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EFFECT OF POTASSIUM FERTILIZATION ON THE YIELD, QUALITY AND POTENTIAL ETHANOL YIELD OF FIVE CORN HYBRIDS

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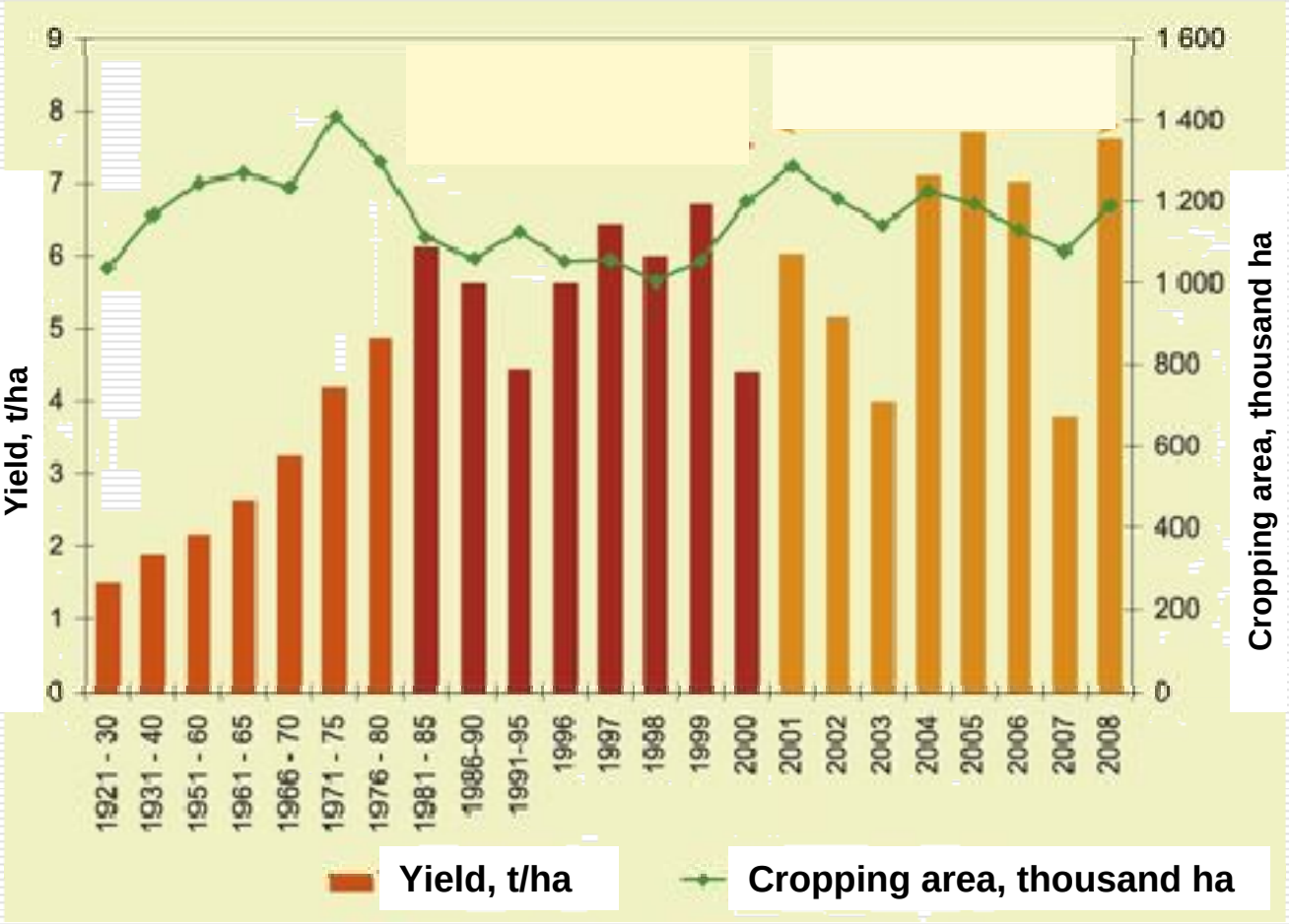
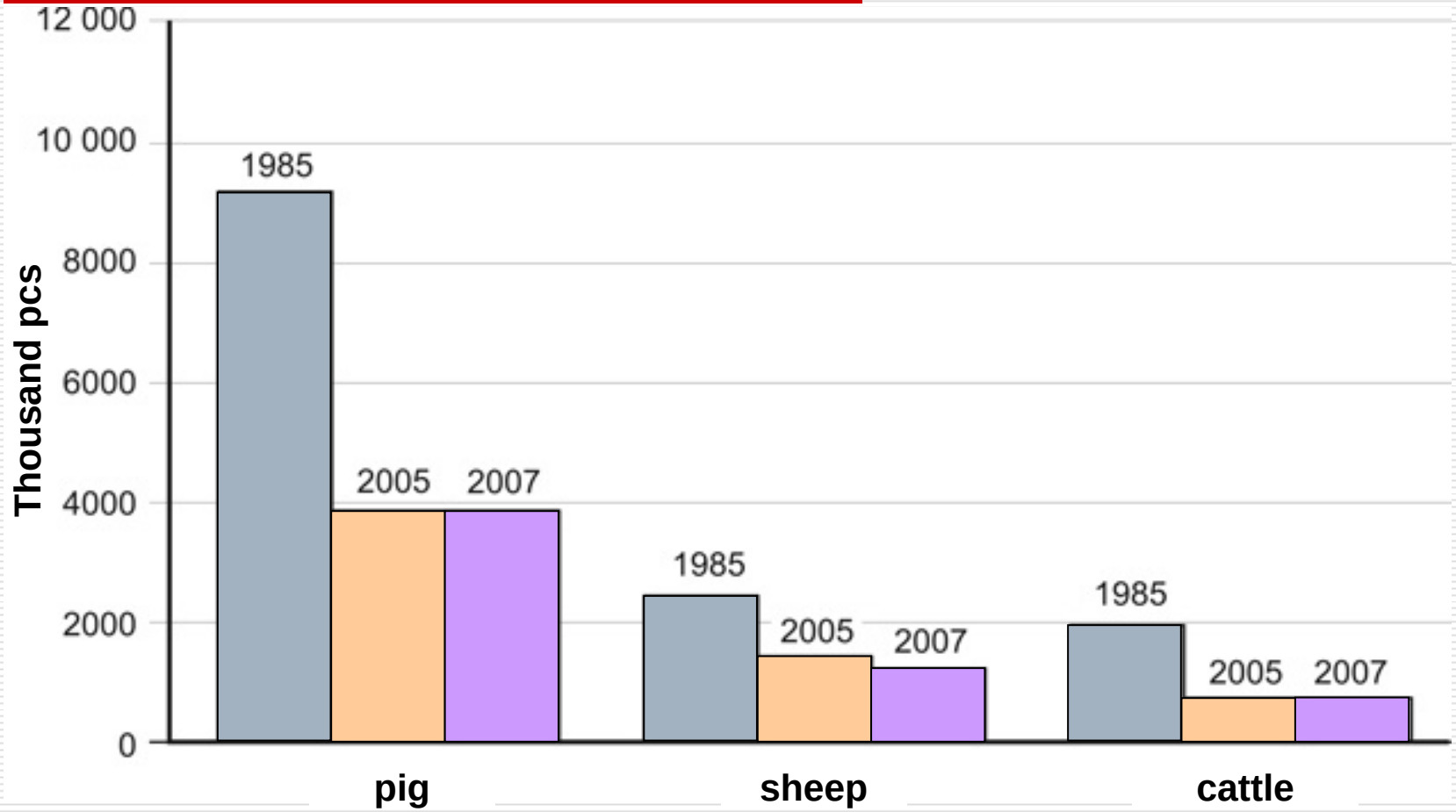
Formation of the yield and cropping area of corn in the last 90 years in Hungary



