

Intercropping of cereals and grain legumes for increased production, weed control, improved product quality and prevention of N –losses in European organic farming systems (INTERCROP)



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Agrobiodiversity

- resource use efficiency
- biomass productivity
- weed, pest and disease infestation
- yield stability and resilience to stress
- crop quality
- nutrient loss
- landscape quality



Agrobiodiversity in organic farming

Which direction should/can/are we moving?



**Field size, intercropping, agroforestry (diversity in space)
is complementary to diversity in time (rotation)**





- Yield level and stability managed by input factors (fossil energy, fertilizers, irrigation, agrochemicals, heavy mechanization)
- Homogeneity – visually and harvested product
- Inefficient use of resources and losses
- Limited biodiversity



- Yield level and stability managed by diversity, complementarity and competitive interactions (ecosystems services)
- Heterogeneity - visually and harvested product
- Efficient use of resources and lower losses
- Greater biodiversity





intercropping

- the simultaneous cultivation of several species on a field
- well-known in grass mixtures
- arable crops less frequently intercropped
- two species or cultivars are the most simple intercrop



intercropping potential mechanisms and effects



competition:

- niche differentiation
- resource use and sharing
- weed control

diversity:

- pest and disease control

facilitation:

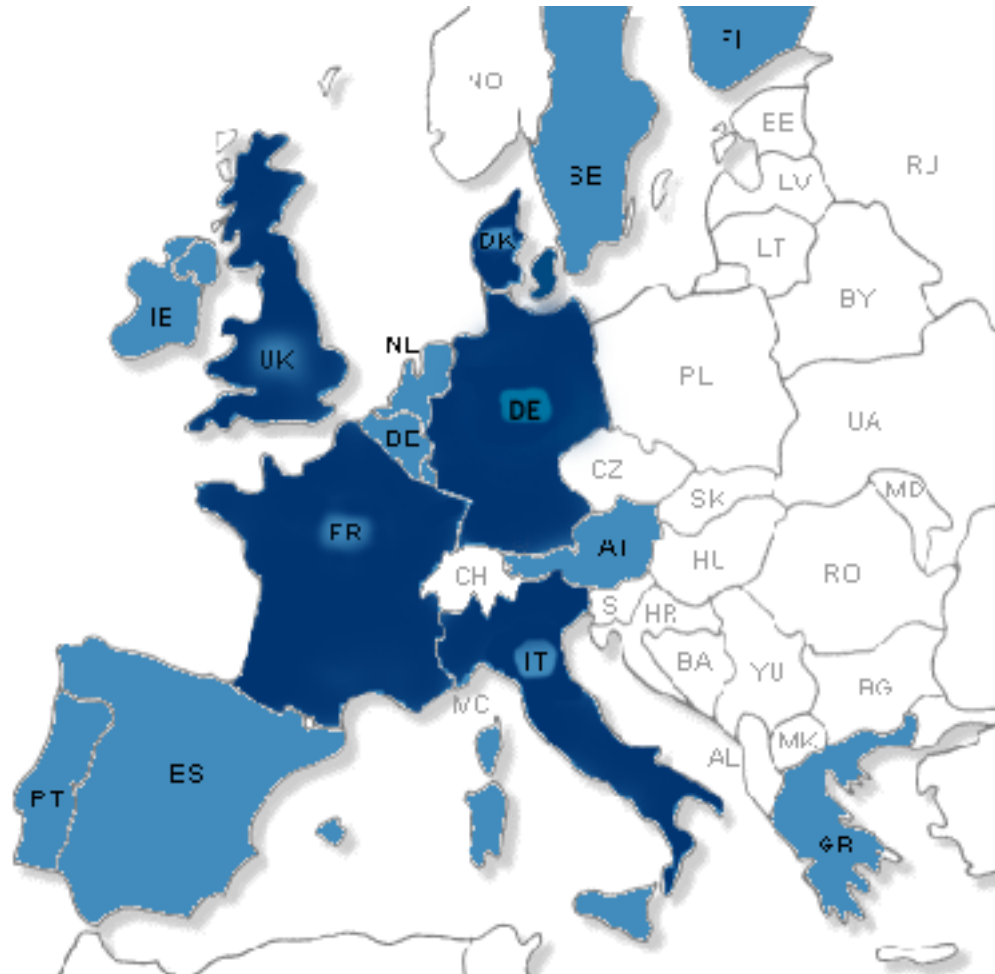
- physical support
- excretion of N & allelochemicals
- modification of the rhizosphere

associated diversity:

- habitats for natural predators
- litter diversity enhances soil microbial diversity



the INTERCROP project 2003-2006



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The University of Reading



Ministry of Food, Agriculture and Fisheries
Danish Institute of Agricultural Sciences



