Intercropping Advantages

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Background

Intercropping

→ Growing two or more crops simultaneously on the same field
→ Potential for higher resource use efficiency than in monocropping
→ Mechanisms for potential advantages are:
reduced competition, **complementarity**, **facilitation**

Study Approach

→ Experiment with field pea and spring barley *(see 'Treatments')*
→ Growth in pots under deficiency of P and micronutrients
→ Substituted design *(see 'Treatments')*

Research Questions

→ Does intercropping increase biomass production and P and Zn uptake?
→ Which are the plant traits possibly contributing to any advantages?

Hypotheses

→ Legumes promote P and Zn uptake in cereals.
→ Improved P and Zn uptake translates into increased biomass production.

Outcome

→ Higher relative biomass production probably resulted from increased P and Zn content.
→ Intraspecific competition > interspecific competition
→ Our findings comply with other studies on nutrient availability in cereal-legume intercropping.
→ **Intercropping increases nutrient acquisition, but does not necessarily translate into net yield benefits.**

Facilitation

→ P and Zn mobilization by root exudates of pea
→ Efficiently absorbed and translated into biomass by barley

Competition

→ plant density effect = intraspecific competition
→ density effect higher in barley with large root system
→ self-inhibition in pea due to smaller root system
→ larger advantages in barley by interspecific competition
→ pea mutant restricted by root-trait defects[1, 2].

LER

Land Equivalence Ratio

$$= \frac{\text{Intercrop A}}{\text{Monocrop A}} + \frac{\text{Intercrop B}}{\text{Monocrop B}}$$

LER is the proportion of land needed for intercropping relative to monocropping

LER > 1
Intercropping advantage

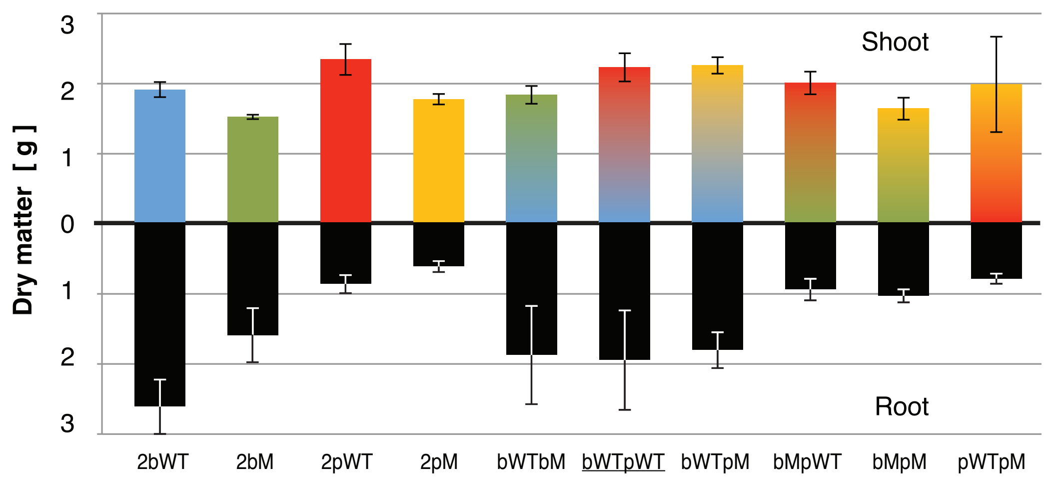
LER < 1
Intercropping disadvantage

LER > 0.5
Advantage of intercrop component A or B

Treatments

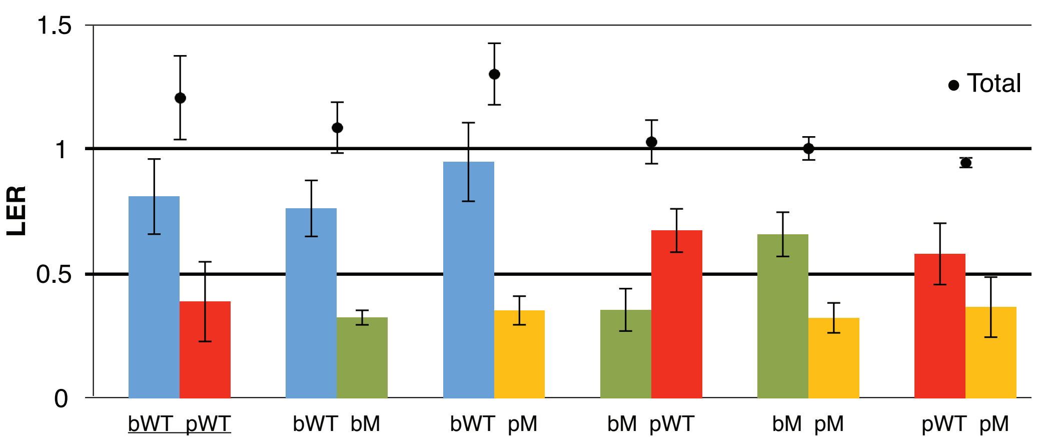
bWT	barley wild type
pWT	pea wild type
bM	barley mutant no root hairs
pM	pea mutant no AMF, no rhizobia
	bWTbM
	bWTpWT
	bWTpM
	bMpWT
	bMpM
	pWTpM

Absolute Root and Shoot Biomass



No absolute intercropping advantage
→ Total biomass: wild type > mutant
→ Root biomass: barley >>> pea

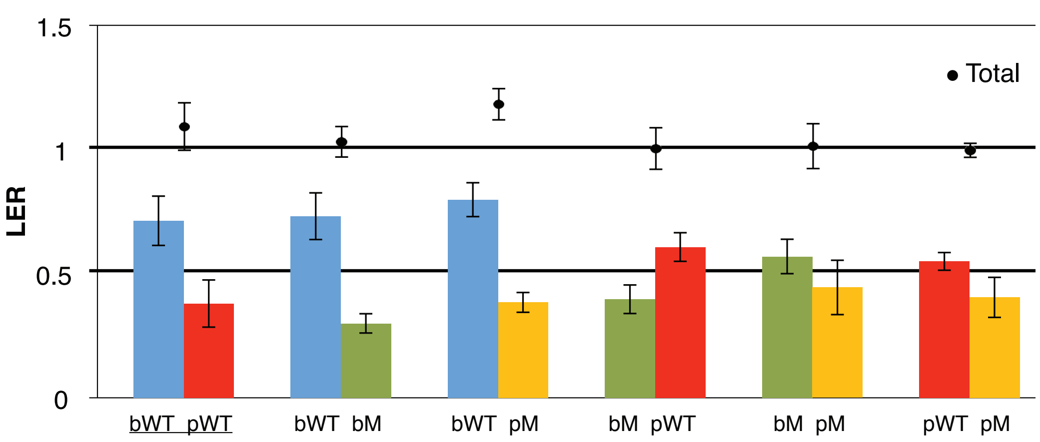
Relative Shoot P Content



Note: Virtually identical results for Zn content.

Intercropping advantage: Increased P and Zn acquisition from soil
→ Advantage is larger with pea mutant than with pea wild type
→ Barley profits

Relative Shoot Biomass



Intercropping advantage: Increased shoot biomass production
→ Advantage is larger with pea mutant than with pea wild type
→ Barley profits from reduced competition and increased nutrient availability

References
1 Li L, Li S, Sun J et al (2007). PNAS, 104(27): 11192–11196.
2 Li S, Wang Z, Stewart BA (2011). Advances in Agronomy, 110(3): 125–130.

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