

Effects of organic wheat cultivation in wider rows on grain yield and quality

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Introduction

- ❑ **the most significant differences in quality of common wheat from organic and conventional agriculture usually comprise the differences in the crude protein content in grain dry matter**
- ❑ **this worsens possibilities of baking processing**
- ❑ **other measures for improvement of baking quality should be sought when common wheat is cultivated in organic agriculture**

Material and methods

- ❑ **exact small-plot field trials were conducted during the years 2005, 2006 and 2007 on the experimental station of CULS Prague in Uhrineves (295 m above sea level, average annual temperature 8.4°C, average annual sum of precipitation 575 mm)**
- ❑ **two winter wheat varieties: Ludwig and Sulamit (both quality group E – elite)**
- ❑ **three row spacings: 125, 250 and 375 mm**
- ❑ **three sowing rates: 200, 300 and 400 germinating grains per m²**
- ❑ **pea was a preceding crop**
- ❑ **date of sowing: about October 5th**
- ❑ **weed management:**
 - **the widest rows – line weeding using the thrust hoe (as necessary)**
 - **other variants – weeding harrows (as necessary)**



narrow rows 125 mm



wider rows 250 mm



the widest rows 375 mm

narrow rows 125 mm



wider rows 250 mm



the widest rows 375 mm



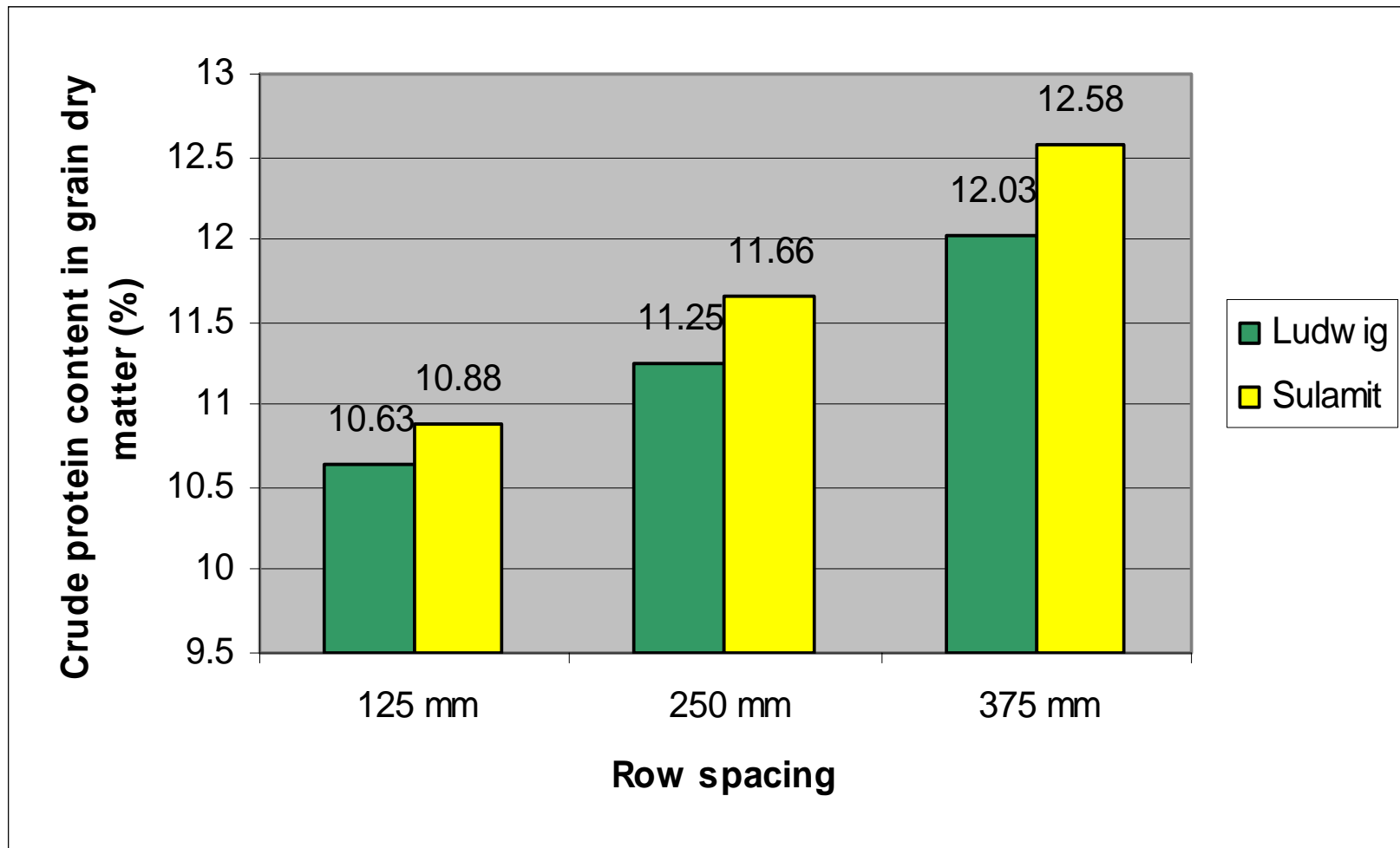
Results of quality evaluation



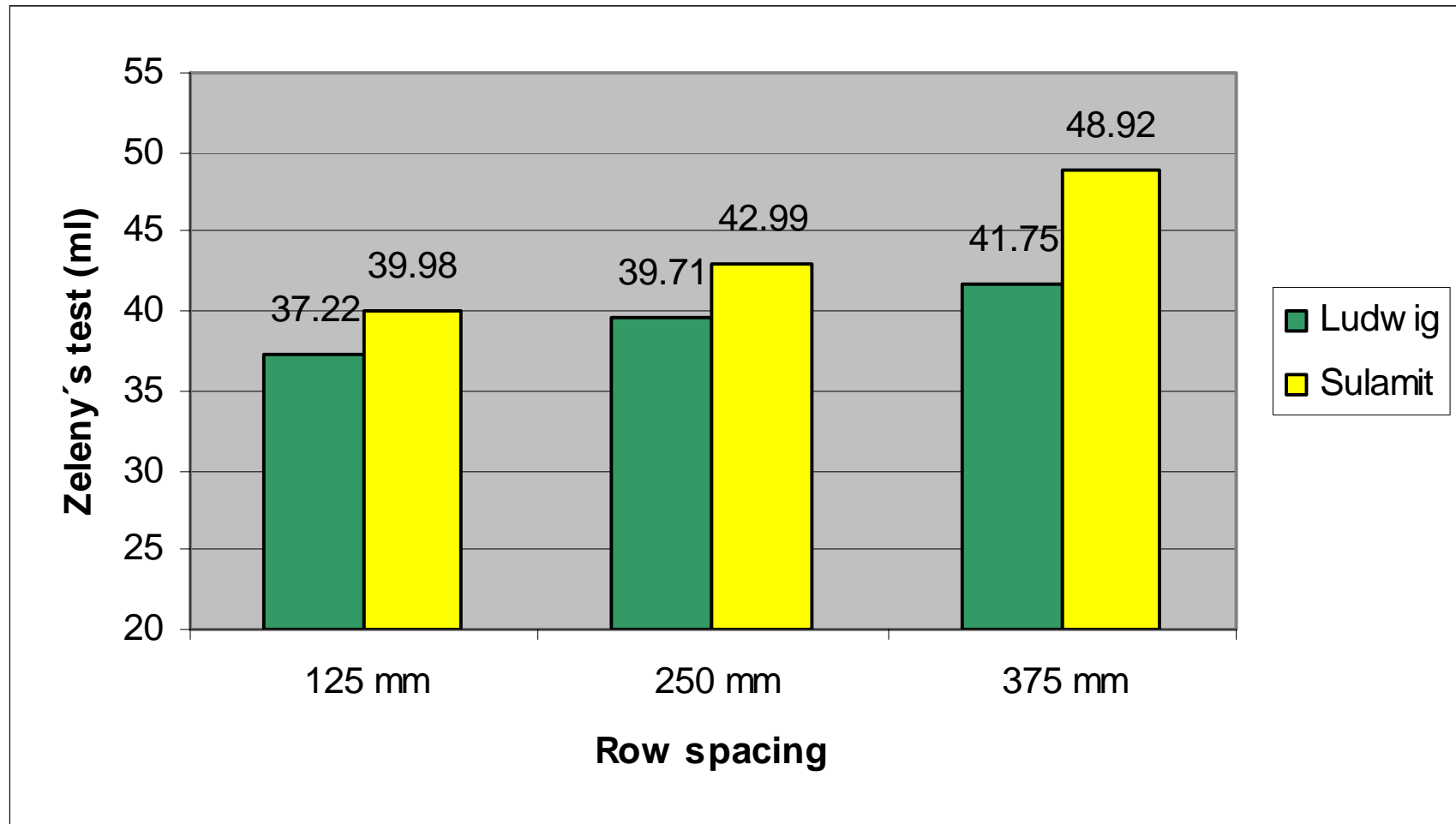
LSD test for crude protein content in grain dry matter and for Zeleny's test (LSD, $\alpha = 0.05$)

		Crude protein content (%)	d_{\min}	Sign.	Zeleny test (ml)	d_{\min}	Sign.
Variety	Ludwig	11.30	0.28	a	39.56	2.19	a
	Sulamit	11.70		b	43.97		b
Row spacing (mm)	125	10.76	0.42	a	38.63	2.76	a
	250	11.45		b	41.35		a
	375	12.30		c	45.33		b
Sowing rate (germin. grains. m ⁻²)	200	11.50	0.37	a	42.11	2.48	a
	300	11.52		a	41.17		a
	400	11.49		a	42.04		a
Year	2005	11.35	0.36	a	41.80	2.05	a
	2006	11.44		a	41.74		a
	2007	11.72		b	41.78		a

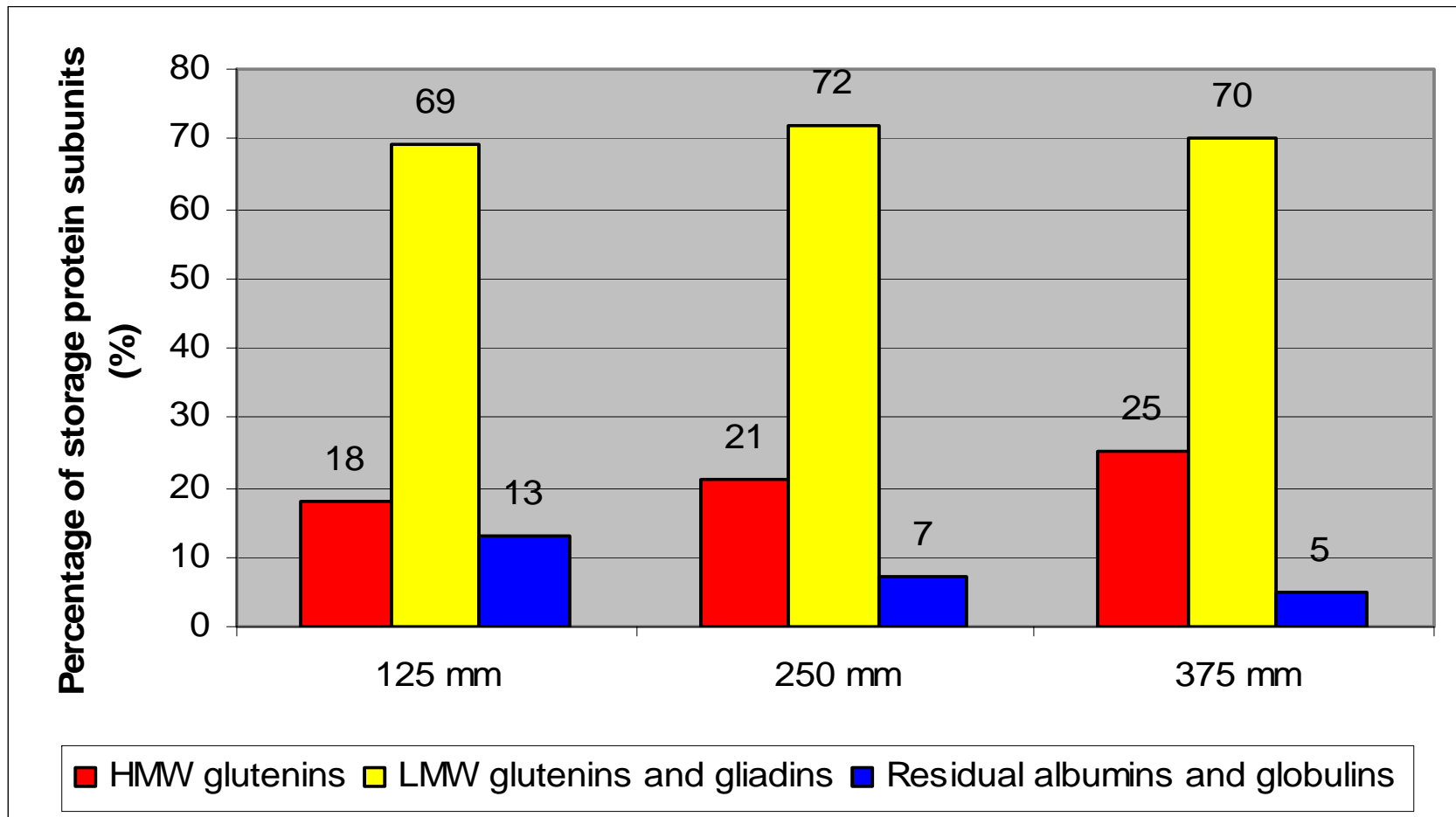
Crude protein content in grain dry matter (average of 2005 – 2007)



