

Integration of protein crops in cropping systems and agricultural landscapes

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Imports, market and economics?



Cropping systems, fertilisers, forecrops etc?



Added value for the farmer and/or consumer?



Public opinion - GM

FINAL USERS OF PROTEIN CROPS



ANIMAL FEED PERSPECTIVE



yesterday



today



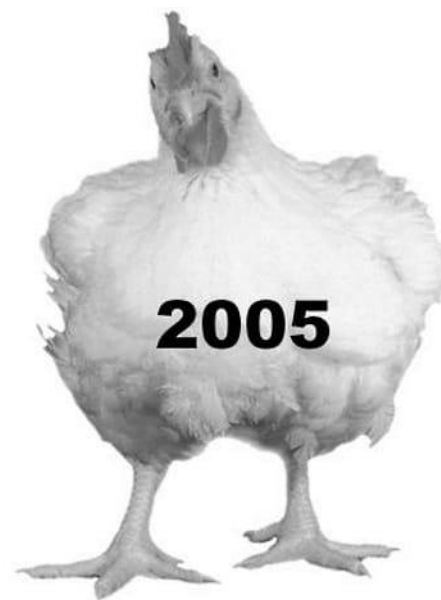
1957

905 g



1978

1,808 g




2005

4,202 g

50 YEARS OF GENETIC SELECTION!



 Hill WG, Kirkpatrick M. 2010.
Annu. Rev. Ecol. Evol. Syst. 41:1–19

COMMON LANGUAGE

PLANT BREEDERS



ANIMAL NUTRITIONIST

Polish Plant Protein Program 2011/2015 and 2016-2020

<http://bialkoroslinne.iung.pl/>

Aim: Improvement of the protein security

- Increased production of locally grown plant protein
- Protein “banks” for feed operators
- Knowledge transfer directly to farmers
- Integrated food production based on local proteins
- Sustainable agriculture, fertilisers and GHG emissions
- Nutritive value of legumes for feed operators
- 50% reduction of soybeans import
- Increase of legumes production to 650.000 tones annually

SEED MATERIAL OF DIFFERENT LEGUMES IN POLAND (HA)

LEGUME	YEAR						
	2011	2012	2013	2014	2015	2016	2017
Blue lupin	2 754	2 768	2 584	3 501	6 924	5 060	4 301
Pea	2 305	1 650	1 333	1 980	4 984	3 606	3 618
Yellow lupin	1 872	1 768	1 606	1 852	3 035	2 029	1 738
Faba beans	442	333	558	901	2 095	861	1 187
Common vetch	268	269	342	708	1 554	2 112	1 100
White lupin	13	11	31	17	70	8	17
Soybean	48	454	597	1 976	4 073	1 662	1 671
Total	7 702	7 253	7 051	10 935	19 239	15 338	13 632
%	100	94	92	142	295	199	170

LIMITATIONS WHAT CAN WE USE TODAY IN ANIMAL NUTRITION?



LEGUMES



SOYBEAN



RAPESEED



SUNFLOWER

Antinutritive factors	+++	++	++	+
Heat treatment	YES	YES	YES/NO	YES/NO
Feed enzymes	YES	YES	YES	YES
Other methods	YES	YES	YES	YES
New varieties	!!!	!!!	!!	-
Nutritive value	++	+++	++	++



