Requirements of varieties and cultivation of grain legumes for animal feedstuff production in Organic Farming

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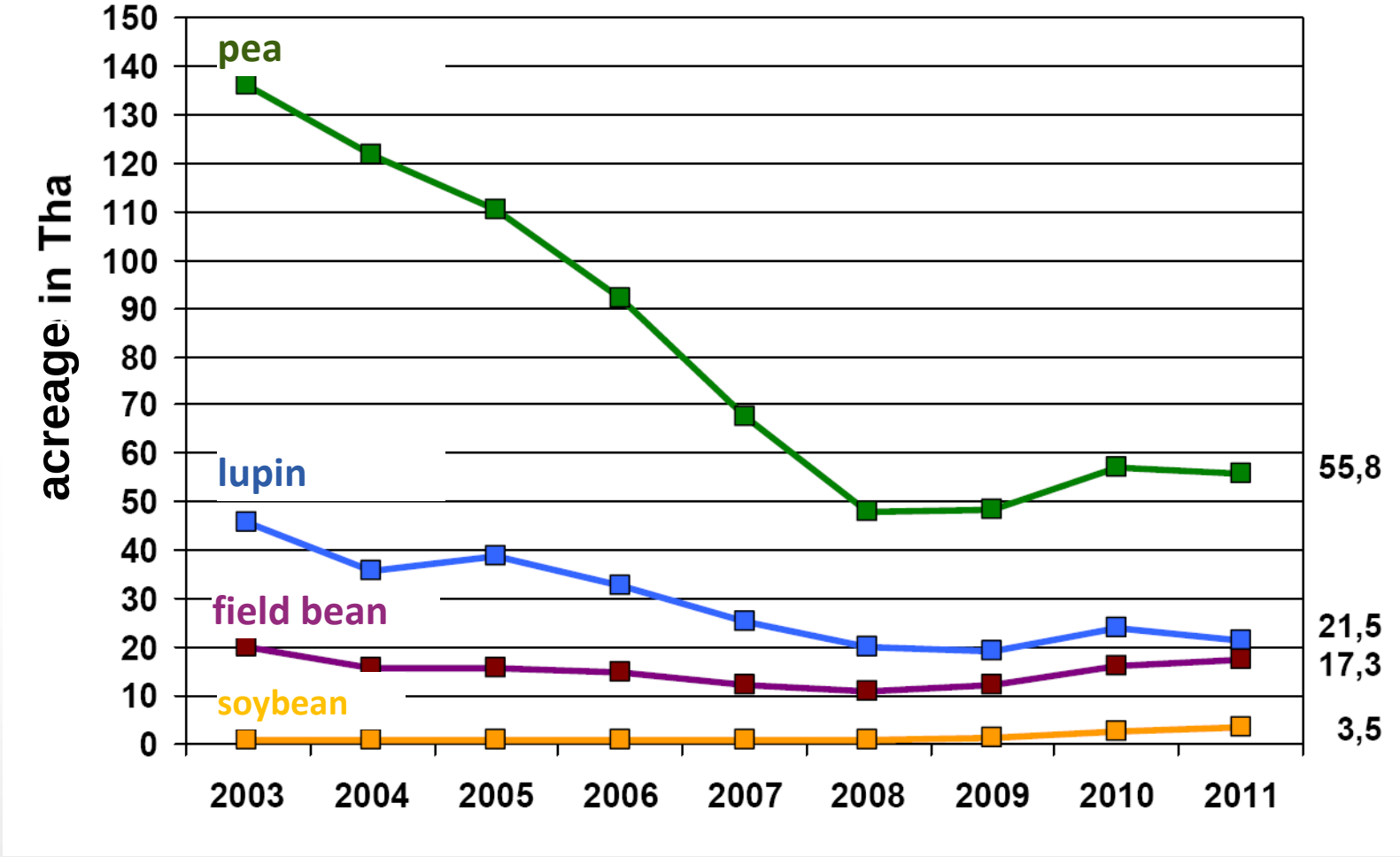
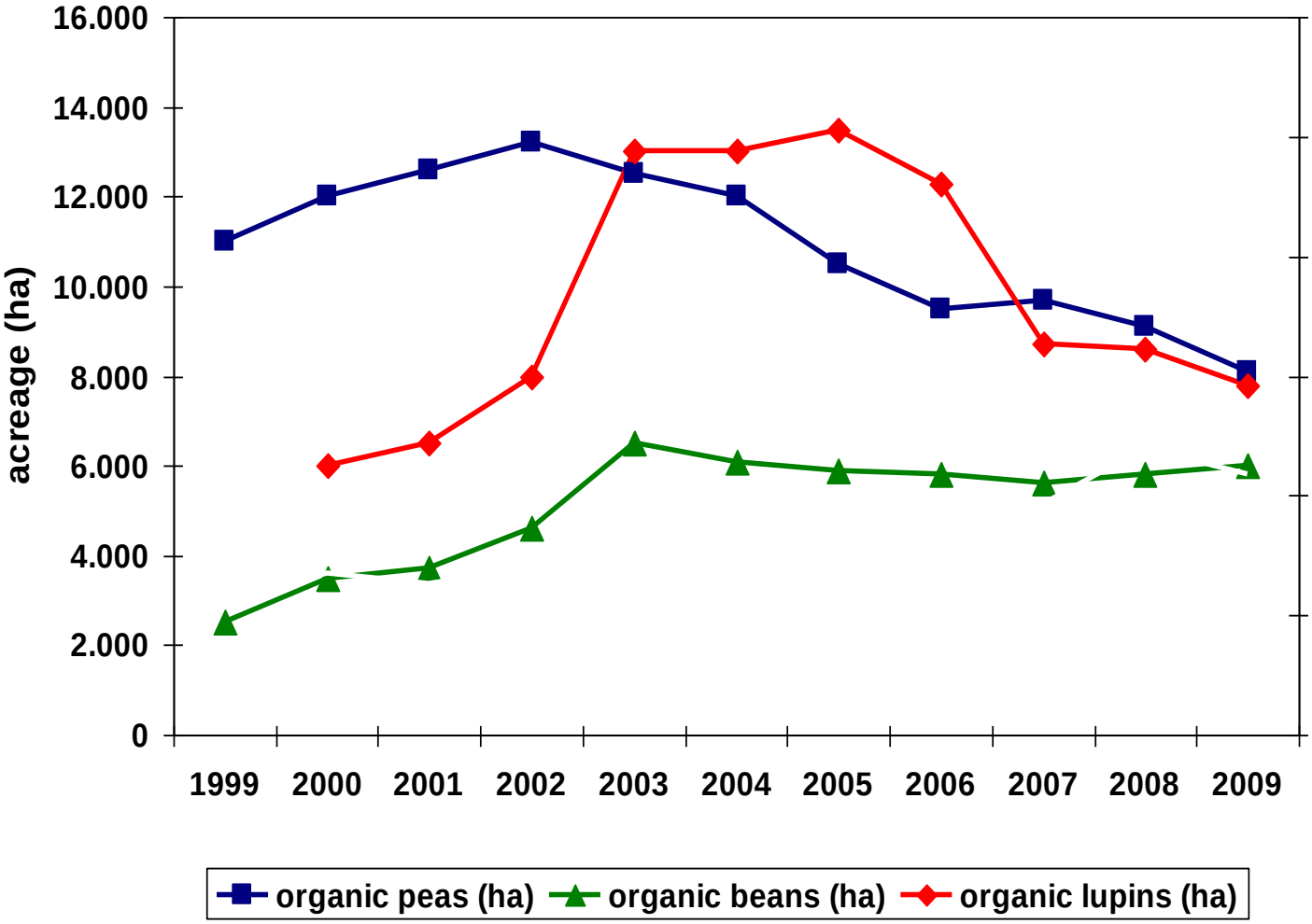
Copenhagen,
den 28.10.2013

