



Fababeans and Field peas : a general breeding overview
and activities at NPZ

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Dr. Olaf Sass

NPZ in Germany



NPZ Hohenlieth
NPZ Innovation GmbH

NPZ Malchow / Poel

SAATEN-UNION
RAPOOL-RING
Isernhagen

WvB Eckendorf

Norddeutsche Pflanzenzucht Hans-Georg Lembke KG

**A medium-sized, family-owned company
with over 115 years of tradition in plant breeding**

1897 Hans Lembke initiates oilseed rape breeding programs in Malchow on the Isle of Poel
1905-1945 Breeding, seed production, trading and nominating of various varieties in DLG list
After WW II during Soviet occupation, expropriation and continuation as state-owned VEG
1946 Foundation of Norddeutsche Pflanzenzucht (NPZ-Lembke), since 1952 located in Hohenlieth
1960 Dietrich Brauer joins NPZ-Lembke, General Managing Partner in 1973
1991/92 Foundation of SLM Malchow; Re-Purchase of the breeding station of Prof. Hans Lembke
1997 Dietmar Brauer becomes General Managing Partner of NPZ-Lembke

NPZ TODAY 235 employees at locations Hohenlieth, Malchow

Shareholder

of Saaten Union GmbH, Rapool-Ring GmbH and
ce GmbH

German



Research, Breeding – Production, Processing – Extension, Distribution



OILSEED RAPE – Winter- and Spring types

PULSES – Faba beans and Field peas, Winter- and Spring types



FORAGE CROPS – Perennial and Italian ryegrass, Red clover

Milestones of pulse breeding at Norddeutsche Pflanzenzucht Hans-Georg Lembke KG

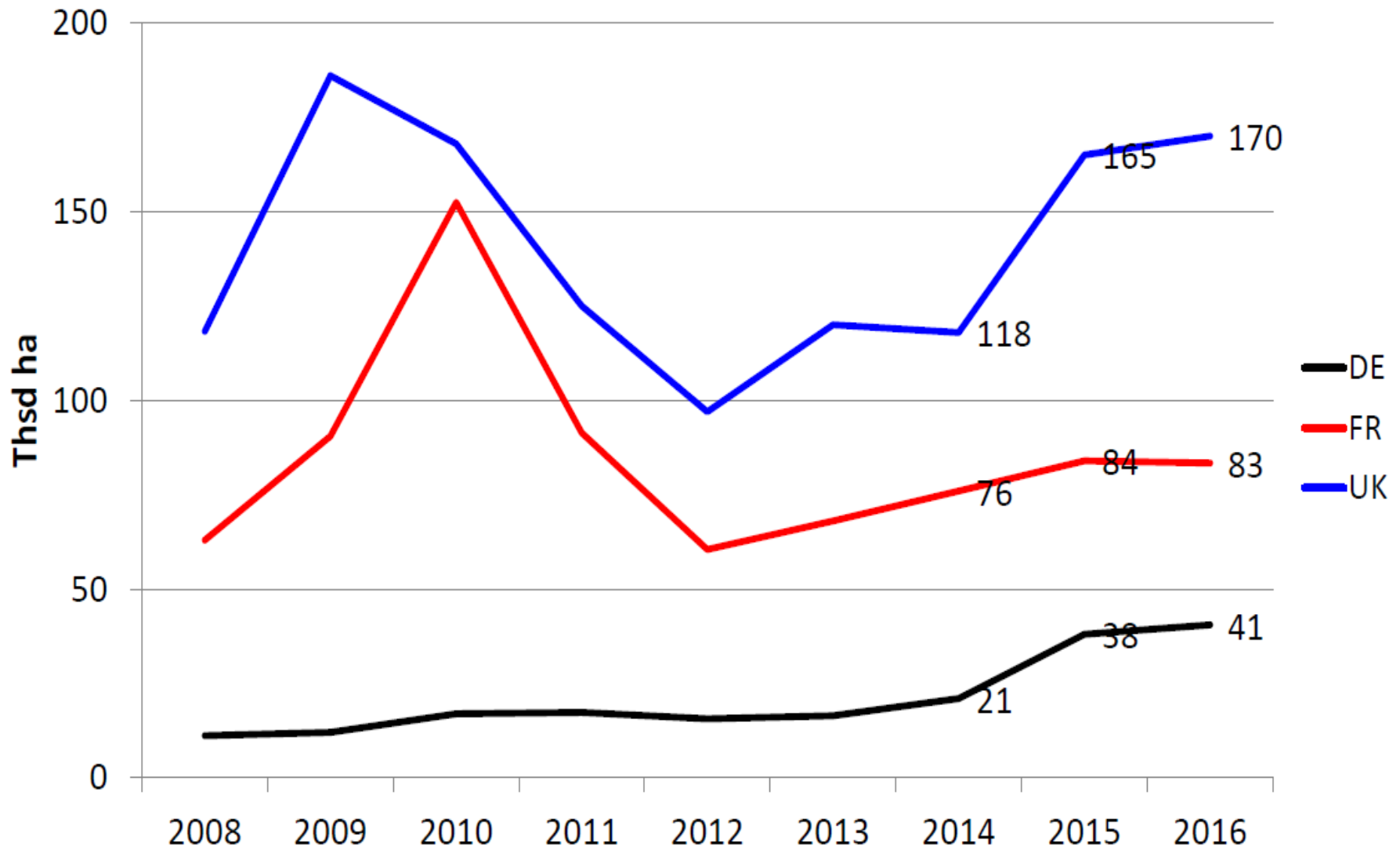
- **Since 1981:** Breeding of faba beans, testing and marketing of field peas from other partners in Germany
- **1999:** winter bean germplasm from H. Littmann, Malente is acquired
- **2006:** Acquisition of field pea program from SWS GbR, Germany
- **2007:** Acquisition of field pea program from Toft AS, DK
- **Since 2009:** start of cooperation with Fa. RAGT/F (ex Serasem)
- **Since 2012:** more focus on winter peas in Germany
- **2016:** Introduction of the first high performing low vicin/convicin faba bean variety TIFFANY in F and D

Faba beans





FABA BEANS EUROPE PRODUCTION AREA DEVELOPMENT

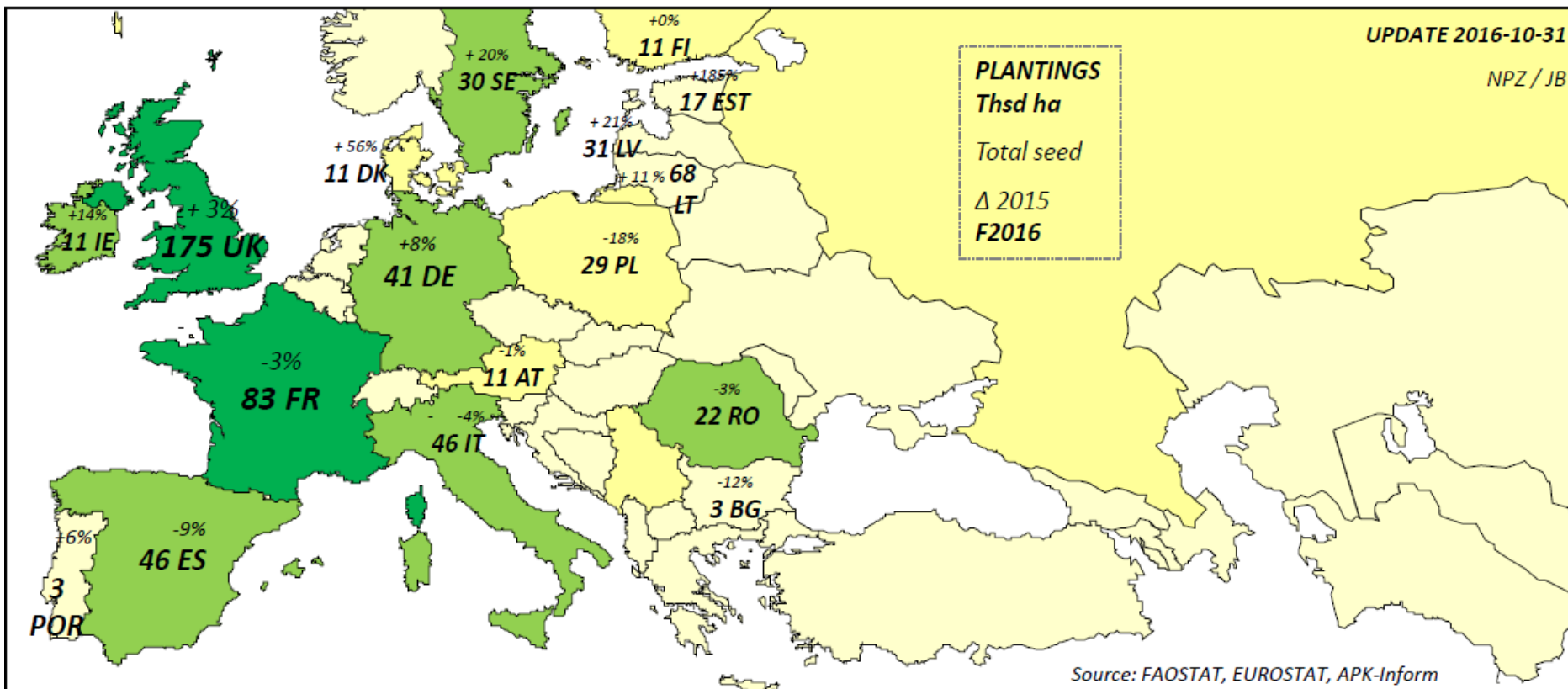


FABA BEANS EUROPE TOTAL AREA PLANTINGS F2016



UPDATE 2016-10-31

NPZ / JB



Source: FAOSTAT, EUROSTAT, APK-Inform

SAATEN-UNION / NPZ

EU 28 +3% 620 Tha (2015: 601 Tha)