+



SOYBEAN

RAPESEED

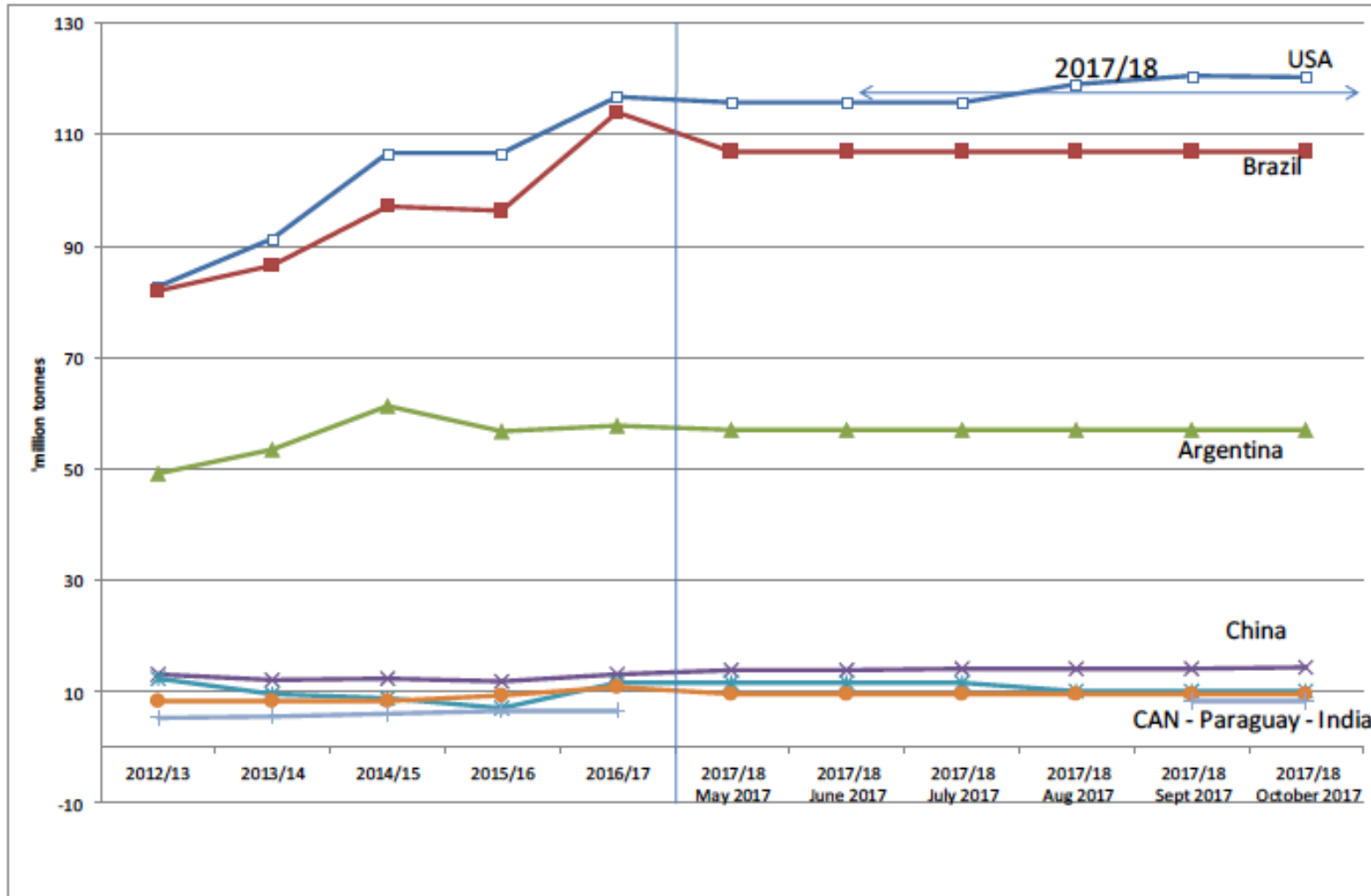
COMPLEMENTARY NUTRITIVE VALUE
DIFFERENT BY-PRODUCTS AS OIL, CAKE
PROTEIN/ENERGY/YIELD
FEED/FOOD APPLICATION
STABILITY
WATER CONSUMPTION/YIELD
CROPPING SYSTEM

ADDED VALUE OF SOYBEAN IN POLISH CONDITIONS

- Added value of nitrogen
 - 30-100 KG/HA
 - Soil structure
 - Water needs
- Added value of of forecrops
 - Equivalent of 0,5-1 tone of wheat