Acreage (Tha) of grain legumes in Germany from 2003 -2011



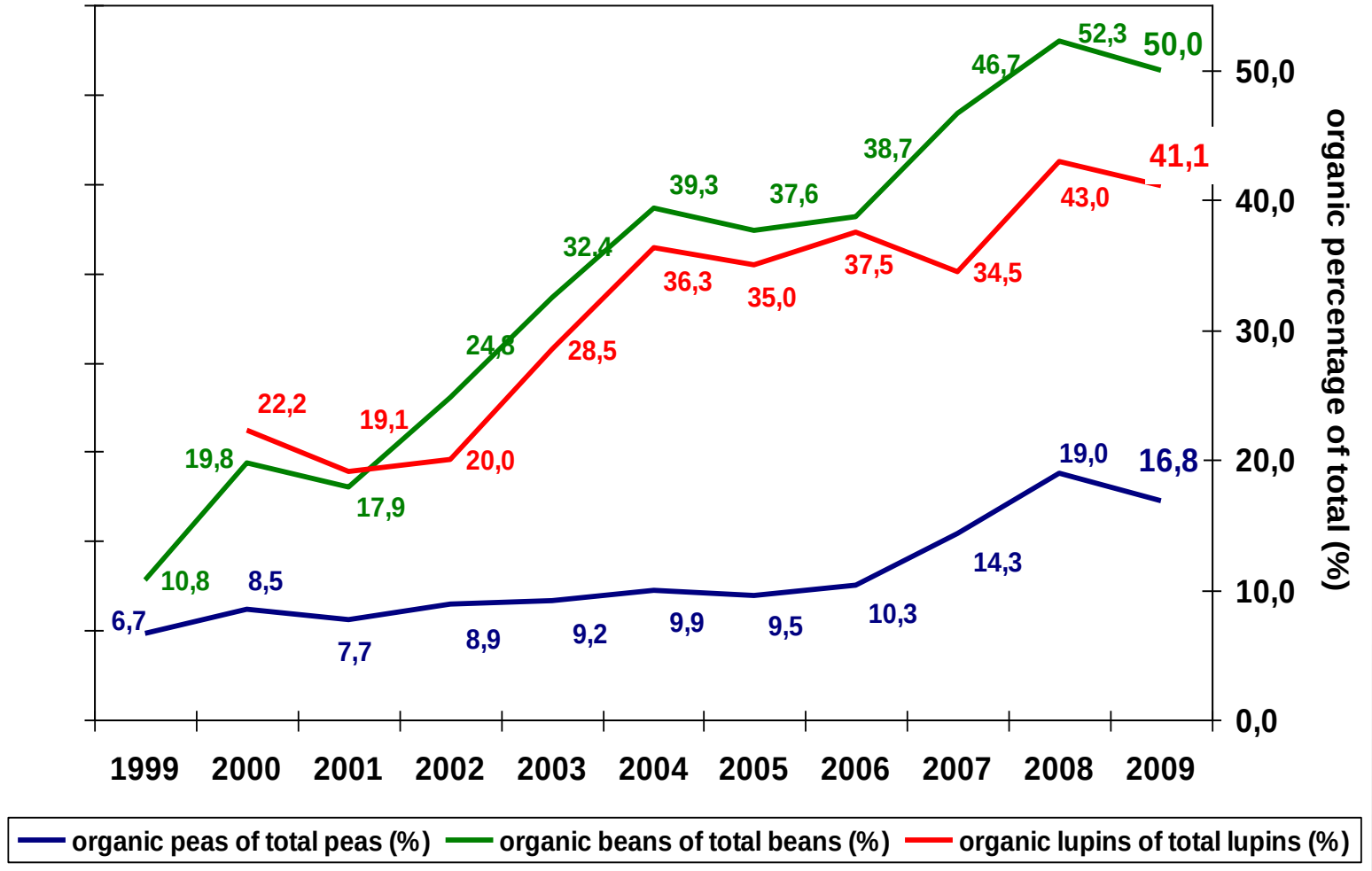
(destatis; aus Wehling 2012)

Acreage (ha) of organic grain legumes in Germany



(ZMP, Statistisches Jahrbuch (different volumes))

Percentage of organically cultivated grain legumes of the total acreage of the different grain legumes in Germany



(ZMP, Statistisches Jahrbuch (different volumes))

Official variety trials of blue lupins in Germany

conventional

organic

11 locations | **3(4) locations**

(own search by internet)

Official variety trials of peas in Germany

conventional

35 locations

organic

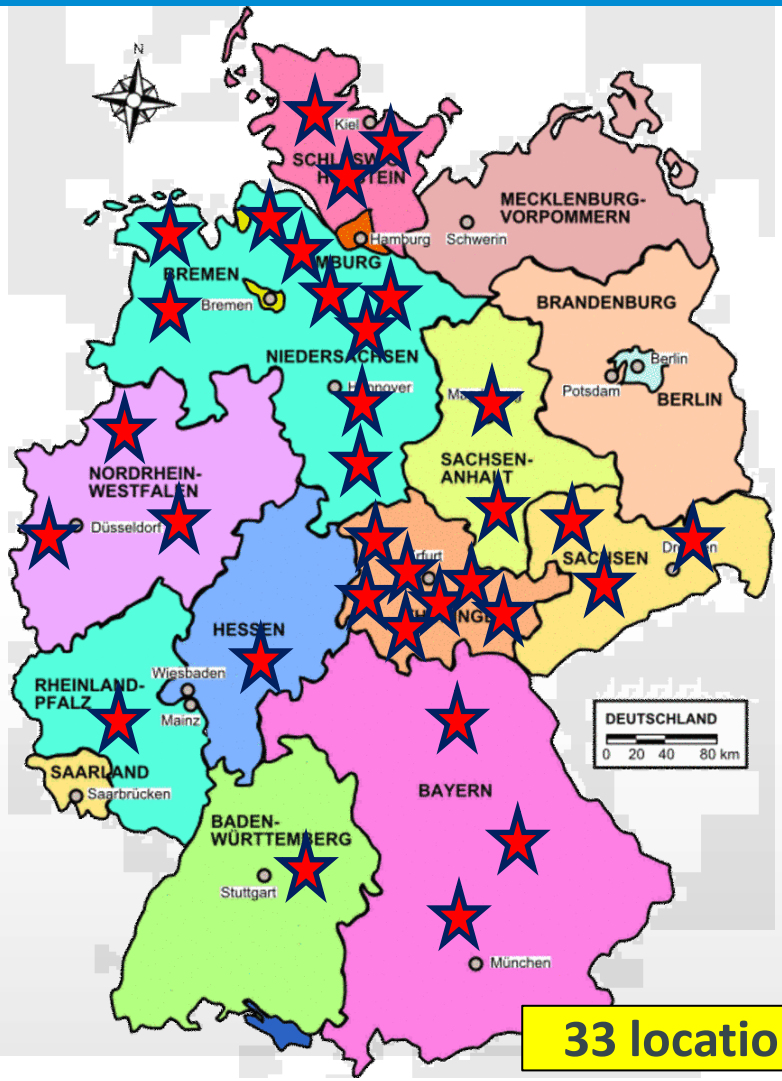
11 locations

(own search by internet)