Institut National de la Recherche Agronomique



INTERCROP objectives

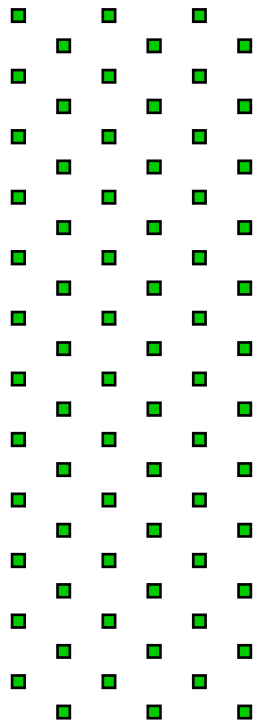
- To increase the knowledge and awareness of the multifunctional role of intercropping systems in organic farming with special emphasis on arable cropping systems
- To quantify yield advantage and stability of selected intercrops compared to sole crops in organic farming systems under different agro-ecological conditions in Europe.
- To determine the effect of intercropping on weed suppression, pest and diseases in organic arable crops
- To determine crop nitrogen dynamics in intercrops compared to sole crops and the potential of intercrops for minimizing the risk of N-leaching in organic farming systems.
- To determine the effects of and potential for manipulating grain quality parameters by intercropping.
- To develop and test new methods of intercropping for multifunctional purposes.
- To develop a simulation model to intercropping of grain legumes and cereals.