Source: Sárvári and Boros, 2009

Formation of livestock in the latest 25 years in Hungary



Source: Udovecz, 2009

Possible utilizations of corn

- Feed
- Food
  - Milled
  - Extruded
  - Germ oil
- Industrial
  - Starch
  - Solution for bacterial cultures
  - Glucose-fructose syrup
  - Ethanol

Prelude and aims of study

- 2007-2008: Corn fermentation experiment for NIR calibration
- We started a potassium fertilization experiment
  - with different hybrids and applied different potassium forms and doses.
  - We have examined the yield, the chemical composition of grains and we have determined the ethanol yield in a laboratory scale fermentation experiment.

Materials and methods

1: Location

- Polifactorial experiment was set up in random block design in 2007 and 2008.
- Type and properties of soil:
  - moderately leached chernozem, loamy clay, formed on loess.
  - pH($CaCl_2$): 5.6,
  - Humus 2.9%, AL-P_2O_5 314 mg/kg, AL-K_2O 355 mg/kg,
  - AL-Ca 4142 mg/kg, AL-Mg 422 mg/kg.

Materials and methods

2: Weather conditions

- The precipitation of April, June and July was lower than the 30-years-average in 2007, while the temperature was higher than it, except in September.
- The precipitation of the vegetation period exceeded the 30-years-average in 2008. The temperature conditions, what were similar to the 30-years-average, were favourable for fertilization and grain filling.

Materials and methods

3: Hybrids and mineral fertilizers

1. PR38B12 (FAO 310)
2. PR37D25 (FAO 330)
3. KWS 353 (FAO 350)
4. DKC 5211 (FAO 460)
5. PR36K67 (FAO 490)

Treatments	N, kg/ha	P_2O_5, kg/ha	K_2O, kg/ha	MgO, kg/ha
1.	**120**	**80**	**-**	**-**
2.	120	80	100 (KCl)	-
3.	120	80	100 (Korn-Kali)	15
4.	**120**	**80**	**200 (KCl)**	**-**
5.	**120**	**80**	**200 (Korn-Kali)**	**30**

Materials and methods

4: Field and laboratory analyses

- Plant phenometry and plant protection related examinations
- Yield
- Classic quality parameters: moisture content by MSZ 6367-3:1983, protein content by MSZ 6830-4:1981, fat content by MSZ 6830-6:1984 and starch content by MSZ 6830-18:1988)
- Ethanol fermentation trial:
  - milling by Retsch SR2 laboratory grinder using 0,4 mm sieve.
  - 160 g of corn-water mash with 27% dry matter content was liquoficated by Liquozyme amylase enzyme (Novozymes) on 83°C.
  - Saccharification was made by Spirizyme glucoamylase enzyme (Novozymes) simultaneously by the fermentation.
  - Fermentation was performed by Ethanol Red Yeast (Fermentis) complemented by AYF1177 yeast nutrient (Ethanol Technology), urea, 50069 alcalase (Novozymes) and LactoStab (BetaTec Hopfenprodukte GmbH) for 72 hours.
  - Final ethanol concentrations of mashes were determined by HPLC method by UV detector and estimated by weight loss.

