The effect of pre-crop and fertilization on baking quality of organic spring wheat

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Great variation in the baking quality of organic wheat is problematic for its industrial use in Finland. Bakery industry is not willing to adjust its procedures and timetables according to the flour quality. In Finland the mills buy organic wheat, which protein content is over 11.5%. In 1996 large part of wheat samples collected in the "Organic cereals" -project (run by a group of extension centres) did not reach that high. The next year organic wheat produced high yields, high protein contents and no problems in the baking quality. The summer 1998 was peculiar as well: extremely rainy. It was interesting to notice, that organic wheat on average succeeded better than conventional wheat. For example hectolitre weights of organic wheat were higher than in conventional wheat. Wheat yields were satisfactory, mainly over 2300 kg/ha.

In this preliminary study we wanted to investigate how different preceding crops influence the growth and gluten protein quality of spring wheat. Different preceding crops and fertilizers mineralize their nitrogen in a different rythm, and that might influence the composition of gluten proteins. Baking specialists say, that if the falling number is high, the protein content has a strong positive correlation with baking quality. It would be valuable for marketing of organic wheat, that farmers by using certain pre-crops could produce wheats with a good baking quality although the raw protein content were somewhat lower than 11.5%.

Material and methods

The pre-crop/fertilization trial was conducted on circa 20 organic farms in southern Finland. The studied wheat fields were sorted to 4 groups according to their preceding crops and fertilization:
1) pea-cereal mixture, pea-monoculture
2) clover-grass ley (1st and 2nd year)
3) grass-clover + manure (lower clover%)
4) cereal crop + manure

Fields with varieties Tjalve, Manu and Reno were accepted. Totally 74 sampling plots were established to the fields, a pair to each field. Most farms had several pairs. Some farmers even established their own trials beside this research frame.

Table 1. Baking quality characteristics, protein and gluten contents in organic spring wheat in different pre-crop groups, (st.dev. in parenthesis)

Pre-crop	n	Water absorption (%)	Develop-ment time (min)	Dough stability (min)	Raw protein (%)	Wet gluten (%)
pea/mixture	7	58.5 *(1.3)*	1.9 *(0.5)*	3.8 *(2.4)*	12.2 *(0.9)*	22.2 *(2.8)*
clover ley	11	59.4 *(0.9)*	2.8 *(1.5)*	5.4 *(3.3)*	13.1 *(1.4)*	24.3 *(4.0)*
ley + manure	5	59.8 *(1.7)*	2.3 *(1.0)*	3.9 *(2.1)*	13.0 *(1.9)*	24.2 *(5.0)*
cereal+manure	9	59.3 *(1.4)*	2.9 *(1.0)*	3.8 *(2.8)*	13.1 *(2.0)*	23.6 *(5.0)*

The nitrogen status of the wheat canopy was recorded by clorophyll measurements during the wheat development (Minolta). Daily precipitation was recorded by farmers. A visual estimation of the amount and frequency of weeds, pests and diseases was made.

After harvesting the crop samples run through a normal market analysis. Also Zeleny and SDS-sedimentation tests were conducted. Farinogram and wet gluten content were analysed in the cereal laboratory of Plant Production Inspection Centre (KTTK).

Results

Soil structure in the wet season in 1998 seemed to be the most important factor which influenced wheat development. Wheats with clover ley as a preceding crop had on average more clorophyll than the other groups (fig. 1). Mostly the SPAD-values were somewhat lower than the "conventional" optimum SPAD-value, which is 38–41 at the time of ear emergence. However, the variation in all parameters inside the groups was high. The varia-

