RECENT ACHIEVEMENTS IN BREEDING WORK ON WINTER RAPE /Brassica napus L./ IN POLAND

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Polish climatic conditions are less suitable for winter rape cultivation than marine climate of West Europe. Poland is situated on the border line between continental and marine climate which makes our weather very variable. Varieties of winter rape for cultivation in Poland should be enough winterhardy and resistant to periodic droughts. These requirements make that the breeding of double low varieties is very difficult and needs a longer time.

Material and methods.

The breeding works are based on strains and lines of winter rape obtained by crossing between winter rape varieties and spring rape Bronowski variety. Intense back-crossing and recurrent selection are conducted now to continue the improvement of agronomic and technological value of double low winter rape. These works are concentrated on the following traits:

- better yielding ability and higher 1000 seed weight
- improved winter hardiness and ability to regenerate after winter damages,
- earliness,
- tolerance to diseases and pests,
- resistance to lodging and shattering,
- better use of mineral fertilization,
- higher oil and protein content in seeds,
- thinner seed coat,
- increased linolic and decreased linolenic acid content,
- increased palmitic acid content.

New breeding targets can appear when chemical composition of seeds will be more complete especially according

to hydrocarbons /dietary fiber/ and phenolic compounds.

Besides the classical method of individual selection the possibility of haploid use is investigated. Obtained results will be reported separately.

Research on importance of heterosis effect by double low winter rape indicate that heterosis has strong influence on seed yield and generates better tolerance to unfavourable enviromental conditions. Synthetic varieties utilize this effect only partially. Hence a good cytoplasmic male sterility /cms/ system is necessary to produce hybrids commercialy. Intense search is conducted in this field.

Works on various male sterility types of different origin are carried out. The aim of these works is:

- investigation of genetic control of male sterility occurrence,
- evaluation of male sterility usability for breeding hybrid varieties,
- development of full system ensuring the production of F_1 hybrid seeds,
- introduction of full male sterility system into agronomically valuable double low lines of winter rapeseed.

Selection of full male sterile plants or to a high degree male sterile forms is performed by visual observations, selfings and estimations of the degree of crosspollination by the use of high erucic variety Górczański as a tester. Also histological methods are used in this work.

Interspecific crosses are made to produce new sources of male sterility or restorers in Ogura cms. In vitro cultures of embryo are used in these works.

Results

Variety Jantar of double low winter rape was licenced in 1985. It is the first variety of winter rape which reached the quality standard of Canadian spring rape Canola type.

Jantar variety is of intensive type and late. It needs

early and not too dense sowings /4-6kg/. Protection against wild animals is very important in autumn and winter.
It is resistant to lodging. Jantar is less affected by Phoma lingam and Peronospora parasitica. Content of protein and oil in seeds is high, about 5 per cent higher than in seeds of Jet Neuf variety /table 1/.
Plantations of Jantar variety passed through last very hard winter as well as plantations of low erucic varieties. Experience achieved by introducing the Jantar variety to cultivation indicate that low glucosinolate content in produced seeds not exceeding 30 μM/g ffm can be reached only when seeds used for sowing have geneticaly stabilized glucosinolate content not higher than 16 μM/g ffm.

New double low varieties are now evaluated in official trials. Some of them are promissing according to winter hardiness and seed yield.
In table 2-5 are shown results of experiment with different levels of nitrogen fertilization in spring. 80kg and 160kg of N per ha were used. There are significant differences in reactions of investigated strains of double low quality. Correlation coefficient between yielding ability and reaction on higher nitrogen fertilization is not significant what means that it could be possible to breed high yielding varieties of double low winter rape which do not need so high nitrogen fertilization as it is used now. This could be an element to so called "low input varieties".

Only a small part of double low lines produced by anther culture has satisfactory vigour and yielding ability. The best of them are evaluated now in field trials. Observations made by carring out the anther cultures and plant regenerations indicate that this method can serve not only to the production of homozygous lines but also allows to get and fix new variability created by somaclonal mutation.

The search for male sterility has become a very important part of our reseearch programme.

At present the following types of male sterility are investigated /Table 6/:

- cytoplasmic male sterility - Ogura type,
- cms found in spring variety Polima,
- cms originating from Brassica juncea,
- cms Bronowski type,
- male sterility found in Janpol variety.

The source of cms Ogura type was obtained from France. These totally sterile plants became double low, winter-hardy with oil content higher as compared to initial forms by multi back-crossings with double low lines. As it is known the main problems connected with this type of sterility are the lack of restorers and chlorophyll deficiency of male sterile plants. Traditional methods of breeding allowed obtaining neither restorers nor ms lines without chlorophyll deficiency. Now the programme to obtain a restorer by interspecific crosses: cms lines x Raphanobrassica is developped.

