

# Pilot production of High-oleic low-linolenic (HOLL) winter oilseed rape in Switzerland

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## Abstract

Research stations, cooperative and professional organizations set up a pilot production of low-linolenic oilseed rape in Switzerland in 2004, 2005 and 2006. The goal was to test HOLL winter oilseed rape varieties under the climatic conditions and farming systems of Switzerland and to supply industry with enough row material for the first frying tests. 300 ha were harvested in 2004 as well as in 2005, and nearly 1000 ha in 2006. A minimum distance of 50m between HOLL and conventional oilseed rape fields was required in 2005 to avoid gene flow that could depreciate HOLL oil quality. Farmers answered a survey describing their farm and crop management practices.

With an average yield of 29dt/ha in 2004 and 31dt/ha in 2005 in the pilot production, these varieties are not as productive as conventional ones, but yields are close to expectations based on performance in varietal tests. A high variability among fields has been observed. The lowest yields were often related to climatic constraints, the best ones were obtained with more intensive practices.

Average linolenic acid content of the surveyed pilot production was 2.6% in 2004 and 2.8% in 2005 with a large variability among fields. Distance between HOLL and conventional rapeseed fields did not seem to have much effect. In 2005, the analysed fields were grouped in five areas in Switzerland. Significant differences appeared among locations, with only small variability among fields located in the same area.

Location and rapeseed volunteers seem the main factors influencing oil quality. Farmers play nonetheless an important role to determine final quality by adopting adapted crop management practices to control rapeseed volunteers and separate carefully HOLL low-linolenic and conventional grains from sowing to harvest.

**Key words:** alpha-linolenic acid, rapeseed, low-linolenic cultivars.

## Introduction

Low-linolenic varieties have been tested in Agroscope Changins-Wädenswil ACW research station since 2002. In 2003, cooperative and professional organizations, in collaboration with ACW research station, set up a pilot production of two low-linolenic varieties in Switzerland: MSP01 (Spiral) and Splendor. MSP01 was eliminated at the end of the first year and a new variety, MSP12 (V141OL) replaced Splendor in the pilot network sown in 2006, due to its good results in experimental conditions. The pilot production is a way to test these new varieties in farmers' conditions, and also to provide industries with enough raw material to test the technological properties of these oils and create new recipes.

## Material and methods

Low-linolenic oilseed rape was cultivated for three years in a network of farmers' fields in Switzerland. 300 ha were sown in 2003 and 2004, and about 1000 ha in 2005. Varieties grown were MSP01, Splendor and V141OL (Monsanto). Farmers were asked to respect a minimal isolation distance of 100m in 2003 and 50 m in the subsequent years between low-linolenic and conventional rapeseed. Low-linolenic rapeseed was harvested and stocked in collecting centres.

Samples from several fields were analysed for oil content by near infrared spectrometry (NIRS) and fatty acids profile by gas chromatography.

Farmers involved into the pilot production answered a survey giving information on i) location of the low-linolenic field, ii) crop management practices, iii) duration of the rotation.

## Results and discussion

Nine collecting centres, located in eastern, central and western Switzerland, participated to this production. Differences among the three monitored years, as well as among these nine areas can be observed both in yield and oil fatty acid composition.

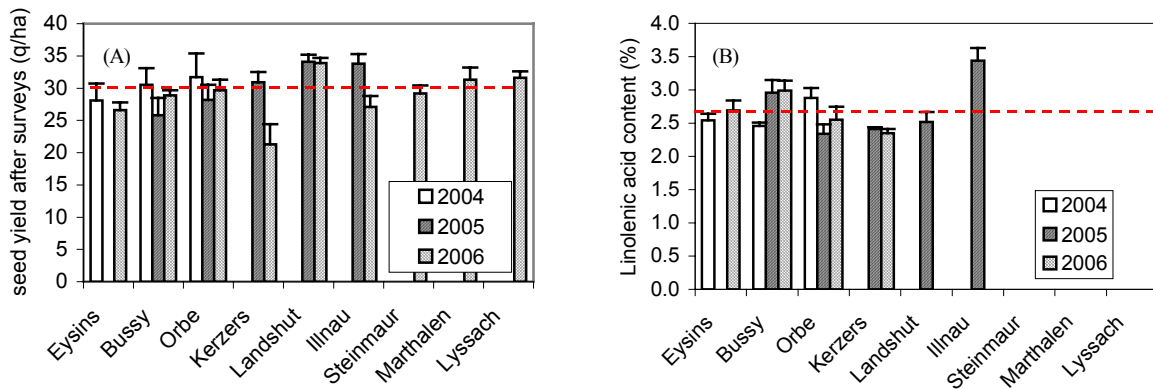


Fig 1: Variability of the low-linolenic rapeseed production among years and locations. A – Seed yield. B – Linolenic acid content. Error bars indicate standard error of the mean with n varying from 3 to 25.