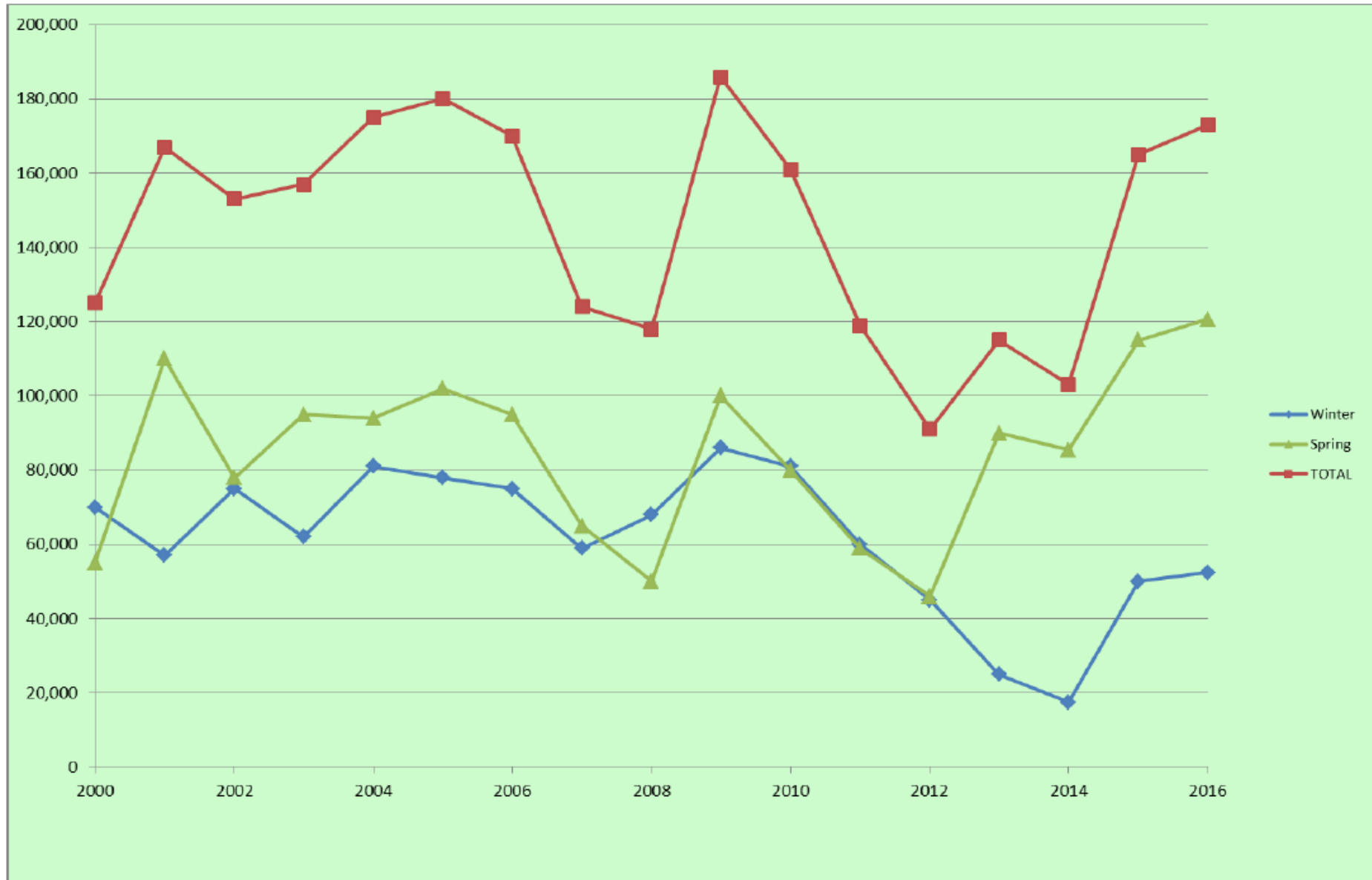
Production:

EU 28 -3% 1690 Tto (2015: 1741 Tto)

Yield: -7% 27 qt/ha (2015: 29 qt/ha)

UK: Historical Area

2016 total beans 173 kHa



Breeding goals in faba beans

Agronomic features:

- Yield of grain: high and stable
- Standability
- maturity
- Winter hardiness

- Resistance to:
 - chocolate spot (*Botrytis fabae*)
 - bean leaf and pod spot (*Ascochyta fabae*)
 - downy mildew (*Peronospora viciae*)
 - bean rust (*Uromyces viciae fabae*)



Breeding goals in faba beans: Quality



Quality features:

- Protein content
- White hilum
- Vicin/Convicin reduction
- Absence of tannin

Different challenges of markets

Breeding goals for UK

1. High and stable Grain Yield
 2. White hilum
 3. Resistance to downy mildew
 4. standability
 5. maturity
- Tannin and low vicin/convicin content : **not of interest**

Breeding goals for Germany

1. High and stable Grain yield
2. standability
3. Protein content and yield
4. Absence of Tannin
5. Low vicin/Convicin content



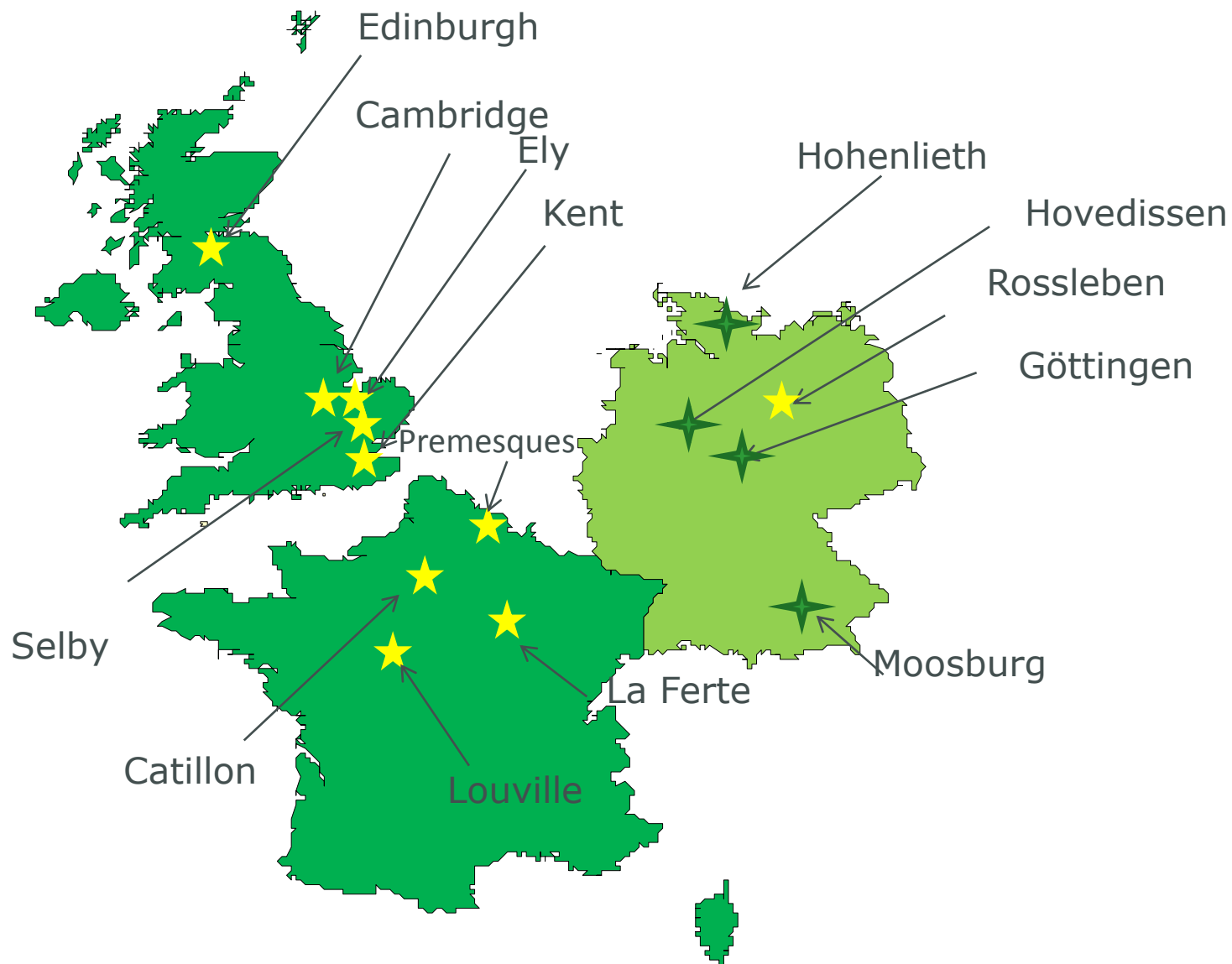
Relevant components for breeding of faba beans

ingredient	content (100% TS)	location	effect
protein	28-35%	cotyledons/ whole grain	supply of protein
starch	53-57%	cotyledons/ whole grain	Supply of energy
condensed tannins	2,0- >4% in the seed Tannin free : 0%	Seed coat	Reducing the digestibility of the protein in chicken and pigs Higher stability in the rumen of ruminants-> improved digestibility
vicin+covicin	0,5-1,2% Low vicin/Convicin: 0,03-0,08%	cotyledons/ whole grain	Low egg weight and lower egg numbers of laying hens

Breeding of faba beans at NPZ



Spring faba bean network 2016



Some remarks of season 2016 referring to faba bean breeding

- Very mild winter until New Year, after that strong bare frosts in the north of Germany with differentiation and/or losses in Germany
- Average sowing dates, average temperatures until flowering, good conditions before maturity in the north of Germany, wet in the south, yields ok to high overall
- **But:** partially serious attacks with viruses which caused up to 50 % losses, mainly PEMV but also Nanoviruses (PNYDV.) which are not new but unknown so far as a disease in faba beans (peas) in Germany
- 10 NL-1 locations for spring faba beans yielded reasonable data = 90 % !