Seeds of Polima summer rapeseed were obtained from China. First observations conducted under greenhouse conditions in 1982 indicated that it was a segregating population of summer rapeseed. Also the plant vigour was very weak.

Male sterile plants have been already crossed four and five times with double low winter rapeseed lines. After these backcrossings a vigor of ms plants is improved. This type of male sterility is giving totally male sterile plants with strong flower modifications and a lack of differentiationof male archesporium into maternal cells of pollen. Also plants producing little amount of pollen are observed. Double low lines of winter rape investigated up to now can be classified as maintainers or partially maintainers of this sterility. Only one "00" line seems to be a restorer.

Seeds of ms plants of Polima type were initially characterized by low fat content - about 30%, high erucic

acid and high glucosinolate content. Synigrine was observed besides the main glucosinolates characteristic to B.napus. As the result of crossing with "00" winter rapeseed lines a considerable progress in improving seeds quality was achieved. Synigrine content either remained on the same level or was totally removed. It seems that synigrine content in Polima seeds is determined by one pair of recessive alleles. Detailed results about cms Polima are presented separately in the poster.

Investigations on the male sterility system originating from Brassica juncea were initiated in the season 1985/86 using seeds obtained from France and Netherland. Plants observed both in greenhouse and in the field condition were very small with several mustard traits. Male sterility was very stable. The hybrids of ms plants crossed with "00" winter rapeseed lines are growing now in greenhouse.

As it is known the specific trait of male sterility of Bronowski type is its unstability which manifests itself by producing small quantity of pollen in higher temperatures, mainly in the end of flowering period. Therefore one of the main problems is to select plants sterile to a high degree or fully sterile. As the result of such selection about 50 lines producing a very small amount of pollen in field conditions were obtained.

In the case of male sterility of Bronowski type there is no problem with restorers, because majority of rapeseed strains and varieties has got restorer genes. It is difficult however to produce a good "00" maintainer which should have genotype with normal cytoplasm and recessive restorer genes.

Male sterility originating from zeroerucic variety Janpol has a genic character. This sterility is very interesting because of the lack of flowers modifications. The plants have good agronomic characteristics. Only the production of microspores and their differentation is

stopped. "00" lines which segregate to ms plants were obtained after several crosses with "00" lines of winter rape.

Conclusions.

- Further improvement of "00" varieties of winter rape by recurrent selection and backcrossing should be continued. New promissing strains are obtained.
- Results obtained in research on male sterility and heterosis indicated that it would be possible to produce hybrid varieties of winter rape in near future.
- Experiments with different levels of N-fertilization show that it is possible to breed so called "low input varieties".

Table 1. Crude fat and protein content in seeds of some varieties of winter rape /% d.m./

Variety	type	protein	fat	protein+fat
Jet Neuf	0	21,9	43,8	65,7
Jupiter	0	20,1	45,7	65,8
Beryl	0	22,2	46,3	68,5
Start	00	21,5	48,7	70,2
Jantar	00	21,5	49,7	71,2
$LSD_{0,05}$		0,80	1,60	2,40

Table 2. Trials design

Randomized bloks repeated in localities

strains	- S - 20
levels of N-fertilization	- N - 2
localities	- L - 3
blocks	- B - 3x4

N fertilization in spring 80 kg and 160 kg/ha

Table 3. F calculated

	trial 1	trial 2
S-strains	14,18xxx	22,32xxx
N-fertilization	130,73xxx	88,39xxx
L-localities	2061,84xxx	1760,51xxx
S x N	2,16xxx	2,27xxx
S x L	4,31xxx	4,39xxx
N x L	61,98xxx	112,15xxx
S x N x L	2,26xxx	2,20xxx

xxx - significant at =0,005

Table 4.

Gain of seed yield (kg/ha) caused by higher N-fertilization (80-160kg/ha)

	trial 1	trial 2
$\bar{x}$	311	253
max	660	619
min	-95	-149
$LSD_{0,05}$	239	236
$LSD_{0,01}$	315	311

Table 5. Correlations between yielding ability of strain and gain of seed yield caused by additional N-fertilization

	trial 1	trial 2
seed yield by 80kg of N/ha	0,0211n.s	-0,0491n.s
seed yield by 160kg of N/ha	0,6571xx	0,5226x

n.s - not significant at α=0,05
x - significant at α=0,05
xx - significant at α=0,01

Table 6. Results of work on male sterile systems

Systems / Aims	Ogura cms	Bronowski cms	Polima cms	Juncea cms	Janpol ms
ms lines stability	+	- +	+	+	+
"00" maintainer lines	+	- +	+	+	
"00" restorer lines	-	+	+		
winter form	+	+	+	-	+
zero erucic	+	+	+	-	+
low glucosinolate	+	+	+	-	+
oil content	+	+	+	-	+