Official variety trials of field beans in Germany

conventional

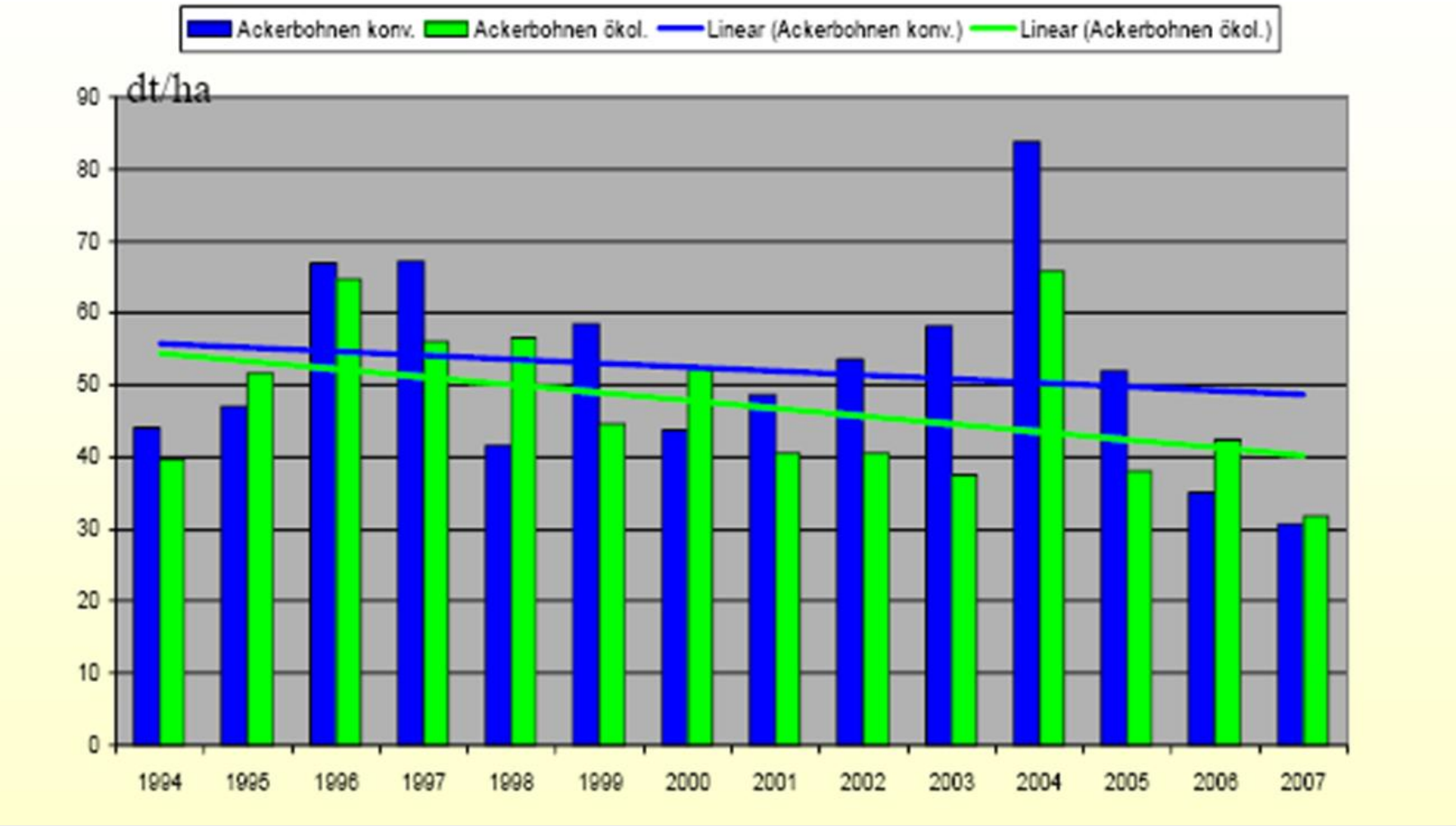
organic



33 locations | **9 locations**

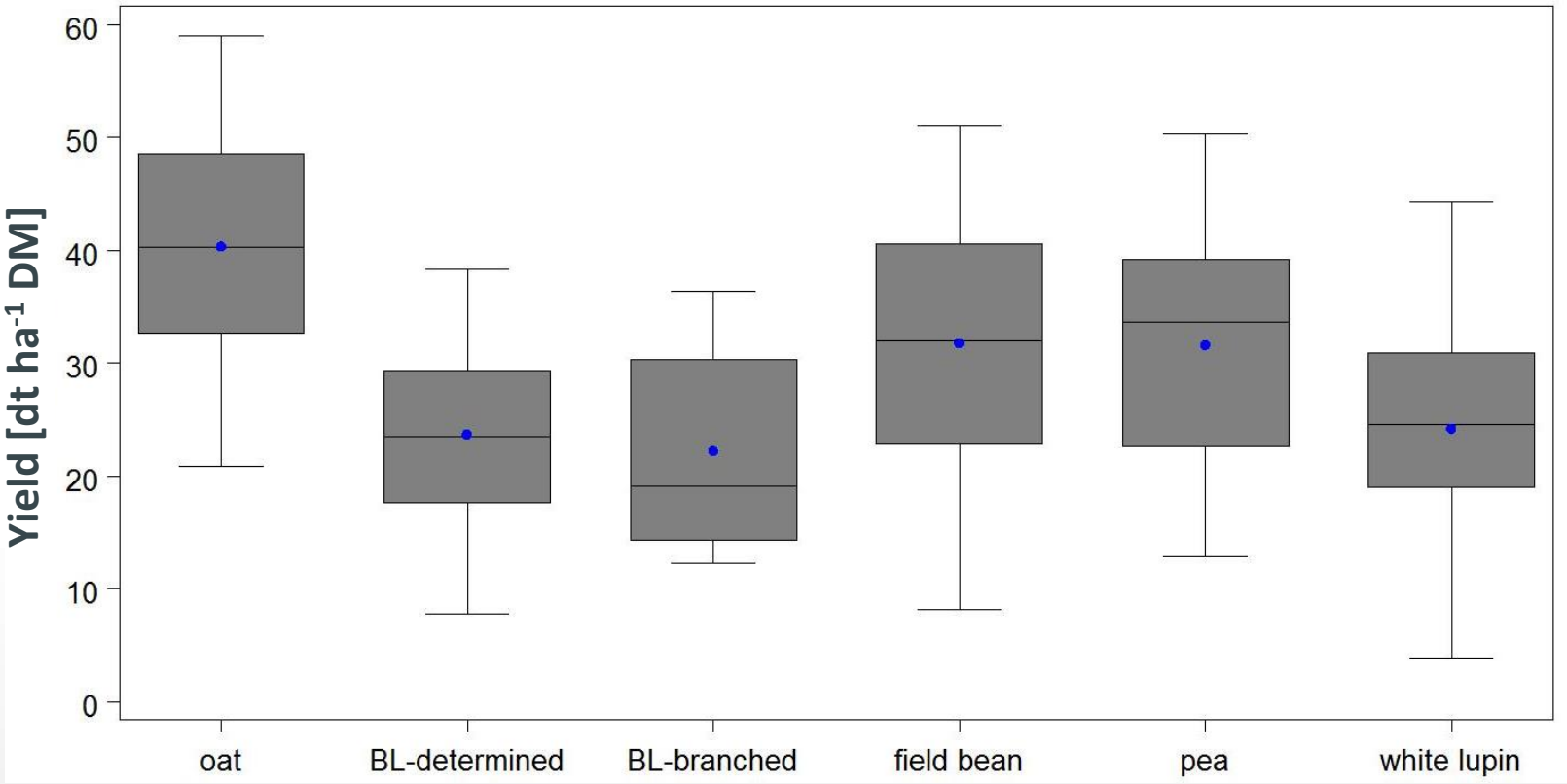
(own search by internet)

Yield development of faba beans in organic and conventional farming from 1994 to 2007



(LLH Hessen)

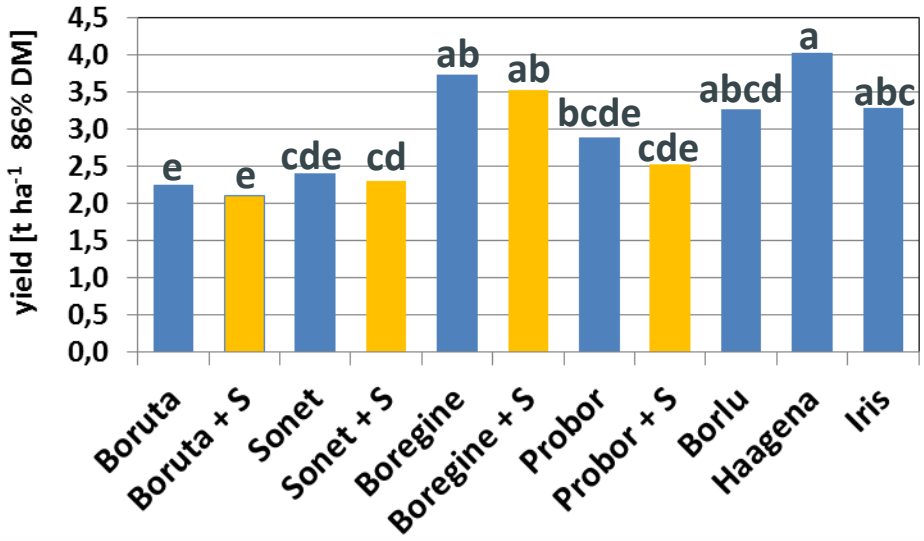
Boxplots of different grain legumes in comparison to oat in the years 2003 – 2013 (site Trenthorst)



	oat	BL-determined	BL-branched	field bean	pea	white lupin
cv% =	25,5	35,0	39,0	34,9	33,2	39,8

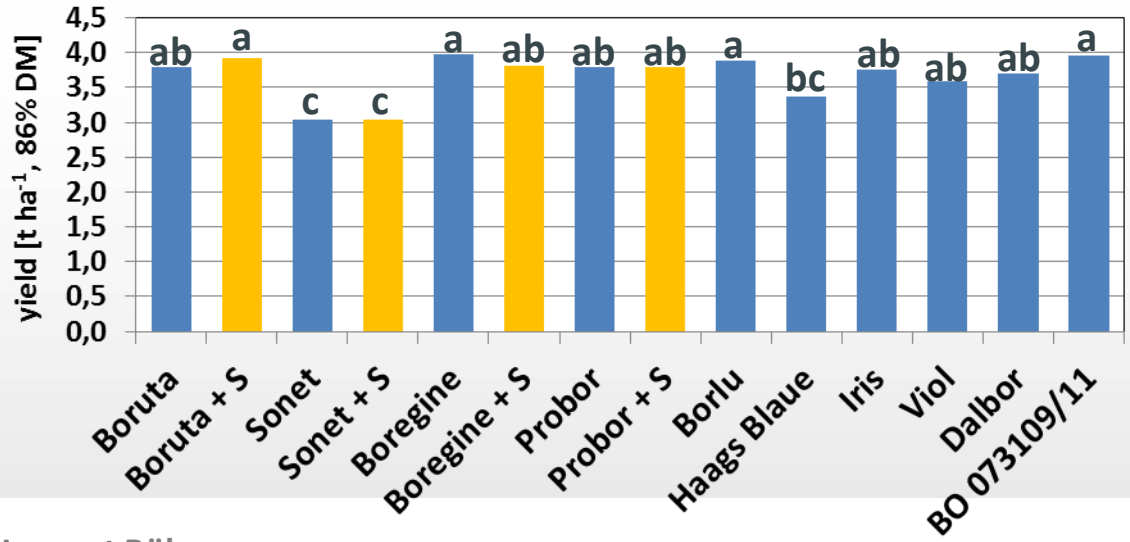
Yield of blue lupins at the experimental station Trenthorst