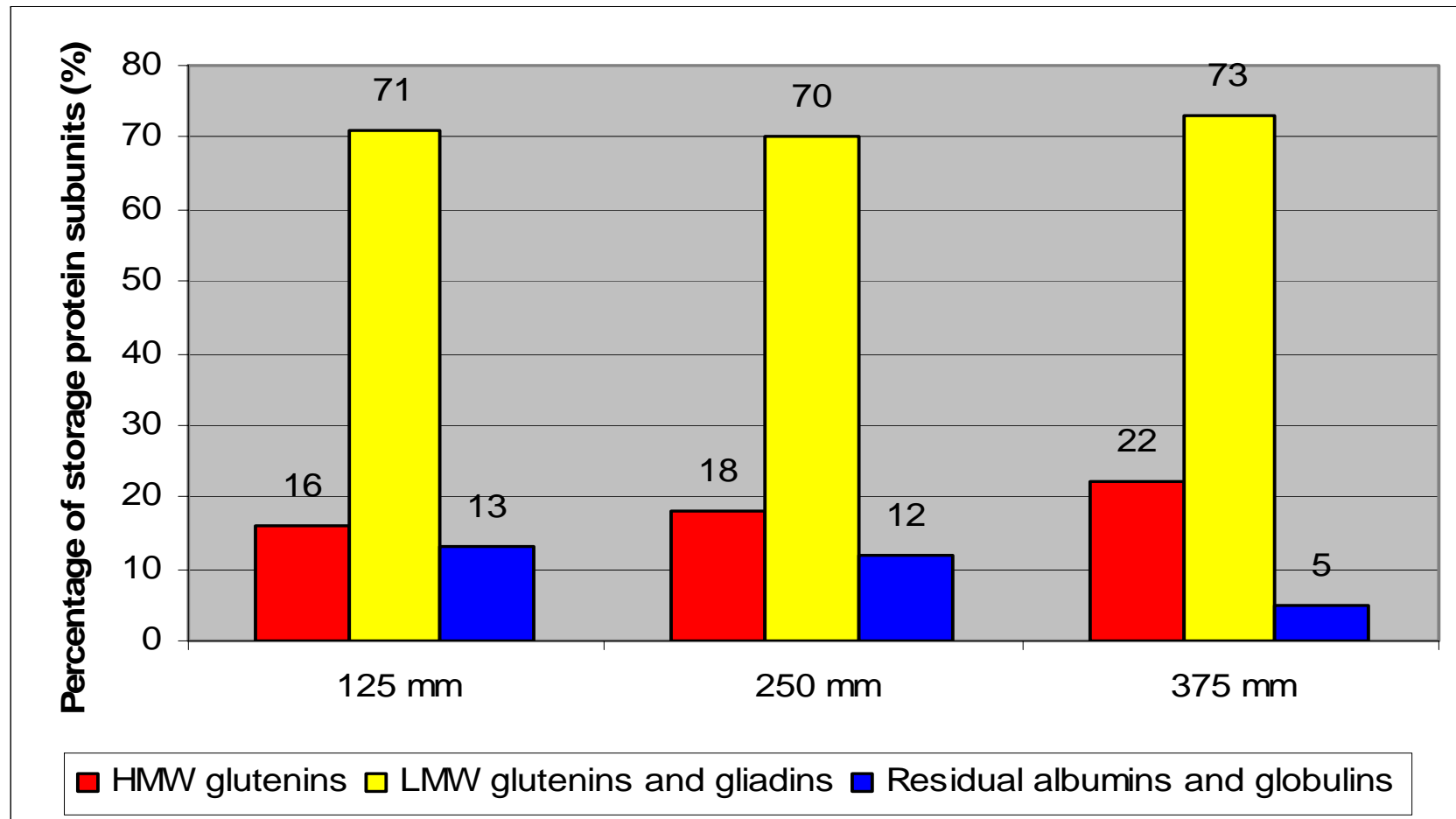
Zeleny's sedimentation test (average of 2005 – 2007)

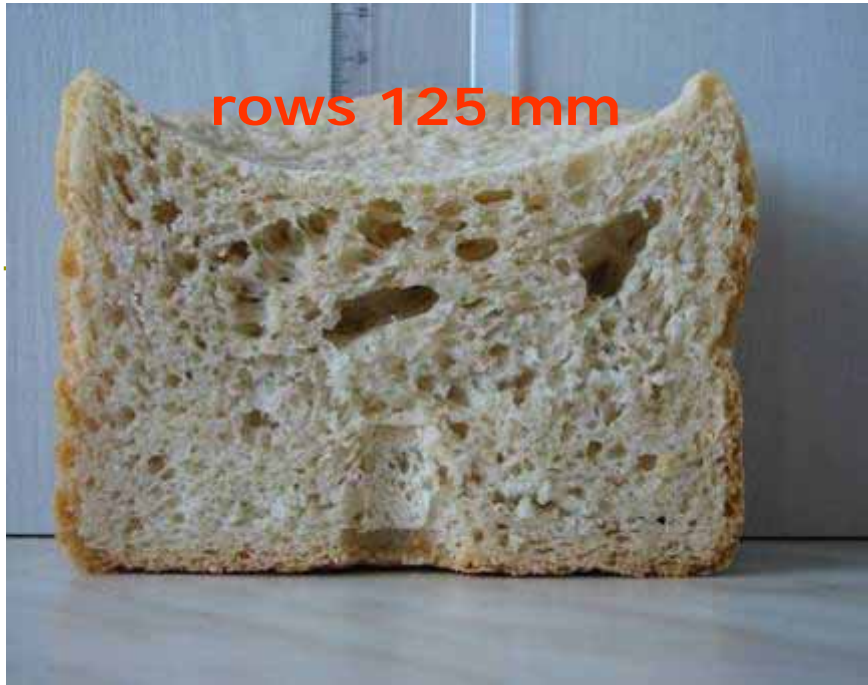


Quantitative evaluation of SDS-PAGE electrophoretic analysis of storage proteins (Sulamit, average of 2005 – 2007)

