Yield gap analysis extended to marketable grain reveals the profitability of organic lentil-spring wheat intercrops

Loic Viguier, Laurent Bedoussac, Etienne-Pascal Journet, Eric Justes

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

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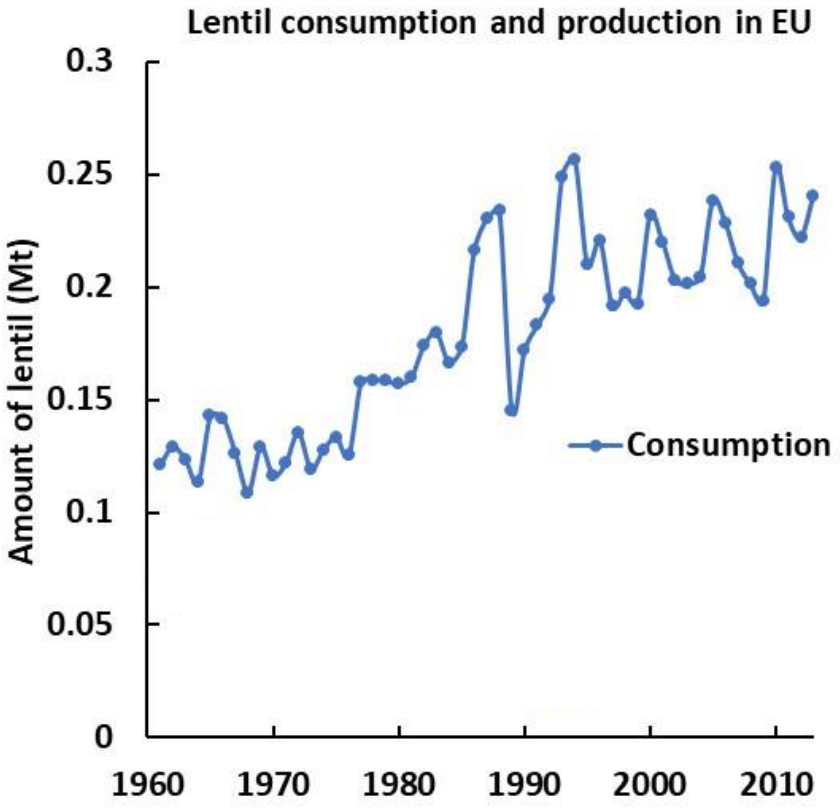
AGroécologie - Innovations - TeRritoires

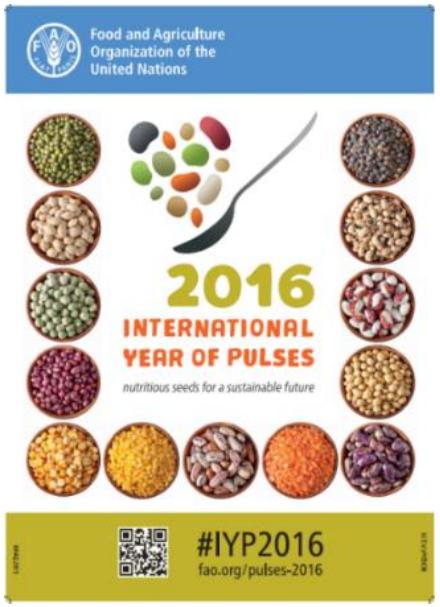
VASCO Team
Varieties and cropping systems for an agroecological production

