INHERITANCE OF GLUCOSINOLATE CONTENT AND COMPOSITION IN SEEDS OF WINTER RAPE /BRASSICA NAPUS L./

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Detailed knowledge of glucosinolate inheritance is necessary to choose efficient methods of rapeseed breeding for low glucosinolate content. First researches on this field were done by Krzymański /4,5/ and Kondra /3/. Presented researches include not only low and high glucosinolate lines but also two lines of natural mutants found in breeding materials /1/. These mutants may be interesting for breeding and for feeding purposes because of more profitable glucosinolate composition.

Material and methods.

Seven inbred lines of winter rape were used for studies: two double low lines, three zeroerucic lines and two lines of natural mutants characterized by changed glucosinolate composition. These mutants are low in progoitrin, the most noxious of glucosinolates, and possess increased gluconapin content /table 1/.

These lines were crossed in complete diallelic design twice in two following years. Next field trial was sown in completely randomized block design, in three repetitions. It included all hybrids from diallelic crosses and inbred parental lines.

Factor variance analyses in cross classification according to maternal plants and pollinators were performed for the investigated traits of seeds obtained from self- and cross-pollination and from F_1 plants. Components of genetic and non-hereditary variability were estimated by factoring of mean squares into expected values /2/.

Results.

The analysis of butenyl isothiocyanate content displayed no differentiation between its content in seeds obtained by cross-pollination and by self-po-

llination. Significant differences appeared between groups set up according to maternal plants and between reciprocal crosses. In case of groups set up according to pollinator butenyl isothiocyanate contents were similar and did not differ significantly. Completely different relations were obserwed for seeds collected from F_1 plants. I this generation groups set up according both to maternal plants and pollinators differed significantly from one another and no differences between reciprocal crosses were stated. These results showed that gluconapin content in seeds is controled genetically but maternal plant environment play essential role so influence of embryo genotype is insignificant.

Similar results were obtained for inheritance of glucobrassicanapin /table 3/ and progoitrin /table 4/.

Ratio of the total of butenyl and pentenyl isothiocyanate contents to vinyl oxazolidinethione content was taken as a measure of glucosinolate composition in rape seed meal. It appears that also glucosinolate composition is determined by maternal plant genotype. Futhermore, in hybrid generation ITC/VTO ratio shifted almost to normal. From this may be concluded that glucosinolate composition characteristic for mutants is a partially recessive trait /table 5/.

Factoring of mean squares into expected values allowed to determine the influence of different factors on seed phenotype. Total phenotypic variability in seeds from cross-pollination was determined by maternal plant genotype in case of all examined glucosinolates and their composition /table 6/.

Variability analysis for seeds collected from F_1 plants showed that participation of maternal plant and pollinator genotypes in phenotypic variability is almost equal in respect to both individual glucosinolate content and their composition. This confirms the thesis that phenotypes of these seeds are under control of F_1 genotypes of maternal plants /table 7/.

Conclusions.

- In lines with normal glucosinolate composition and in mutant lines glucosinolate content and composition is completely determined by maternal plant genotype, and not embryo genotype. Therefore, information about genotype of the obtained hybrid in respect of these traits is received in phenotype of the next generation.
- Interaction of both parental genotypes significantly affects glucosinolate content and composition.

- Glucosinolate composition characteristic for mutant lines is a partially recessive trait in relation to glucosinolates composition present in normal and double low lines.
- High glucosinolates content is a dominant trait, and dominance degree is different for particular glucosinolates.
- Environmental variability significantly modifies glucosinolates content.

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Parental lines characteristics.

Table 1

Lines	Butenyl-ITC mg per 1 g f.f.d.m.	Pentenyl ITC mg per 1 g f.f.d.m.	Vinyl-oxazolidine-thiones mg per 1 g f.f.d.m.	Ratio ITC:VOT
Double low lines				
375	0,08	0,03	0,35	0,31
736	0,06	0,01	0,39	0,18
Zeroerucic lines				
1261	1,99	0,53	4,80	0,52
1265	1,85	1,09	6,34	0,46
1266	2,79	1,55	7,24	0,60
Mutants 1198	9,40	1,33	1,73	6,20
1200	10,11	1,58	1,67	7,00
$LSD_{0,05}$	1,51	0,27	1,35	0,99