Basic pea(■)-barley(■) intercrop design

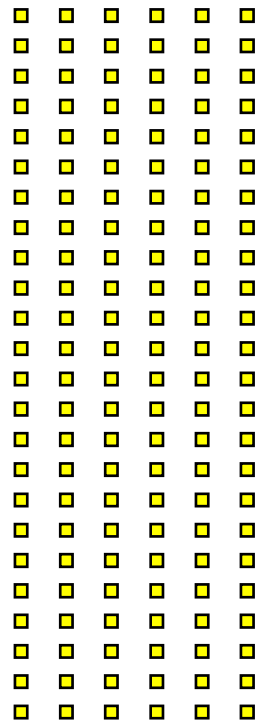
Sole cropping

P100



90 pl. m⁻²

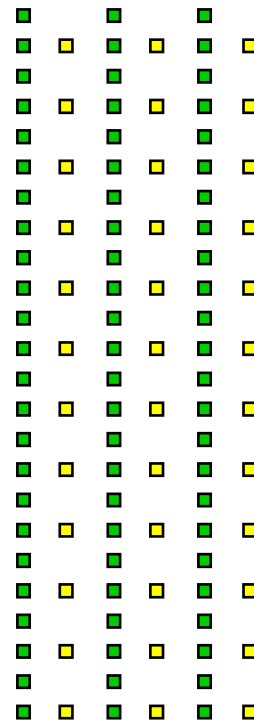
B100



300 pl. m⁻²

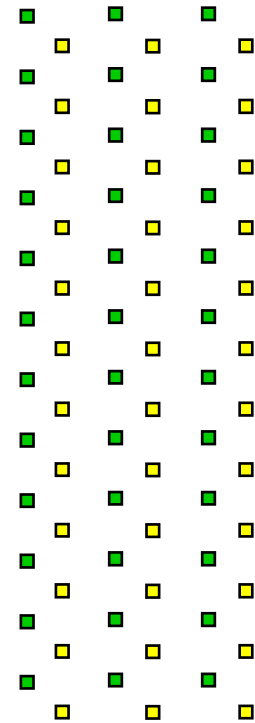
Row-by-row intercropping

P100B50



90+150 pl. m⁻²

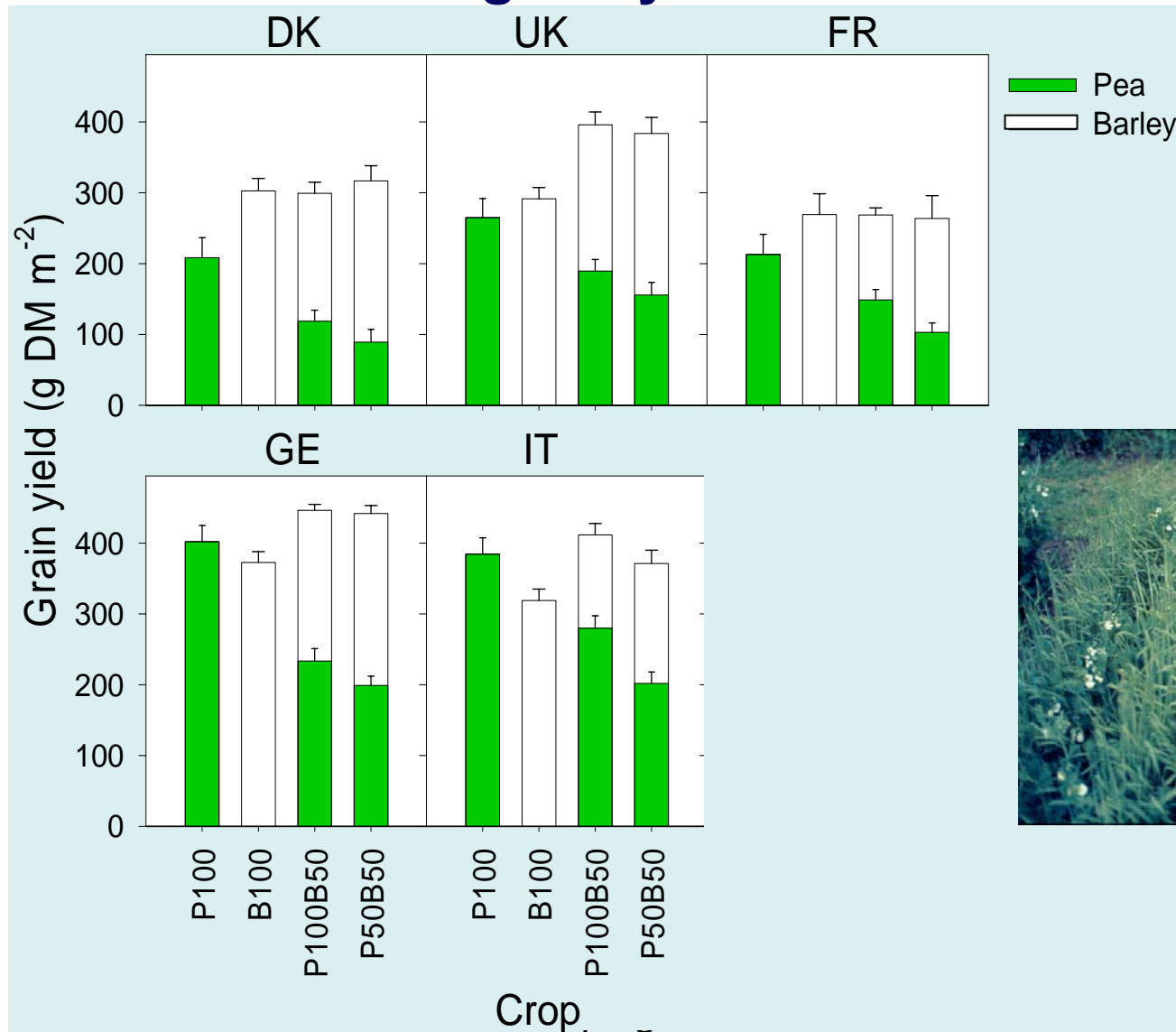
P50B50



45+150 pl. m⁻²



pea-barley intercrop agronomic performance grain yield



land equivalent ratio (LER)