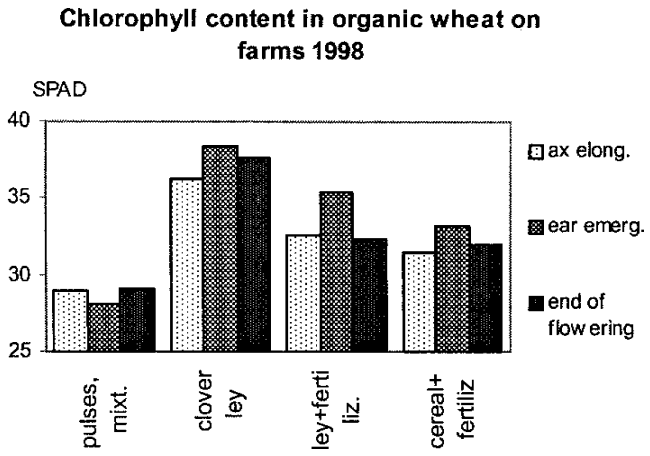

Figure 1. Chlorophyll contents during the growing season in different pre-crop groups.

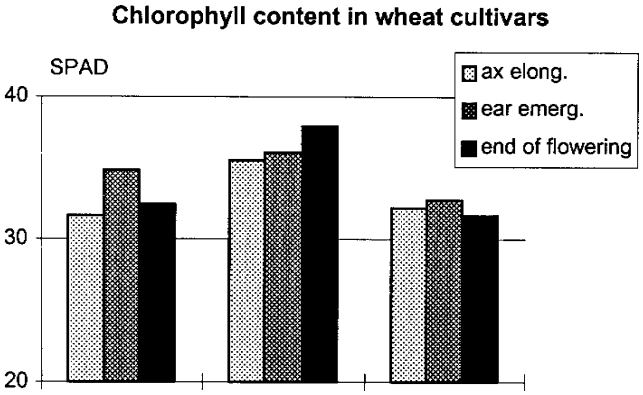

Figure 2. Chlorophyll content in spring wheat cultivars Manu, Reno and Tjalve

tion can also partly be explained with the different occurence of cultivars in different groups. Cultivars seemed to have a typical clorophyll content (fig. 2).

Unfortunately the crop yields cannot be analysed statistically due to unproper data. However, the trend of yields correspond quite well the variation in chlorophyll contents. Poor yields and missing data occurred mainly in the group pea/mixtures.

The mean chlorophyll content in group 3 (ley + fertilization) was much lower than in the clover ley group (group 2). Manure is of course given after a ley in which clover content is low. It seems, that manure nitrogen was immobilized in soil and little nitrogen was available for wheat. The protein content in the yield showed a broad variation. On average the groups clover ley, ley with manure and cereal with manure produced flours with equal protein contents. The pea group gave lower contents.

No statistically significant differencies between pre-crops were found in the evaluation of the baking quality tests due to high variation in the pre-crop groups. Yield protein content correlated positively with wet gluten and with dough stability as well as with Zeleny sedimentation volume. The water absorption of cultivars Manu, Reno and Tjalve in this material was slightly higher than in conventionally cultivated variety trials in Finland. Cultivar seemed to explain the characteristics of wheat flour more than the pre-crop.

Soft gluten was achieved only from those wheat samples, where the clorophyll contents of the flag leaves had been more than 36 SPAD-units at the

Table 2. Zeleny and SDS sedimentation volumes relative to gluten quality

Gluten quality	n	Zeleny-sedim. volume (ml)	SDS-sedim. volume (ml)
soft	7	48.4 *(16.3)*	62.2 *(8.0)*
short	19	37.0 *(11.2)*	55.3 *(10.3)*
brittle	6	29.7 *(5.5)*	55.9 *(5.2)*

phase of ear emergence. The gluten quality was better described by Zeleny than the SDS sedimentation volume (table 2).

Conclusions

Soil structure more than previous crop seemed to influence the development of organic spring wheat during the extremely wet growing season in 1998. However, the best soil structures and strongest wheat crops were found after clover leys and the poorest after peas. The most important determinant for the baking quality of the flour was the cultivar. Although no statistically significant differencies between pre-crop groups were found, the project still gave possibilities to evaluate the suitability of different pre-crops and fertilizations for spring wheat. Clorophyll content determinations seemed to be useful for predicting the baking quality in organic wheat crops.