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



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



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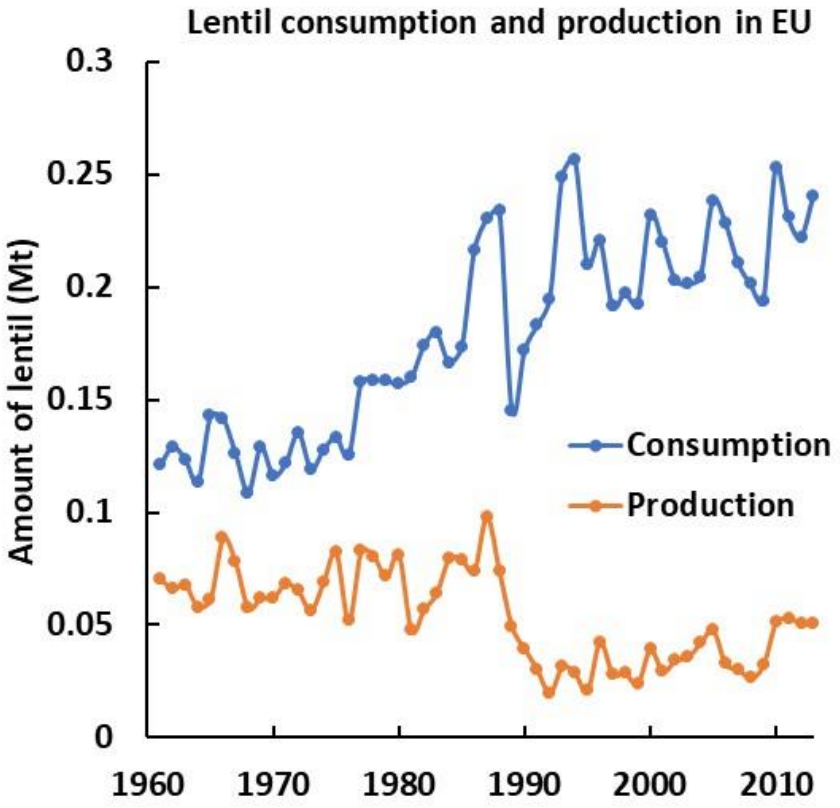

- Growing consumption [1]
- Enhanced communication:
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- Consumption > Production
  → **Regional deficit** [1]
  → **Market opportunity**

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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) ?

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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

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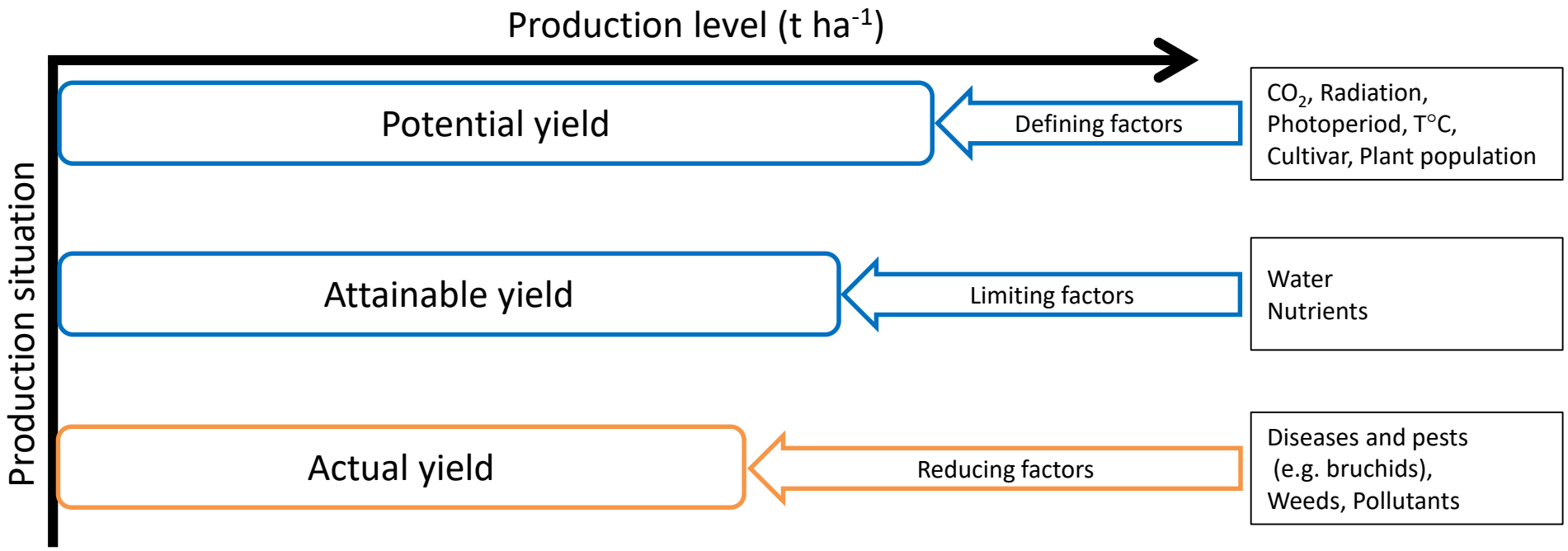
Yield gap concept
(adapted from Evans 1993 and Van Ittersum et al. 2013)