2012



+S = 40 kg S ha^{-1} (SO_4-S)

2013

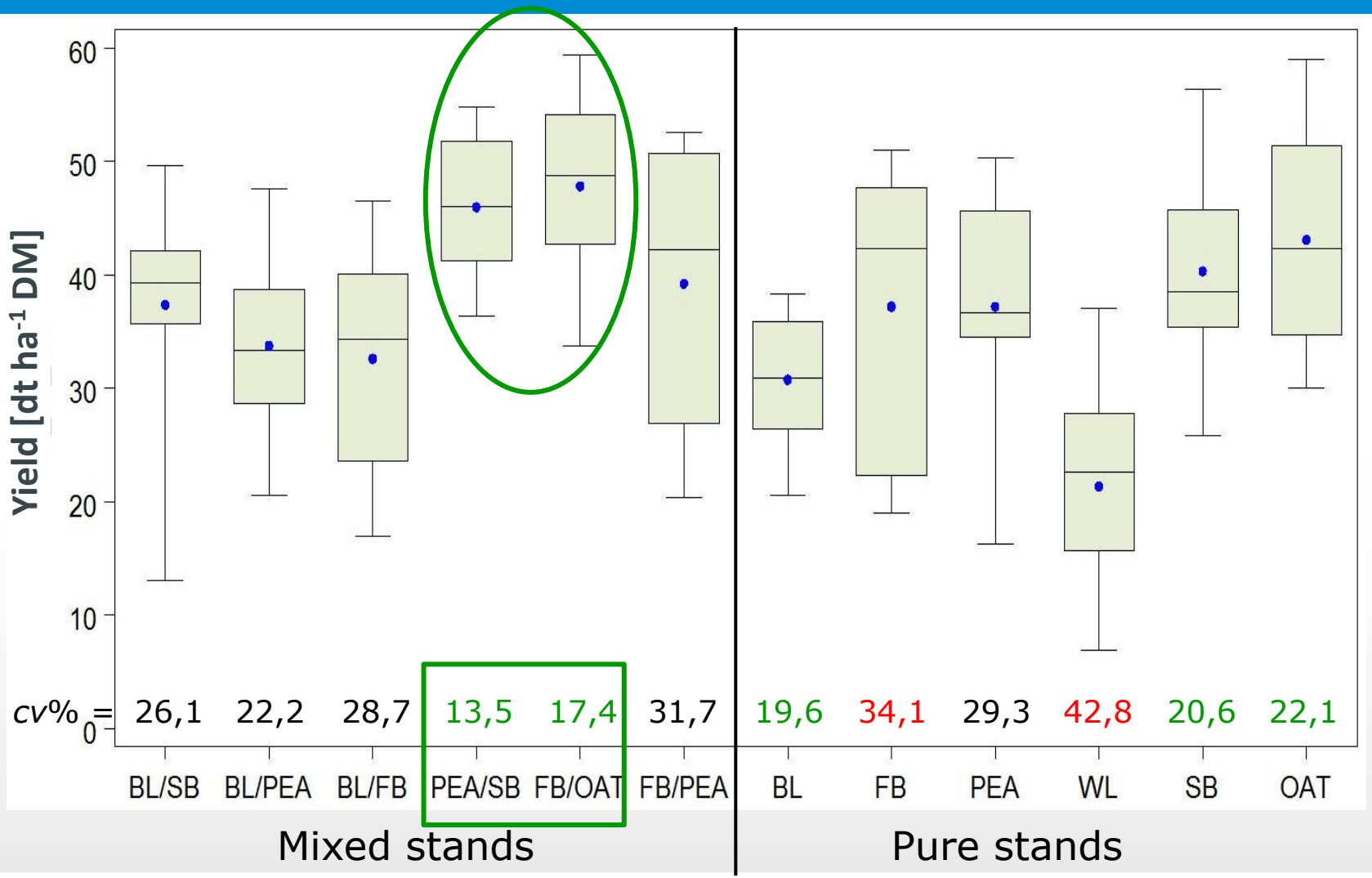


Pure and mixed stand of grain legumes in the years 2003 to 2005 at site Trenthorst

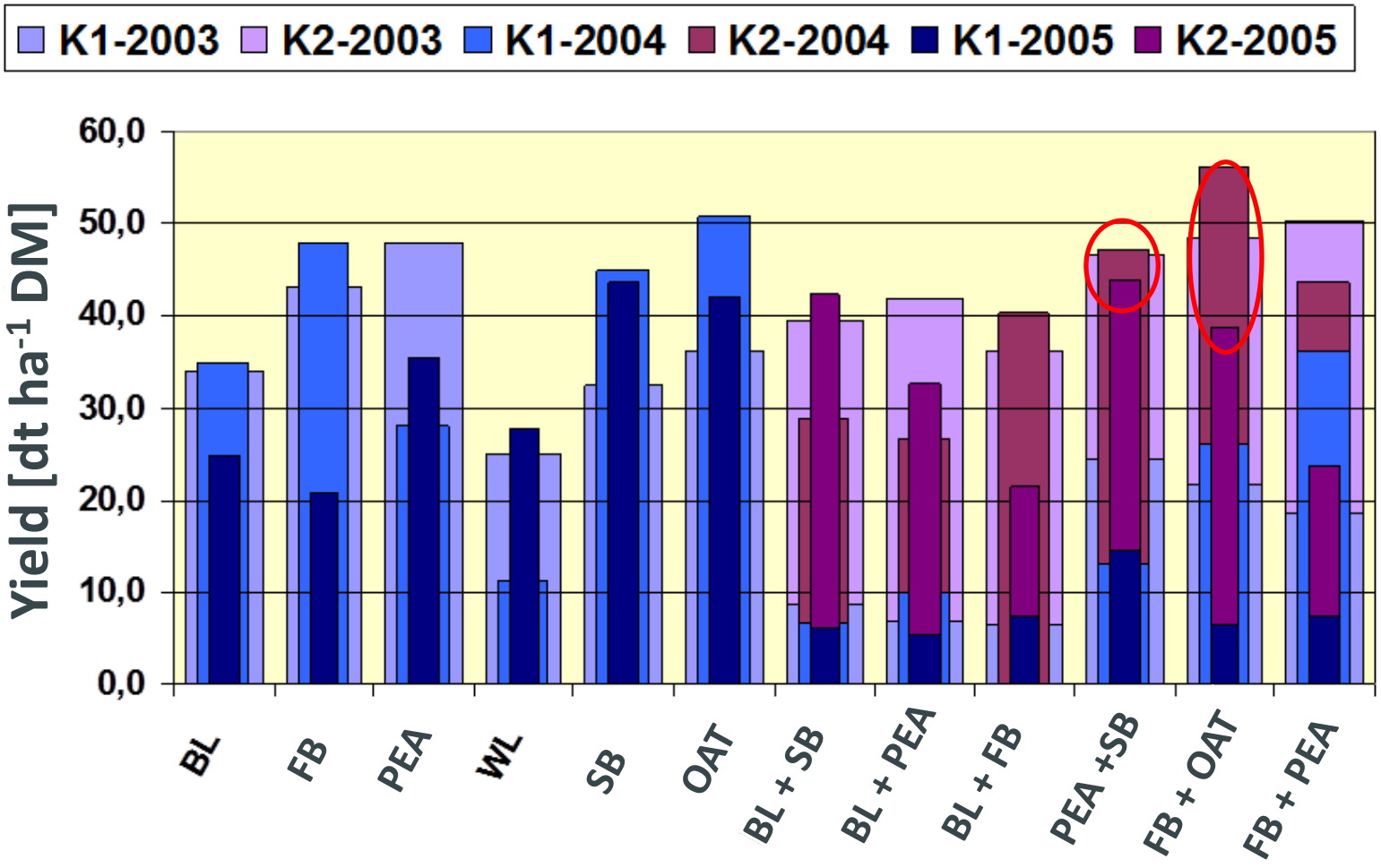
Tested pure and mixed stands:

species	abbr.	variety	seeds m^{-2}
blue lupin	BL	Boruta	130
field bean	FB	Columbo	35
pea	PEA	Madonna	70
white lupin	WL	Bardo	70
spring barley	SB	Krona	300
oat	OAT	Flämingsprofi	300
blue lupin + spring barley	BL + SB	Boruta + Krona	65 + 150
blue lupin + pea	BL + PEA	Boruta + Madonna	65 + 35
blue lupin + field bean	BL + FB	Boruta + Columbo	65 + 35
pea + spring barley	PEA + SB	Madonna + Krona	35 + 150
field bean + oat	FB + OAT	Columbo + Flämingsprofi	18 + 150
field bean + pea	FB + PEA	Columbo + Madonna	18 + 35