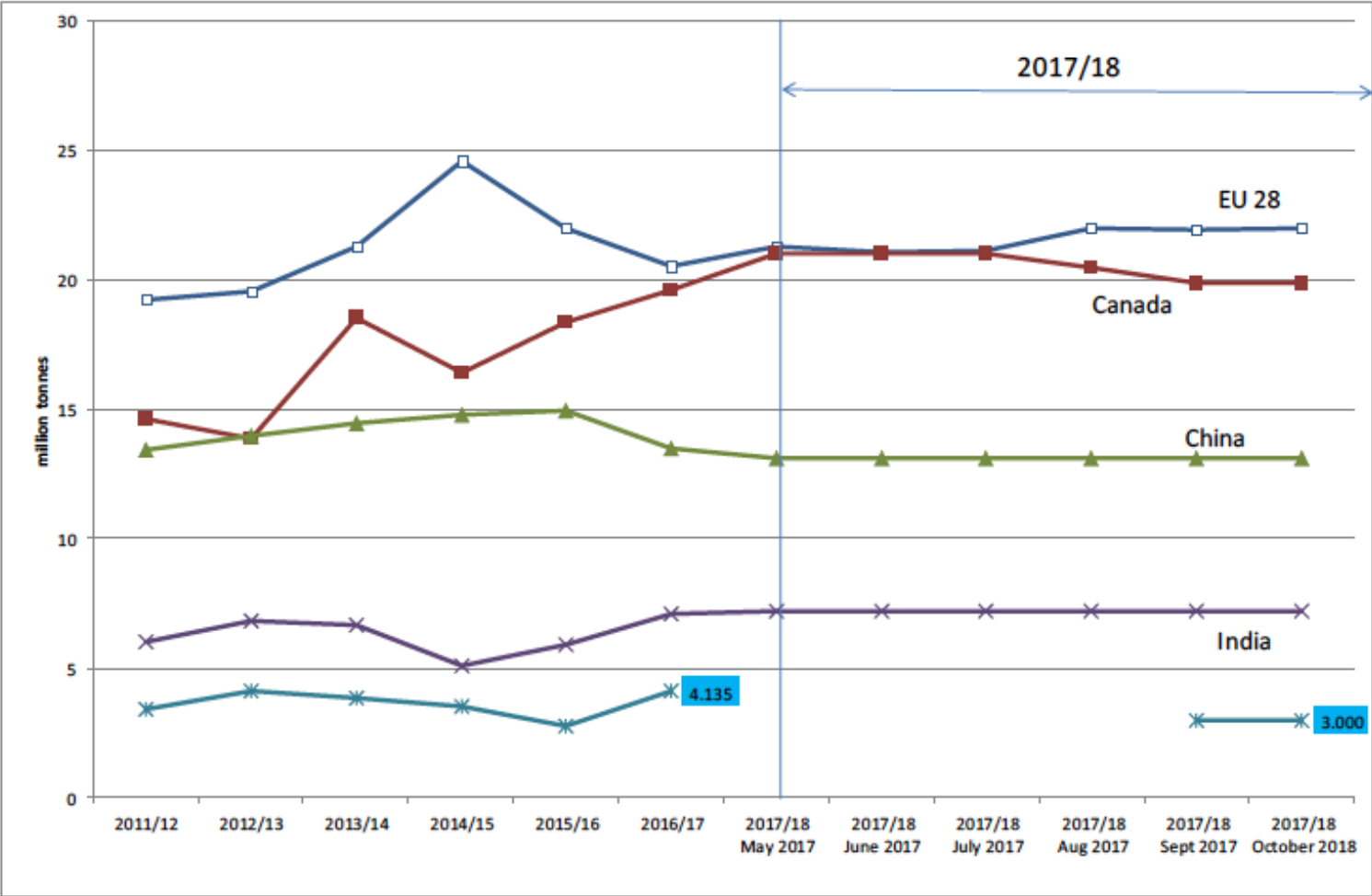


SOYBEAN PRODUCTION FORECAST BY COUNTRY



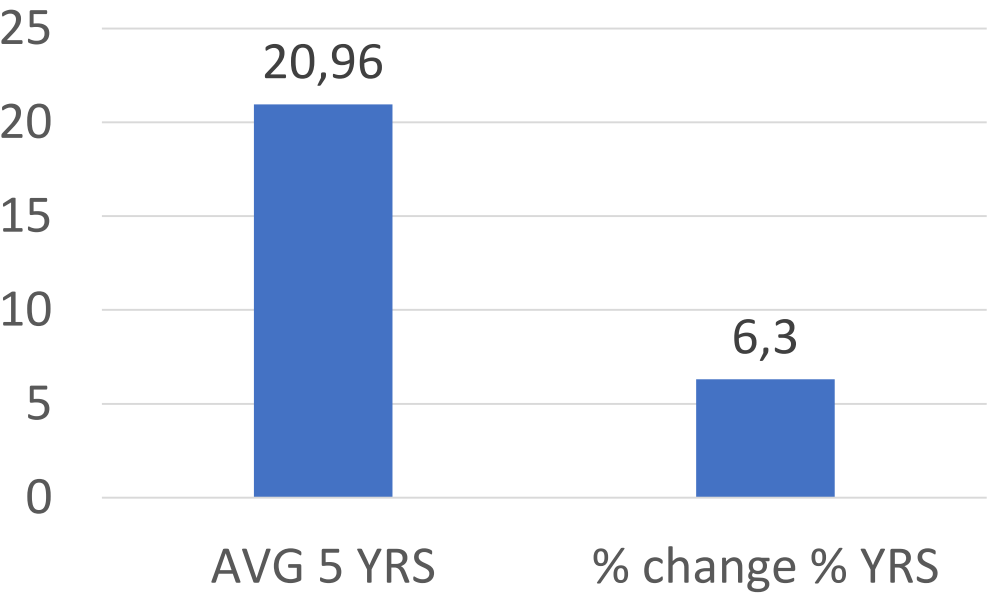
+ 8% vs 5 years average

RAPESEED PRODUCTION FORECAST BY COUNTRY