Breeding of Synthetic varieties of faba bean: the example of FUEGO

year	Breeding step	Multiplication
1997	Synthetic-Suitability-Test	
1998	Yield trial of the SET-progenies 3 loc, 2 Reps → Selection of 6 Components	
1999	Production of Syn-1 in Isolation	
2000	Production of Syn-2 in Isolation 3-loc yield trial	Components in Iso-cage
2001	Production of Syn-3 in Isolation 7-loc yield trial → NL 1 Germany and UK	Components in local isolation
2002	1. year VCU1/DUS 1. year	Syn-1: 1 ha
2003	2. year VCU2/DUS 2. year	Syn-4: 4 ha / Syn-2: 30 ha
2004	3. year VCU 3/ DUS 3. year → Registration Germany by BSA	Syn-5: 90 ha / Syn-3: 270 ha

TIFFANY – productive and suitable for poultry feeding

		Grain yield	Protein yield	Protein content	TSW	Plant length	lodging
		rel.	rel.	[%]	[g]	[cm]	
TIFFANY	Ø 15	108	110	25,55	488	127	3,4
vicin/convicinarm	Ø 14	106	108	25,43	477	142	4,1
VRS 1	Ø 15	102	101	24,81	520	123	3,0
	Ø 14	103	102	24,63	509	139	3,0
VRS 2	Ø 15	95	97	25,55	489	127	3,1
	Ø 14	96	97	25,34	487	144	3,4
VRS 3	Ø 15	102	103	25,25	506	124	3,6
	Ø 14	102	103	25,17	491	141	3,6

BSA-rating of faba bean lines 1985/2006/2015 – maturity and plant length

Beschreibende Sortenliste 1985				Beschreibende Sortenliste 2006				Beschreibende Sortenliste 2015			
line	registra tion	matu rity	Plant length	line	registrati on	maturity	Plant length #	line	registra tion	matu rity	Plant length #
Herz Freya	vor 1953	4	5	Condor	1990	6	5	Taifun*	EU	5	4
Kl. Thüringer	vor 1953	5	5	Scirocco	1992	5	3	Pyramid	EU	4	4
Diana	1969	4	4	Gloria*	1996	5	4	Boxer	EU	5	4
Herra	1973	6	5	Limbo	1998	5	5	Espresso	2003	5	5
Kristall	1973	5	5	Bilbo	2003	5	5	Fuego	2004	5	4
Alfred	1983	5	4	Espresso	2003	5	4	Fanfare	2012	5	5
				Fuego	2004	5	4	Tattoo*	2006	4	4
				Taxi*	2005	6	3	Tangenta*	2007	4	4
tanninfree				Crisbo	2005	5	4	Isabell	2007	5	5
#1 Note lower as BSL for comparability with 1985				Marcel	2003	5	3	Tiffany	2015	5	5
Quelle: Beschreibende Sortenlisten				Valeria*	2006	5	5				

BSA-rating of faba bean lines 1985/2006/2015 – lodging and grainyield

Beschreibende Sortenliste 1985				Beschreibende Sortenliste 2006				Beschreibende Sortenliste 2016			
line	registrati on	lodging	Grain yield	line	registrati on	lodging	Grain yield	line	registrati on	lodging	Grain yield
Herz Freya	vor 1953	5	5	Condor	1990	2	7	Taifun*	EU	3	6
Kl. Thüringer	vor 1953	6	5	Scirocco	1992	3	8	Pyramid	EU	2	7
Diana	1969	5	5	Gloria*	1996	6	6	Boxer	EU	2	7
Herra	1973	6	5	Limbo	1998	2	7	Espresso	2003	2	7
Kristall	1973	4	5	Bilbo	2003	3	7	Fuego	2004	2	7
Alfred	1983	3	5	Espresso	2003	2	8	Fanfare	2012	3	7
				Fuego	2004	2	8	Tattoo*	2006	4	5
				Taxi*	2005	2	6	Tangenta*	2007	2	6
tanninfree				Crisbo	2005	2	6	Isabell	2007	2	6
				Marcel	2003	2	7	Tiffany	2015	3	8
Quelle: Beschreibende Sortenlisten				Valeria*	2006	6	5				

Yield-comparison of old and new faba bean lines 2012

line	registration	Hohenlieth	Moosburg	Göttingen	Grain yield [dt/ha]	Grain yield rel	TSW [g]	Flowering day	Plant length [cm]	maturity	lodging
Pyramid	UK 2010	1	1	2	52,33	107	526	148,0	133,7	7,5	2,0
Fanfare	D 2012	3	2	1	50,66	103	517	146,0	138,9	7,4	2,5
Fuego	D 2005	2	3	4	49,09	100	557	146,0	131,3	7,1	2,0
Espresso	D 2003	16	4	5	44,13	90	455	146,8	138,0	7,0	1,5
Victor	UK 1991	13	13	7	42,50	87	518	148,0	124,1	7,6	2,0
Alfred	D 1983	21	9	8	40,71	83	487	148,0	135,2	7,8	2,0
BB 686 wn		15	19	18	38,78	79	629	144,5	118,6	8,0	3,0
Kristall	D 1973	22	22	24	35,16	72	381	148,8	153,1	7,2	2,5
GD 5%					6,14	13	68	2,7	7,8	1,3	

Yield distribution on selected farms in Germany (research project LeguAN 2012 -2014)

		Ackerbohne			Erbse			Lupine		
		2012	2013	2014	2012	2013	2014	2012	2013	2014
Ertrag (dt/ha)	Maximum	63,0	70,1	75,0	46,0	51,4	63,1	34,0	27,6	26,6
	Mittelwert	53,0	50,4	58,3	35,4	39,1	39,6	25,3	20,0	17,8
	Minimum	40,0	28,2	37,0	17,1	23,2	8,7	12,9	11,5	11,8
	Ø Bund *	38,9	36,3	40,9	31,0	34,1	37,1	17,6	17,9	17,6

* Quelle:D. Alpmann, BMELV 2013

SPRING BEANS - Provisional Table of Characters - DRAFT

Control - Mean of Fuego and Vertigo

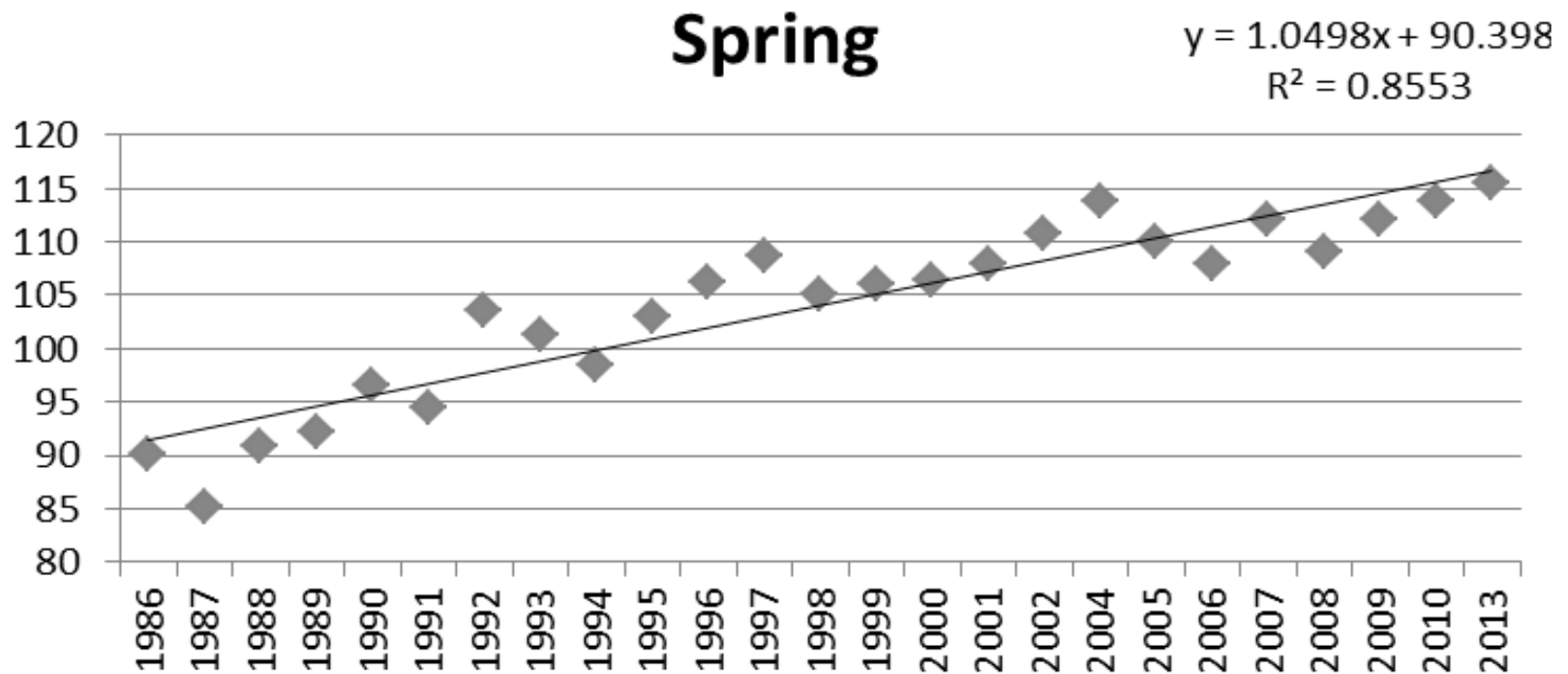
Type	Pale Hilum												Tic	
	Coloured flowered													
Recommendation categories	Lynx	Vertigo	LG Cartouche	Fanfare	Fury	Trumpet	Fuego	Scoop	Boxer	LG Oracle	Pyramid	Babylon	Maris Bead	LSD (P=0.05)
R Recommended														
P1 Provisional year 1														
P2 Provisional year 2														
O Becoming outclassed														
Recommendation status 2016	P2	R	P1	R	R	x	R	x	R	x	O	O	R	
Yield as % control (5.44 t/ha) 5 year mean	103	103	102	101	99	99	97	97	97	96	95	93	85	6.4
Agronomic characters														
Earliness of ripening	6	7	7	7	8	7	7	6	7	7	8	7	6	
Shortness of straw	5	5	7	5	7	5	6	4	6	6	6	8	4	
Standing power	8	6	8	7	7	8	8	7	7	7	7	8	5	
Resistance to														
Downy mildew - For publication	7	6	4	5	6	5	4	6	4	3	6	7	7	
Downy mildew - For information	7.3	5.5	3.7	4.8	6.0	5.2	4.4	6.2	3.5	2.6	5.6	6.6	6.7	
Seed characters														
Thousand seed weight (g) (@ 15% mc)	509	564	535	527	512	478	550	560	547	638	551	526	388	26.9
Protein content (% dry)	27.4	27.6	29.8	28.3	27.8	27.5	27.7	26.0	27.5	25.4	27.1	27.1	29.3	0.7
Year first listed	2016	2013		2013	2010		2005		2012		2010	2011	1964	