Boxplots of different grain legumes in pure and mixed stand in the years 2003 to 2005 (site Trenthorst)



Yields of grain legumes in pure and mixed stand in the years 2003 to 2005 at site Trenthorst



Relative Yield Total (RYT-value)

(de Witt 1960)

Example: Mixed cropping with 2 partners

M1, M2 = mixed partner, P1, P2 = pure stands

$$RY_1 = {}^{M1}/_{P1} \qquad RY_2 = {}^{M2}/_{P2}$$

$$RYT = {}^{M1}/_{P1} + {}^{M2}/_{P2}$$

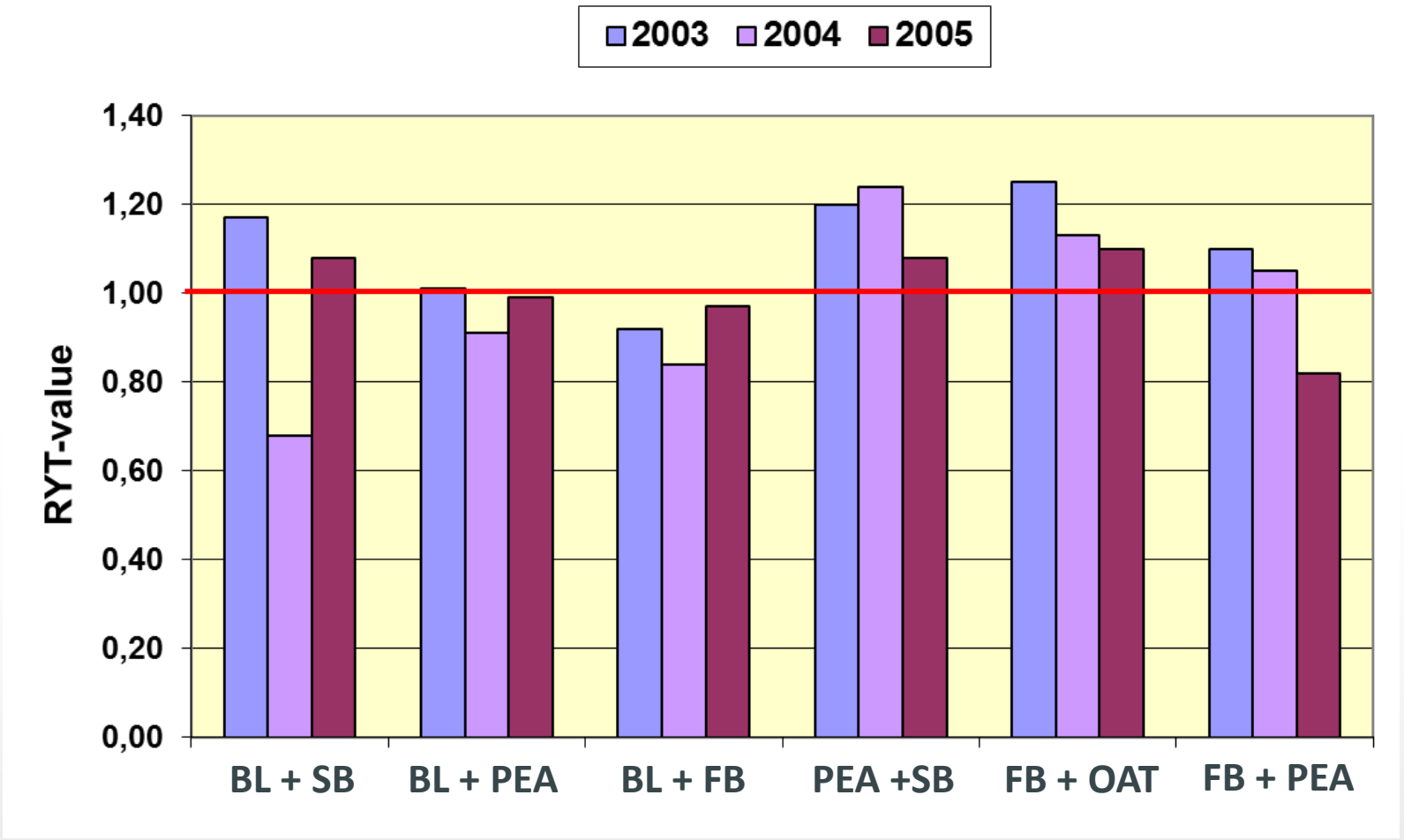
RYT > 1: Relative higher yield of mixed cropping compared to pure stand:
a complementary use of growth factors (water, light and nutrients) has taken place in the mixed cropping system, low competion.

RYT < 1 Relative lower yield of mixed cropping compared to pure stand:
no complementary use of growth factors, but the mixed cropping partner were in close competition with each other.

RYT = 1 Mixed cropping has the same yield compared to pure stands;
no complementary use of growth factors;
both partners were in an intensive and complete competition.

RYT = 2 Twice as high yield of mixed cropping compared to pure stands;
no competition between the mixed cropping partners;
growth ressources for DM-production were used fully complemantary.

Evaluation of yield using the RYT-method for mixed cropping



Protein content of grain legumes

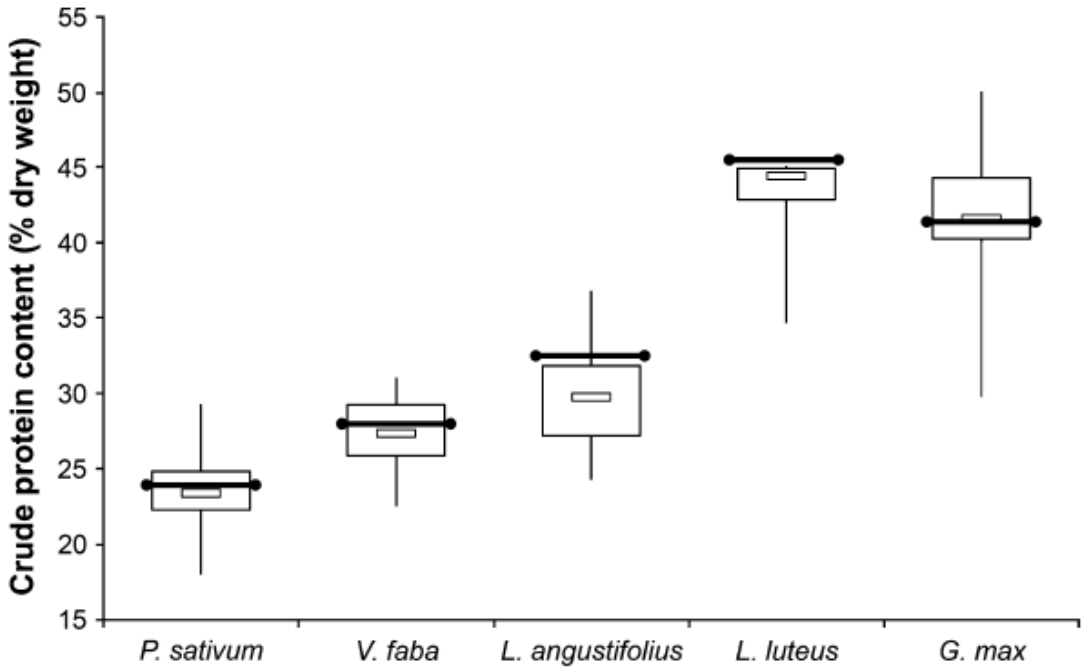


Fig. 1: Seed crude protein content of cultivars of five legume species. Averages according to the literature (Schuster et al. 1998, Sujak et al. 2006) are indicated as black lines. (n cultivars): *Pisum sativum* = 50; *V. faba* = 50; *L. angustifolius* = 46, *L. luteus* = 4; *Glycine max* = *119* (*G. max* from Shi et al. 2010 and Zarkadas et al. 2007)