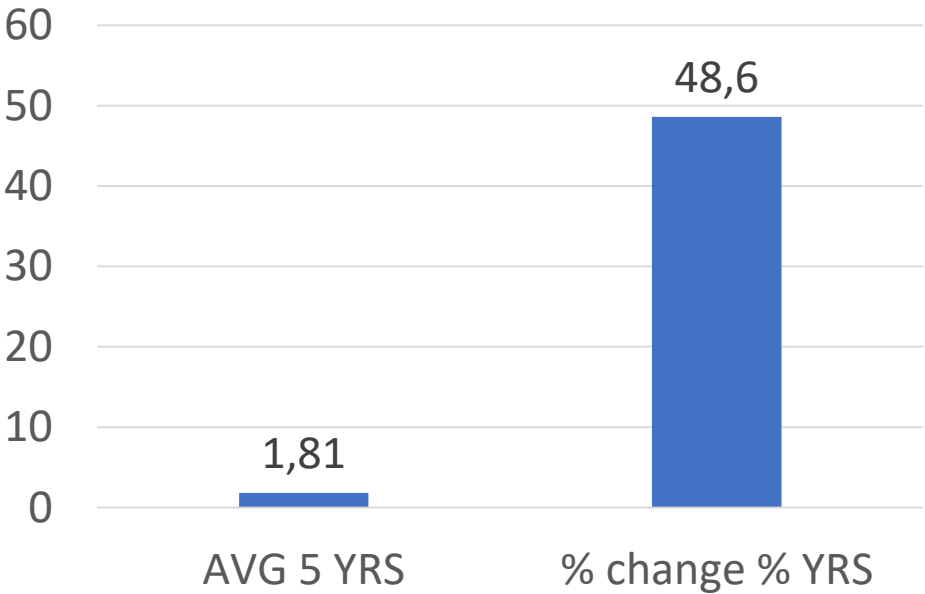


+ 5% vs 5 years average

EU RAPESEED PRODUCTION



EU SOYBEANS PRODUCTION



SINCE 2013 PROTEIN CROPS +114% AND SOYBEANS +121%

SOYBEAN YIELDING IN DIFFERENT PARTS OF POLAND [t/ha]