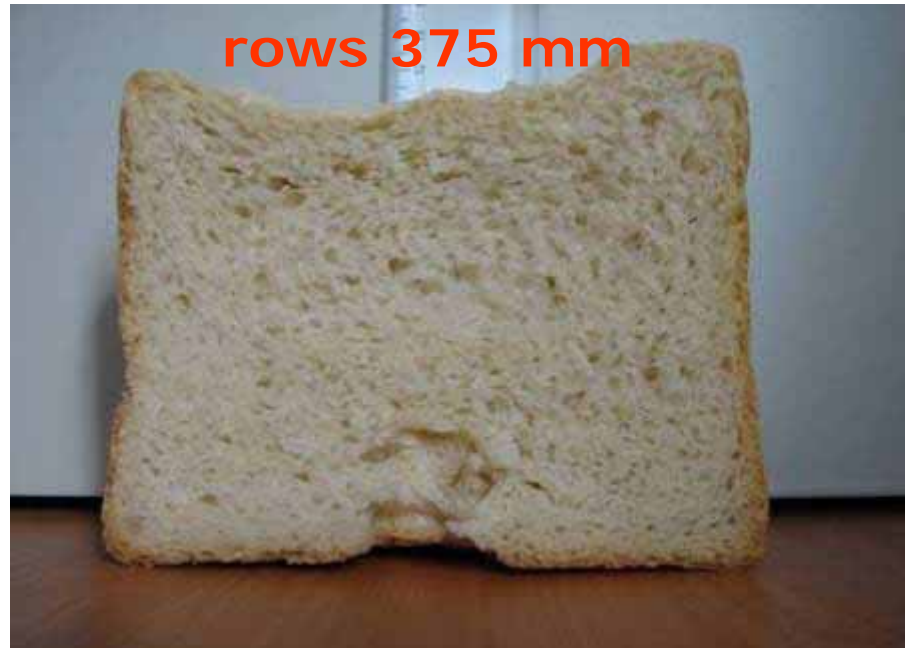


Quantitative evaluation of SDS-PAGE electrophoretic analysis of storage proteins (Ludwig, average of 2005 – 2007)