A large variability has been observed among years and locations (Fig 1). Differences between fields cultivated the same year in the same area could be explained by crop management practices.

**Tab 1: Parameters leading to the best and worse seed yields (lower than first quartile and higher than last one)**

	Seed yield < 25.6 q/ha (n=49)	Seed yield $\geq$ 33.3q/ha (n=49)
Linolenic acid content (%)	1.8 to 4.0 (Avg=2.6)	1.9 to 3.8 (Avg=2.8)
Year(s) and location(s)	All places and years	All places and years
Altitude (m)	370 to 760 (Avg=509)	400 to 700 (Avg=485)
Level of mineral nitrogen fertilisation (kg/ha)	75 to 175 (Avg=136)	104 to 200 (Avg=147)
Organic manure	Exceptional	Usual
Plant protection	Sometimes	Usual

#### Data from the surveys in Switzerland 2004, 2005, 2006

The lowest yields are usually related to climatic constraints (hail damages, late snow, bad emergence) but also to more extensive practices (reduced plant protection without fungicide or pesticide, lower nitrogen fertilisation) (Tab 1). Intensive practices with fungicide and insecticide protection, high fertilization level and additional organic manure gave the best seed yields. It was not possible to relate yields to linolenic acid content, geographic area or altitude.

**Tab. 2: Information on the fields leading to low and higher linolenic acid contents.(lower than the first quartile or higher than the last one)**

	Linolenic acid content < 2.4% (n=32)	Linolenic acid content $\geq$ 3.1% (n=35)
Yield (q/ha)	17.3 to 45.4 (Avg=30.8)	17.1 to 42.2 (Avg=28.4)
Year(s) and location(s)	Geneva Lake area in 2004, central Switzerland in 2005 and 2006.	Northern Switzerland in 2005, western Switzerland in 2006
Altitude (m)	400 to 650 (Avg= 477)	420 to 730 (Avg=511)
Level of mineral nitrogen fertilization (kg/ha)	83 to 192 (Avg=133)	80 to 175 (Avg=137)
Plant protection	Yes	Yes
Size of the field (ha)	0.8 to 7.0 (Avg=2.9)	1.2 to 5.2 (Avg=2.7)
Distance to conventional field (m)	1 to 3000 (Avg=563)	50 to 2000 (Avg=471)
Years since last rapeseed	3 to 35 years (Avg=15) or never had rapeseed	4 to 10 years (Avg=6)

Data from the surveys in Switzerland 2004, 2005 and 2006

Very little difference appeared between crop managements leading to a rapeseed with low or higher linolenic acid content (Tab. 2). Most of the fields were well isolated and anyways the results showed that the influence of neighbouring field was very limited. Nitrogen fertilisation, yield, and altitude could not be related to final linolenic acid content. Most of the fields with high linolenic acid content were cultivated during the same year in the same area. We can suppose that this area had sub-optimal climatic conditions with low minimal temperatures during grain filling, which led to higher linolenic acid content as shown by Baux *et al.* (2007). In some cases and despite a long enough time between two rapeseeds (5-6 years), inappropriate soil tillage may have conducted to large number of volunteers, depreciating oil quality. Finally, the fields with very high linolenic acid contents could also be the result of a strong contamination of the sowing seeds or of an accidental seed mixture at harvest.

## Conclusions

Low-linolenic varieties have been tested in Switzerland on a large scale for three years. The average yield and quality (linolenic acid content) were satisfactory in regard to expectations. Low-linolenic varieties tested were not as productive as the usual conventional double-low varieties, but their cultivation did not require any specificity, other than the management of volunteers and an “isolation distance” of 50 meters from any conventional rapeseed field, to prevent cross-pollination. More intensive practices with fungicides, insecticides and high nitrogen fertilization conducted to better yields, without negative effect on fatty acid composition. Linolenic acid content seemed mainly affected by location and year, which is in agreement with our results on the effects of temperatures on linolenic acid content (see companion paper, Baux *et al.*, 2007). The cross-pollination between two neighbouring fields do not seem to have any impact on the quality, as most fields are big enough to “dilute” the few heterozygote seeds resulting from the contamination. However, a few fields were characterised by abnormally high linolenic acid content. This is probably the result of a high amount of volunteers (in spite of the long rotations) or the consequence of a mixture of sowing-seeds or during harvest.

## Acknowledgements

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## References

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