Variety	DIFFERENT REGION OF POLAND						
Aldana	2,60*	2,47	2,40	2,92	3,22	1,98	1,67
	2,81**	1,83	0,6	2,34	2,25	2,14	-
Anushka	3,00	2,50	-	3,07	3,99	2,60	2,66
	3,53	1,74	-	2,30	3,20	1,70	2,04
Merlin	4,84	2,88	4,30	4,18	5,39	4,08	3,54
	4,27	1,94	3,10	3,82	4,10	2,70	1,98
Lissabon	4,75	2,87	4,56	4,00	4,29	4,10	3,60
	4,29	1,63	2,90	3,33	2,80	2,57	2,37
Aligator	-	-	-	-	-	-	-
	4,30	1,05	2,40	4,06	5,20	3,31	2,66

CALCULATION OF THE SOYBEANS ECONOMY IN POLISH CONDITIONS (EURO/HA) in 2017 (Szukala et al.2017)

ITEM		System		
		PLOUGHING	DIRECT DRILLING	ULTRA-SHALLOW TILLAGE
	Yield [t·ha ⁻¹]	3,40	3,56	3,57
1.	Total value	1463	1514	1517
1.1	Main production (seed)	1098	1150	1152
1.2.	Land subsidiary	110		
1.3.	Legume subsidiary	145		
1.4.	“Green” direct payment	74		
1.5.	Seed subsidiary	35		
2.	Total cost	815	795	761
2.1.	Direct cost	530	543	543
2.2.	Indirect cost	274	252	217
3.	Direct surplus	932	971	974
4.	Cost of the seed production (1t)	236	223	213
7.	Income euro/ha	658,6	718,9	756