Schumacher et al. (2011): Plant Breeding 130(2): 156-164

Variation of amino acid quality in different grain legume species

Table 5: Calculated AA quality in seed protein of five legume species relative to ideal protein for growing pigs (according to Boisen 1997)

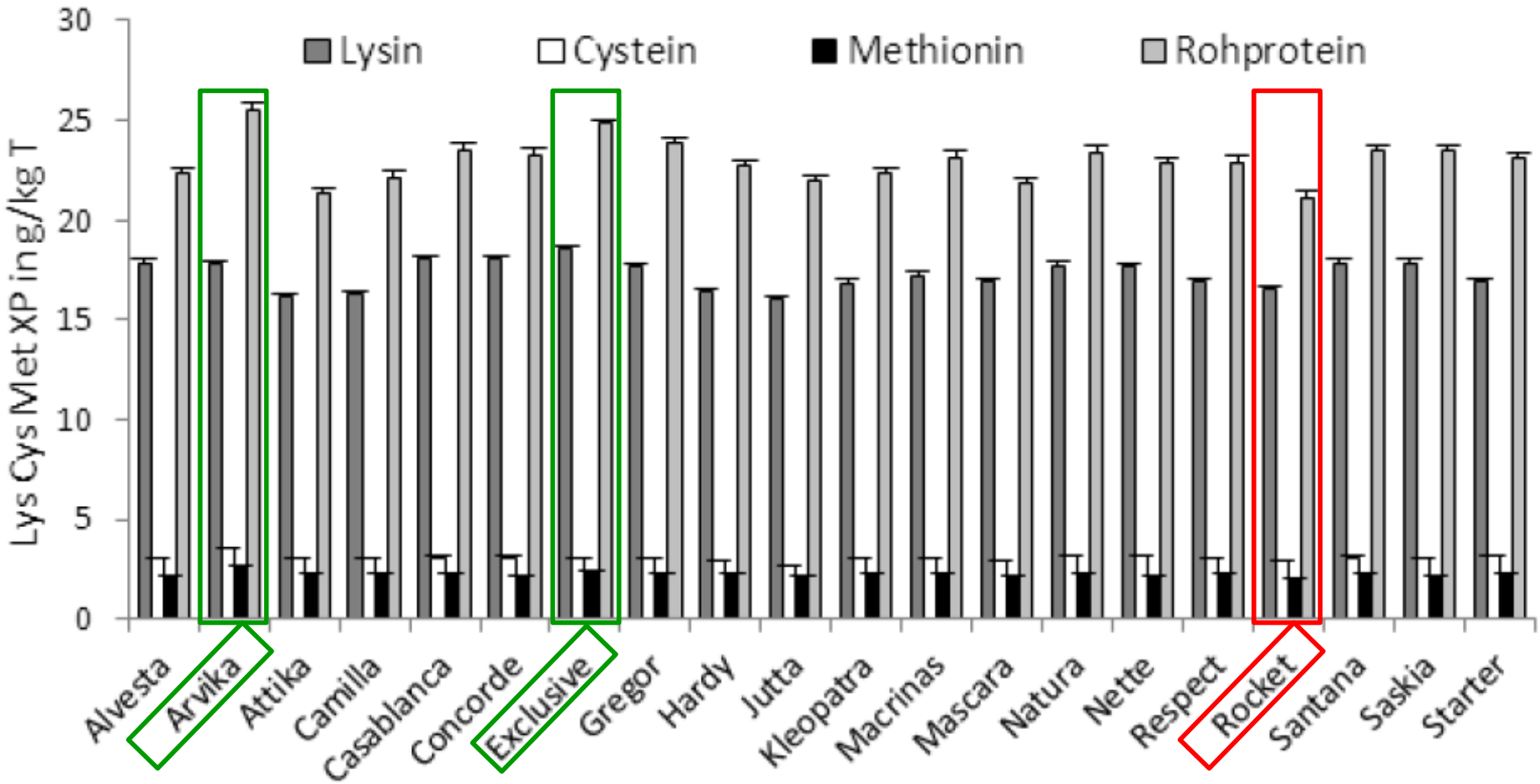
	Pisum sativum	*Vicia faba*	*Vicia faba* (winter)	*Lupinus angustifolius*	*Lupinus luteus*	*Glycine max*
Lys (mean)	103.7	90.5	87.5	69.1	69.4	82.1
(range)	89.4–112.9	82–98.8	85.9–90.2	59.5–76.8	68.6–70.4	78–85.4
Cys + Met (mean)	64.9	49.9	49.5	59.7	68.7	101.8
(range)	52.9–74.1	40–56.6	46.7–54.8	44.9–72.7	65.8–72.4	91.1–106.7
Thr (mean)	83.8	75.6	73.6	77.4	72.5	103.9
(range)	75.4–92.3	69.3–79.8	71.9–76.6	67.3–86.4	71.3–73.5	89.8–130.4
Ile (mean)	109.1	104.2	103.1	106.5	100.2	108.2
(range)	97.9–117.9	96.6–108.4	100.4–105.2	100.2–113.8	98.7–101.8	100.3–114
Leu (mean)	89.7	89.3	88.8	87.2	90.3	86.0
(range)	82–96.9	83.2–93.4	85.8–90.9	78.4–93.1	89.4–91.4	82–88.5
Val (mean)	94.6	88.9	87.8	80.0	71.9	94.6
(range)	85.9–101.7	84.1–92	85.3–89.3	71.2–87.6	70.7–73	86.7–99
Phe + Tyr (mean)	105.9	96.2	94.2	97.0	91.3	104.6
(range)	92.5–113.6	91.4–105.2	92.9–96.1	91.7–104.9	90.3–92.8	99.9–113.1

AAs, amino acids.

+ 22%

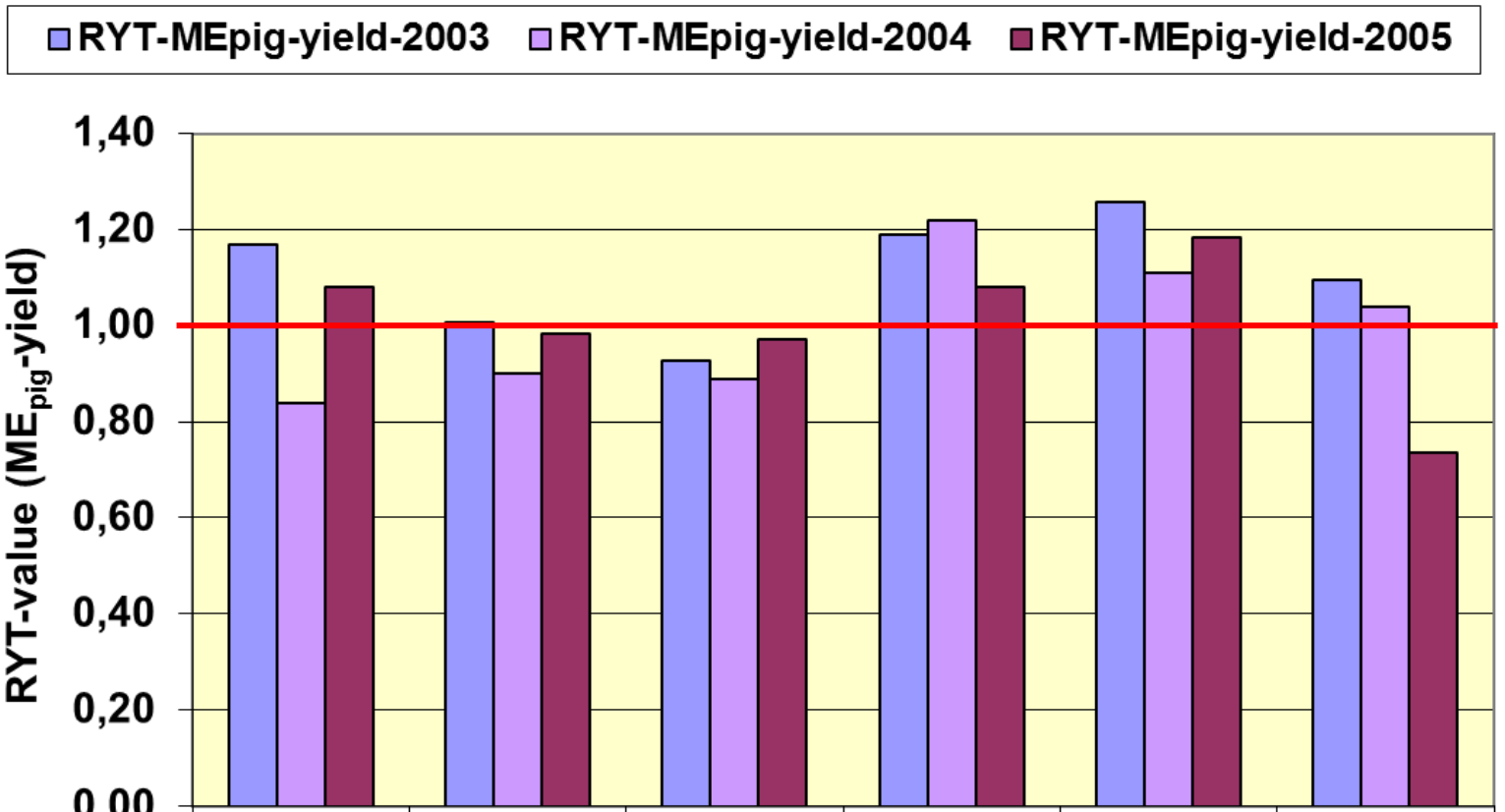
Schumacher et al. (2011): Plant Breeding 130(2): 156-164