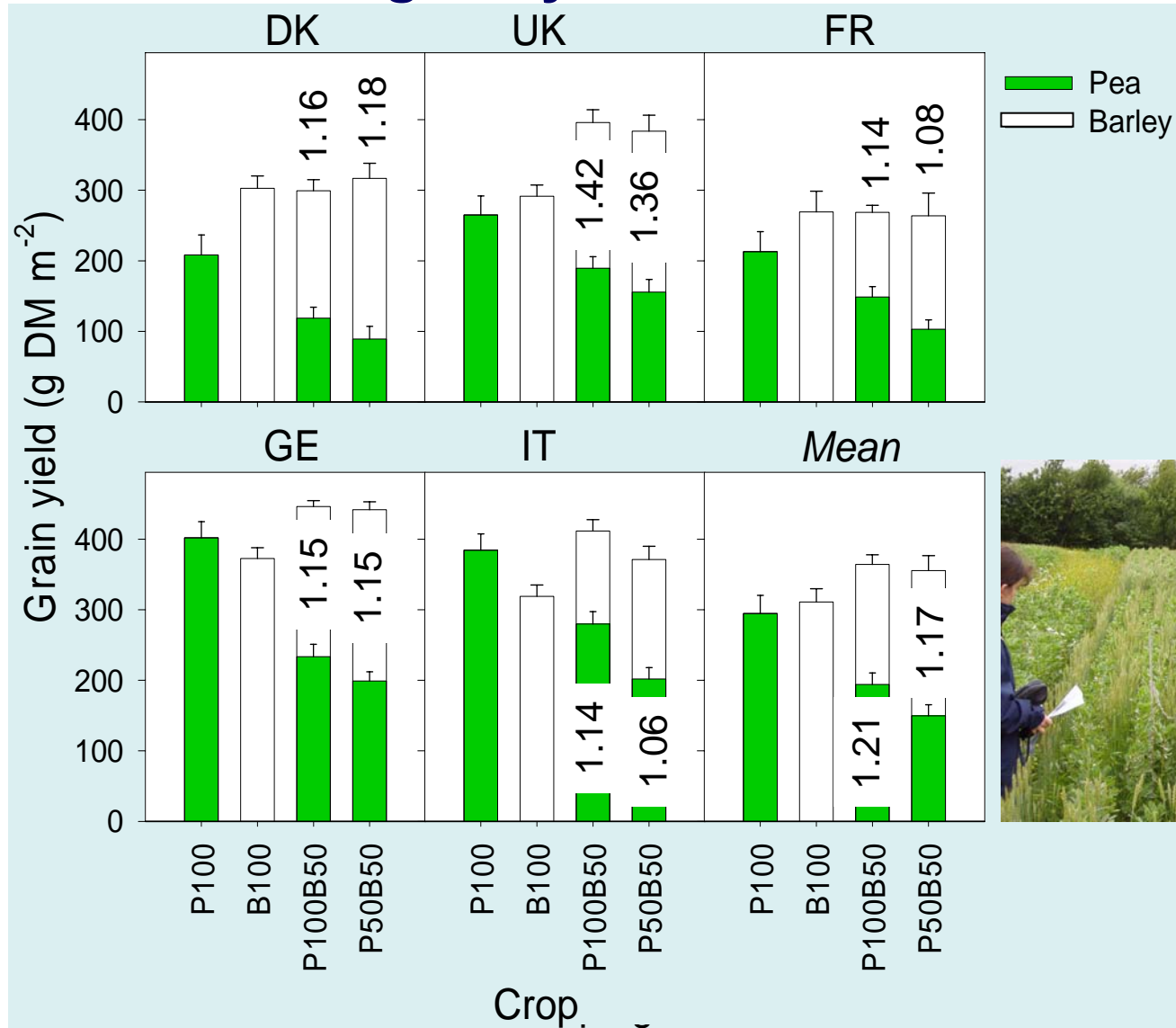
$$LER_{AB} = \frac{Y_{AB}}{Y_{AA}} + \frac{Y_{BA}}{Y_{BB}}$$