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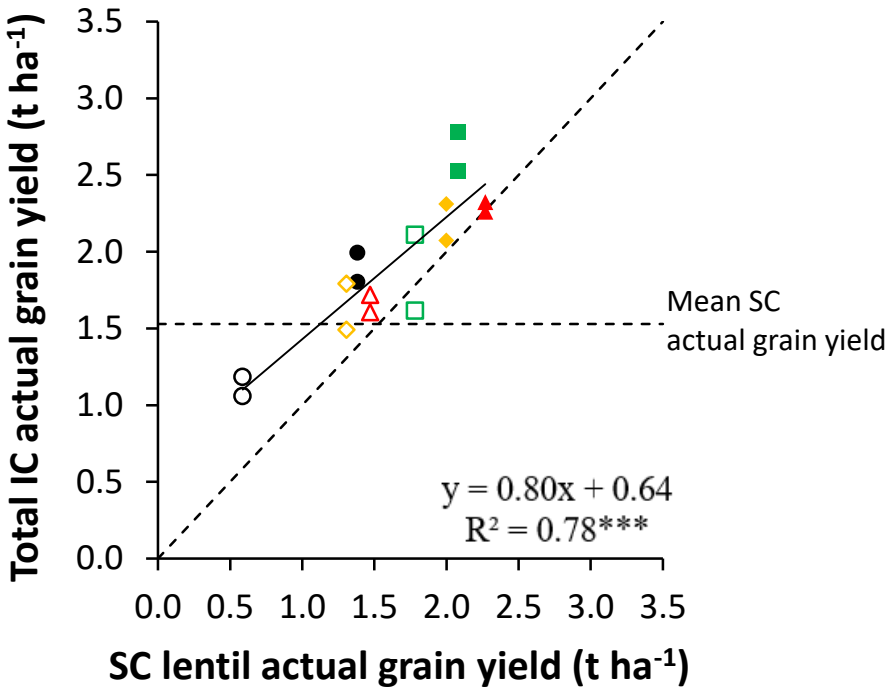
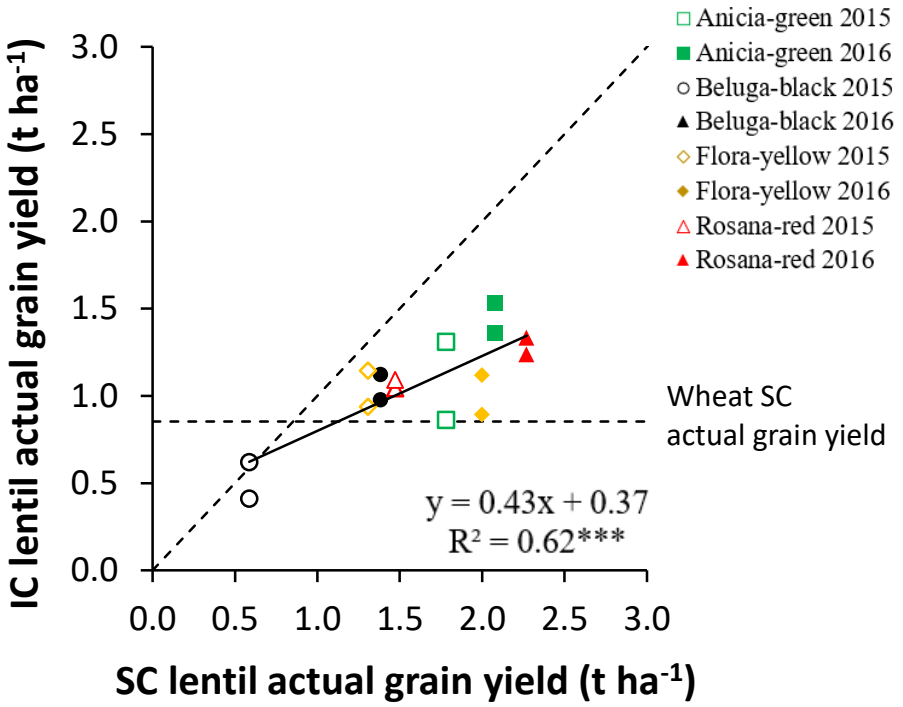
Effect of intercrops (IC) on actual grain yields