Experiments on poultry



RAPeseed

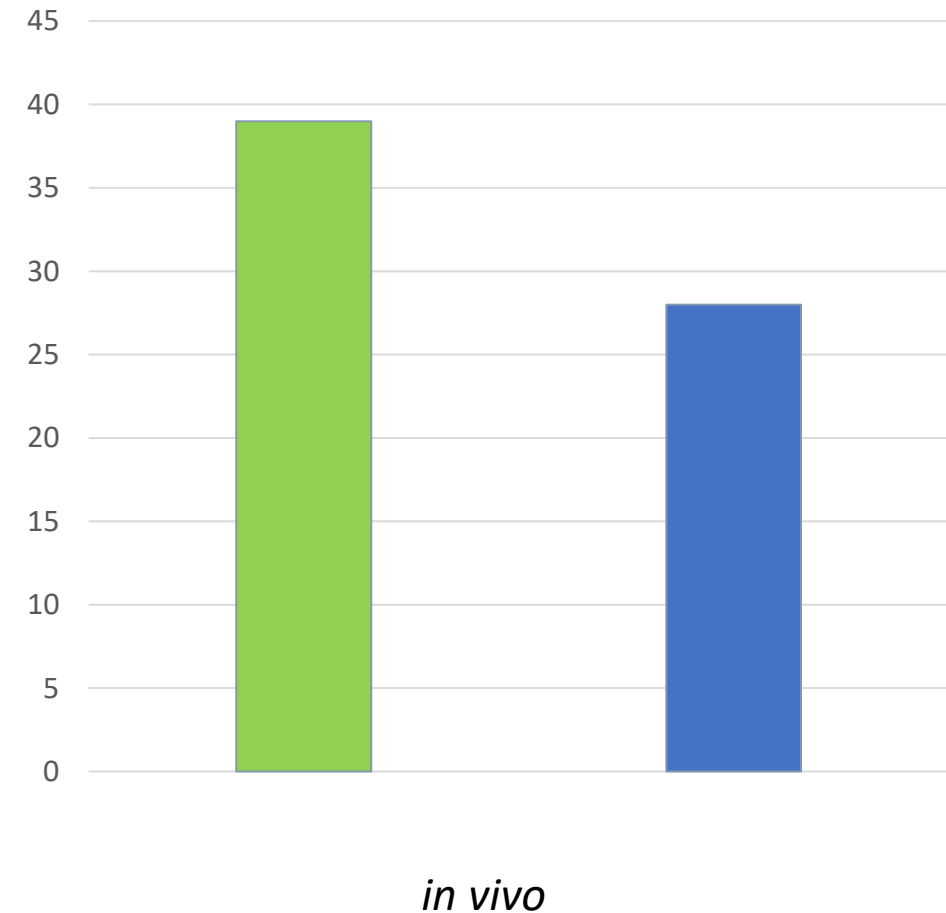
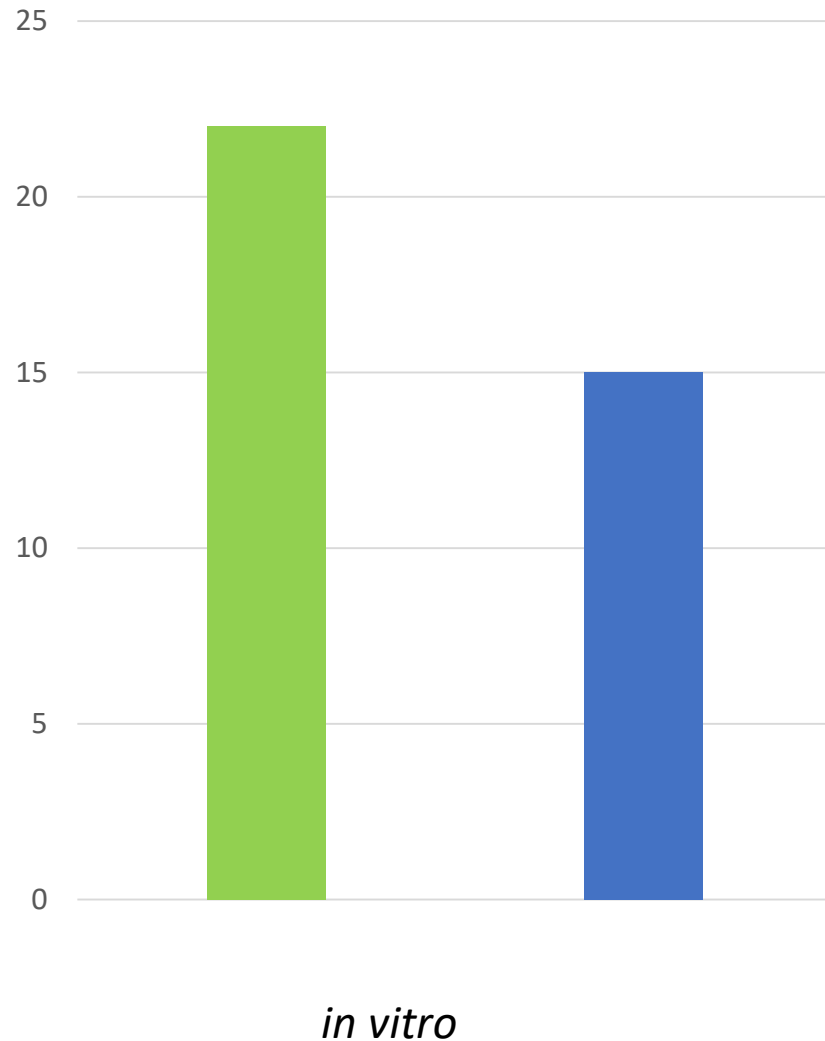
RAW/ FERMENTED RAPESEED CAKE

Content (%) in dm	RAW RAPESEED CAKE	FERMENTED RAPESEED CAKE
Crude ash	6.700	6.702
Crude protein	32.511b	34.855a
True protein	26.801b	29.569a
Crude fibre	15.517	16.384
Crude fat	9.956	9.287
NFE	35.315a	32.773b
EB(kcal)	5126.59b	5240.29a
Phosphorus	1.151	1.143
Phytate-P.	0.307a	0.016b
Phytate/P (%)	26.67a	1.40b
Glucosinolates (μmol/g)	16.30a	1.66b
Raffinose	3.21a	1.47b
Stachiose	17.66a	0.48b

a,b – means within a column with no common superscripts differ significantly ($P < 0.05$)

