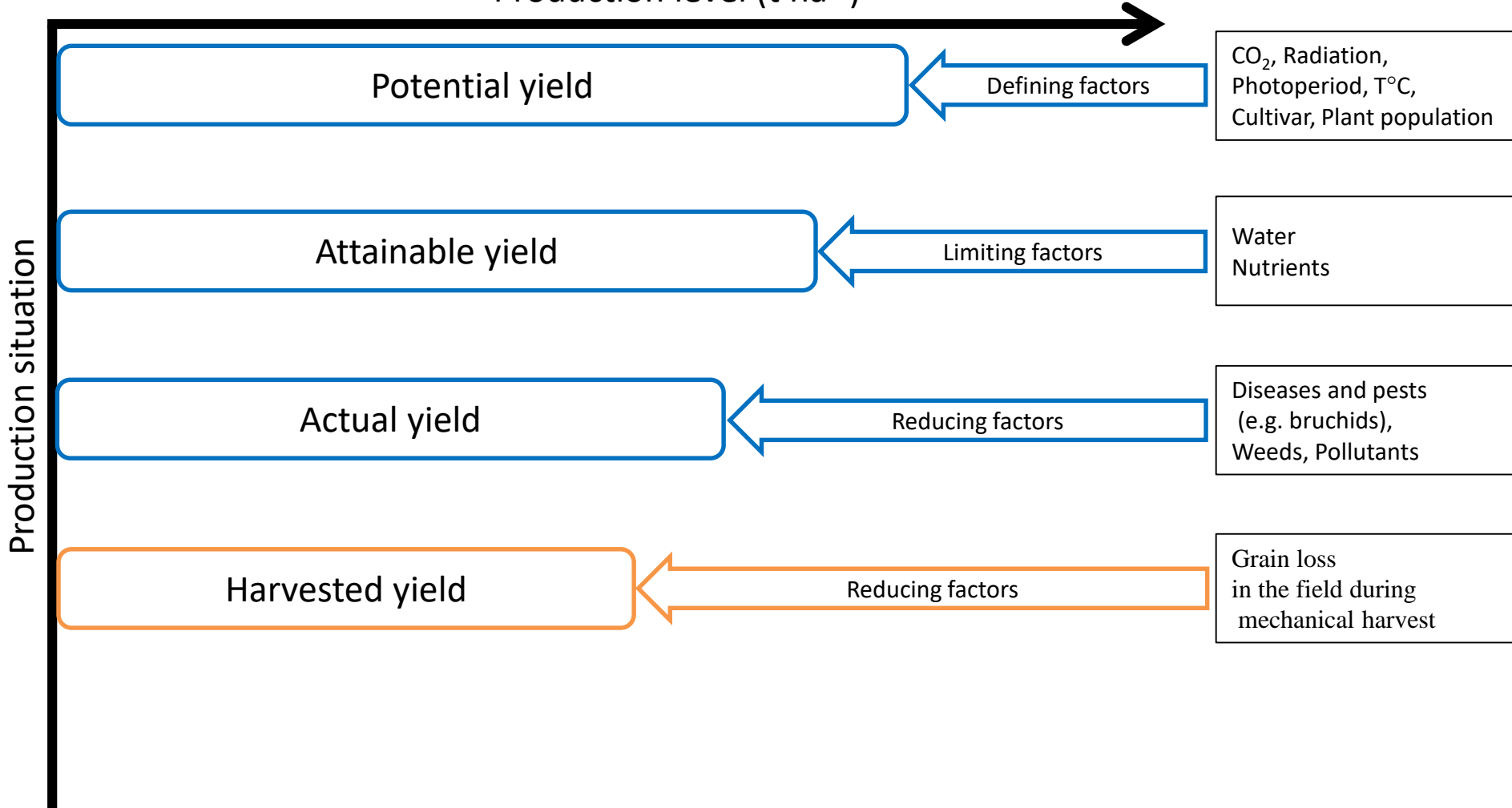
➤ Lentil price = 4 × wheat price



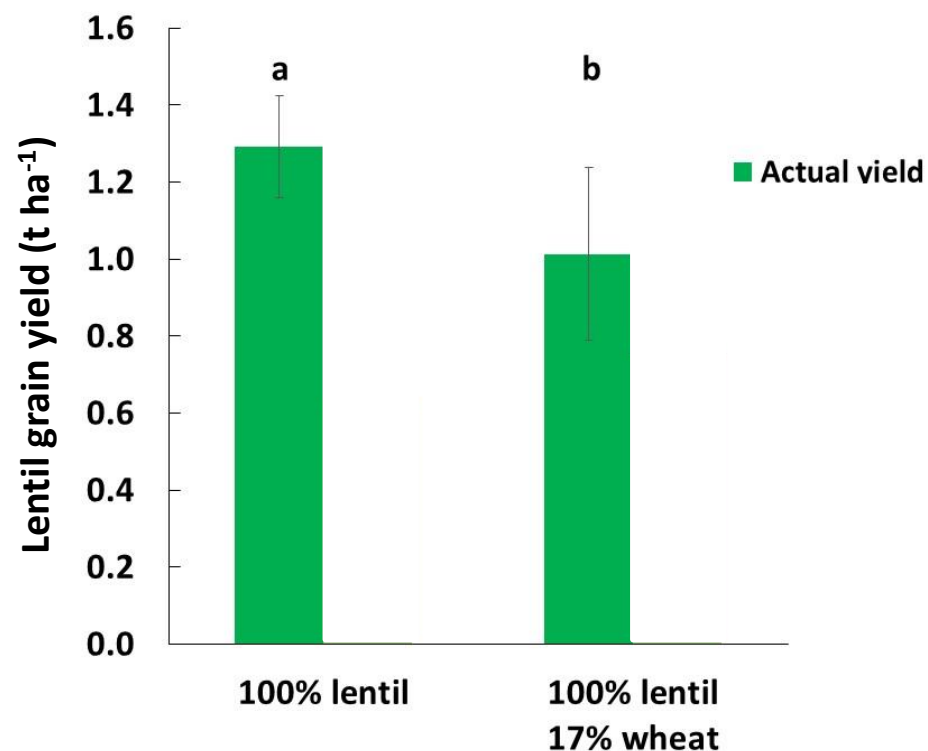
- Mechanical harvest efficiency ?