- 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 ?**

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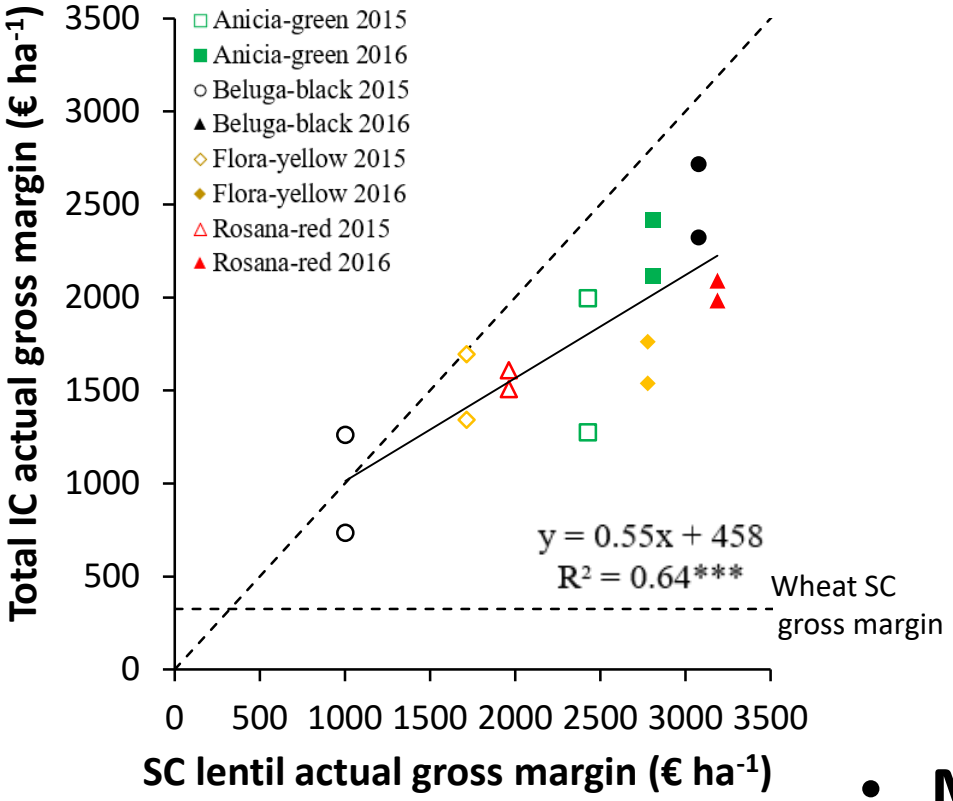
Effect of intercrops (IC) on actual gross margins