Protein and amino acid content of different varieties of peas



Lietzow et al. (2013): Proc. Wissenschaftstagung Ökologischer Landbau 180-183

Evaluation of the yield of metabolized energy (ME) for feeding pigs according to the RYT-method for mixed cropping

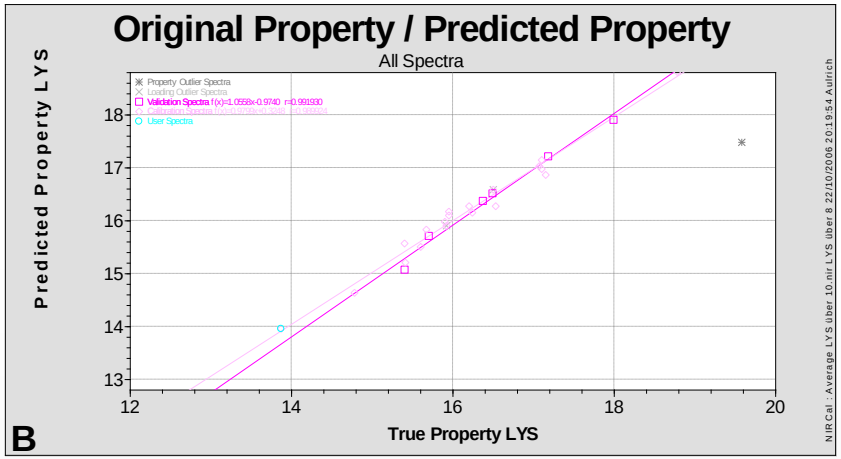


Easy and fast determination of crude nutrients and amino acids with Near InfraRed Spectroscopy (NIRS)

Aim:

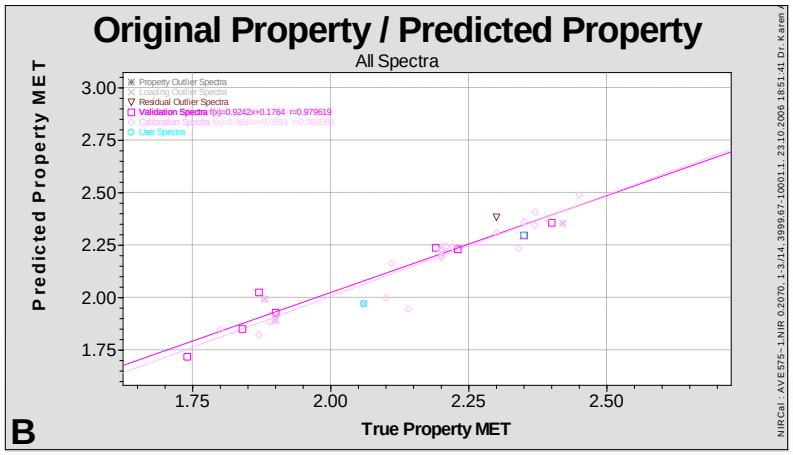
Development of NIR-calibrations for the determination of crude nutrients and amino acids

lysine



Aminosäure	SEE	r_{Kal}	SEP	r_{Val}
Lysin	0.4	0.99	0.49	0.99
Lysin >10	0.15	0.99	0.14	0.99
Lysin <10	0.08	0.99	0.07	0.99

methionine



Aminosäure	SEE	r_{Kal}	SEP	r_{Val}
Threonin	0.22	0.99	0.23	0.99
Methionin	0.06	0.98	0.06	0.98
Cystein	0.4	0.95	0.39	0.95

Quelle: Aulrich (2009)

Mixed cropping of winter peas with oilseed rape or triticale

Site Trenthorst – winter pea at flowering (29/05/2009)

Winter pea pure stand

Winter pea – oilseed rape mixture

Winter pea – triticale mixture

Mixed cropping of winter peas with oilseed rape or triticale

Site Trenthorst – crops at harvest time (21/07/2009)