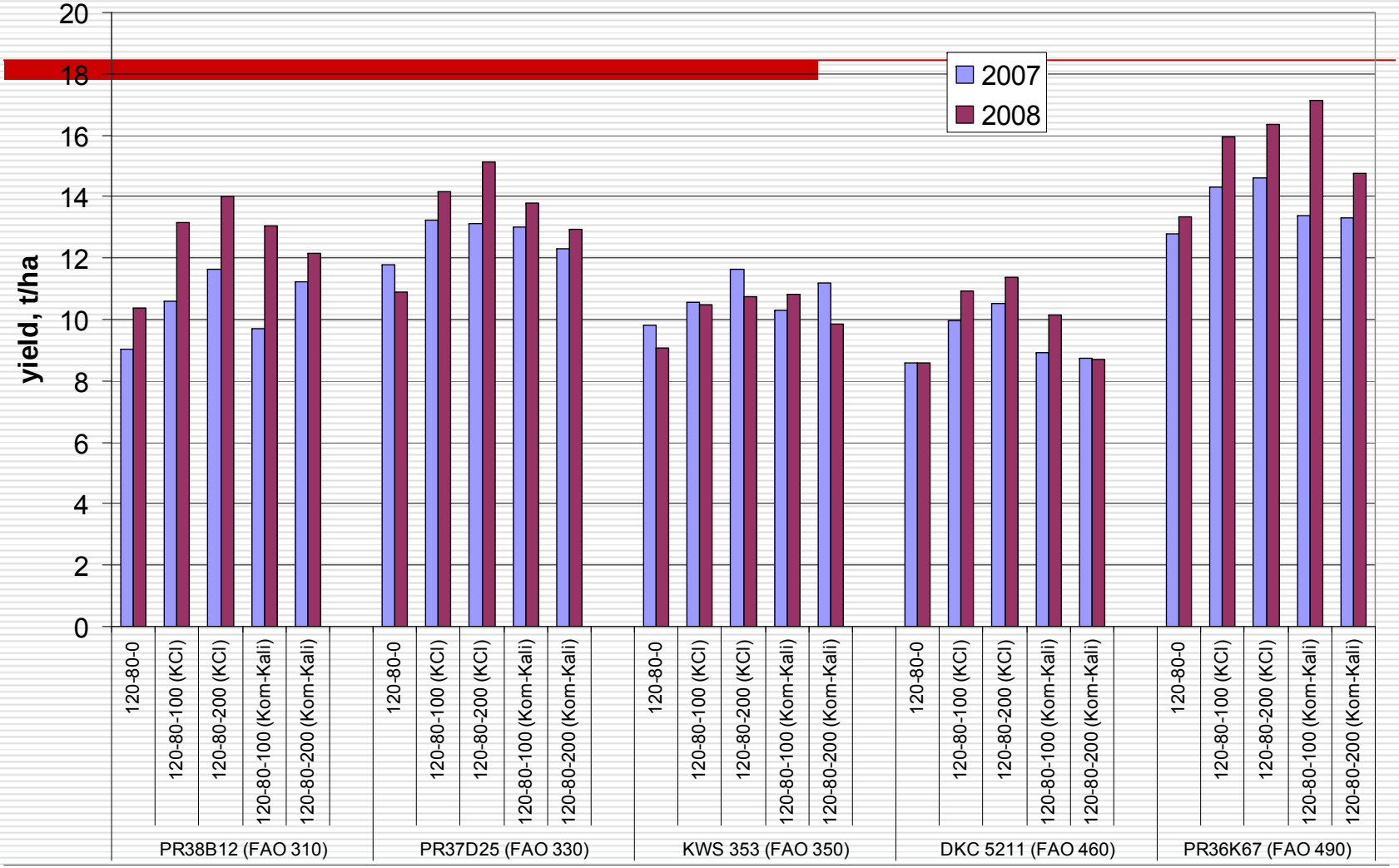
Materials and methods

5: Measure and estimate ethanol yield

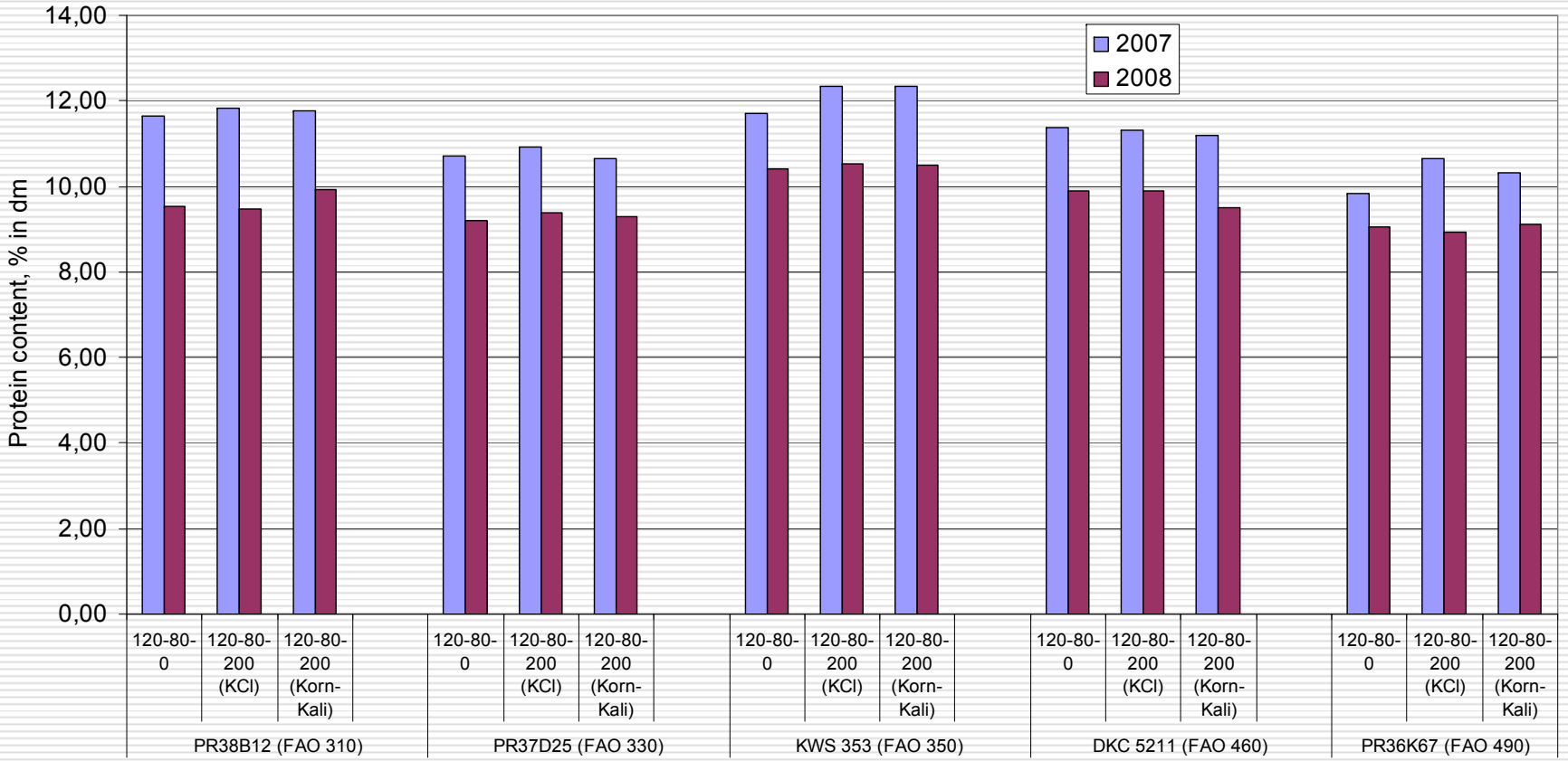
$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