- 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 ?**

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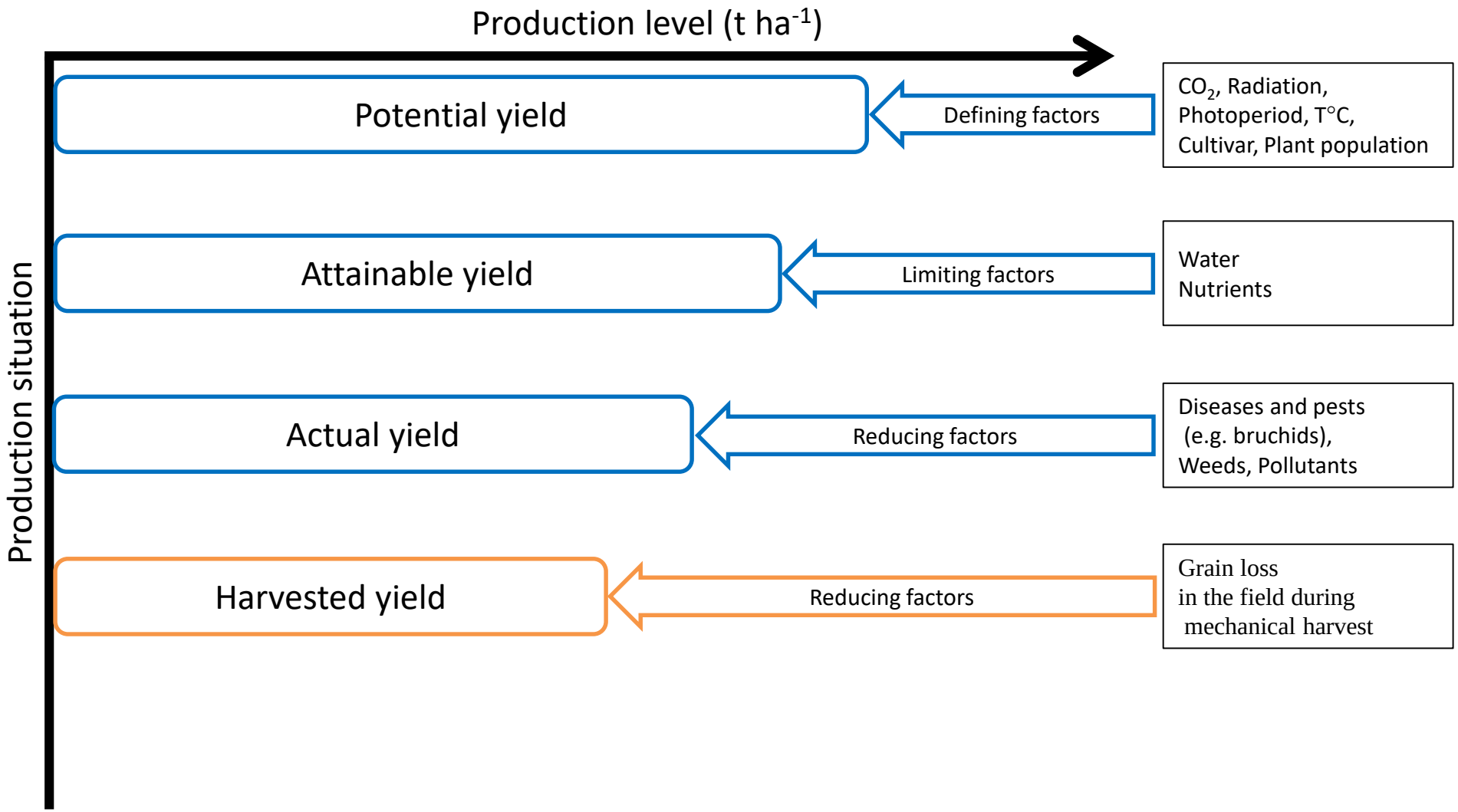
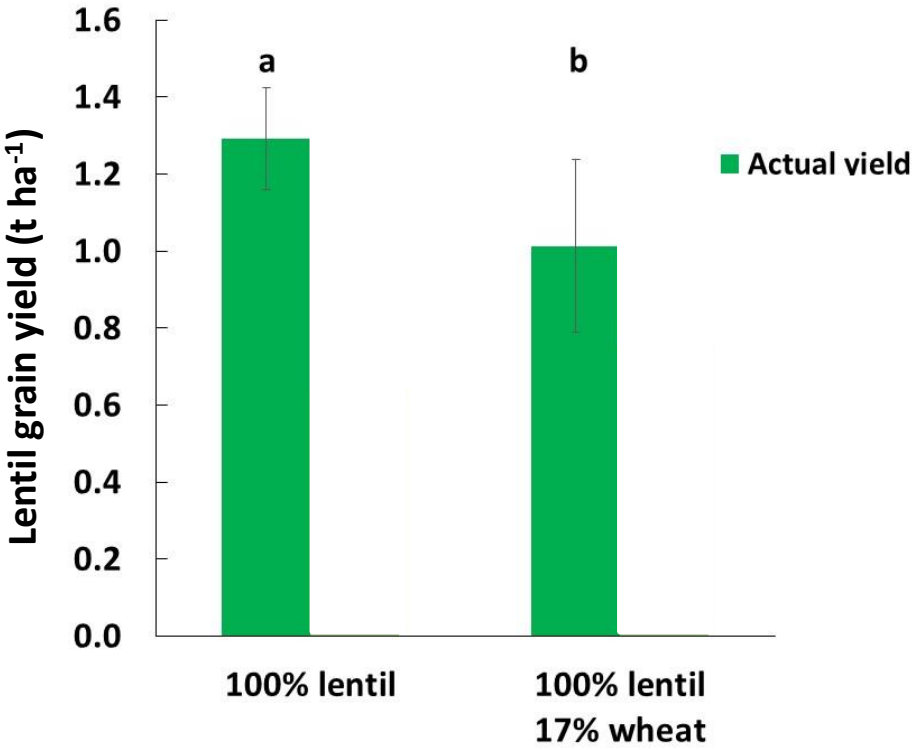
Yield gap concept (adaptation Viguier et al. 2018)