A high figure indicates that the variety shows the character to a high degree.

The scales of characters of spring beans do not necessarily correspond with those for winter beans.

Progress of yield of spring faba beans in UK

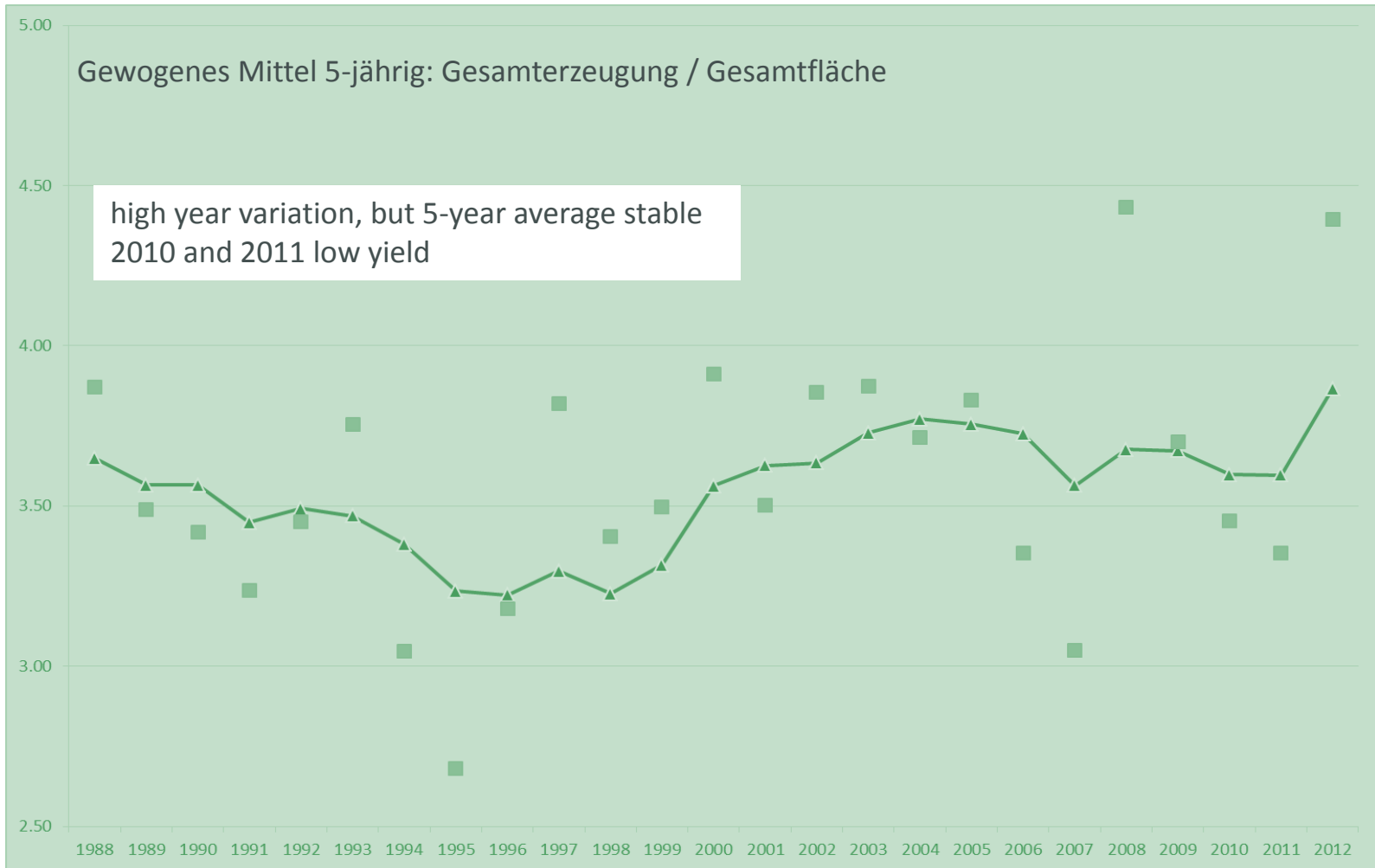
Average of rel. yield



1st year in trial

mittlere Erträge in englischen NL- und RL-Versuchen, bezogen auf das Erstanmeldungs-jahr einer neuen Sorte,
Quelle: NIAB classified list

UK: progress of yield on farms (winter- and summer form at faba beans)







Maturity at nursery of faba beans







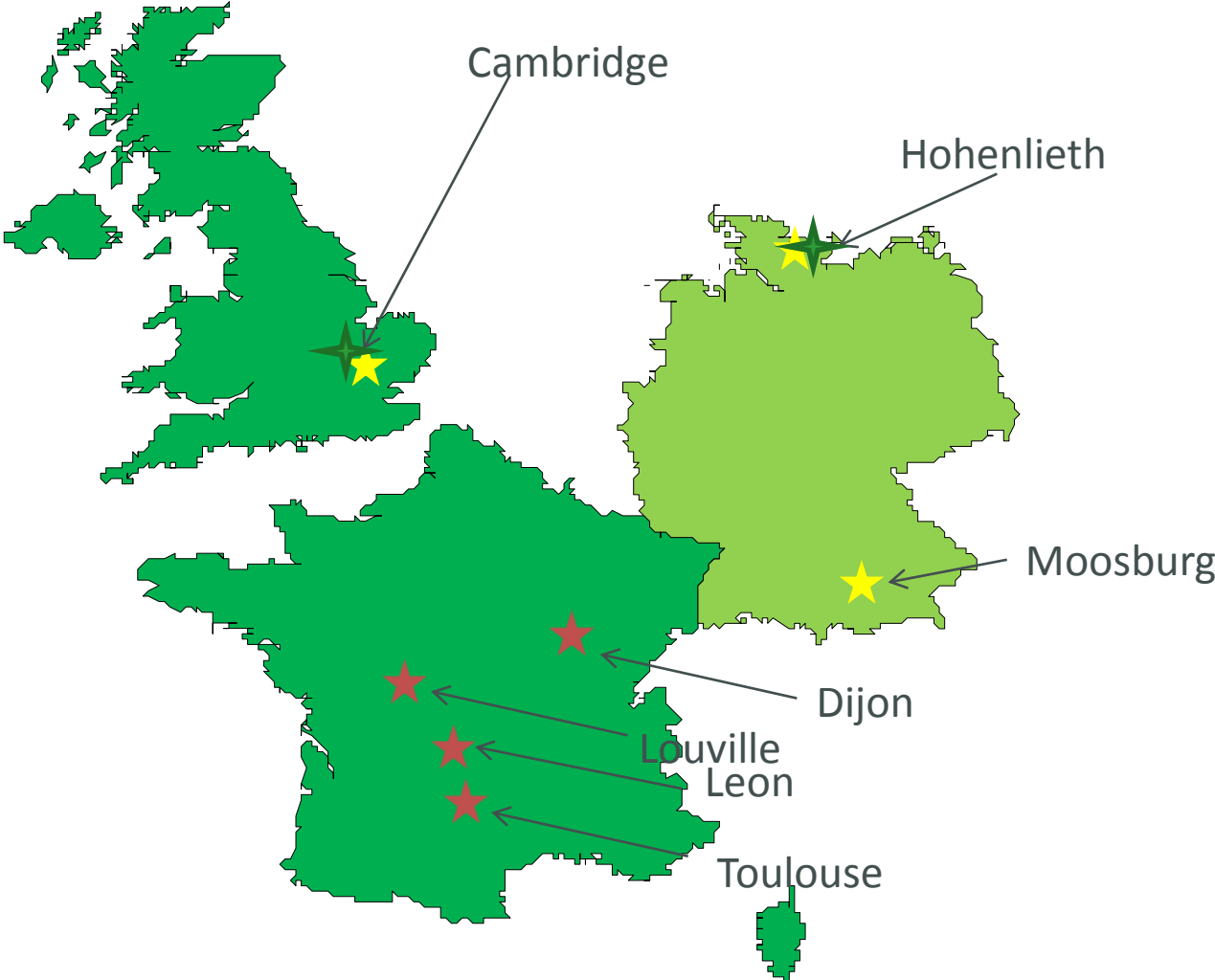




Winter faba beans



Winter Faba bean network : locations 2015-16



WINTER BEANS - Provisional Table of Characters						
Control - Mean of Arthur and Wizard						
Type	Pale Hilum				Black Hilum	LSD (P=0.05)
Recommendation categories						
R Recommended						
P1 Provisional year 1						
P2 Provisional year 2						
O Becoming Outclassed						
	Tundra	Bumble	Wizard	Honey	Arthur	
Recommendation status 2016	R	P1	R	R	O	
Yield as % control (4.89 t/ha) 5 year mean	104	104	97	93	103	4.5
Agronomic characters						
Earliness of ripening	8	8	8	9	8	
Shortness of straw	8	7	8	9	7	
Standing ability at harvest	7	6	7	8	6	
Resistance to						
Leaf and pod spot (<i>Ascochyta fabae</i>)	-	-	9	-	9	
Seed characters						
Thousand seed weight (g) (@ 15% mc)	646	697	678	692	657	24.4
Protein content (% dry)*	26.5	25.7	26.9	26.3	25.9	0.7
Year first listed	2013	-	2003	2012	2007	

A high figure indicates that the variety shows the character to a high degree.