Yield gap concept (adaptation Viguiet et al. 2018)

Production level (t ha⁻¹)



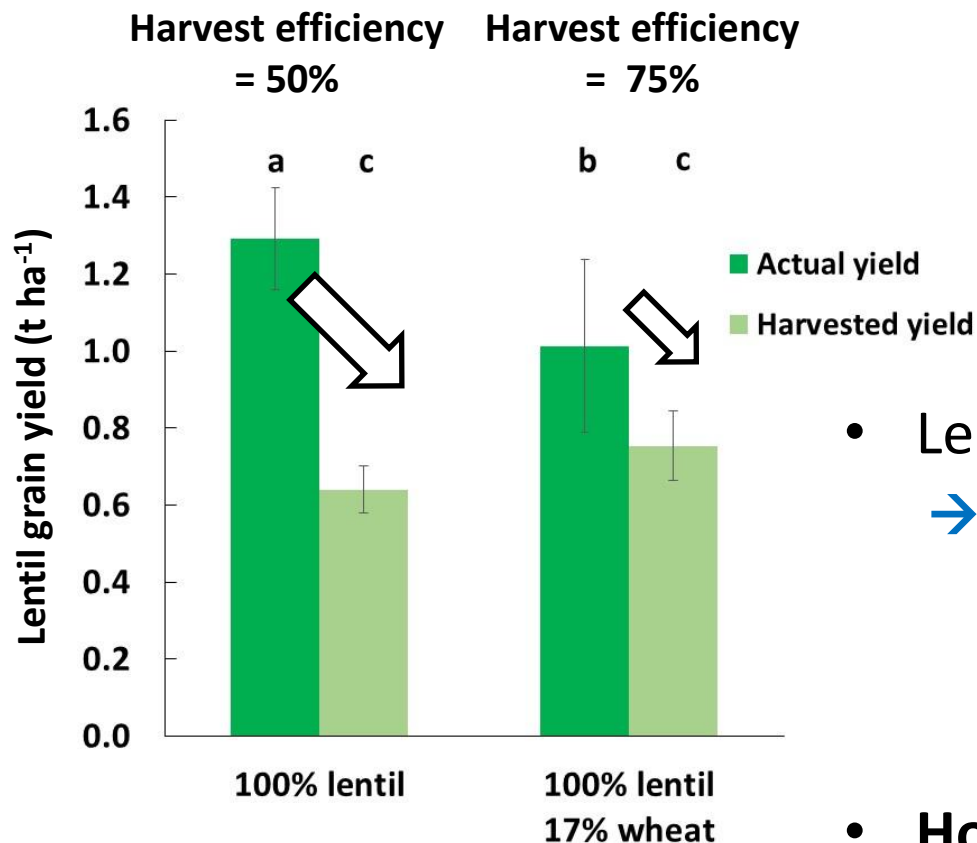
Effect of intercrops (IC) on lentil harvest efficiency



