Controlled Crosses in Modifying Linoleic and α-linolenic Acid Levels in Spring Turnip Rape (*Brassica campestris* L.)

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Introduction

In the breeding programme aimed at higher linoleic (LA) and lower α-linolenic acid (α-LLA) content in rapeseed oil controlled pair-crosses between spring turnip rape plants grown in the field were performed in summer 1992. In this study, the variation of fatty acids is compared to the results obtained by free-pollinated conditions.

Material and Methods

A total of 19 single plant pedigrees from long-term selection experiments with most desirable fatty acid compositions were used as source material (1). The mean linoleic and α-linolenic acid levels of the parental seeds were 27.6 and 8.1%, respectively, the LA/α-LLA ratio thus being 3.44.

Controlled pair-crosses were done within each pedigree. Bag-isolated plants in a pair were reciprocally hand-pollinated. Plant yields within a pair were threshed together and analysed for fatty acid composition (n=57). In addition, control populations, common varieties and other breeding materials were parallely grown in the field, which have been also submitted for yield trials in subsequent years.

Results and Discussion

Fig.1.Frequency distribution for linoleic acid in control and hand-pollinated breeding materials.

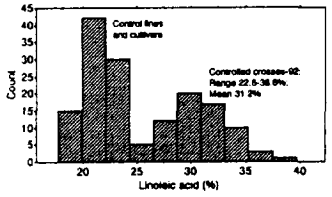
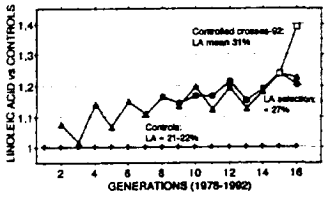
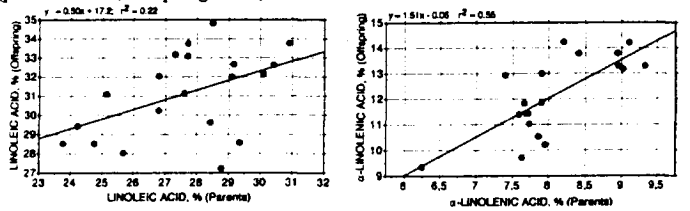


Fig.2.Linoleic acid *vs.* control lines. Controlled crosses compared to the long-term breeding experiments.



Controlled crosses resulted pair-cross yields with a mean LA content of 31%. The range clearly exceeds that of controls suggesting that considerably higher LA levels, even up to 40%, can be achieved in field conditions.

Fig.3.Offspring-parent regression for linoleic and α-linolenic acid levels. (parents 1991; offspring 1992).



Regression analyses show a marked response to selection for LA and α-LLA.

A number of pair-cross yields with the LA / α-LLA ratio of more than 3.0 were found, the highest ratio being even 4.3. This was mainly due to the high LA levels. α-LLA had a wide range (from 7.4 to 16.2%) but the mean increased up to the level of controls (8.1-12.1%).

Fig.4.Frequency distribution for α-linolenic acid in control and free-pollinated breeding materials.

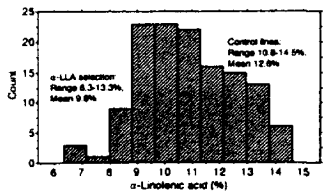
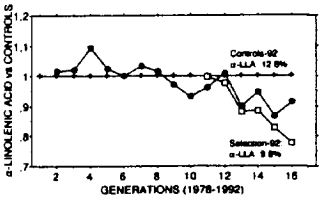


Fig.5.α-Linolenic acid *vs.* controls. Selection for low α-LLA and high LA/α-LLA ratio (free pollinated).



Selection for low α-LLA content is very effective, and single plant yields with α-LLA levels down to 6-8% are continuously found.

Fig.6.Frequency distribution for palmitic acid in controls and free-pollinated breeding materials.

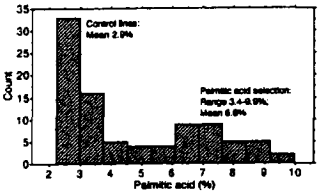
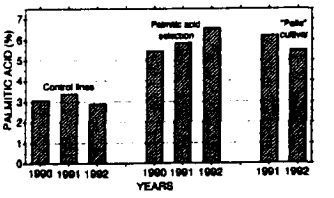
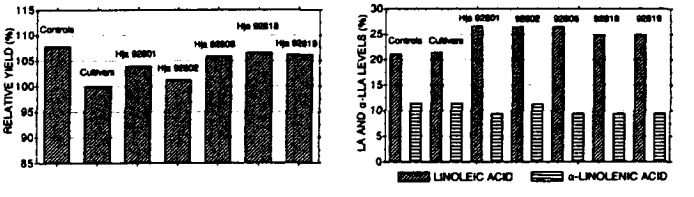


Fig.7.Comparison between palmitic acid levels in controls and selected lines in subsequent years.



Progress in selections for higher palmitic acid content is rapid and efficient. Levels of more than 6% have been achieved in 3 years' period.

Fig.8. Controls, standard cultivars and selected lines with best seed yield and linoleic and α-linolenic acid content in the 1992 field trial.



A number of good-yielding lines combined with higher LA (≈26%) and lower α-LLA levels (≈9%) have been produced.

Conclusions

Controlled crosses within pedigrees maintained the high proportion of linoleic acid, whereas the originally low α-linolenic acid levels tended to restore.

Selection for lower α-linolenic acid content shows continuous progress in long-term breeding, and lowest levels are most frequently found in free-pollinated seed materials.

The results indicate a considerable variability for linoleic and α-linolenic acids to be utilised for further fatty acid breeding of spring turnip rape cultivars.

Reference

1)S. Hovinen & I. Laakso: *Proceedings of the 8th Int. Rapeseed Congress*, Saskatoon, Canada, Vol.1, 159-163 (1991).