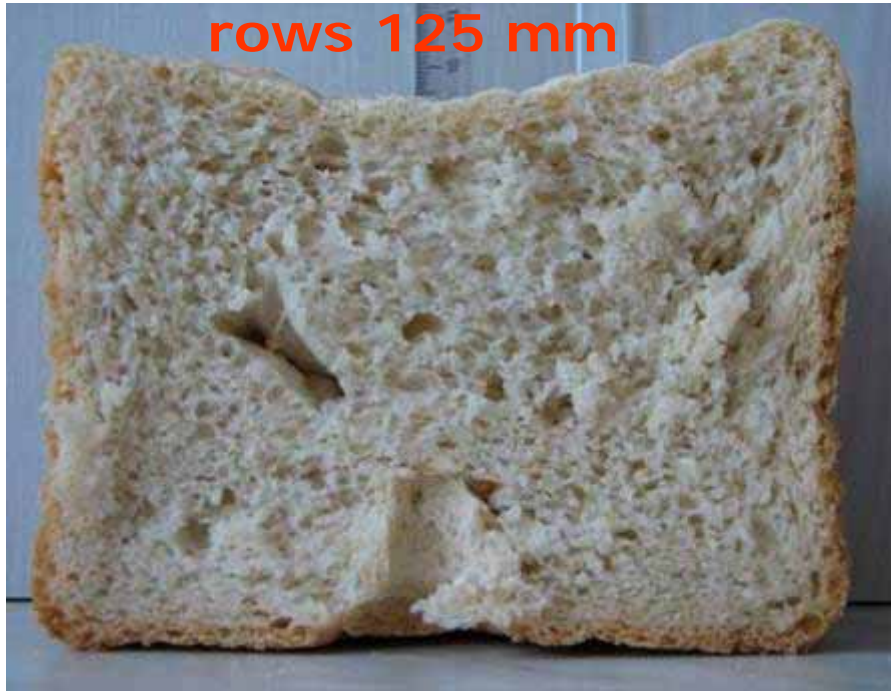




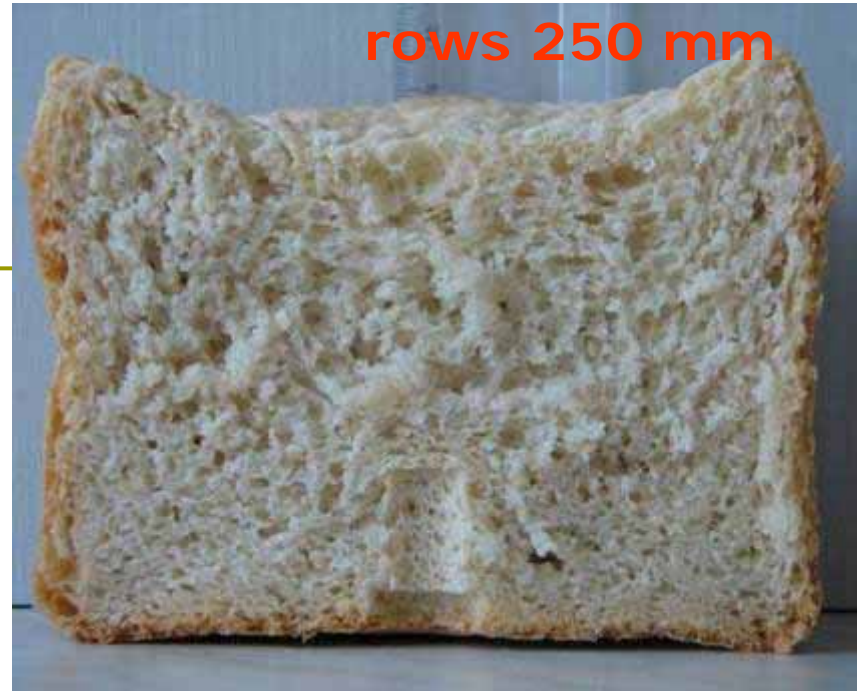
Ludwig



rows 125 mm



rows 250 mm



rows 375 mm



Sulamit

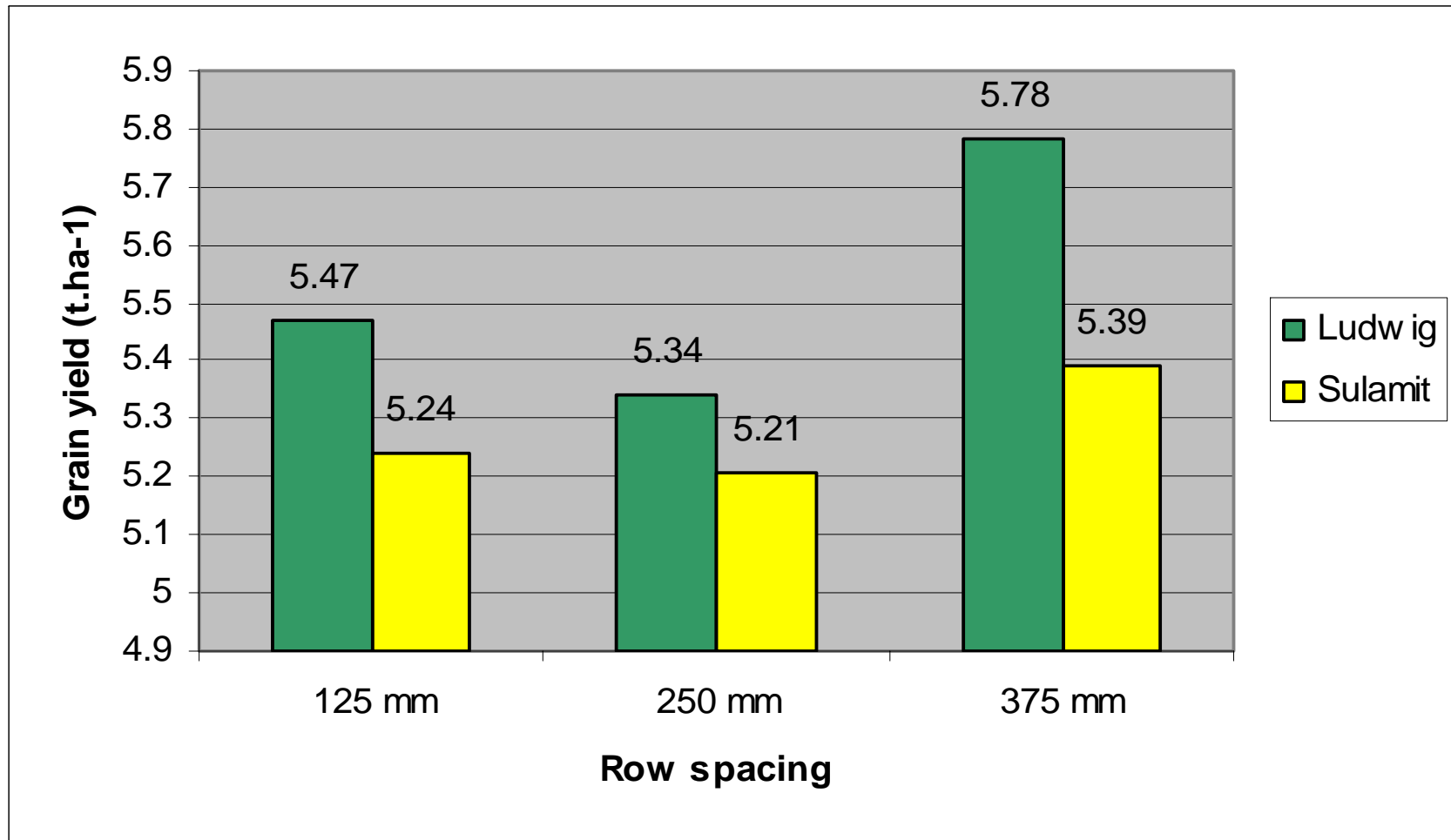
Results of yield evaluation



LSD test for yield of grain (LSD, $\alpha = 0.05$)

		Grain yield (t.ha ⁻¹)	d _{min}	Sign.
Variety	Ludwig	5.54	0.22	a
	Sulamit	5.28		b
Row spacing (mm)	125	5.35	0.24	ab
	250	5.28		a
	375	5.59		b
Sowing rate (germinating grains. m ⁻²)	200	4.85	0.30	a
	300	5.57		b
	400	5.80		b
Year	2005	5.59	0.24	a
	2006	5.54		a
	2007	5.09		b

Yield of grain (average of 2005 – 2007)