Effect of intercrops (IC) on lentil harvest efficiency



Mechanical harvest at INRA in 2016



- Lentil IC harvested yield = lentil SC
→ Importance of considering harvest losses
- How to explain harvest efficiency ?



Effect of intercrops (IC) on lentil harvest efficiency



Intercrop lentil at harvest

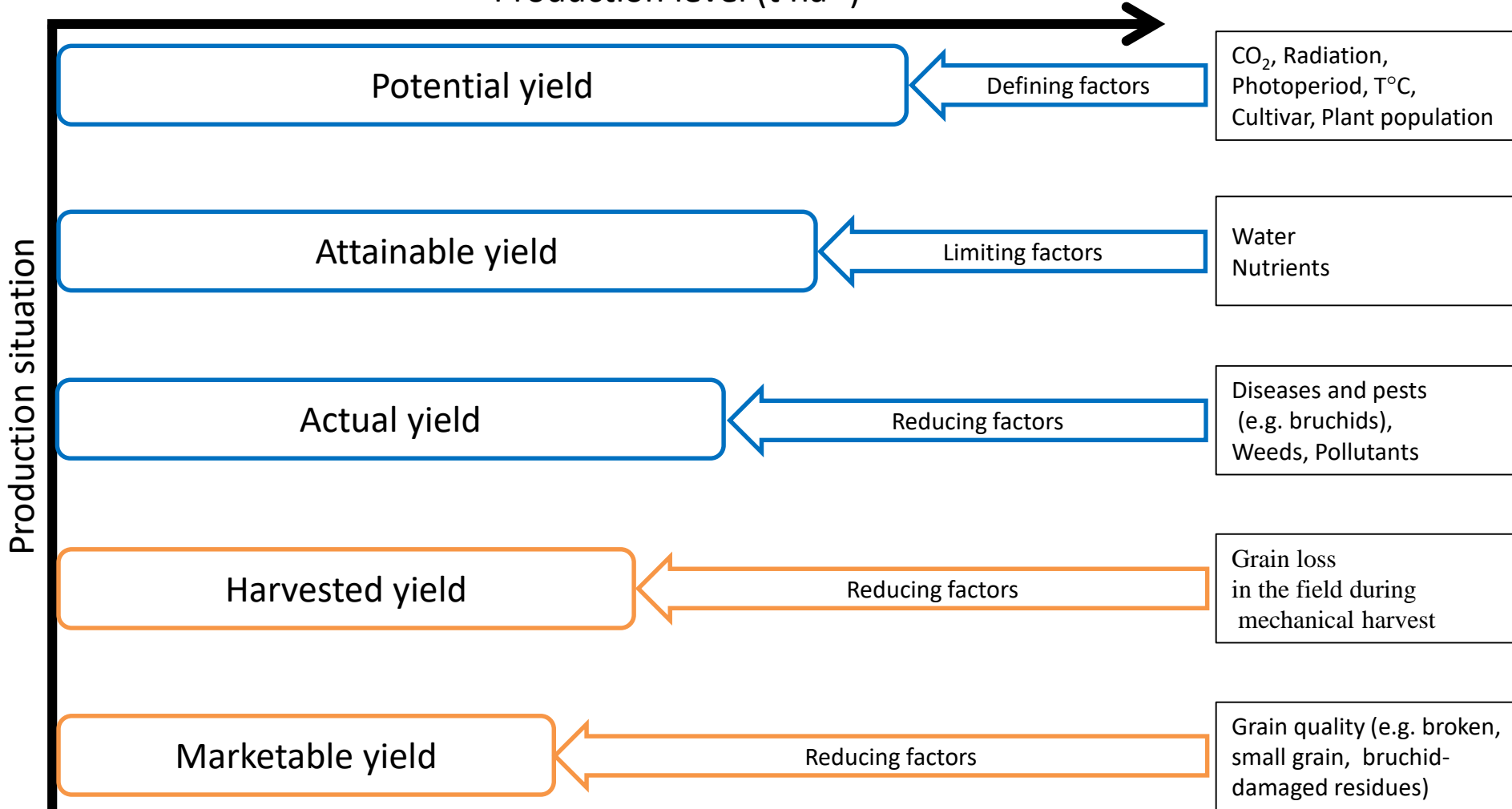


Sole crop lentil at harvest

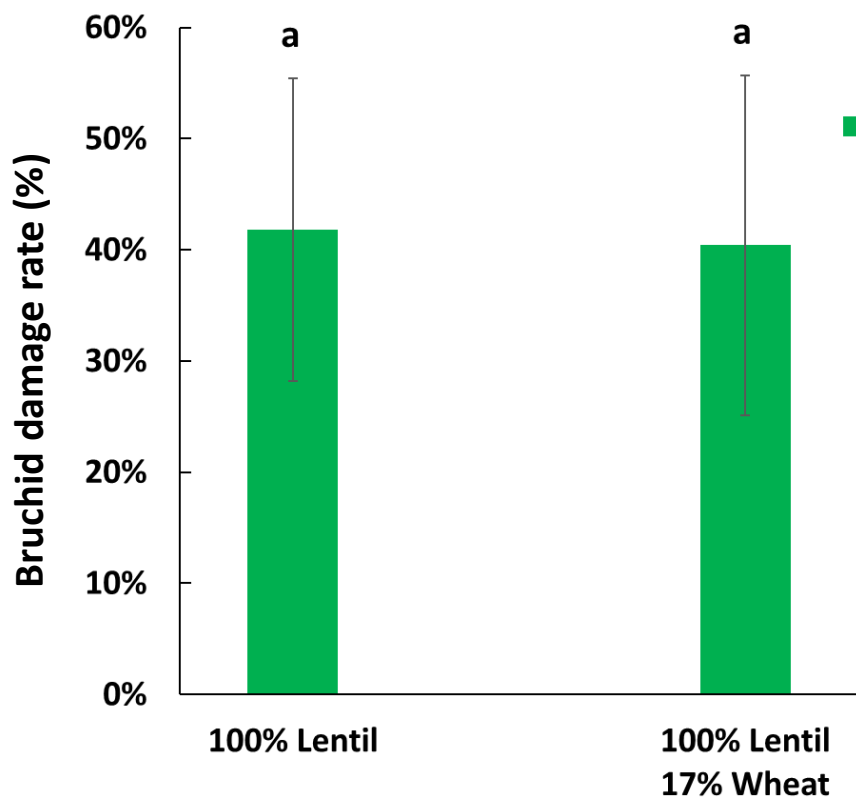
- Lentil IC lowest pod height > lentil SC
→ Stake effect from wheat