- The analysis by HPLC
  - requires expensive equipment and materials
  - costly
  - accurate
- The estimation method
  - less reliable
  - rapid and cheap
  - usually reports higher yields, since the theoretical base of estimation is that assumption that the weight losses, measured during fermentation, come completely by the vaporizing CO_2 from the alcoholic fermentation of carbohydrates

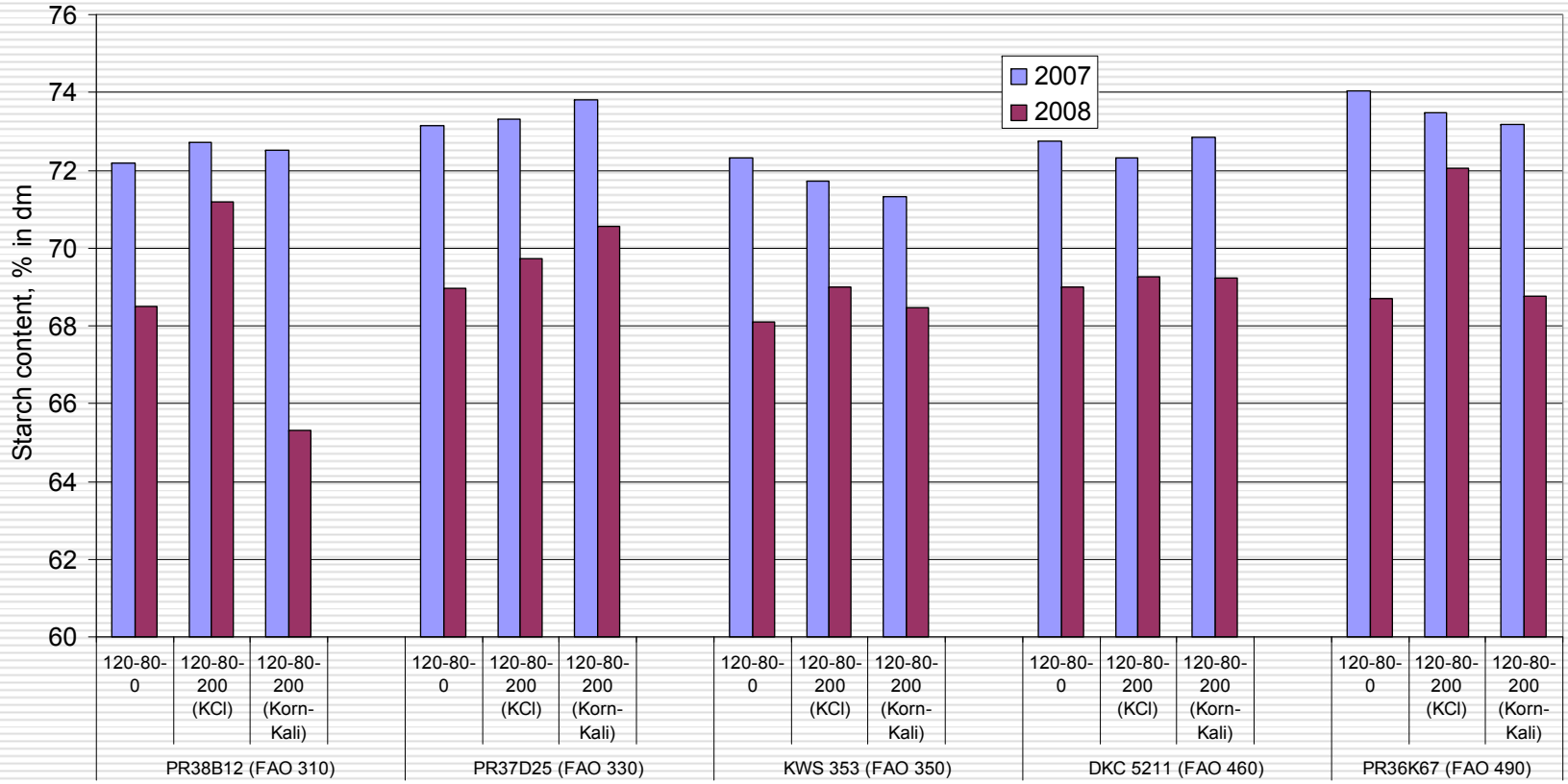
Results - Yield



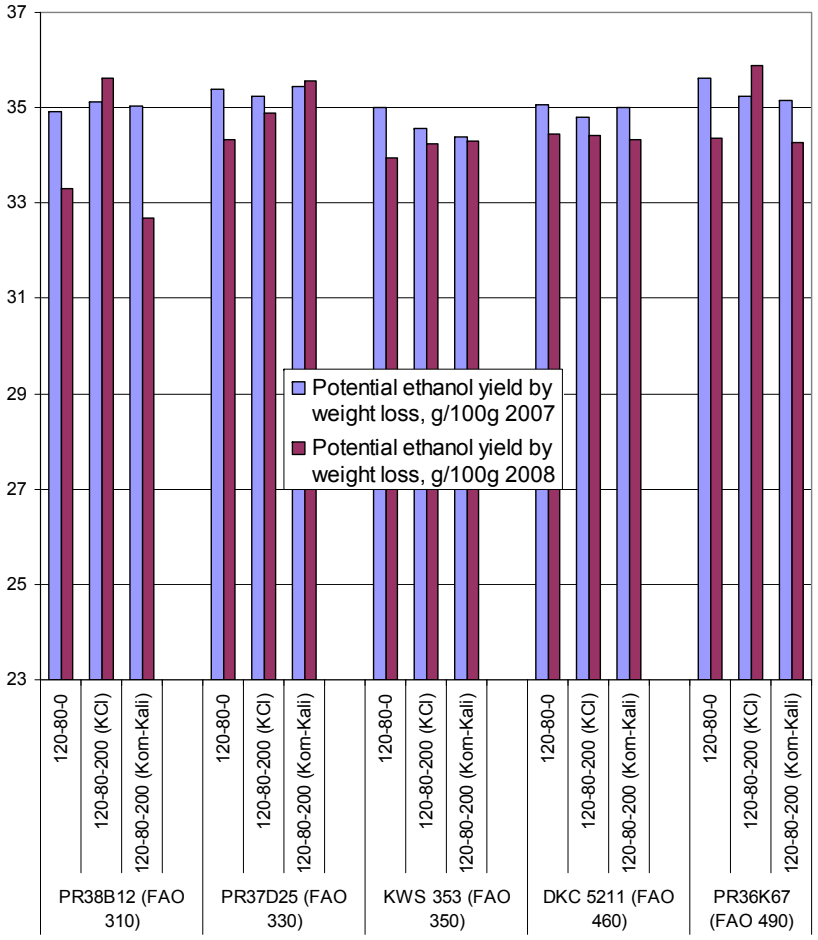
Results – Protein content

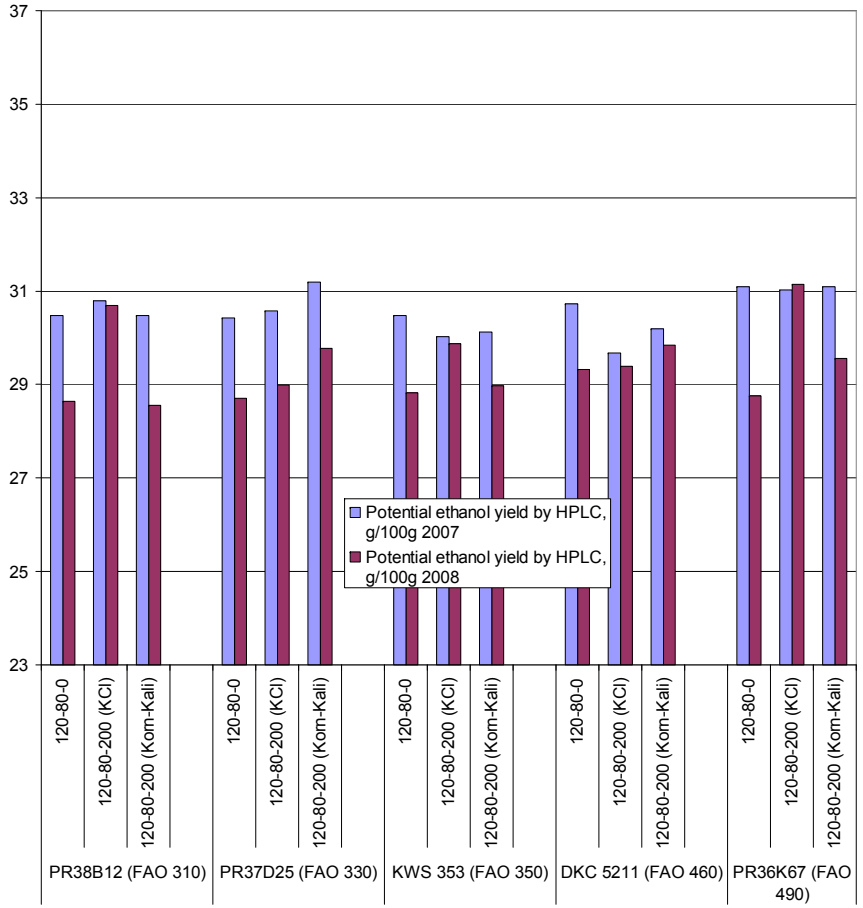