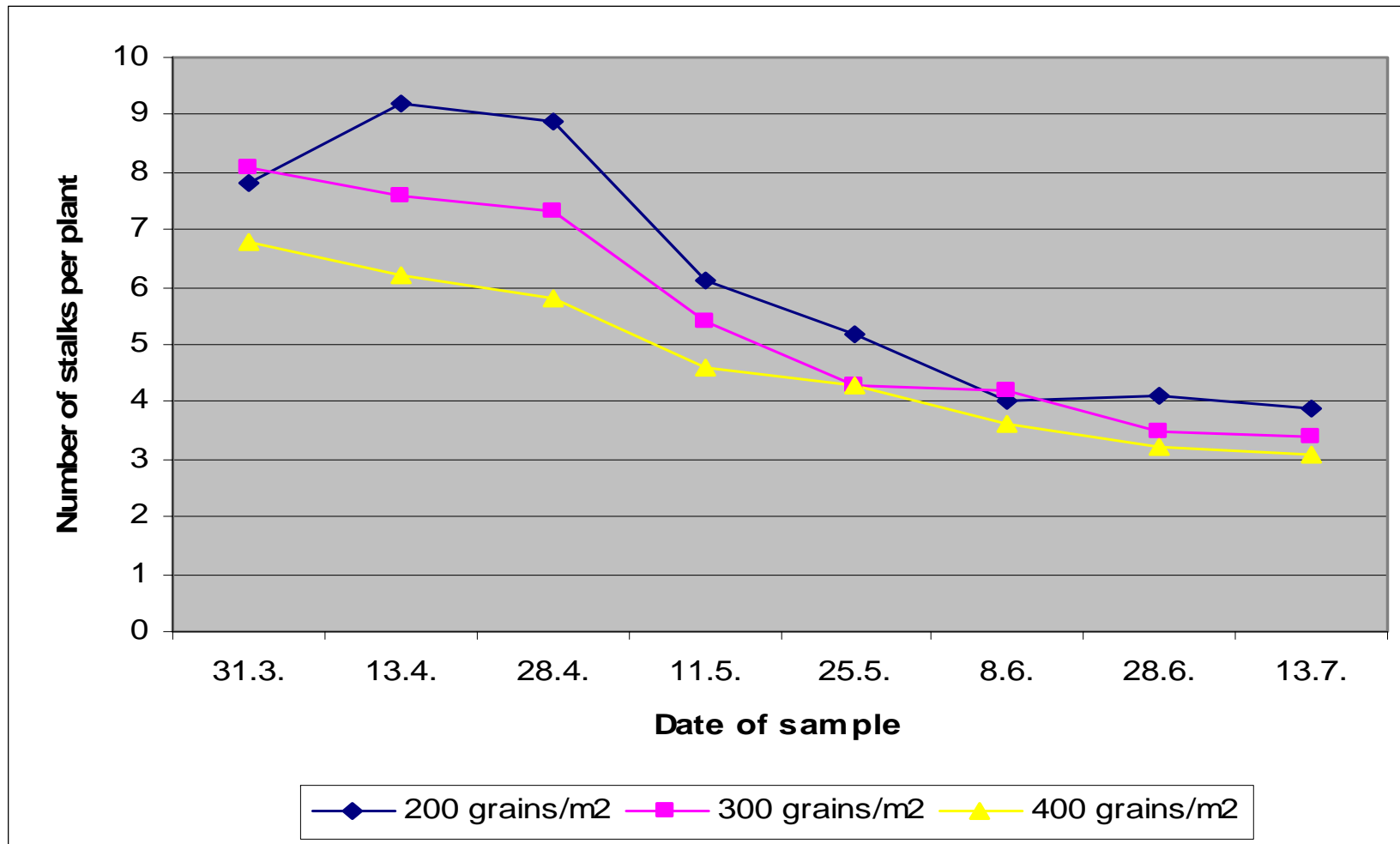


Yield structure

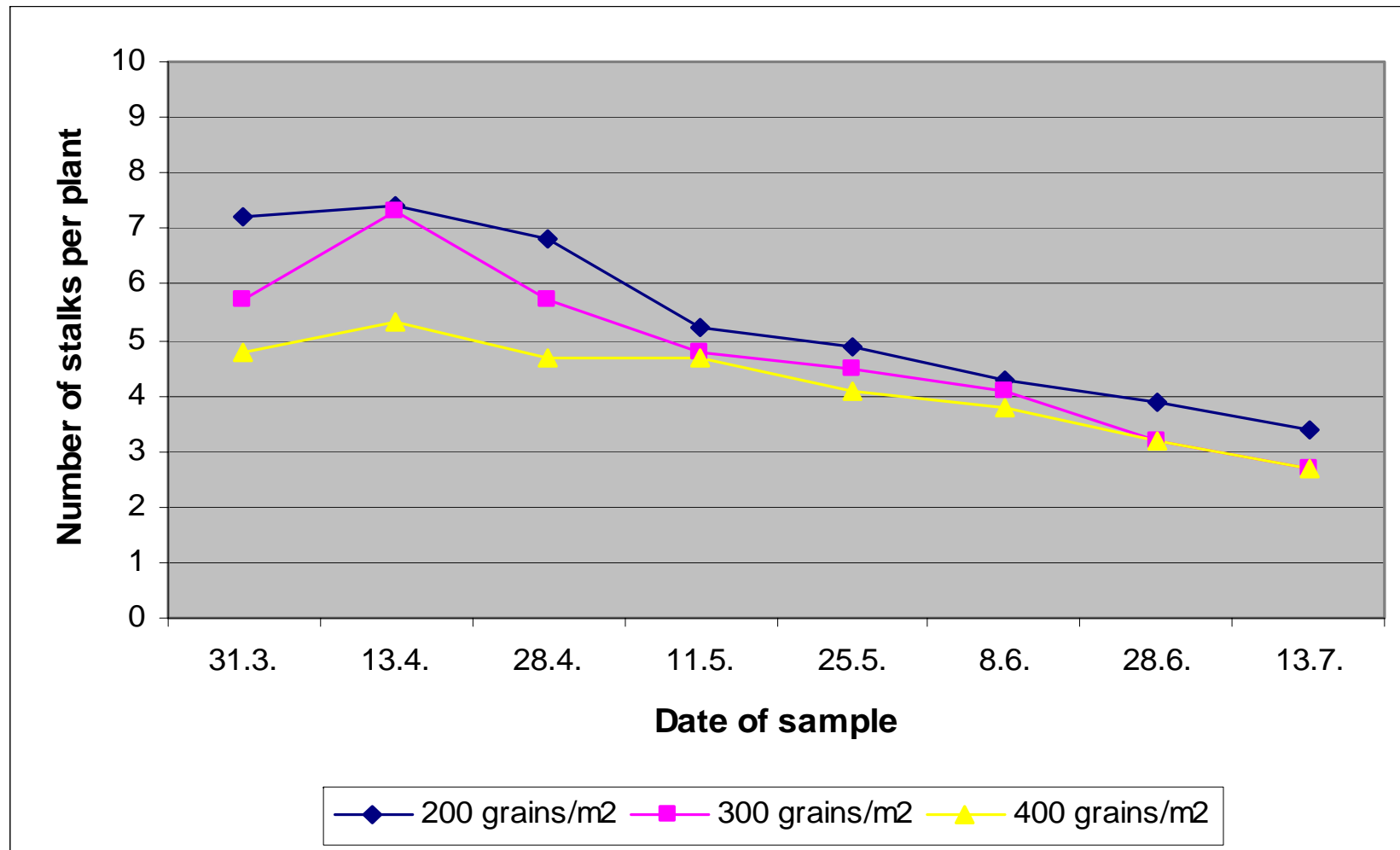
(average of 2005 – 2007)

Variety	Row spacing	Number of ears per m ²	Number of grains per ear	Weight of grains per ear (g)	Thousand grains weight (g)	Grain yield (t.ha ⁻¹)
Ludwig	125 mm	432	27	1.25	46.24	5.47
	250 mm	386	29	1.34	46.52	5.34
	375 mm	375	32	1.53	47.12	5.78
Sulamit	125 mm	438	26	1.18	45.22	5.24
	250 mm	367	32	1.43	44.87	5.21
	375 mm	362	31	1.44	45.26	5.39