The scales of characters of winter beans do not necessarily correspond with those for spring beans.

All current varieties are coloured flower, high tannin types.

Nursery – Winter faba bean 2015/16



Nursery – Winter faba beans 2015/16

Working on new lines
new line „Augusta“ in WP 2 in Germany





Winter faba beans- progenies

Concluding remarks faba beans

Improved harvest index
and standability

Faba beans have
become an easy to
combine field crop

Improved yield by
using partial heterosis
in Synthetic varieties

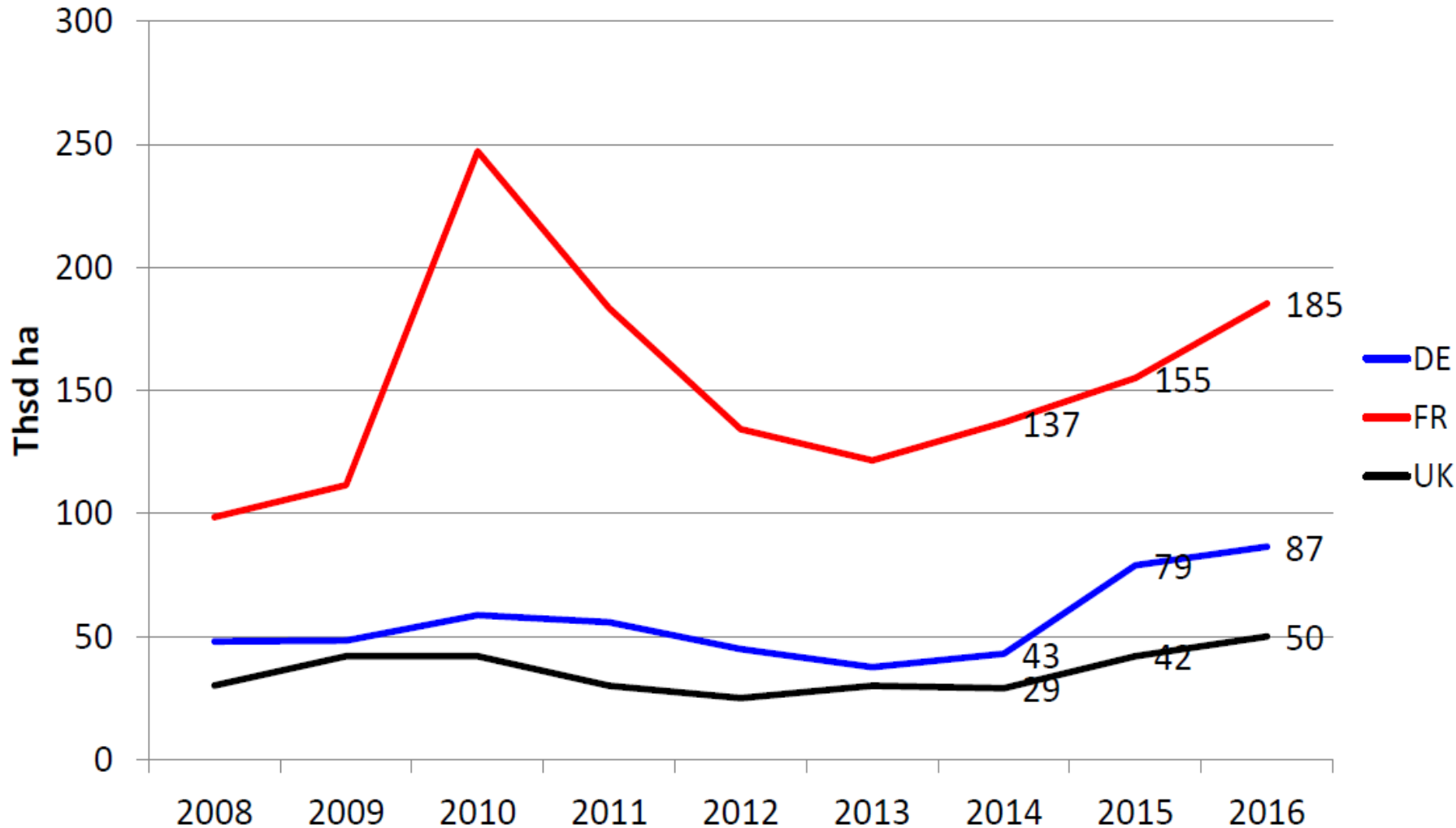
Hypothesis: the achieved improvement in yield is mainly based on breeding,
not so much by improved agronomic practises

A problem: do the farmers also find those better yield on their farms ?



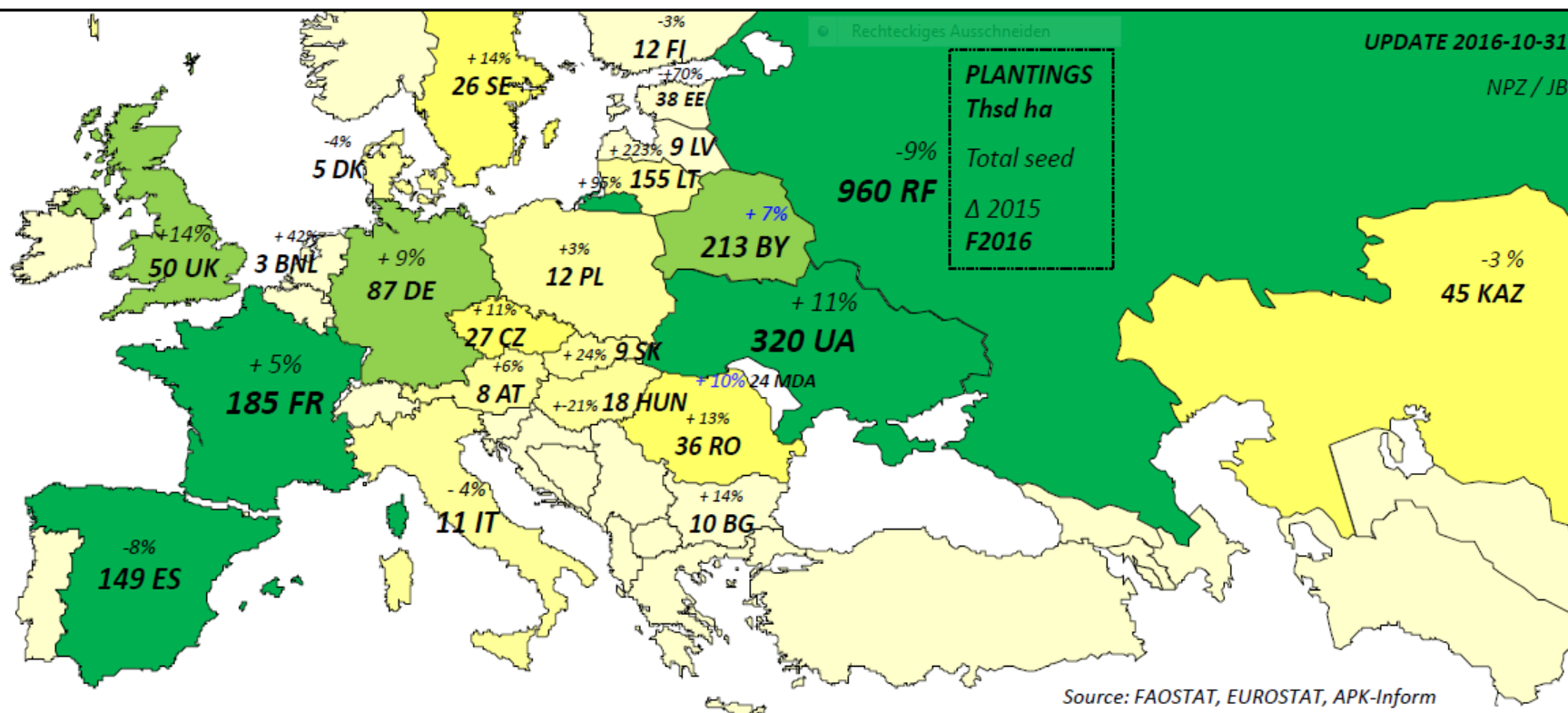
Field peas

FIELD PEAS EUROPE PRODUCTION AREA DEVELOPMENT



Source: Eurostat / UNIP

FIELD PEAS EUROPE TOTAL AREA PLANTINGS F2016



Source: FAOSTAT, EUROSTAT, APK-Inform

EU 28 + 15% 851 Tha (2015: 742 Tha)

Production:

EU 28 +2% 2059 Tto (2015: 2016 Tto)

Yield: -10% 25 (qt/ha) (2015: 28 (qt/ha))

SAATEN-UNION / NPZ

% certified seed (2015) to be updated

EU 15 45-60% (IT, ES?)