Results – Starch content

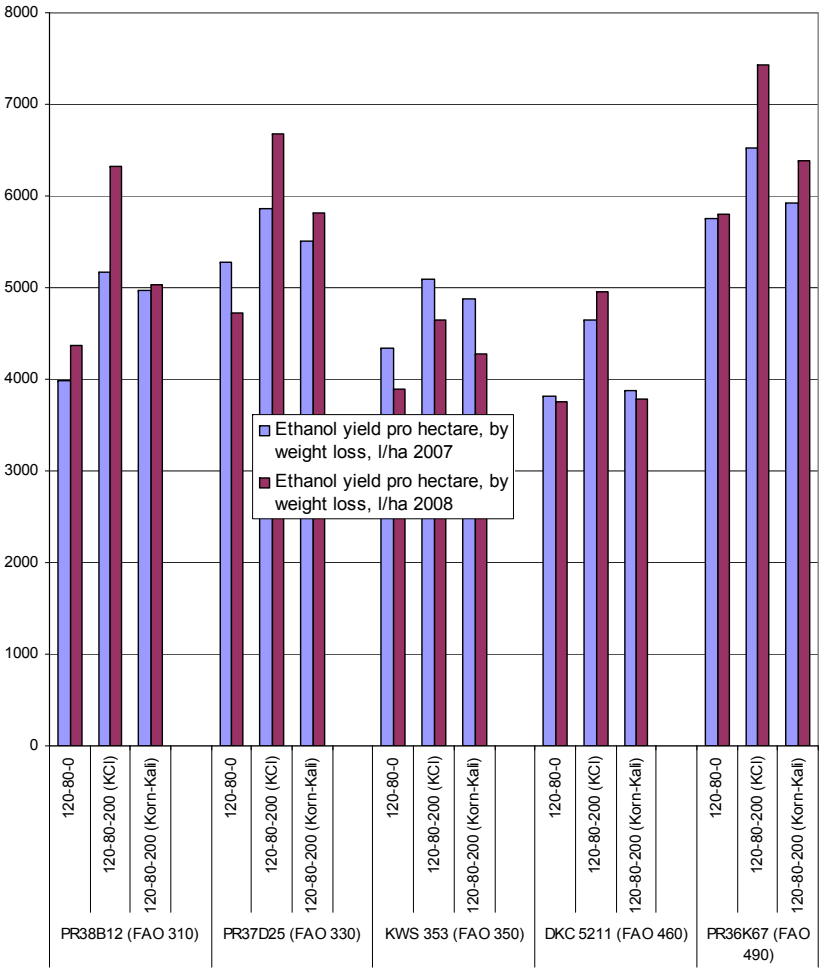


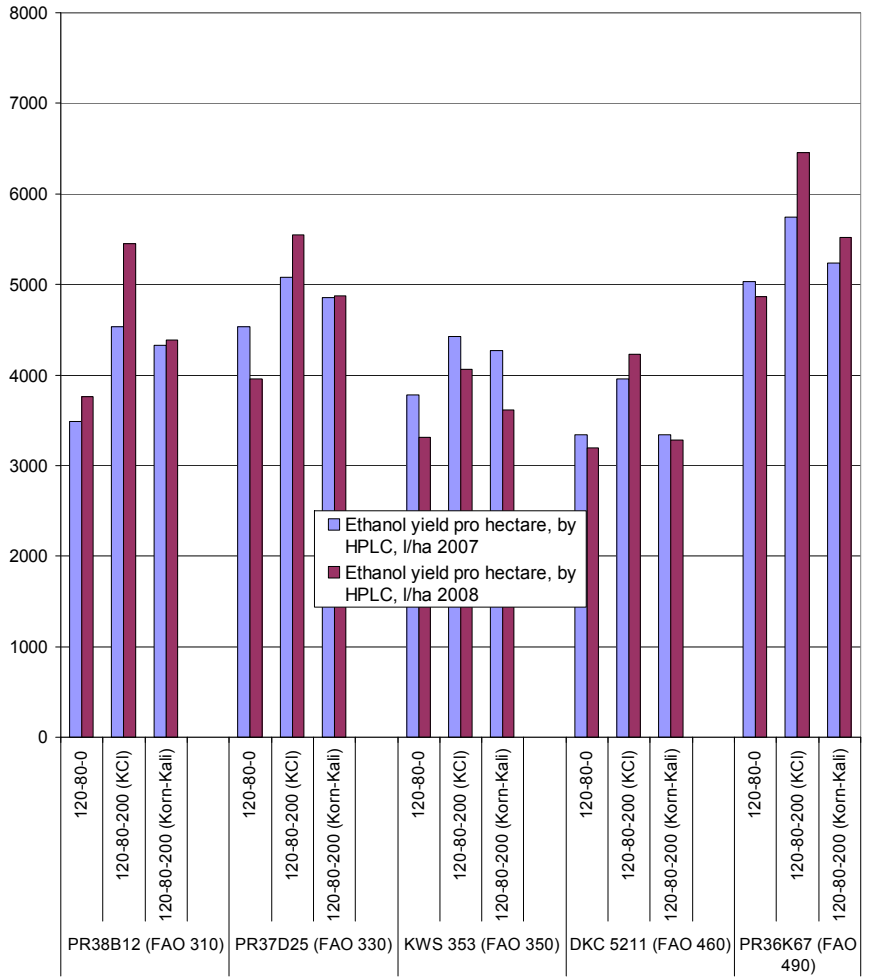
Potential ethanol yield of examined corn samples (% m/m, dm)



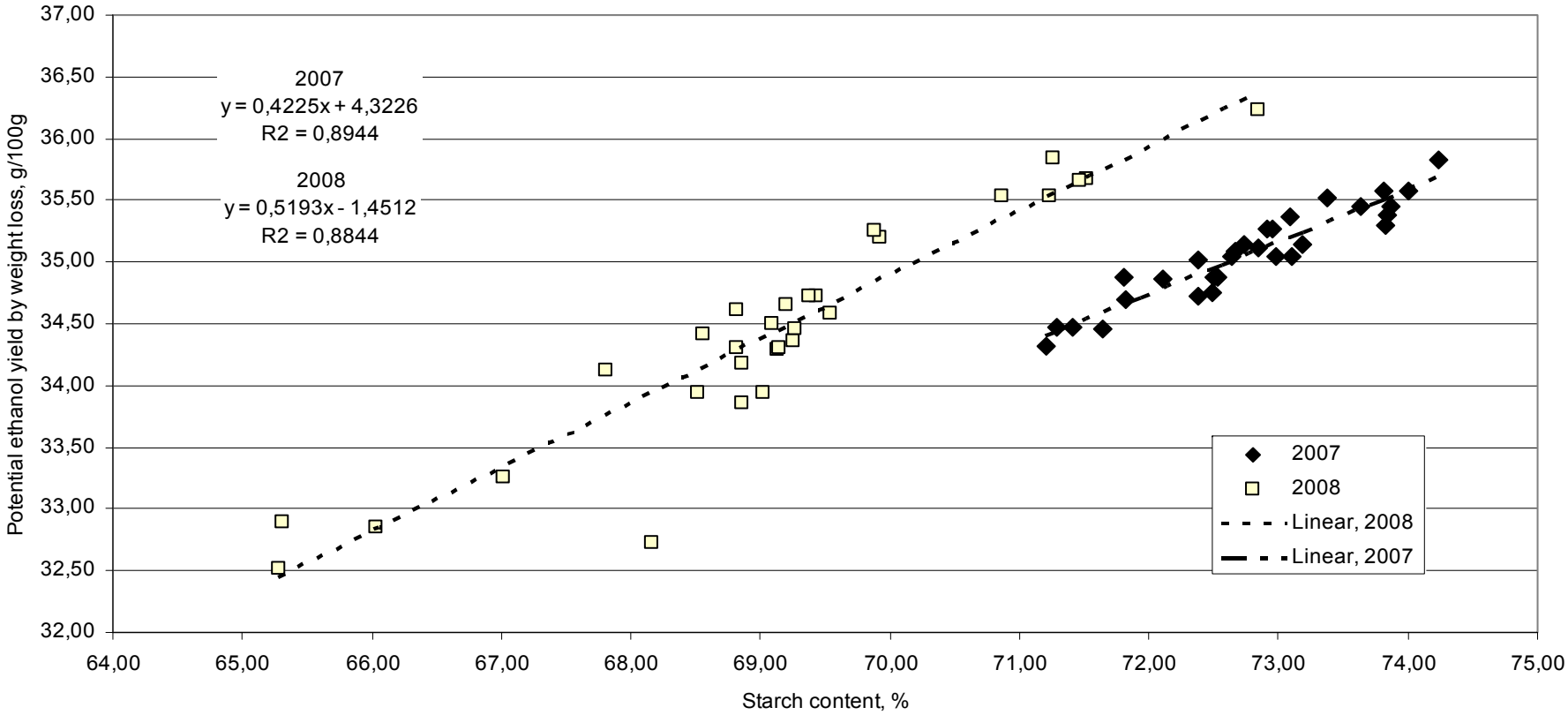


Ethanol yield pro hectare of examined corn samples (I)