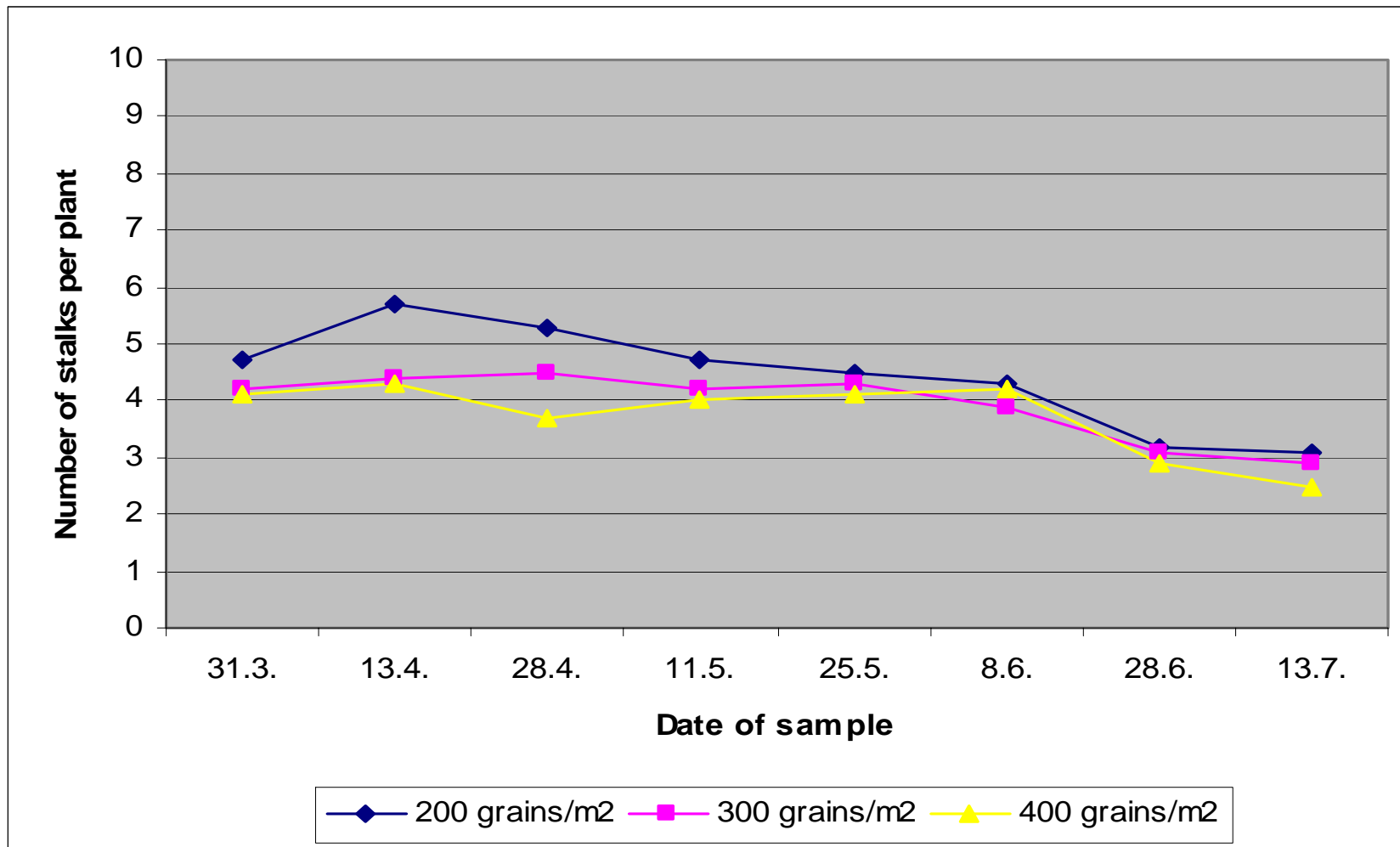
Average number of stalks per plant in different sowing rates (Ludwig, row spacing 125 mm)



Average number of stalks per plant in different sowing rates (Ludwig, row spacing 250 mm)

