

THE POTENTIAL OF RESYNTHESED RAPSEED FOR HYBRID BREEDING

H.C. BECKER

Institute of Agronomy and Plant Breeding, Georg-August University, Von-Siebold-Str. 8,
D-37075 Göttingen, Germany

G.M. ENGQVIST

Institute of Plant Breeding Research, Swedish University of Agricultural Research,
S-26831 Svalöv, Sweden

ABSTRACT

A requirement for hybrid breeding is the availability of genetically diverse gene pools. A long time perspective for hybrid rapeseed could be to develop a gene pool of resynthesized rapeseed with good agronomic performance and to combine lines from such a gene pool with lines from conventional breeding programs. Sixteen resynthesized winter rapeseed lines were crossed with the commercial cultivar 'Falcon' and 5 crosses were performed within resynthesized lines. Genetic distances were estimated based on RAPD data from six primers with in total 62 bands. The mid parent heterosis for leaf dry matter of six week old hybrid plants was significantly correlated ($r=0.55^{**}$) with the genetic distance between the parents.

INTRODUCTION

A requirement for hybrid breeding is the availability of genetically diverse gene pools. One promising strategy could be the use of artificially resynthesized rapeseed. Many, but not all resynthesized lines were observed to differ largely from the commonly used breeding material in their RFLP pattern (Becker et al. 1995). The aim of the present study was to evaluate in how far the genetic distance based on molecular markers can be used to predict heterosis and/or hybrid performance.

MATERIAL AND METHODS

The material used consisted of 21 crosses. Sixteen resynthesized lines were crossed with the cv 'Falcon' in a male sterile version. The other five crosses were made by hand pollination among resynthesized lines. Both parents and crosses were grown in a climate chamber for six weeks, and the leaf and root dry matter of the plants was measured. The material was grown as randomised block design with one plant of each genotype and 16 replications.

Genetic distances (GD) between the parents of the crosses were estimated as $GD=1-\text{Jaccard's similarity coefficient}$ based on RAPD data from six Operon primers with in total 62 bands. For more details see Engqvist and Becker (1994).

RESULTS

The mean values and mid parent heterosis for the different characters in the various groups are presented in Table 1. The resynthesized lines were the group with the lowest

leaf and root dry matter production. The hybrids showed in general higher values than the parents, and the group with the highest mean values and the highest mid parent heterosis consisted of crosses within the resynthesized lines.

TABLE 1. Dry matter of 6 week old rapeseed plants [g/plant]

Material	N	Leaf	Roots	Total
Resynthesized Lines	16	0.65	0.17	0.82
Falcon	1	0.77	0.25	1.02
Resyn x Falcon	16	0.84	0.28	1.12
Resyn x Resyn	5	0.93	0.27	1.20
Heterosis§ Resyn x Falcon		17.7	36.8	22.0
Heterosis§ Resyn x Resyn		37.2	41.2	38.0

§Mid-parent heterosis in %

The analysis of variance revealed significant variation between the groups for all characters. The within group variation was only significant for leaf and total dry matter, but not for root dry matter which had the relatively largest experimental error. Therefore we will concentrate on leaf dry matter in the following.

When considering all 21 crosses, the correlation between [dry matter of the hybrids and the genetic distance between the parents was 0.40 for leaf dry matter and 0.38 for total dry matter, both non significant. The correlation between mid parent heterosis and genetic distance was slightly higher and significant both for leaf dry matter (0.52*) and for total dry matter (0.55**), see Figure 1.

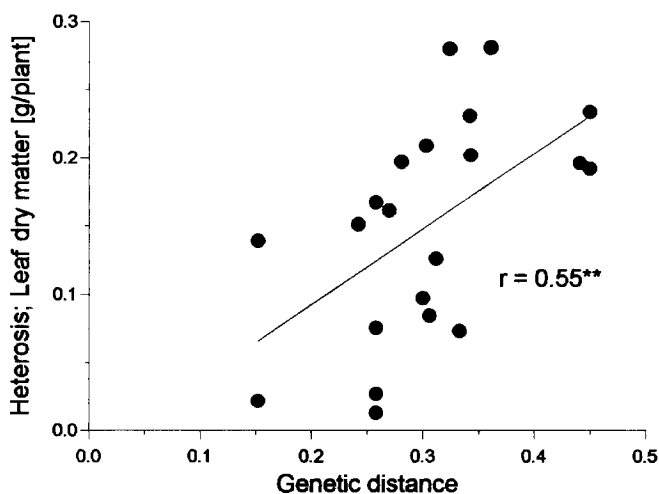


FIGURE 1: Correlation between the genetic distance between the parents and the mid parent heterosis for leaf dry matter in 6 week old rapeseed hybrid plants

DISCUSSION

The number of markers used in this study is extremely low, and an investigation with a higher number of both isozyme and RFLP markers has been started. Nevertheless, we consider the results from few markers to be reasonably reliable for a first screening of resynthesized lines. In a similar experiment, the correlation between the same set of six RAPD primers and RFLP data from 51 probe-enzyme combinations with in total 355 bands was 0.76 (Engqvist and Becker 1994).

As pointed out by Melchinger (1993), a high correlation between heterosis and genetic distance can only be expected, when at least some of the crosses have related parents. In numerous studies with maize, no correlation was found for crosses of unrelated lines from different heterotic groups. In our material, all parents should be unrelated, and hence the significantly positive correlation is unexpected. The surprisingly low genetic distance of some of the lines to the cv 'Falcon' could perhaps be due to some outcrossing with breeding material during the multiplication of these resynthesized lines.

We used the dry matter of young plants to estimate heterosis, for this character is perhaps a better indication for the potential of resynthesized rapeseed than grain yield. Grain yield will be influenced by the poor agronomic performance of some resynthesized rapeseed lines due to low winter hardiness and late flowering time, which might not be reflected in the genetic distance of molecular markers. Experiments to evaluate the material in field trials have been started.

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REFERENCES

- Becker, H.C., Engqvist, G.M. and Karlsson B. (1995). Comparison of rapeseed cultivars and resynthesized lines based on allozyme and RFLP markers. *Theor. Appl. Genetics* (in press)
- Engqvist, G.M. and Becker, H.C. (1994). Genetic diversity for allozymes, RFLPs and RAPDs in resynthesized rape. In *Biometrics in Plant Breeding: Applications of Molecular Markers*. Eds. J.W. van Ooijen and J. Jansen. pp. 85-90. Wageningen: CPRO-DLO.
- Melchinger, A.E. (1993). Use of RFLP markers for analysis of genetic relationships among breeding materials and prediction of hybrid performance. In *International Crop Science I*. pp. 621-628. Madison, WI: Crop Science Society of America.