EU 10+3 30-45%

CIS: 20-25%

Breeding goals in field peas





Focus of breeding:

- Improvement of grain yield
- Enhancement of standing power: 100 % semi-leafless lines
- Yellow colour of seeds, tanninfree ,small seeds
- Resistance to diseases: *Aphanomyces euteiches*

Material for speciality market:

- lines with green colour of seeds for UK (Large Blues)
- Lines with big and green colour of seeds for UK (Marrowfats)
- Lines with small seeds and high biomass for green manure

Variety of field peas UK (nach PGRO, Peterborough)

Traits	Combining Peas					
Flower Colour	White			Coloured		
						
	White peas	Small blues	Large blues	Marrowfats	Large maples	Small maples
Seed size	Medium 250- 350g	Small 130- 250g	Large 280 - 360g	Large 300- 450g	Large 360g	Small 200g
Seed shape	Smooth and round	Smooth and round	Smooth and round	Dimpled and dented	Dimpled and dented	Smooth and round
Seed coat	White/yellow	Blue/green	Blue/green	Blue/green	Buff- green (often with flecked patterns)	Brown, green ...
Cotyledon colour	Yellow	Green	Green	Green	Various colour	Various colour
Maturity	all ranges	Early	all ranges	Late	Late	Late
Standing ability	very stiff stawed	Stiff stawed	Stiff stawed	stiff stawed	Stiff stawed	stiff stawed
Height	all ranges	Short	All ranges	all ranges	all ranges	all ranges
Uses	Animal feeds; Human consumption (canning as "peas pudding", split for soups and prepared meals)	Animal feed; (as well Pigeon feed) Human consumption (canning as small peas)	Animal feeds; Micronising and Human consumption (as packet sales)	Human consumption (dry packet sales as large peas, canning and snack peas) and Micronising	Animal feed (as well Pigeon feed)	Animal feed (as well Pigeon feed)
Quality criteria	H: smooth seed coat and bright even colour	Canning samples: free from waste and stain, good even green colour	Micronising: sample colour regular, green and even-sized seeds	Packet sales: green colour free from blemishes; Canning: free from waste and stain and good cooking quality	blemish free, round, smooth and brown	blemish free, round, smooth and brown
Suitability	wide range of soils	Fertile soils (short types)	Range of soil types	Wide range of soil types	Wide range	Wide range
Market	Worldwide	UK and some other countries	UK and some other countries	East, Midlands and South of UK	UK	UK

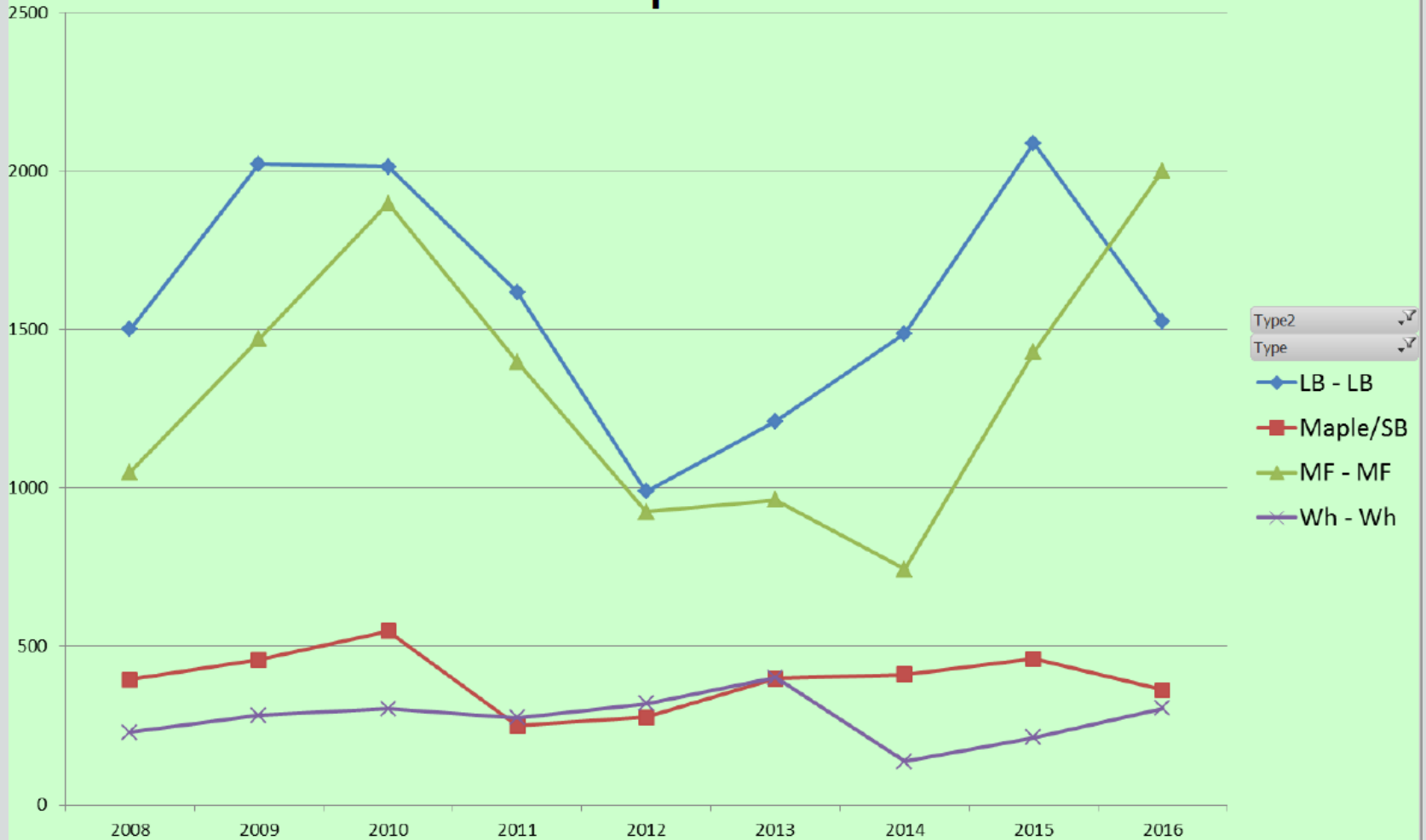
FIELD PEAS FOR COMBINING - Provisional Table of Characters

Control - Mean of Prophet and Mascara

	White grain peas					Large blue peas							Small blue	Maple peas		Marrowfat peas				
Recommendation categories R Recommended P1 Provisional year 1 P2 Provisional year 2			6%						37%				4%	9%			44%		LSD (P=0.05)	
	Karpate	Salamanca	Kareni	Mascara	Gregor	LG Stallion	Bluetooth	Prophet	Vertex	Daytona	Crackerjack	Kingfisher	Campus	Greenwo	Mantara	Rose	Alkido	Sakura		Genki
Recommendation status 2016	P1	R	P2	R	R	P1	R	R	P1	R	R	P2	R	P1	R	R	P2	R	R	
Yield as % control (4.81 t/ha) 5 year mean	105	101	101	99	97	102	102	101	100	99	98	97	97	95	93	90	90	88	83	7.4
Agronomic characters																				
Leaf type	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	SL	
Earliness of ripening	5	5	5	6	5	5	5	5	4	6	5	6	5	6	5	6	5	5	4	
Shortness of straw	5	4	5	5	5	4	5	5	5	5	5	4	4	6	7	5	4	5	5	
Standing ability at harvest	6	7	6	4	5	6	5	5	6	6	4	6	8	4	5	5	6	5	6	
Resistance to																				
Pea wilt (Race 1)	R	R	R	R	R	R	R	R	R	R	R	R	R	-	R	S	R	R	R	
Downy mildew	6	6	6	7	5	6	7	7	7	7	5	6	6	5	7	7	6	5	5	
Seed characters																				
Thousand seed weight (g) (@ 15% mc)	287	265	283	277	298	262	271	290	268	274	287	264	276	253	236	250	373	377	413	12.1
Protein content (% dry)	22.4	22.6	23.6	22.0	23.8	22.4	23.5	21.6	23.1	22.4	22.4	21.1	22.5	21.0	22.5	25.2	23.3	23.4	23.8	0.67
Year first listed		2011	2016	2007	2009		2015	2007		2010	2008	2016	2014		2010	2006	2016	2008	2007	

UK: Multiplication area

Sum of Ha (all grades)



harvest year mult

(Quelle: eigene Zusammenstellung)

RL: 5 year variation



Performance comparison of field pea lines in France 2012

agronomic and qualitative features

lines	Year of registration	Height at maturity [cm]	Plant length [cm]	Begin of flowering	End of flowering	TSW [g]	Yield of protein [% TM] 2013
Kayanne	2008	54	100	8. Juni	23. Juni	255	23,4
Baccara	1992	22	75	-1	-1	285	24,0
Solara	1987	26	66	-3	-4	305	24,6
Number location 2012		10	10	11	5	6	7