Winter pea pure stand

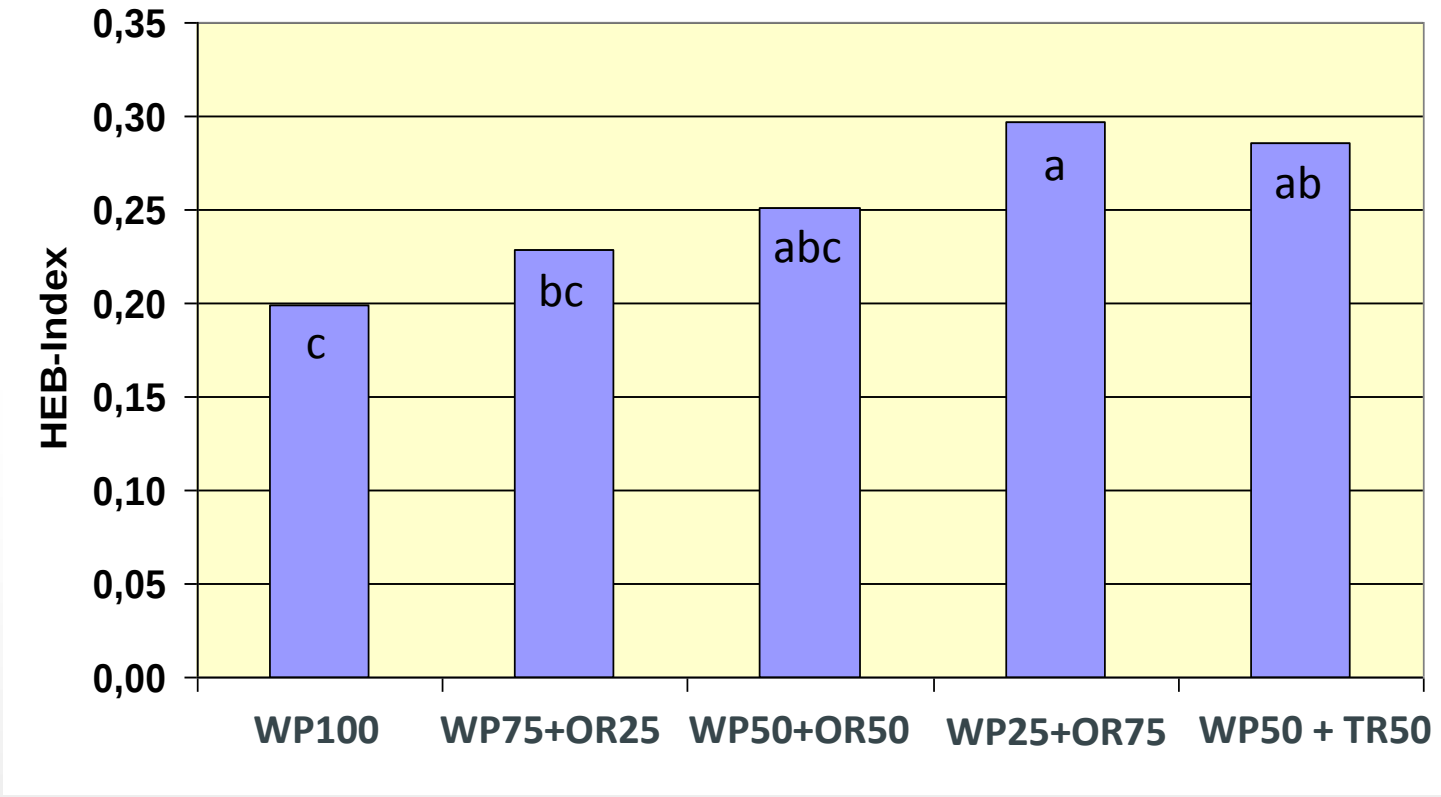
Winter pea – oilseed rape mixture

Winter pea – triticale mixture

Mixed cropping of winter peas (WP) with oilseed rape or triticale

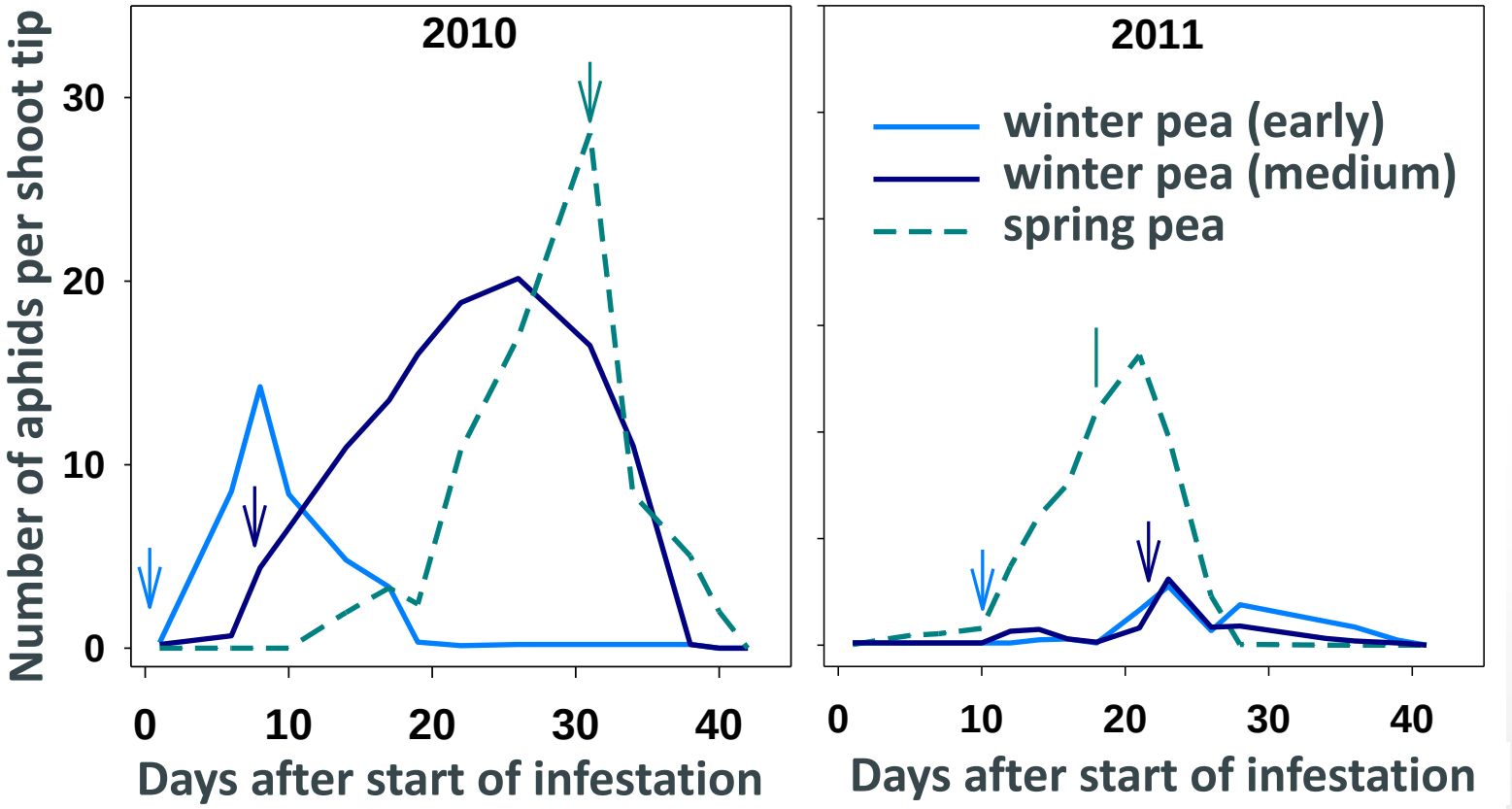
- Resistance to lodging

$$\text{HEB-Index} = \frac{\text{Crop high at harvest}}{\text{Crop high at flowering}}$$



(Gronle & Böhm, 2010)

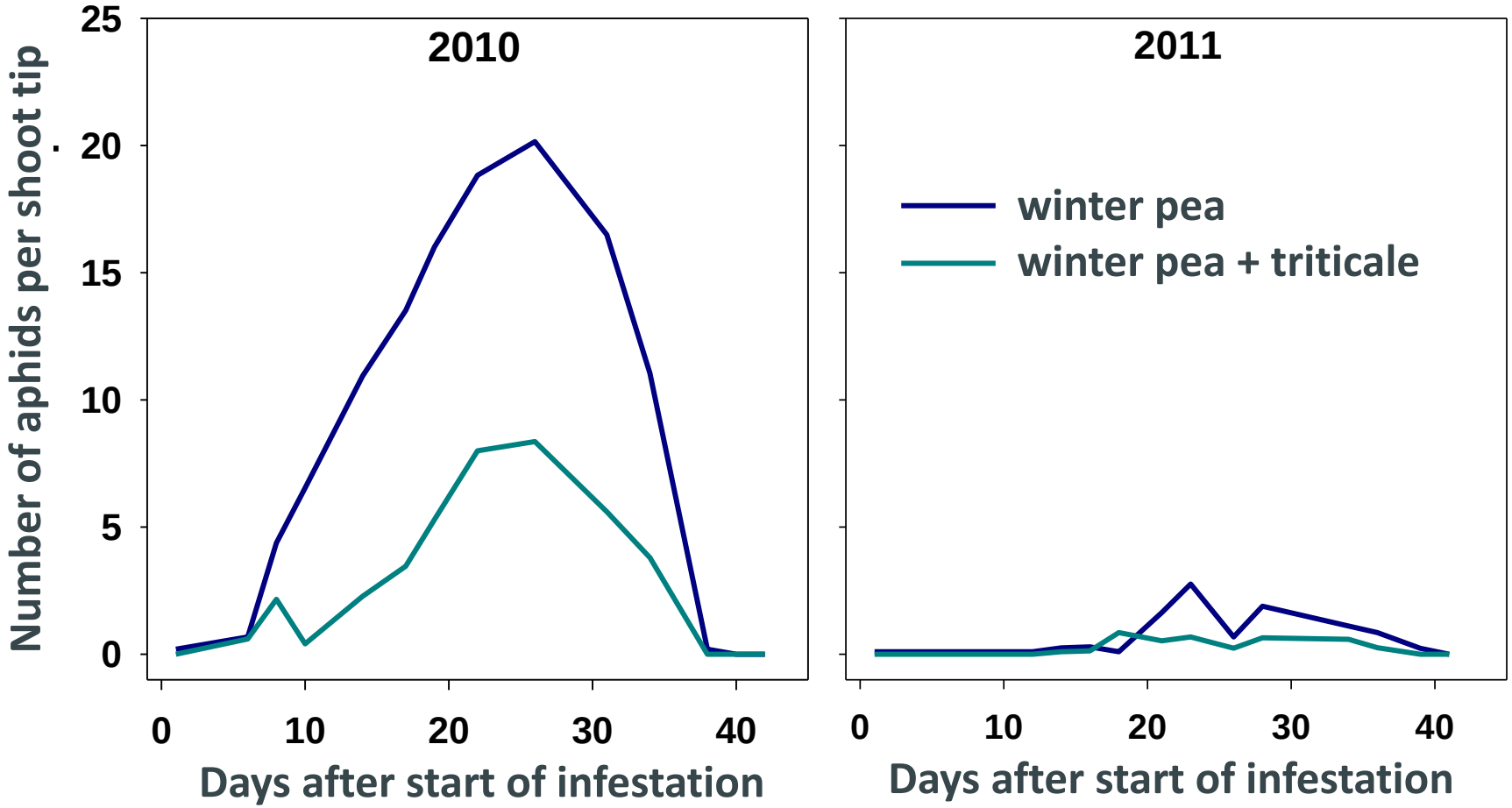
Infestation with aphids



↓ flowering Start of infestation: 02/06/2010 / 19/05/2011

Infestation with aphids

Pure stand of winter peas compared to mixed cropping with triticale



Requirements of varieties and cultivation of grain legumes for animal feedstuff production in Organic Farming

- **High yield potential and yield stability**
  - winter forms, growthhabit, resistance to pod shatter, mixed cropping
- **High weed competition**
  - early plant development
  - mixed cropping systems
- **Good resistance to diseases and pests**
- **Good threshing characteristics and resistance to lodging**
- **High feed values**
  - protein content / amino acid composition
  - protein yield
  - metabolized energy
  - low contents of alkaloids (lupins), vicine and convicine (field bean)
- **Easy and fast determination of nutrients in farm-own feedstuffs**

Thank you for your attention!