Effect of intercrops (IC) on lentil harvest efficiency



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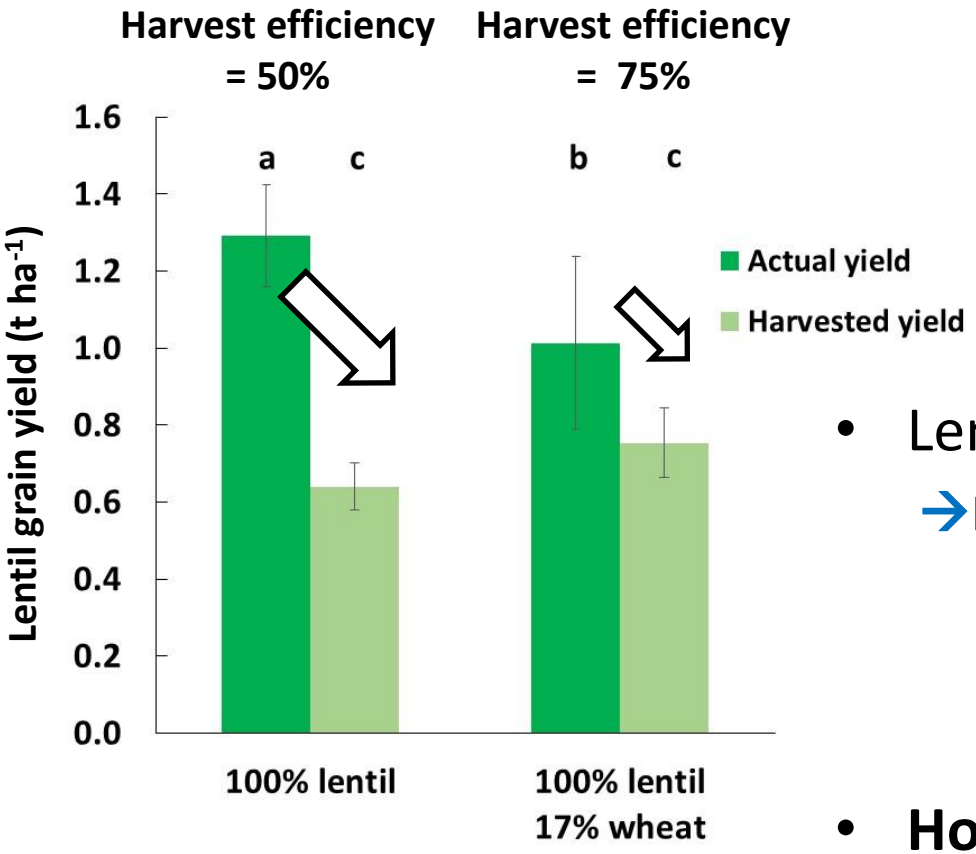

Mechanical harvest at INRA in 2016

- Lentil IC harvested yield = lentil SC
  → **Importance of considering harvest losses**

- **How to explain harvest efficiency ?**

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Effect of intercrops (IC) on lentil harvest efficiency