Results of yield: Arvalis-Netzwerk , France 2012

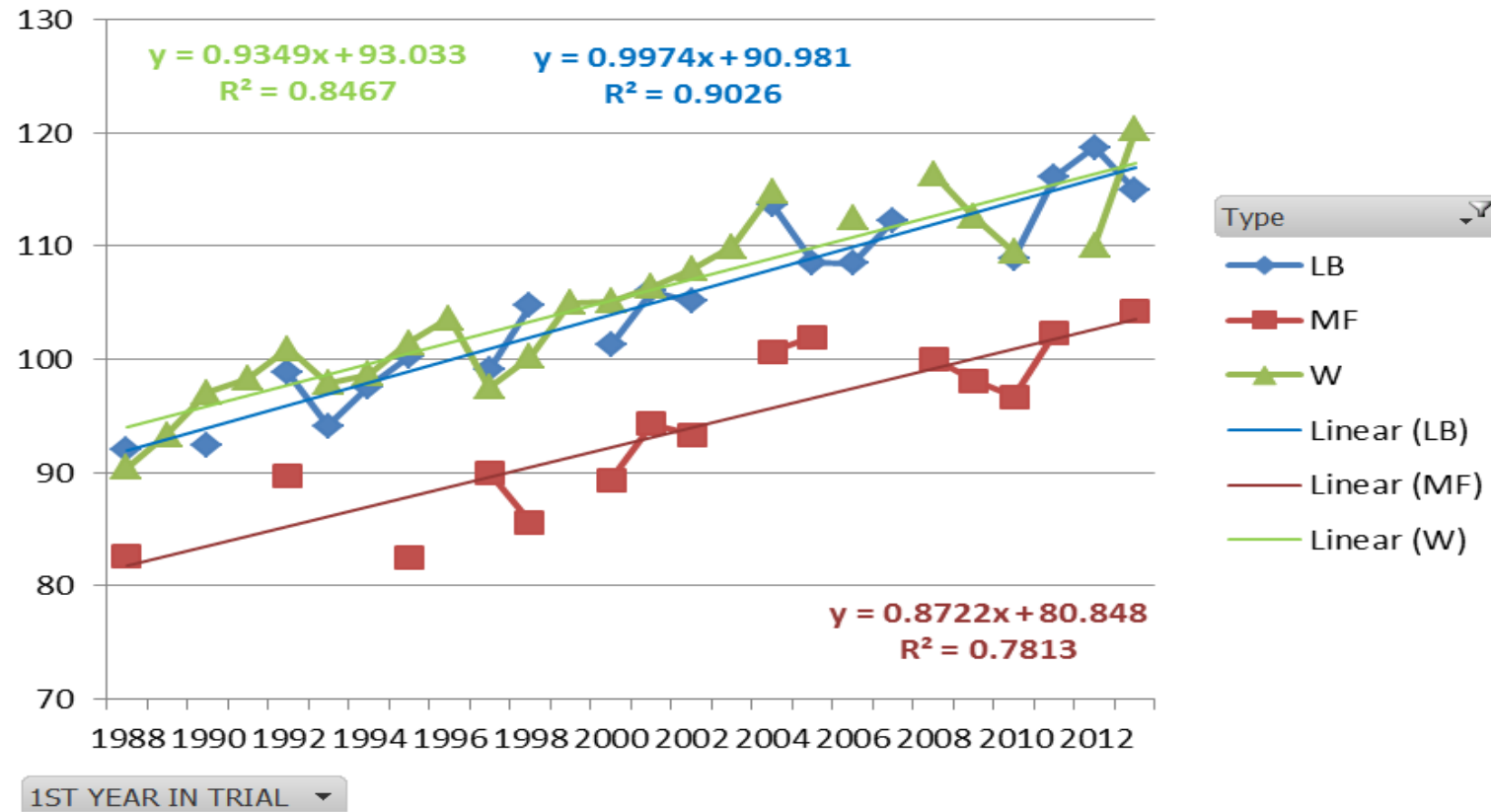
	Year of registration	Yield [dt/ha]	Yield [rel.]	Annual calculated increase of yield
Kayanne	2008	67,1	100	
Baccara	1992	57,5	86	0,6 dt/ha/a
Solara	1987	56,0	83	0,58 dt/ha/a
Number of location 2012			13	

Progress of yield at field peas in UK

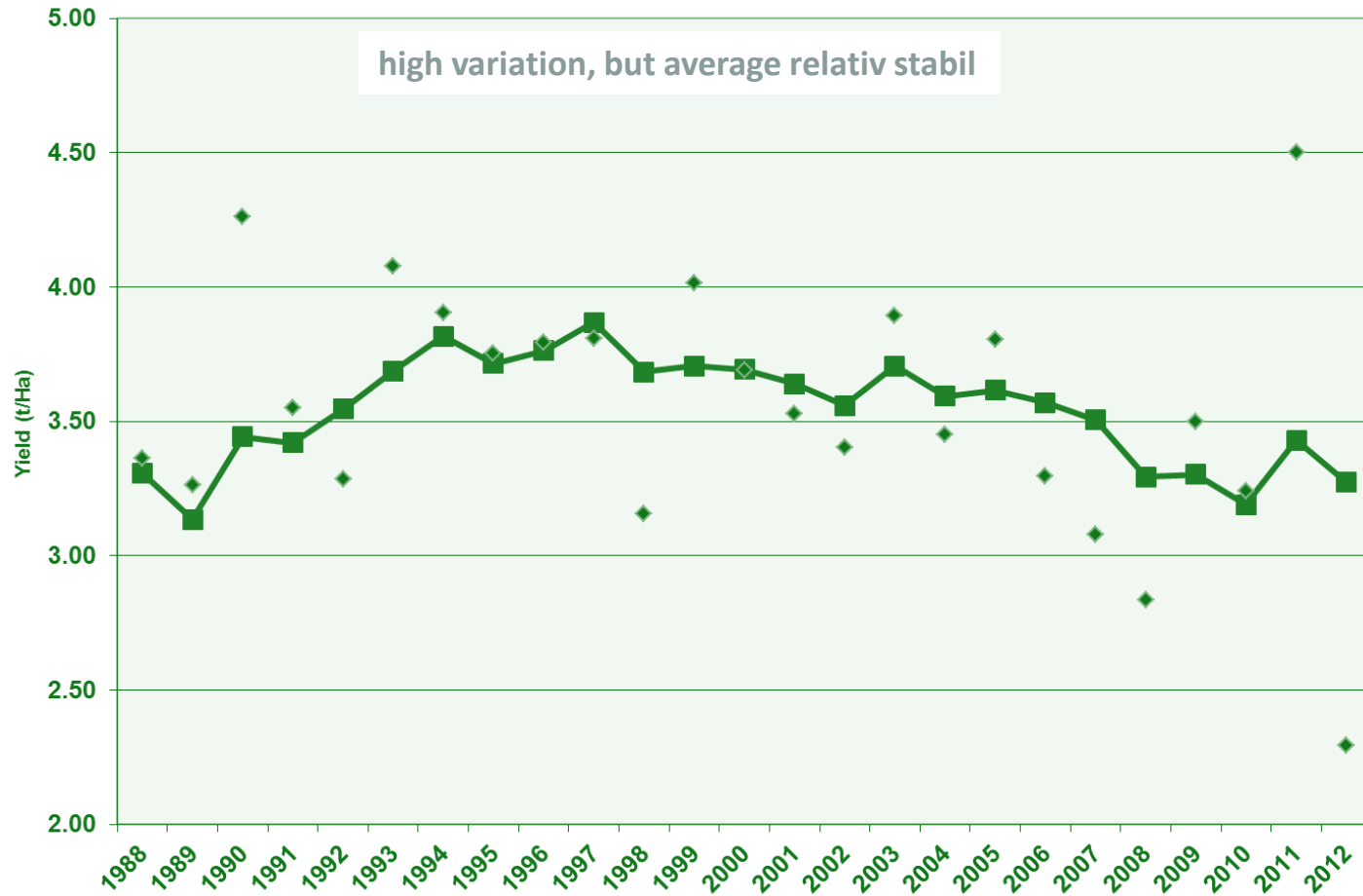
Leaf

Average of % ALL

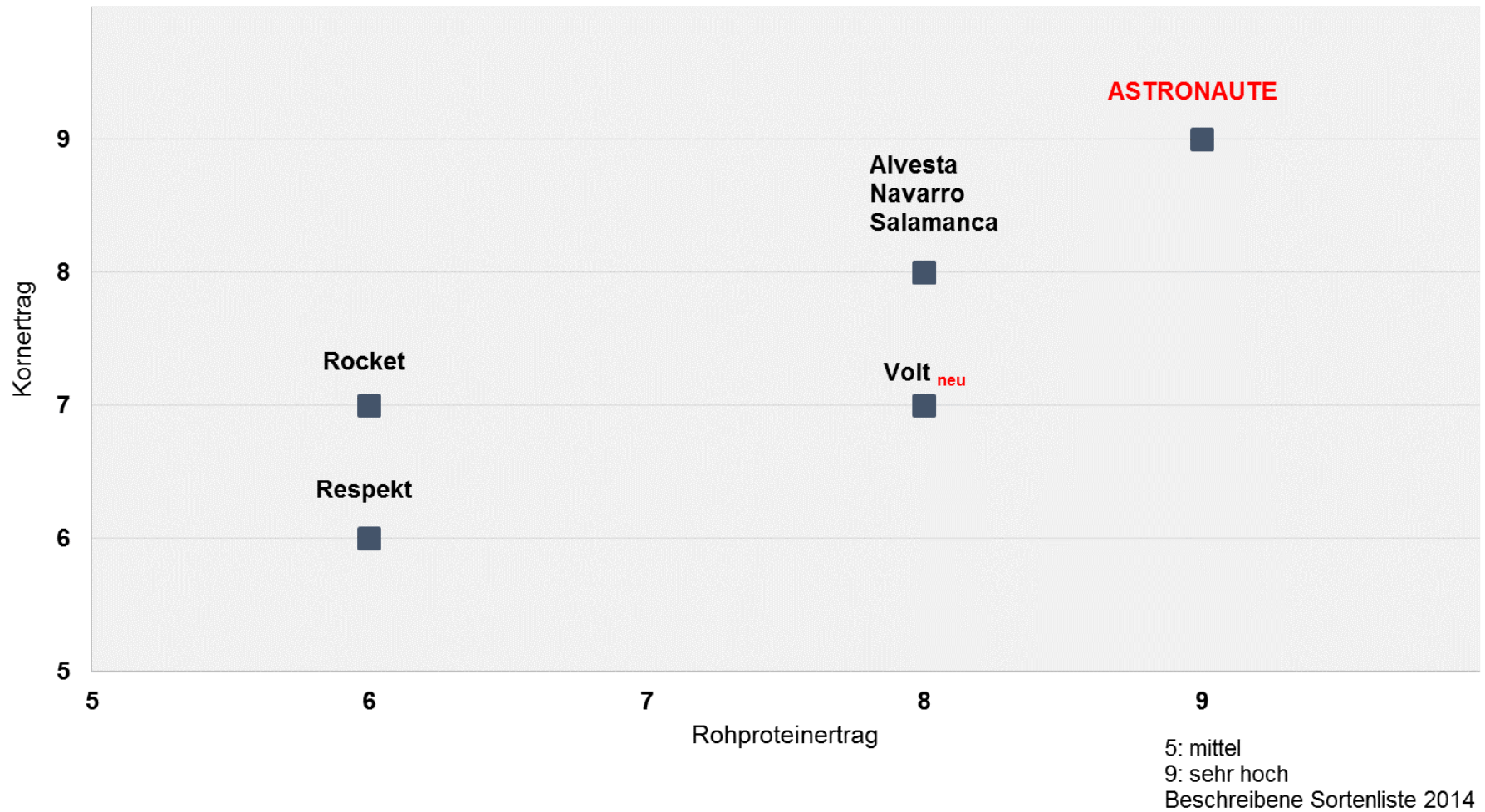
(mittlere Erträge in englischen NL- und RL-Versuchen, bezogen auf das Erstanmeldungs-jahr einer neuen Sorte, Quelle: NIAB classified list)



