

RECENT PROGRESS IN POLISH BREEDING OF WINTER  
RAPE /BRASSICA NAPUS L./ WITH IMPROVED OIL  
AND MEAL QUALITY.

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Amino acid composition of rape seed protein is very close to amino acid composition of animal protein and is rich in essential egzogenic amino acids. However glucosinolates present in rape meal and especially their decomposition products limit full utilization of that protein for fodder purposes. Aim of research and breeding works conducted in our Institute is to obtain new varieties of zeroerucic winter rape with minimal glucosinolate content in meal, so called double low varieties.

Material and methods.

Bronowski variety of spring rape was a source for low glucosinolate content trait in our breeding programme. Winter rape forms used for crossings were:

- traditional varieties verified in many years of cultivation, such as Górczański, Skszeszowicki, Borowski, Warszawski, Gölzower Oelquell,
- zeroerucic strains and low erucic variety Janpol.

This genetical basis was permanently extended by new genotypes collected from different part of world or obtained by interspecific crosses or by mutagenesis.

A knowledge of inheritance and of heritability values of different characters by winter rape helped us to choose the breeding methods. Inheritance of following characters were studied:

- erucic acid content in oil /14, 19, 20/,
- C-18 fatty acid contents in oil /1, 4/,
- glucosinolate content in meal /5, 14, 15/,
- oil content in seeds /1/.

A recombination method with backcrossings and recurrent selection has been applied. A choice of selection manner in segregating generation has been done

with regard to results of research works on inbred /13/, heterosis /3,9,10,11,22,23/ chemical and statistical method of breeding material valuation /7,8,21,22,23,28/. It was shown that field trials accuracy is far from satisfactory and need to be improved /18/.

Results of heritability estimations for different characters in populations of double low winter rape /17,22,23/ helped to choose proper programme of selection in the breeding cycle. Expected genetic gain has been confirmed by obtained breeding progress. Only seed yield economically most important trait is an exception. Heritability lower than estimated is caused by significant interaction of that trait with years so effective selection can be made only on the basis of mean results of trials conducted during several years.

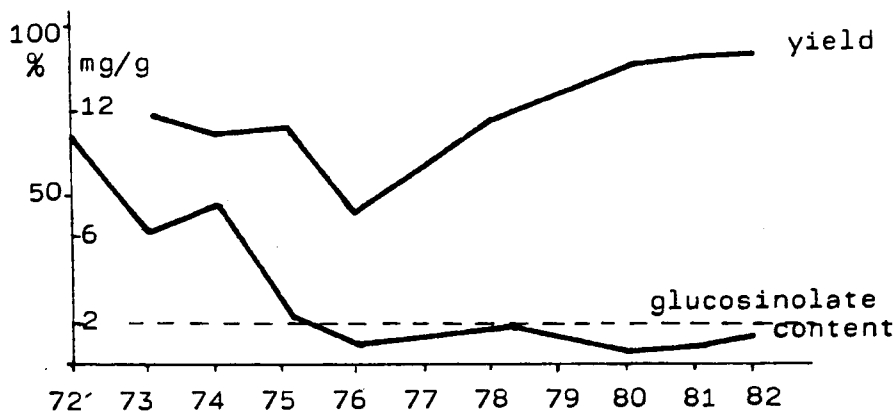
Selection of single seeds may be efficient only for characters having very high heritability and most important, controlled by embryo genotype, similarly as by erucic acid.

In many cases maternal plant environment is predominant and in consequence seed properties are controlled mainly by genotype of maternal plant. This phenomenon has been stated for glucosinolate content /5, 14,15/. Results of last investigations of inheritance in rape seed /1,4/ showed that similar situation is present in zeroerucic strains of winter rape in respect of: oil content in seeds and oleic, linoleic and linolenic acids content in seed oil.