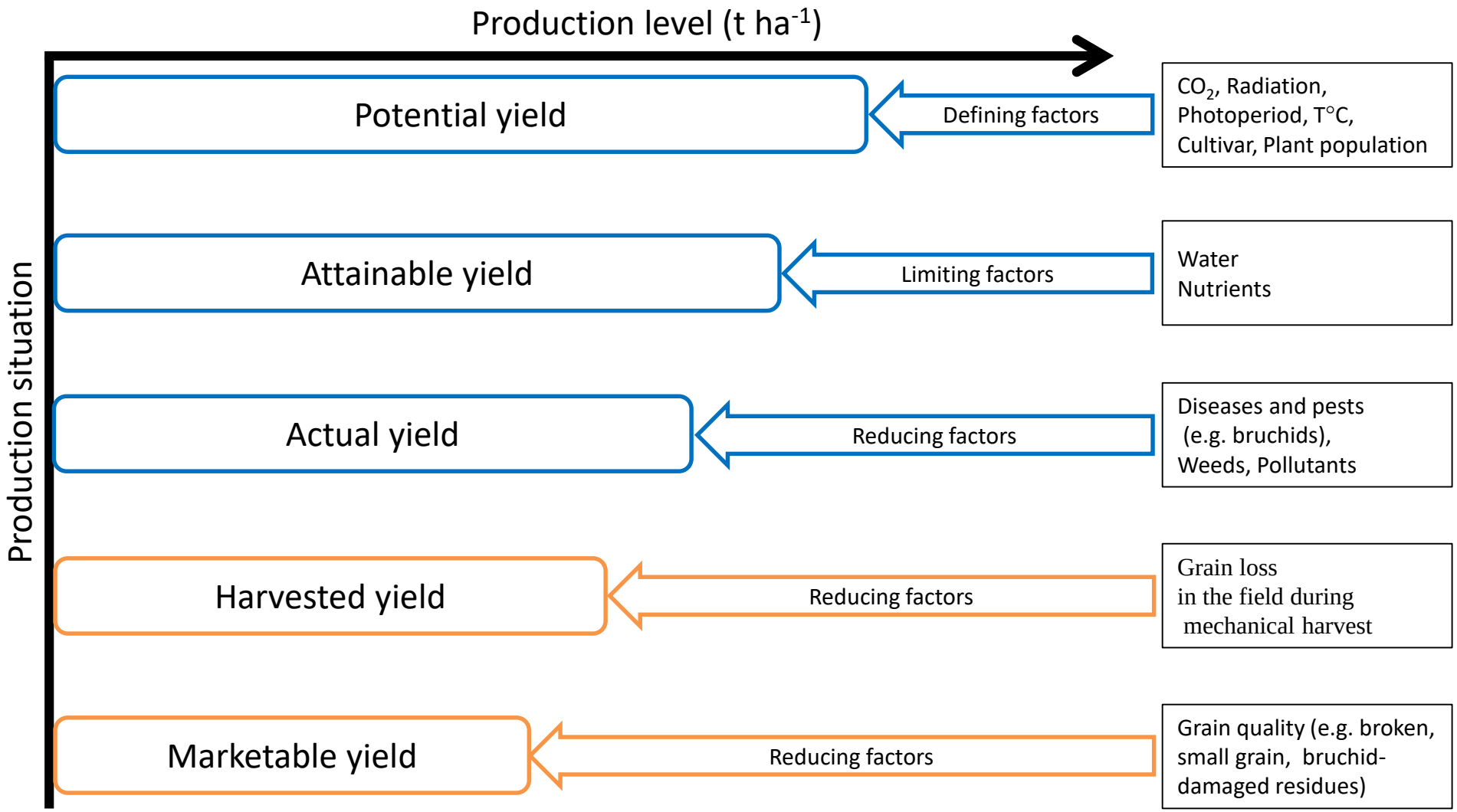
Intercrop lentil at harvest

Sole crop lentil at harvest

- Lentil IC lowest pod height > lentil SC

  →Stake effect from wheat

Yield gap concept (adaptation Viguier et al. 2018)



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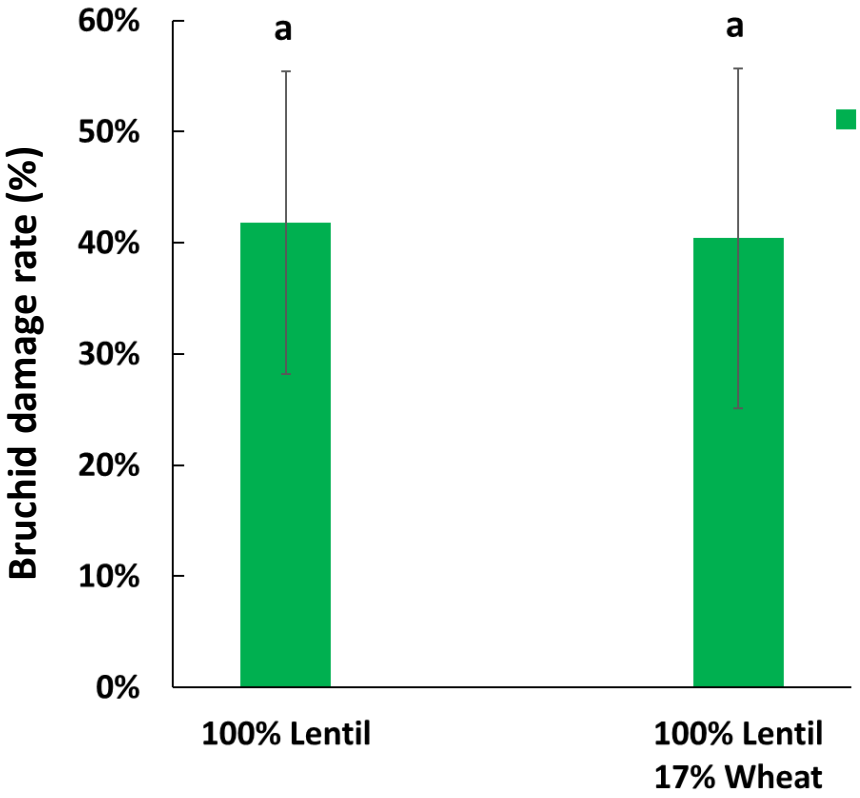
Effect of intercrops (IC) on bruchid damage rate