UK: yield of practices field peas (average of all forms: White, Large blue, Marrowfat)



ASTRONAUTE – Characteristics German Official List





Field peas to maturity







Harvest of field peas

Winter field peas



Breeding progress at winter field peas in France

line	registration	Grain yield [dt/ha]	Grain yield [rel.]	Height at maturity [cm]	Height at flowering [cm]	TSW [g]	Protein yield [% TM]	Frost tolerance
ISARD	2005	56,1	100	32,6	93,3	187,1	21,2	6,0
ENDURO	2007	59,0	105	54,4	84,8	194,4	22,1	3,5
JAMES	2009	55,6	99	53,5	78,3	185,4	23,6	5,5
BALLTRAP	2014	64,6	115	53,8	85,1	182,1	21,4	6,0
CASPER	2014	60,8	108	57,0	82,2	196,4	22,6	5,5
YVER	2014	58,4	104	58,0	93,3	165,4	22,5	5,5

Quelle: CTPS 2014



Winter field peas

Pea plants infected by Bacteriosis (Pseudomonas pisi)





Nursery of winter field peas 2015/16

NPZ/RAGT Lines of pulses in Official trials 2016

	Germany		France		UK		MOE
	NL 1	NL 2	NL 1	NL 2	WP1	WP2	WP1/WP2
Spring faba bean	3	-	2	1	2	1	3
Winter faba bean	1	-	-	-	1	2	-
Spring field pea	2	1	2	-	1	1	2
Winter field pea	3	2	2	1	-	-	3
Spring pea for green manure	1	-	-	-	-	-	-
Winter field pea for green manure	1	-	-	-	-	-	-

Breeding programmes in EU: state 2016

		Field peas		Faba beans		lupines
		spring	winter	spring	winter	
RAGT	FR	+++	+	-	-	-
NPZ	DE	+	+	++	+	-
			-			
Limagrain	FR	+++	+	+	+	-
Desprez	FR	++	+	-	-	-
Momont	FR	+++	-	-	-	-
Laboulet	FR	+				
Lemaire Desfontaine	FR	+				
AgriObtention	FR	(+)	(+)	+	+	-
Selgen	CZ	+	-	-	-	-
Szelejewo	PL	(+)	-	-	-	-
SZ Gleisdorf	AT	-	-	+	(+)	-
Wherry & Son	UK	-	-	-	+	-
SZ Petersen	DE	-	-	+	-	-
SZ Steinach	DE	-	-	-	-	++
INRA	FR	-	-	-	-	(+)
Inst. PL	PL	-	-	-	-	+
Inst. RUS	RUS	-	-	-	-	+
U. Kopenhagen	DK	-	-	-	-	+
		<u>8</u>	<u>4</u>	<u>5</u>	<u>3</u>	<u>4</u>

(Quelle: eigene Zusammenstellung)

Conclusion: status of breeding in faba beans and field peas

Faba beans

Higher and more stable yields by Synthetic varieties , combined with new quality traits like low vicin/convicin

Modified plant architecture with shorter growth and good standing power makes faba beans more easy to combine

New winter hardy germplasm is under development

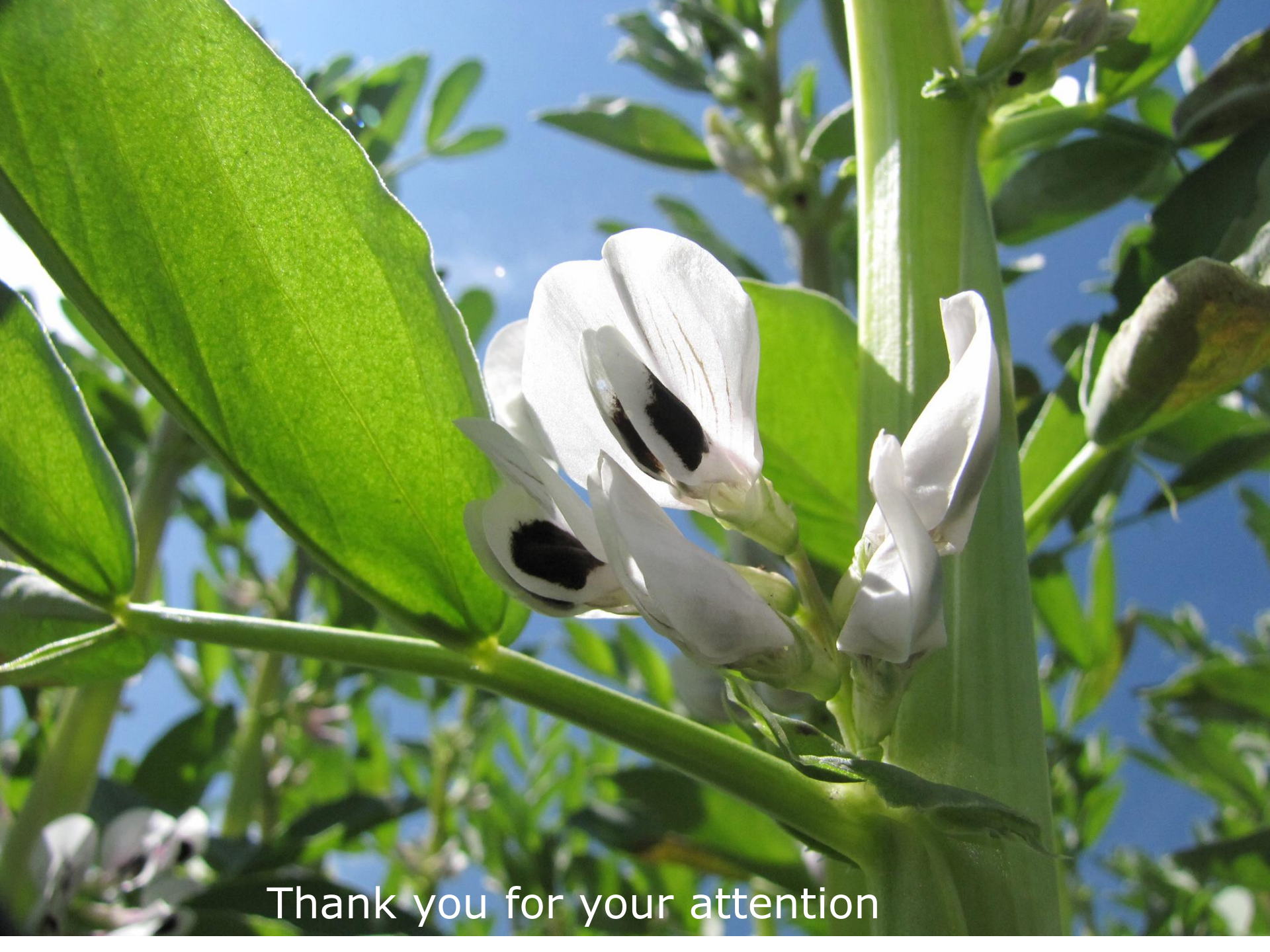
Field peas

Significant improvement of standing power and safe-guarding of harvest

Improved grain and protein yields

Recent breeding success in winter peas can create new opportunities

A good set of high performing pea and faba bean varieties is available



Thank you for your attention

Potentielle Forschungsfelder für die Körnerleguminosenzüchtung in Deutschland



- Systematische Erhöhung der genetischen Diversität unter Nutzung moderner molekularer Methoden
- Stabilisierung der Winterhärte bei Wintererbsen
- Verbesserung der Standfestigkeit bei Wintererbsen
- Resistenzzüchtung:
 - Entwicklung und Anwendung molekularer Marker gegen *Mycosphaerella*, *Peronospora pisi*, *Aphanomyces euteiches* (?)
 - Insektenresistenzen: *Acyrtosiphon pisum*, *Sitona lineatus*

Potentielle Forschungsfelder für die Körnerleguminosenzüchtung in Deutschland



Ackerbohnen

- Erhöhung der Korn- und Proteinerträge durch die Entwicklung von Hybridsorten
- Erhöhung der genetischen Diversität mithilfe moderner molekularer Methoden
- Entwicklung ausreichend winterharter Formen
- Verbesserung der Standfestigkeit bei Winterackerbohnen

- Resistenzzüchtung:
 - Entwicklung und Anwendung molekularer Marker gegen *Ascochyta fabae*, *Peronospora viciae*, *Fusarium spec.*
 - Insektenresistenzen: *Aphis fabae*, *Sitona lineatus*, *Bruchus rufimanus*