DIFFERENCES IN GLUCOSINOLATE CONTENT OF TWO ZERO ERUCIC WINTERRAPE CULTIVARS

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Introduction

In comparative trials with zero erucic and OO cultivars of winterrape in the FRG in 1985 and 1986 the low glucosinolate (GSL) winterrape cultivars yielded about 9% less than the zero erucic ones (ROBBELEN 1987).

All OO type rapes are based on crosses with the Polish summer rape cultivar Bronowski. In order to increase yield it is necessary to cross these lines to high yielding winterrape types. In general the GSL content of the high glucosinolate cross parent is not exactly known.

In the present study it will be demonstrated that the response to selection for low GSL content may depend on the high GSL parent combined in the respective cross.

Material and Methods

Seeds of F_2 progenies of the following two crosses were analysed for their GSL content:

I: Garant x strain 154 (OO rape)
II: Jet Neuf x strain 154

Table 1: Parentage of investigated F_2 plants

1981		1982	1983	
cross	No*	F_1	F_2	
I:Garant x strain 154	2	3 plants	Single plant progenies	100-102
	6	2 "		103-104
	9	3 "		105-107
II:Jet Neuf x strain 154	2	3 plants	Single plant progenies	108-110
	3	3 "		111-113
	4	1 plant		114
	5	3 plants		115-117
	6	3 "		118-120
	7	3 "		121-123
	8	3 "		124-126
	9	1 plant		127

* No of the paternal plant

Eight F_2 progenies went into the experiment from cross I and twenty from cross II respectively. In each progeny about thirty plants were investigated.
a) The material was analysed with the Pd quick test after THIES (1982). The glucosinolates were extracted with water and the formation of the Pd-GSL complex was determined photometrically.
The Pd quick test does not result in absolute values of GSL content. Measurements of extinction are related to the values of three check varieties: Lirama (high GSL-content), Librador (approx. 30 µmol/g defatted meal) and Lirasol (approx. 3-5 µmol/g defatted meal).These GSL contents were determinated by GC.

The classification scale was set up as follows:

1 ↑ 2 3 4 5 ↑ 6 7 8 9 ↑ 10
Lirasol Librador Lirama

The range between the means of the standard cultivars was divided in four equal parts.

b) The GSL content of the two zero erucic cultivars Garant and Jet Neuf was measured by Pd test after GSL isolation with the ion exchanger Ecteola cellulose (MÖLLER et al. 1984). We used Sinigrin as a reference glucosinolate and internal standard. With the same procedure we analysed other available commercial zero erucic varieties in order to get informations for the selection of possible zero erucic cross parents.

Results

Table 2: Distribution of GSL content (Pd quick test) in F_2 progenies of the cross Garant x strain 154 (No of plants)

progeny \ class	1	2	3	4	5	6	7	8	9	10
100		6	5	4	1		1		1	
101	2	4	5	1		2	1	1	1	
102	1	7	7	1	6		1	1	1	1
103		1	1	5	4	4	3	2	1	8
104		1	3	2	3	3			2	13
105					2		2	5	4	12
106					1	4	8	6	6	2
107						1	7	10	9	3
Σ	3	19	21	13	17	14	23	25	25	39

Table 3: Distribution of GSL content (Pd quick test) in F_2 progenies of the cross Jet Neuf x strain 154 (No of plants)

class / progeny	1	2	3	4	5	6	7	8	9	10
108							3	4	5	16
109					2	2	4	7	4	7
110						1	6	6	11	2
111			1		1	1	1	8	4	
112			1	2	2	9	6			
113			1	1		6	6	9	1	
114				2	1	5	2	3	1	6
115					2	1	4	3	2	14
116						1	1	6	1	14
117							3	4	5	17
118							4	3	4	8
119	1					2	3	9	2	13
120								5	8	15
121		1					3	4	13	7
122							2	3	6	17
123				1			1		5	19
124									2	23
125							1	7	3	13
126						1	1		3	19
127							3	2	1	14
Σ	1	1	3	6	8	29	54	83	87	227

a) Paternal effects

In both crosses some combinations were made with the same paternal plant. Grouping the F_2 progenies in relation to their common parents differences in the frequency distributions of F_2 plants according to their GSL content become evident. This is due to cross I especially. This effect is clearly recognizable in one group in cross II (111-113). If we assume the high GSL content parent Garant not to contribute to the segregation of low GSL plants these results demonstrate the different genetical backgrounds of the pollen donor plants in the original crosses.

b) Maternal effects

It is evident that both crosses differ in the number of plants with low GSL content. In the cross with Garant as the maternal parent 73 plants showed a lower GSL content than Librador in contrast of 19 plants in the second cross. These figures correspond to 37% of the F_2 population in the first cross and to 4% in the other one.
A few cross combinations were made with the same paternal plant from strain 154 in both crosses (ref. table 1,100-102 = 108-110; 103-104 = 118-120; 105-107 = 127), which enables us to exclude paternal effects in these comparable arrangements.
These differences must be due to the genotype of the female parent in the original crosses. Therefore we examined Jet Neuf and Garant with the Pd test after isolation of the GSLs.
Jet Neuf showed a higher GSL content than Garant (table 4). This was already proved using the Pd quick test. These results underline our statement from above that the higher GSL content of the paternal plants have caused a higher average GSL content in the cross II progenies.

Tabelle 4: Pd test with isolated glucosinolates from zero erucic cultivars

cultivar	µmol/g Samen
Lirama	115,6
Garant	137,1
Jet Neuf	154,5
Rapora	105,8
Korina	108,0
Belinda	146,9
Lesira	153,1
Doral	175,4

Discussion

It is generally accepted that GSL content is controlled by 3-4 genes (LEIN 1972, KONDRA and STEFANSON 1970). The phenotypic variation of the GSL content was studied in the present investigation in two different crosses of low and high glucosinolate parents. It has been tried to classify the observed variation into groups interpretable in genetic terms. In conclusion we have to state that this could be done successfully only in a very limited manner.

It is often said, that high GSL content is correlated to dominant alleles in homozygous genotypes. Our results do not correspond to this hypothesis. At least one has to take into account a more moderate expression of GSL content. There are remarkable differences in the frequency distri-

bution of plants with different GSL content among the two crosses. Preliminary investigations of the glucosinolates of Garant and Jet Neuf with HPLC (unpublished results) revealed almost the same pattern of glucosinolates. So it may be concluded that differences in the GSL content between these cultivars are controlled by regulative genes or genes acting early during the biosynthesis of glucosinolates.BUSCH and RÖBBELEN (1981) discussed the low GSL content of Bronowski in relation to a similar gene action. Our investigations of other zero erucic cultivars showed also a great variability in glucosinolate content. This could be important for the choice of appropriate parents in breeding for low glucosinolate content.

From the analytical point of view we can conclude that the Pd quick test is suitable to differentiate among rape cultivars with low and high contents. The Pd values originated from isolated GSL extracts agree well with the HPLC data (MARQUARD and SCHLESINGER 1985). The Pd-test is calibrated with sinigrin as the reference GSL. This does not take into account that other glucosinolates differ in the Pd complex formation from sinigrin. Therefore the accuracy of this test is limited.

Literature

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