LER > 1: Advantage from intercropping

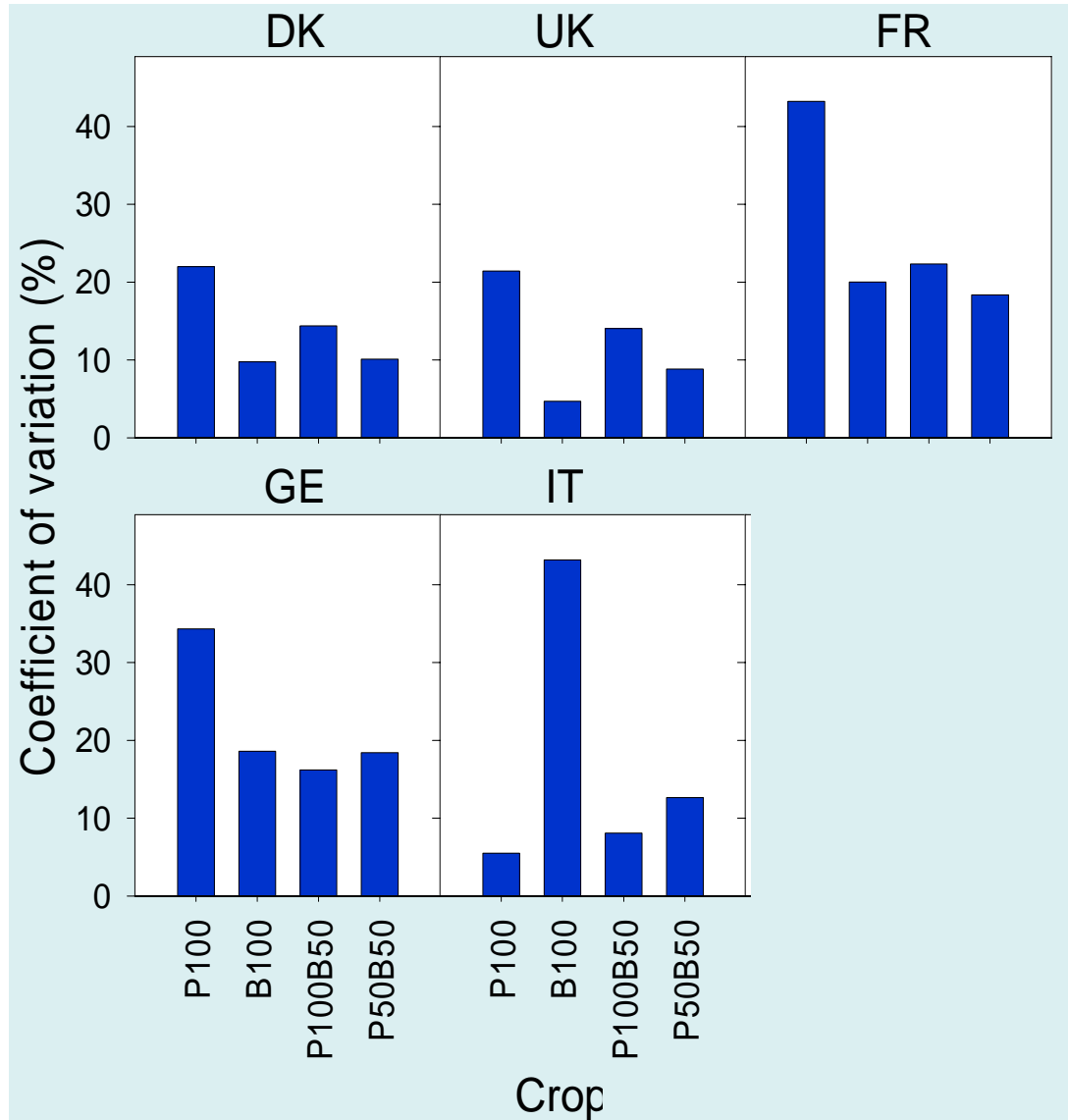
LER < 1: Advantage from sole cropping



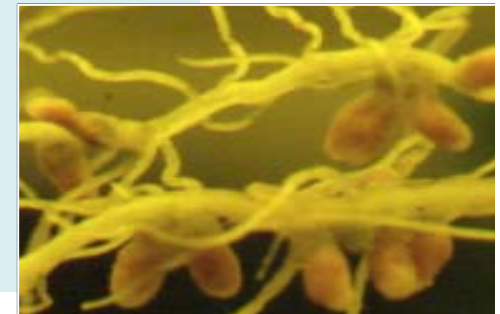
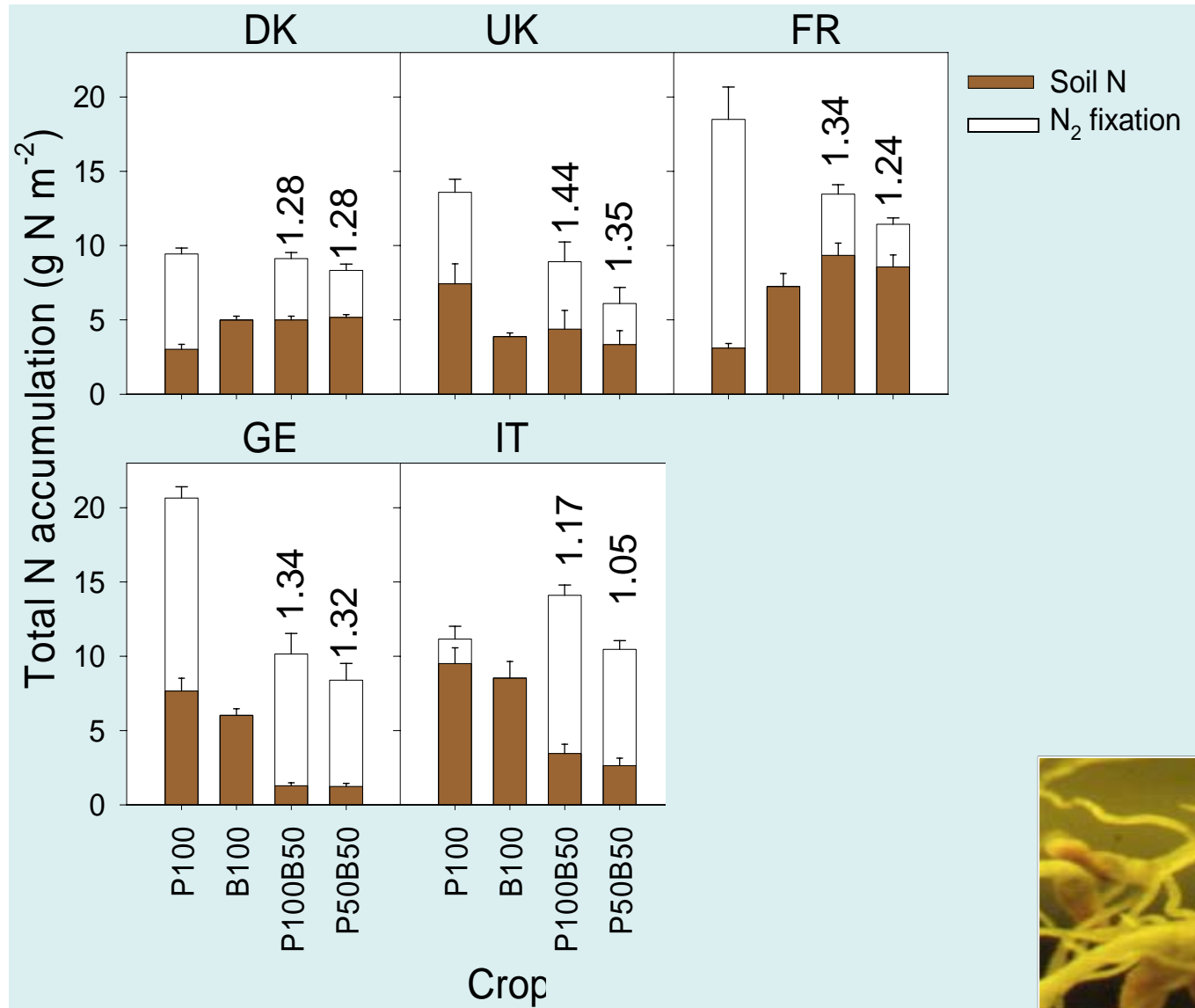
pea-barley intercrop agronomic performance grain yield & LER