- 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**

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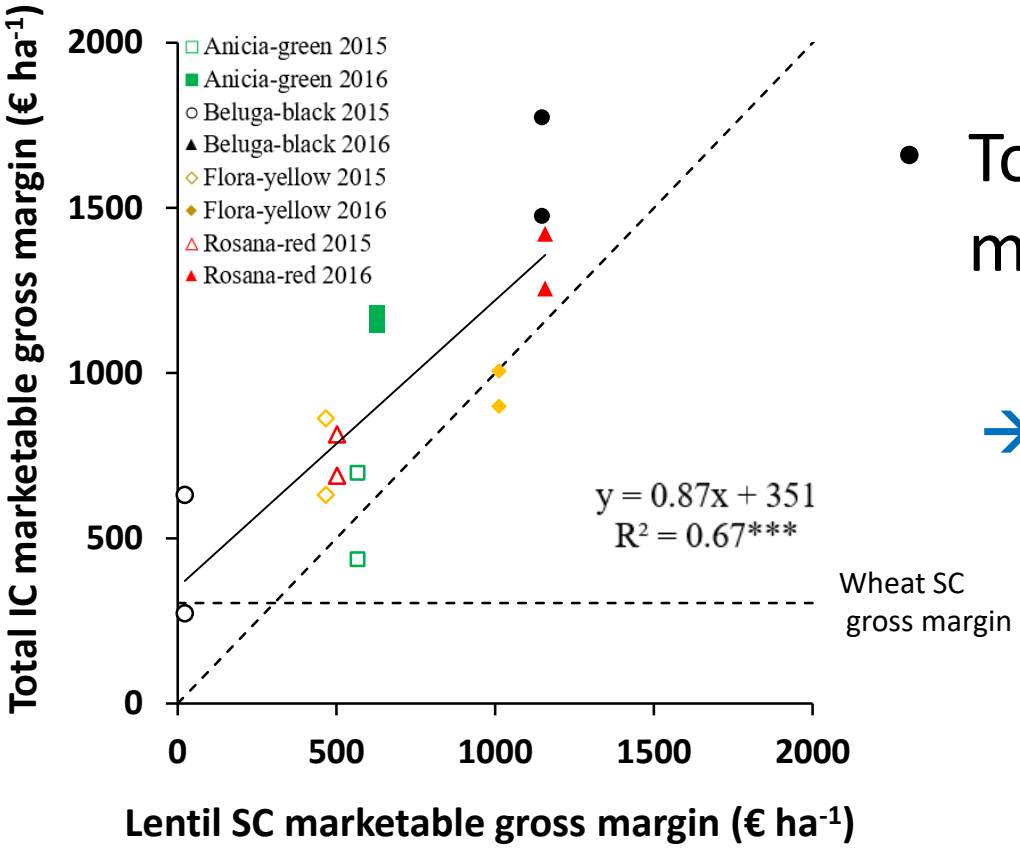
Effect of intercrops (IC) on marketable gross margins



- Total IC marketable gross margin > lentil SC

→**IC is an insurance and a bonus**

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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**

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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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- Acknowledgments :

Technical team AGIR
Michel Labarrère
Benoît Gleizes
Didier Chesneau
Eric Lecloux
Didier Raffaillac
& Experimental unit of INRA-Auzeville

Team Qualisol
Alain Larribeau
Jérémy Grève
Gérard Mamprin