Yield gap concept (adaptation Viguiet et al. 2018)

Production level (t ha⁻¹)



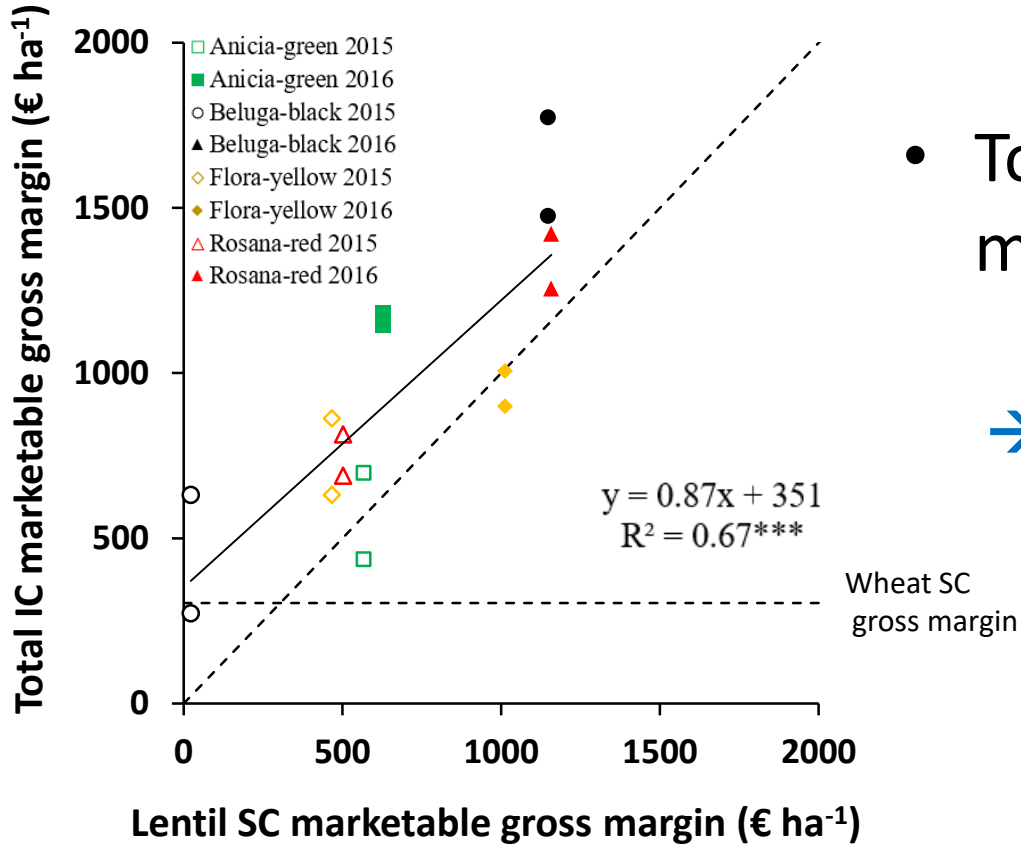
Effect of intercrops (IC) on bruchid damage rate



- No effect of IC on bruchids
→ IC not a lever to lower bruchids
- Important impact of bruchids
- Effect of year and lentil cultivar
→ Trial not designed for such study



Effect of intercrops (IC) on marketable gross margins



- Total IC marketable gross margin > lentil SC

→ IC is an insurance and a bonus



Conclusions

- Intercropping lentil with wheat
 - **Lowers lentil lodging**
 - **Has no effect on bruchid damages**
- Economic analysis
 - **Should consider marketable yield**
 - **Indicates lentil crop is currently far from optimum**



Thanks for your attention

- For more information:
→ **Agron. Sustain. Dev. (2018)**

Agronomy for Sustainable Development (2018) 38:39
<https://doi.org/10.1007/s13593-018-0515-5>

RESEARCH ARTICLE



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