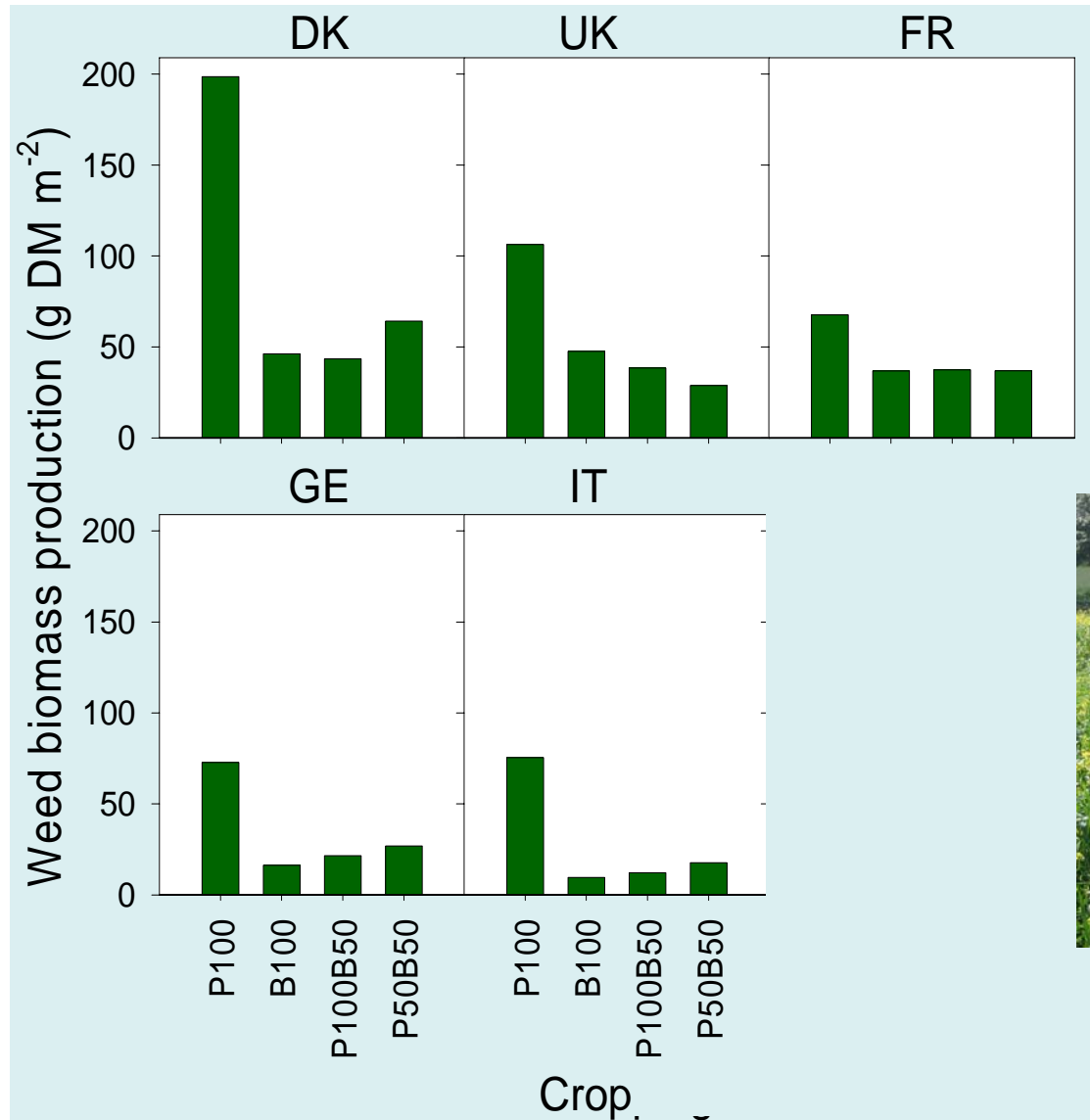
pea-barley intercrop agronomic performance stability (CV%)