Inheritance of butenyl isothiocyanate
/ mg/1g f.f.d.m. /

Table 2

Line	Seeds obtained from self- and cross-pollination			Seeds obtained from F_1 plants		
	parental lines	means for groups according to		parental lines	means for groups according to	
		maternal plants	pollinators		maternal plants	pollinators
375	0,08	0,10	4,97	0,15	2,04	1,98
736	0,05	0,03	4,85	0,07	1,69	1,74
1198	9,39	11,76	4,46	9,65	6,01	5,56
1200	10,10	12,40	4,63	11,18	6,12	5,81
1261	1,98	2,57	4,90	2,19	2,60	2,65
1265	1,85	2,64	4,64	2,97	3,04	3,36
1266	2,79	3,65	4,69	2,70	3,26	3,65
$LSD_{0,05}$	1,51	2,49	2,49	1,21	1,13	1,13

Inheritance of pentenyl isothiocyanate
/ mg/1g f.f.d.m. /

Table 3

Line	Seeds obtained from self- and cross-pollination			Seeds obtained from F_1 plants		
	parental lines	means for groups according to		parental lines	means for groups according to	
		maternal plants	pollinators		maternal plants	pollinators
375	0,02	0,00	0,83	0,02	0,58	0,60
736	0,01	0,00	0,77	0,05	1,29	1,29
1198	1,32	1,20	0,89	1,59	1,56	1,46
1200	1,57	1,46	0,85	1,89	1,67	1,58
1261	0,52	0,50	0,82	0,60	0,92	0,99
1265	1,09	1,13	0,86	1,36	1,44	1,47
1266	1,54	1,53	0,82	2,03	1,69	1,75
$LSD_{0,05}$	0,27	0,32	0,32	0,19	0,31	0,31

Inheritance of vinyloxazolidinethione / mg/1g f.f.d.m. /

Table 4

Line	Seeds obtained from self- and cross-pollination			Seeds obtained from F_1 plants		
	parental lines	means for groups according to maternal plants	means for groups according to pollinators	parental lines	means for groups according to maternal plants	means for groups according to pollinators
375	0,35	0,46	3,69	0,55	3,62	3,60
736	0,39	0,62	3,51	0,54	3,49	3,48
1198	1,73	1,73	3,61	1,64	4,22	4,21
1200	1,66	1,61	3,69	1,55	4,29	4,33
1261	4,80	5,45	3,69	4,84	4,96	4,85
1265	6,34	7,25	3,73	7,05	6,16	6,38
1266	7,24	8,38	3,57	6,69	6,39	6,30
$LSD_{0,05}$	1,35	1,32	1,32	0,41	0,78	0,78

Inheritance of isothiocyanate to oxazolidinethione ratio / mg/1g f.f.d.m./

Table 5

Line	Seeds obtained from self- and cross-pollination			Seeds obtained from F_1 plants		
	parental lines	means for groups according to maternal plants	means for groups according to pollinators	parental lines	means for groups according to maternal plants	means for groups according to pollinators
375	0,29	0,22	2,61	0,33	0,64	0,62
736	0,15	0,06	2,92	0,22	0,70	0,74
1198	6,19	7,54	2,37	7,06	2,76	2,65
1200	7,03	8,69	2,41	8,64	2,94	2,89
1261	0,52	0,56	2,84	0,57	0,72	0,76
1265	0,46	0,52	2,37	0,62	0,74	0,78
1266	0,60	0,62	2,69	0,71	0,80	0,87
$LSD_{0,05}$	0,99	2,42	2,42	1,19	0,55	0,55

Variance components for seeds obtained from cross- and self-pollination /percent of total variability/.

Table 6

Source of variability	ITC-B	ITC-P	VOT	$\frac{\text{ITC-B+ITC-P}}{\text{VOT}}$
Maternal plant genotype	93,90	95,56	95,80	93,52
Pollinator plant genotype	0,00	0,00	0,00	0,00
Genotypes interaction	0,00	0,00	0,08	0,00
Years	2,48	0,00	1,58	0,25
Environment+error	3,62	4,44	2,54	6,23
T o t a l	100,00	100,00	100,00	100,00

Variance components for seeds collected from F_1 plants /percent of total variability/.

Table 7

Source of variability	ITC-B	ITC-P	VOT	$\frac{\text{ITC-B+ITC-P}}{\text{VOT}}$
Maternal plant genotype	38,73	30,61	23,09	22,01
Pollinator plant genotype	30,44	28,57	24,40	19,02
Genotypes interaction	18,60	24,49	42,70	52,72
Environment+error	12,23	16,33	9,81	6,25
T o t a l	100,00	100,00	100,00	100,00