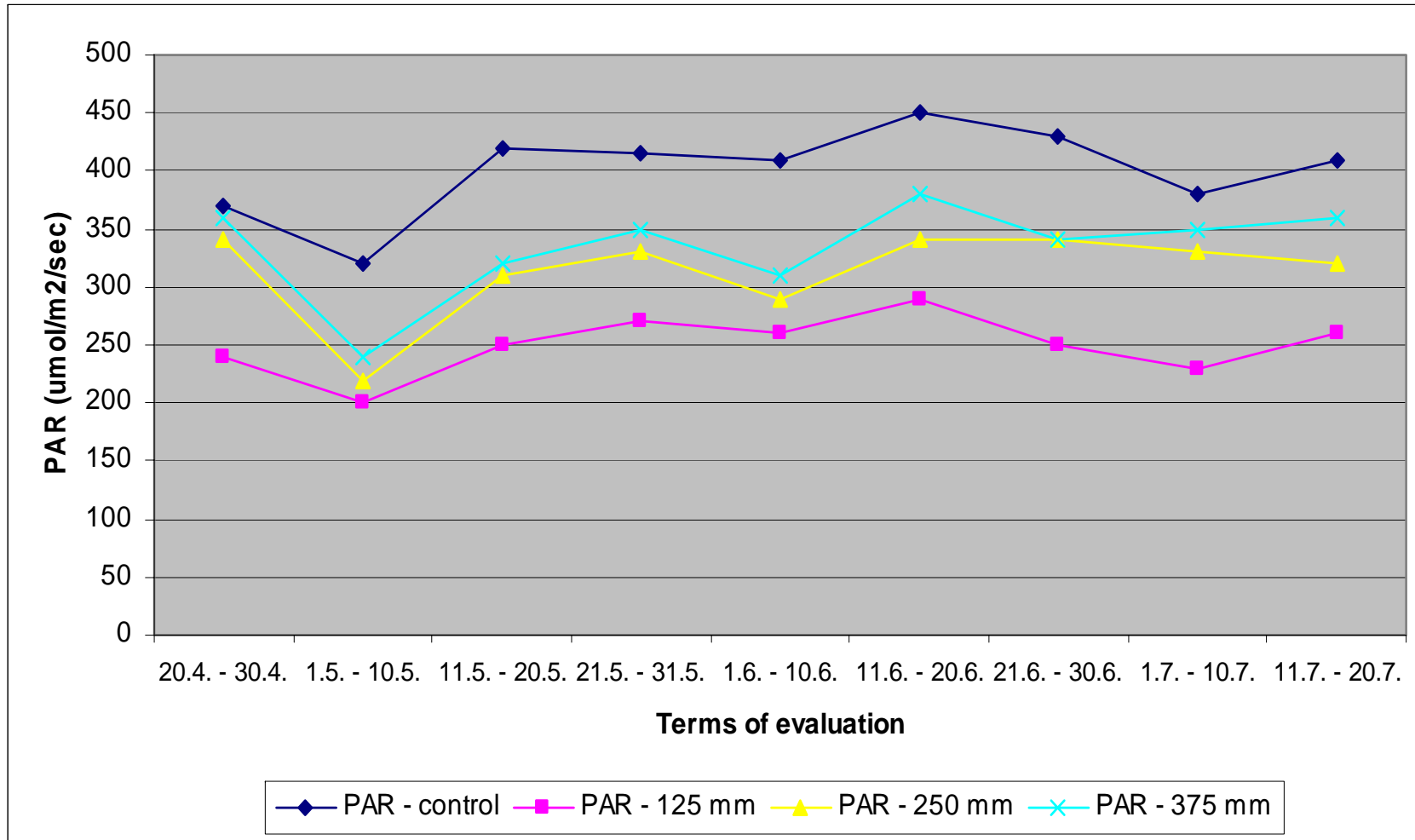


Average number of stalks per plant in different sowing rates (Ludwig, row spacing 375 mm)

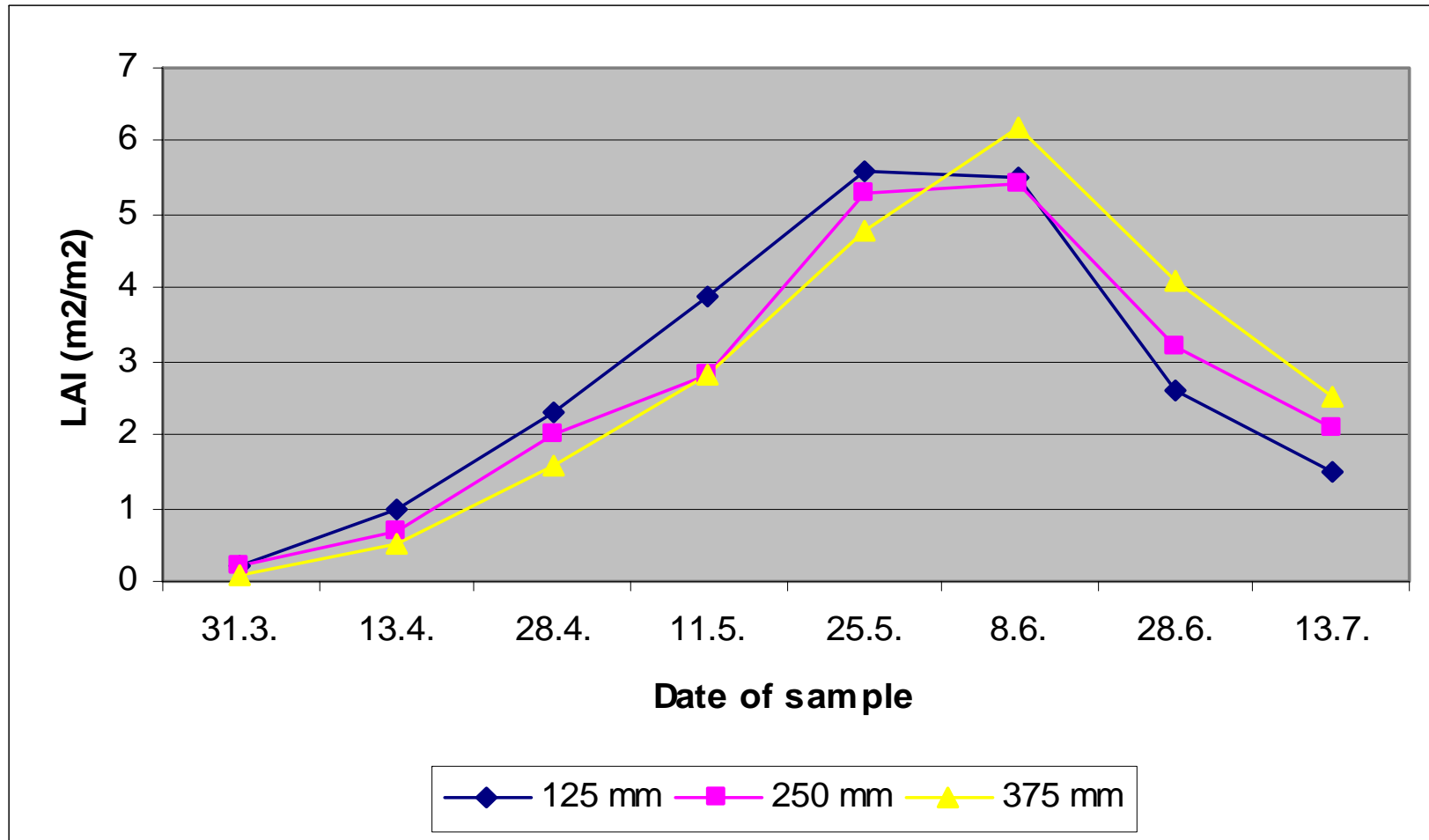




PAR in the stands (in level of upper third of plants)



LAI (Leaf Area Index)



Conclusions

Quality evaluation

- In organic wheat cultivation in wider rows we succeeded to achieve improving of wheat baking quality (the best results were achieved in row spacing 375 mm)

- It was found:
 - statistically significant increase of crude protein content in grain dry matter
 - statistically significant increase of Zeleny test values
 - improving of protein complex composition - increase of percentage of HMW glutenins
 - improving of baking trials results (loaf volume of bread, results of sensoric evaluation)

Conclusions

Quality evaluation

- Our results indicate some trends, that could affect improving of baking quality of organic wheat cultivated in wider rows:
 - better light conditions in the stand
 - slower aging and dying of bottom floors of leaves
 - longer duration of photosynthetic active assimilative tissues
 - better health conditions of plants (lower leaf diseases occurrence)

- For better understanding of principles of found qualitative changes it would be necessary to pay attention to the process of grain proteins synthesis, N and other nutrients dynamics and uptake and other physiological and nutrition aspects

Conclusions

Yield evaluation

- Wheat cultivation in wider rows had no negative impact on the grain yield
- The highest yields were achieved in sowing rate 400 germinating grains.m⁻², but the difference between sowing rates 300 and 400 germinating grains.m⁻² was not statistically significant



Thank you for your attention