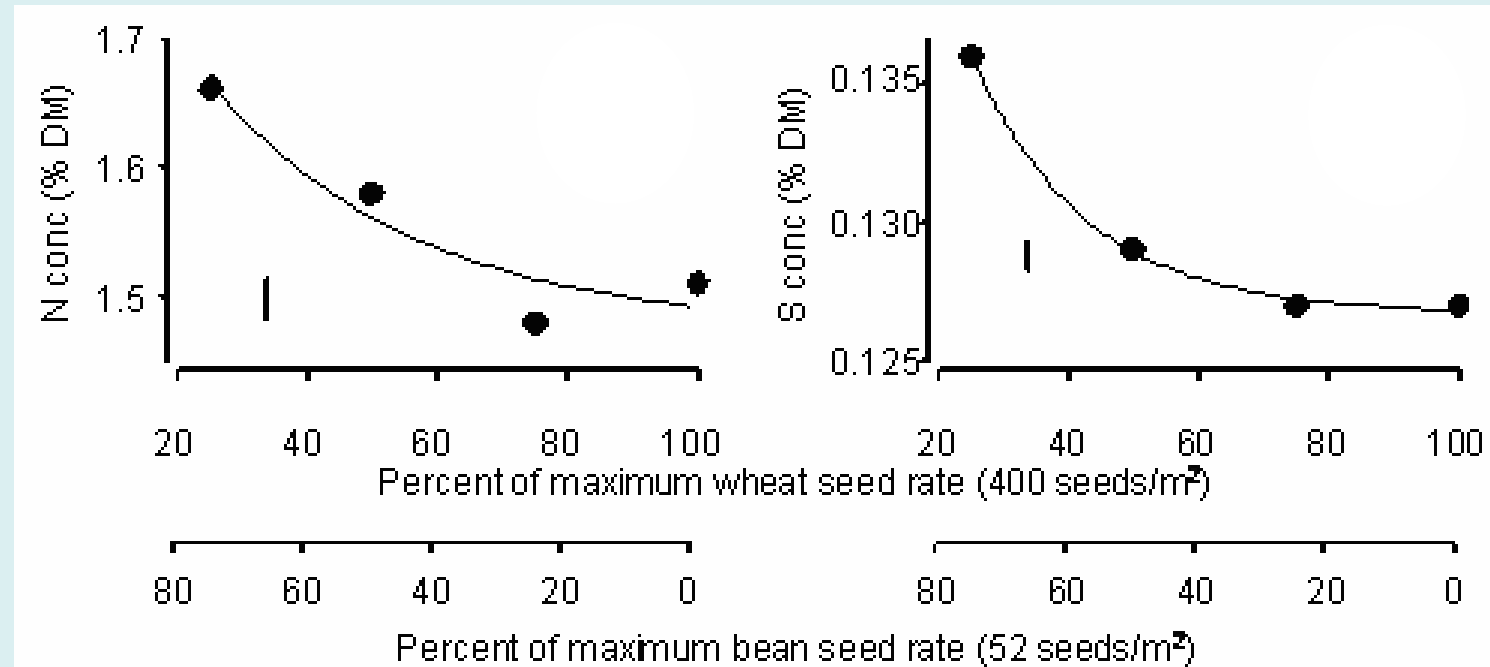
nitrogen resource use soil N+ fixed N kg/ha