Significant increase in efficiency of rape selection for qualitative characters was obtained when inbreeding was applied. Rape has quite considerable ability to self-pollination however longer application of inbreeding causes decrease in viability and inbred depression. To restore yield ability and vigour of double low winter rape it is necessary to make use of heterosis effect. Researches on heterosis effect in low erucic and double low winter rape /3,9,10,11,22,23/ showed that it occurs by inter-varietal, inter-strain and first of all inter-line crossing. The degree of yield increase ranges from 15-100% depending on crossing combination and environmental conditions in which hybrids are grown. The worse the conditions of plants growing the stronger was heterosis effect. Heterosis and general combining ability were significant in all investigations. Specific combining ability was statistically

significant only in certain trials. Heterosis effect can be utilized now only in synthetic varieties but works on male sterility are conducted intensively.

Results of breeding works.



Breeding progress in the last 10 years is best illustrated by above plot. It shows the changes in seed yield and glucosinolate content for population of zero-erucic strains bred in Poznań for low glucosinolate level. There are mean values from comparative field trials conducted in 1971-1981. In the first period glucosinolate content was constantly decreasing till the level which we assumed for double low rape. This level was reached in 1976. Unfortunately, decrease in glucosinolate content was accompanied with strong decrease in seed yield up down to 45% of yield of traditional varieties /Górczański and Skrzyszowicki/. Since then main efforts have been directed to yield improvement with maintenance of low glucosinolate content. These works gave positive results. In 1980 mean yield of double low strains reached 90% of standard. In 1980/81 and 1981/82 the gain of seed yield was less profitable, but it may be stated that the obtained double low lines and strains are beginning to approximate the yield of traditional varieties. Last heavy winters allowed to eliminate materials with unsatisfactory winterhardiness and susceptible to root diseases.

As a results of researches and breeding works, very significant changes in rape species were done. Obtained double low strains differ from the traditional varieties in respect of:

- seed yield 91% /50%-130%/

- % of plants which pass through winter	96%	/53%-147%/
- oil content in seeds	97,4%	/91,4%-103,1%/
- fatty acids composition:		
palmitic	129%	/103%-148%/
stearic	155%	/111%-222%/
oleic	346%	/306%-400%/
linoleic	140%	/94%-170%/
linolenic	111%	/80%-136%/
eicosenoic	15%	/10%-21%/
erucic	0,1%	/0,0%-0,4%/
- glucosinolate content:		
butenyl isothiocyanate	13%	/0,2%-17%/
pentenyl isothiocyanate	2%	/0,0%-28%/
vinyl oxazolidinethione	2,5%	/1,0%-26%/

The above figures are mean values and variability ranges in comparison to standard varieties Górczański and Skrzyszowicki.

The following new varieties of winter rape were accepted to prove in official state trials

- low erucic: JG-75, PUR-182, POB-182, POB-282,
- double low: Start, BKH-180, MAH-181 and MAH-281 /synthetic variety/.

These new double low varieties are also improved in oil and protein content:

variety /type/	oil /% d.m./	protein /Nx6,25% d.m./	total
Jet Neuf 0	43,8	22,7	66,5
Quinta 0	46,1	22,5	68,6
Jupiter 0	45,7	20,5	66,2
Start 00	48,7	22,1	70,8
BKH-180 00	47,3	22,6	69,9
MAH-181 00	49,7	22,6	72,3
MAH-281 00	48,4	22,9	71,3

New double low varieties had first contact with epidemic caused by Phoma and Sclerotinia in 1981/82. They were more susceptible than traditional varieties but they showed also high variability in resistancy degree between the lines. It permits to expect a fast progress in improving this character.

Feeding experiments performed on rats, pigs and poultry gave an excellent results for rapeseed meal produced industrially from seeds of new double low varieties /25,26/.

Investigation on cultivation technology of new varieties are conducted simultaneously with breeding works. They show, that requirements of new double low varieties do not differ essentially from those of traditional varieties.

### Conclusions.

As a results of breeding works on double low winter rape pronounced progress was obtained in last years. Four new varieties are now in official state trials. Further breeding progress may be achieved in the following years due to possessed rich and genetically variable set of double low lines and strains. Breeding methodology has been also improved as a results of performed genetic researches.

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