RAW AND FERMENTED RAPESEED CAKE

– methane production, *in vitro* (mmol) and *in vivo* (ppm)
conditions (37. d chickens)





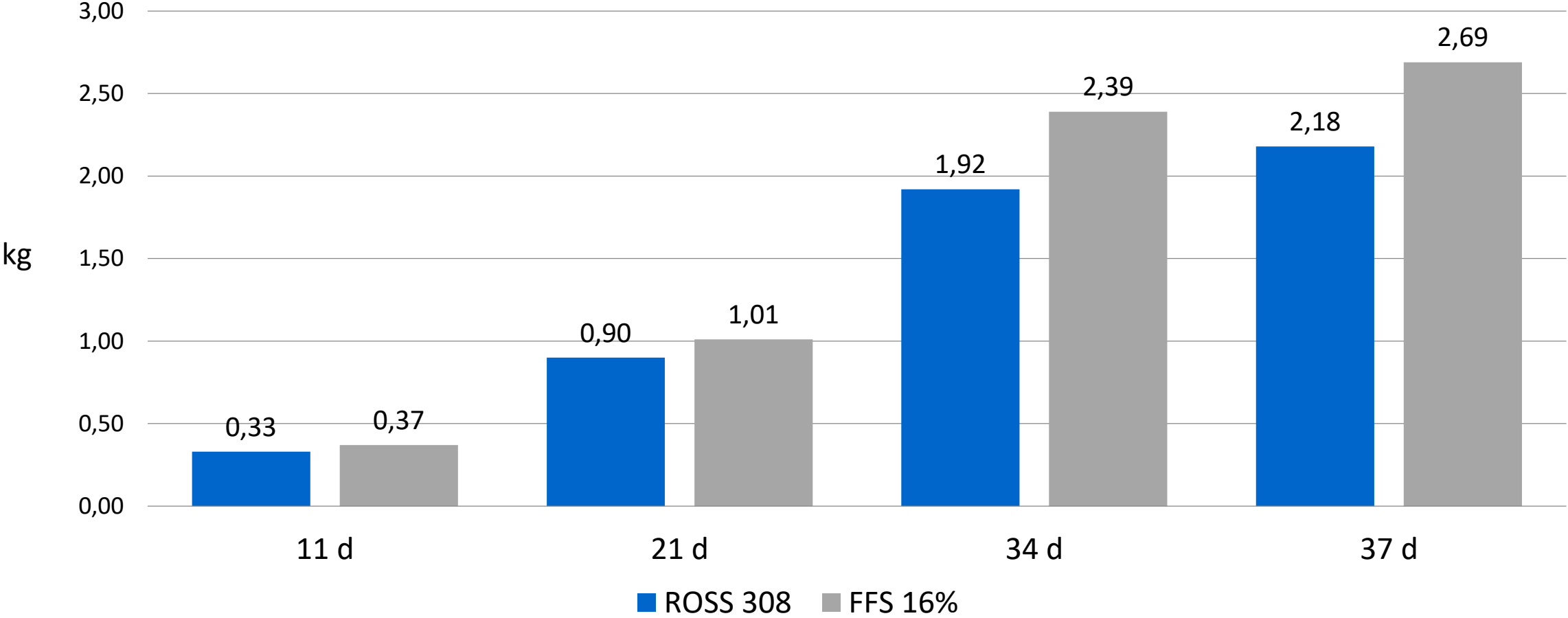
SOYBEAN

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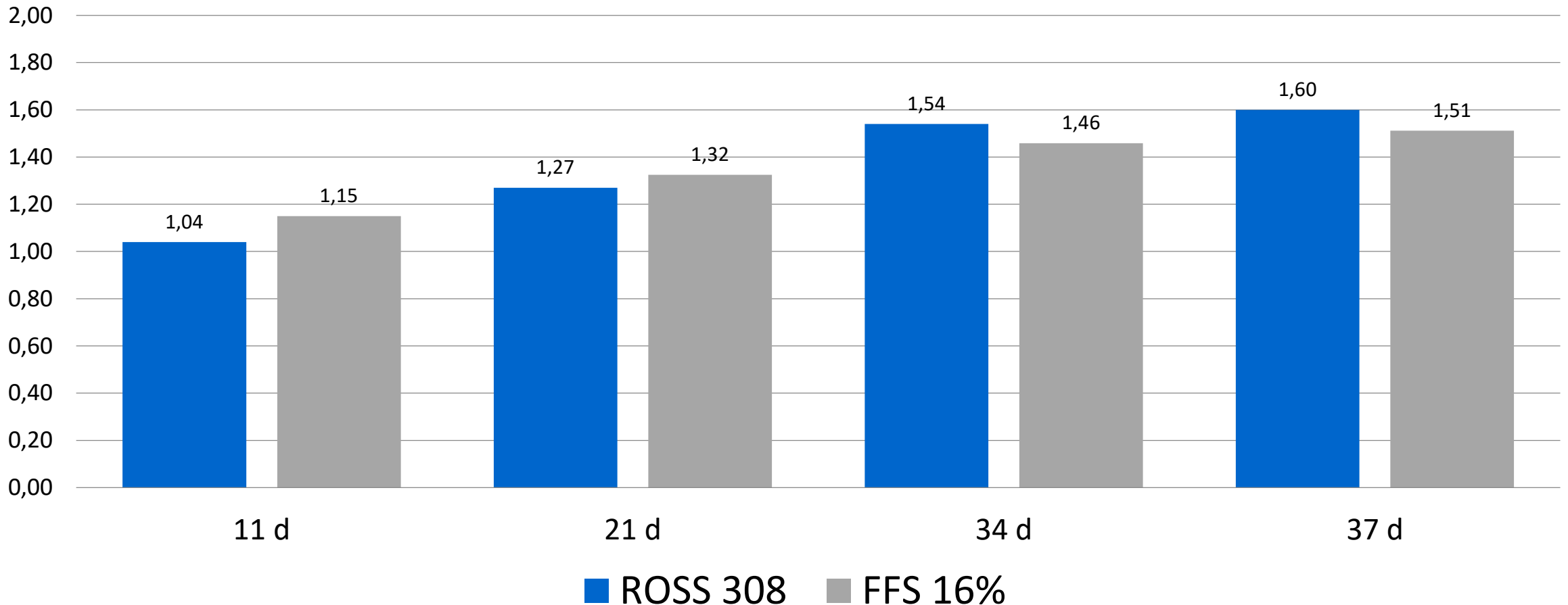


RAPESEED

Body weight gain (kg) of female broiler chickens fed full-fat soybeans/rapeseed based diets in commercial conditions (1-37d)



Feed conversion ratio (kg) of female broiler chickens fed full-fat soybeans/rapeseed based diets in commercial conditions (1-37d)





+



SOYBEAN

RAPESEED

LEGUMES (LUPINS/FABA BEANS/PEAS) **CANNOT TOTALLY REPLACE** IMPORTED SOYBEANS IN POULTRY
LOCALLY GROWN SOYBEAN-RAPESEED : SIMILAR ECONOMICS
HIGHER YIELD NEEDED FOR FARMERS AND FEED OPERATORS

SOYBEAN SHOULD BE INCLUDED IN CROPPING SYSTEM
LOCALLY GROWN SOYBEANS+RAPESEED
CAN TOTALLY REPLACE IMPORTED SOYBEAN MEAL
BOTH CAN BE USED **AS FULL-FAT**
RAPESEED **RAW OR HEAT TREATED**
BOTH CAN BE **FERMENTED** TO IMPROVE NUTRITIVE VALUE