Results: Connection between starch content and potential ethanol yield, estimated by weight loss



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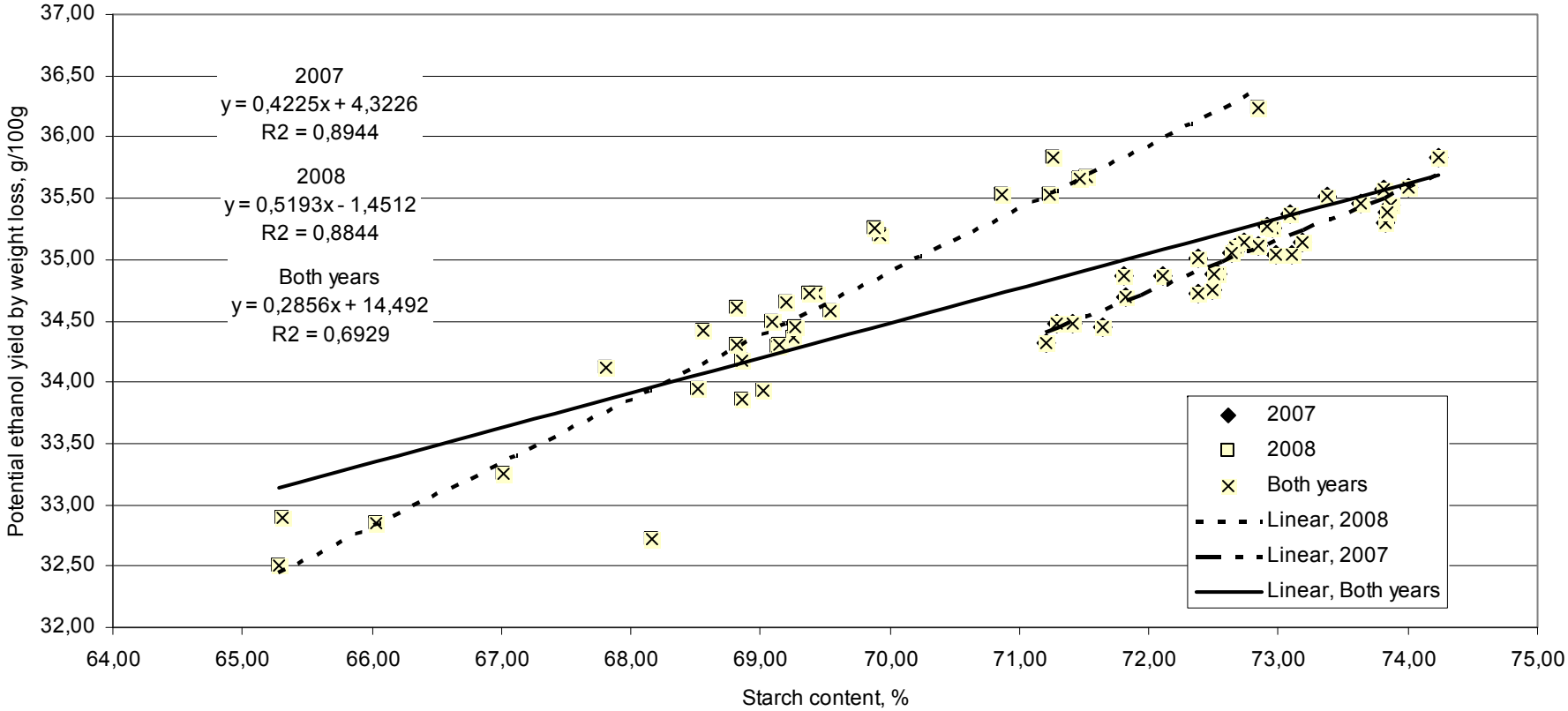
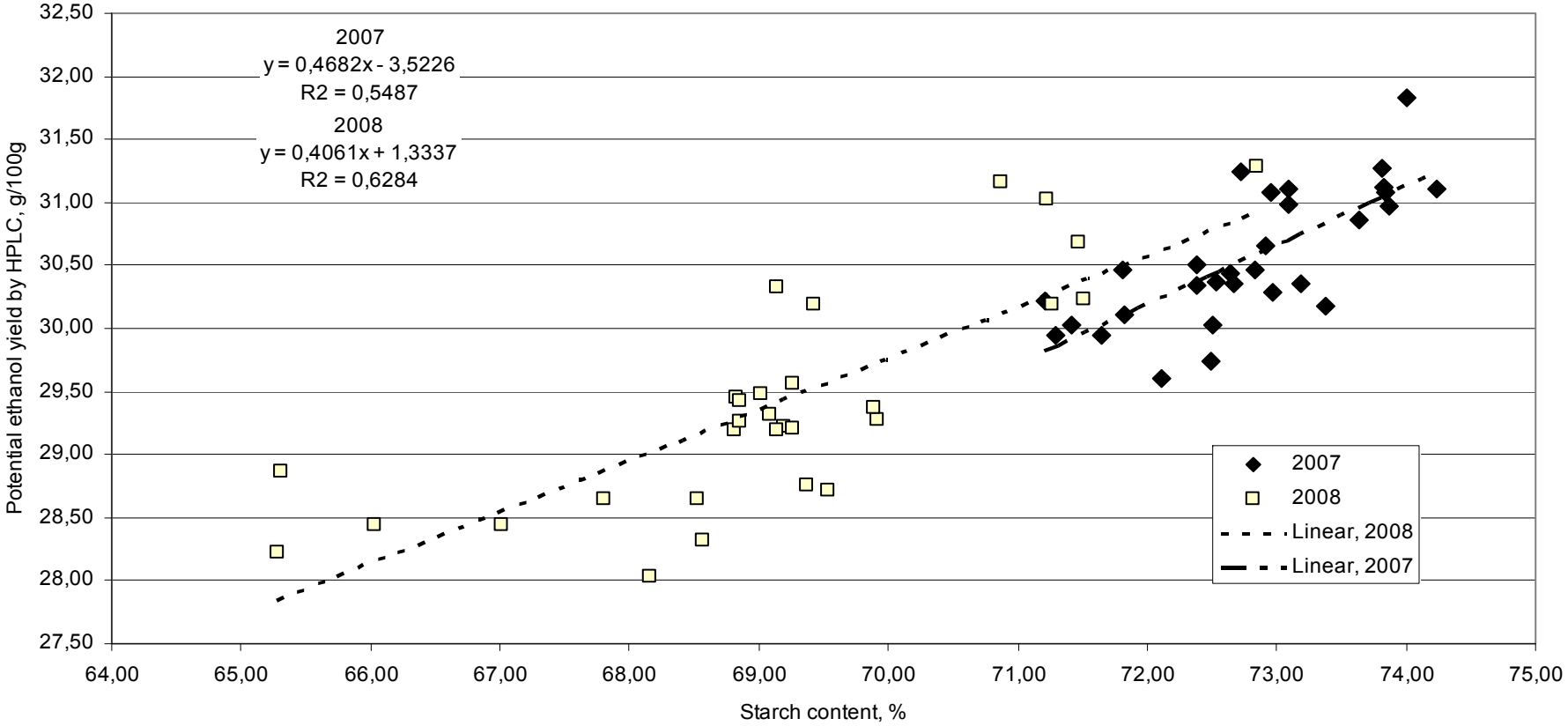
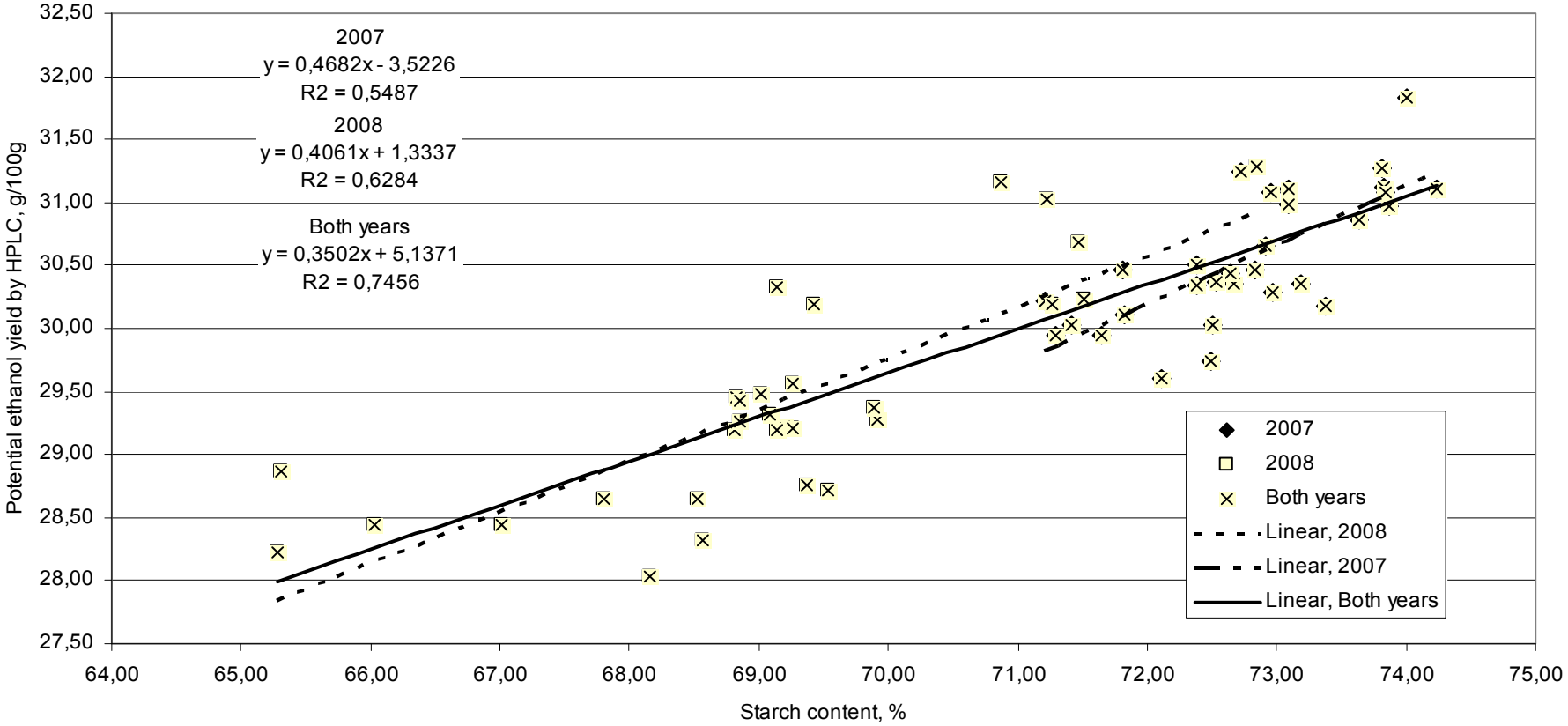


Results: Connection between starch content and potential ethanol yield, measured by HPLC



Results: Connection between starch content and potential ethanol yield, measured by HPLC



Conclusions

- We found strong significant effect of Potassium treatments on the yield of corn in both examined years.
- The treatments did not have a significant effect on the starch, protein and oil contents.
- The potential ethanol yields measured by fermentation also remained almost the same, so Potassium fertilization had no proved effect on this technological parameter. The potential ethanol yield pro hectare, calculated from the yield of hybrids and the volume of ethanol through fermentation, was determined by the yield of hybrids.
- We found strong significant correlation between the starch content and the ethanol yield estimated by the weight loss, as well as medium strength correlation between the starch content and the ethanol yield determined by HPLC. This effect is influenced by the crop year, and we found different equations and regression coefficients during the evaluation of the average of the two examined years.

Thank you for your attention!