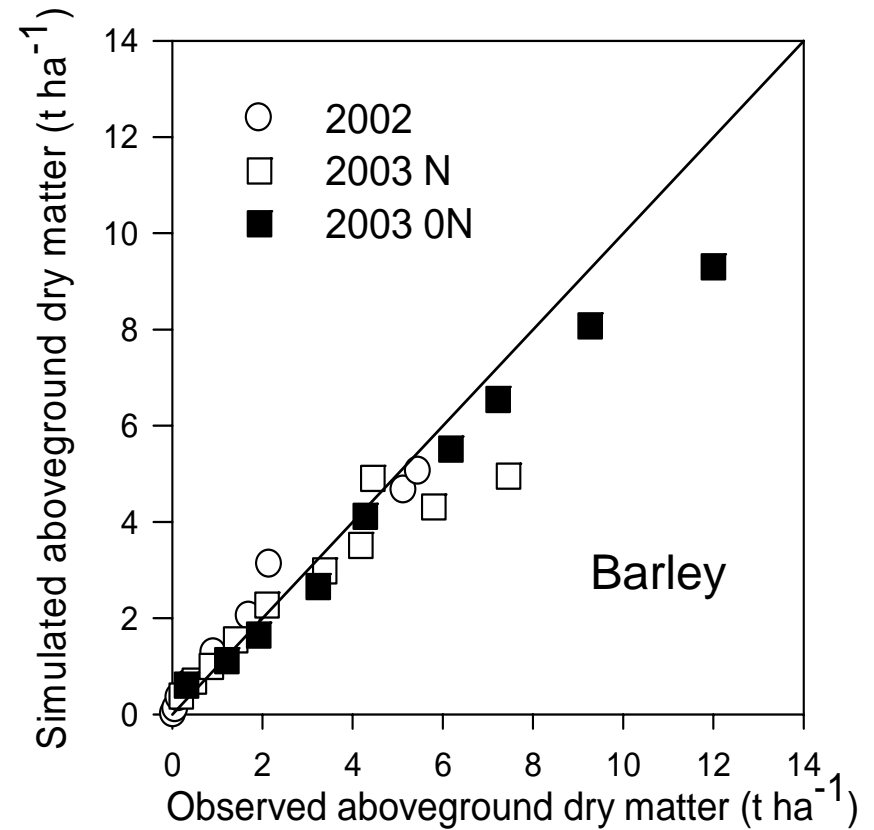
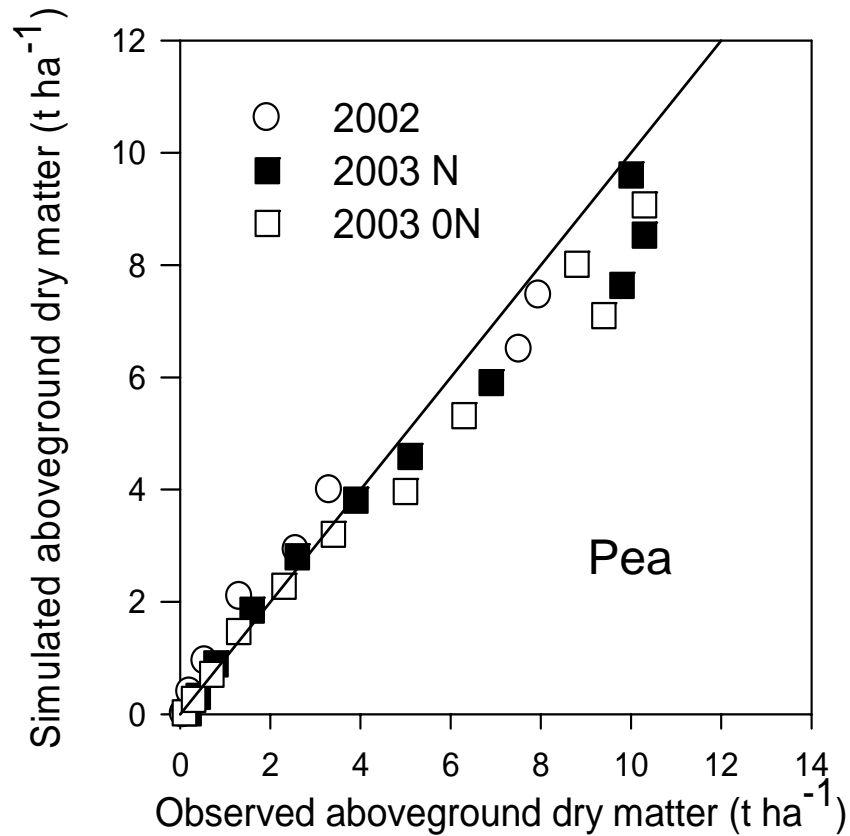
effect of intercropping on weeds



wheat grain quality



STICS simulation model intercropping module



conclusions

- The pea-barley intercrop grain yield advantage is typically 10-20% and the stability of yields over years is always higher than one of the SCs. Similar in wheat-fababean.
- N, P, K and S nutrient resources are used 15-30% more efficiently by pea-barley intercrops than by SCs.
- IC grain legumes with cereals reduces weeds compared to SC GL and diseases in the cereal
- IC enhances cereal grain protein and sulphur concentrations, Hagberg falling number and nutritive value.
- STICS IC module is an operational model for simulating growth and nitrogen accumulation in pea-barley intercrops.



for more results and info about INTERCROP

- visit the intercropping workshop D4-a (Wed.: 9-10.30)
- have a look at the many posters on intercropping
 - and www.intercrop.dk



acknowledgement

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