GENETICAL PROGRESS IN THE BREEDING OF WINTER RAPESEED IN EUROPE

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INTRODUCTION

In the middle of the eighties the European rapeseed programmes focused their breeding efforts on varieties with a low glucosinolate content. In June 1986 when the E. E. C. proposals were announced saying that there will be a qualifying level of 20 µmoles starting from the harvest '92 there was firstly an increase in the number of double low varieties in Official Trials followed by a change in the conventional breeding programme to double low.

The move from single to double low varieties in GERMANY, UNITED KINGDOM and FRANCE was accompanied by a yield decrease of 5 to 10 %.

Several studies have reported the existence of negative effect on agronomical characteristics with the decrease of glucosinolate content.

- thousand grain weight is increased by 0.10 to 0.14 g by 10 units of glucosinolates (µmole x g of seed) (OLIVERI and PARRINI, 1983)
- negative correlations between yield and GLS (Mc DONALD, 1990a)
- decrease of resistance level to certain pests (BUSCH, 1990).

The objectives of these studies were to investigate the effect of decreasing glucosinolates on yield potential and resistance to the main pests and to see the extent of genetical progress in the double low rapeseed breeding over the last three years.

MATERIAL AND METHODS

Trials network

Up to '89, the network comprised :

- 5 locations in France
- 4 locations in Germany
- 3 locations in United Kingdom
- 9 locations in Denmark

Testing Design

In general, block trials having 3 to 4 replicates with plots varying from 10 to 21 m^2. Depending on the equipment available at the testing station, drilled and direct combined in FRANCE and UNITED KINGDOM or combined after swathing in DENMARK, GERMANY, AUSTRIA and THE NETHERLANDS.

Testing Material

- CH5, CH7, CH10, CH11 are experimental lines bred by Semences CARGILL and used only for scientific purpose.

- ENVOL, IDOL, EUROL are Semences CARGILL protected and licensed varieties. The Semences CARGILL varieties are obtained by pedigree breeding method with self-pollinations.

- DSV provided experimental and commercial lines.
- the high erucic varieties were proveided from the INRA collection and then maintained by self-pollination.
- The other varieties used in this study are commercial types and have been obtained in the countries where they were accessible.

Biochemical analysis

Glucosinolates measured by Temperature Programmed Gas Liquid Chromatography, are expressed in µmoles/g of seeds at 9 % moisture. Oil content was determinated by NMR and is expressed in % of dry matter.

Phoma resistance evaluation was carried out according to the methodology described by PIERRE et al. (1982).

RESULTS AND DISCUSSION

Effect of decreasing the glucosinolates content on yield potential and Phoma resistance

The data collected from twenty-eight 00 lines from the testing carried out in 1987-1988 has been analysed by PCA (matrix of correlation).

Table 1 : **Matrix of correlation**

	PHOMA	YIELD	GLUCOSINOLATES
PHOMA	1.00		
YIELD	- 0,365	1.00	
GLUCOSINOLATES	- 0,251	- 0,311	1.00

The data clearly indicates a negative effect of the decreasing glucosinolate content on yield potential and Phoma resistance in the double low lines bred or developed before 1987.

The drastic effect of reducing glucosinolates on yield and Phoma resistance is the result of the introduction of the character "low glucosinolates" from spring varieties such as BRONOWSKI, the progenies of which have reduced yield potential and poor Phoma resistance. The number of backcrosses was not sufficient in this material to give desirable agronomic characteristics.

Evaluation of the yield loss due to the reduction of the glucosinolate content

Table 2 : Effect of glucosinolate content reduction on yield potential of 12 "00" lines

(TAPIDOR, IDOL, ENVOL, EUROL, CH5, CH7, CH10, CH11, FALCON, CERES, SAMOURAI, LIBRAVO).

	1989 RESULTS FRANCE	1990 RESULTS FRANCE	1990 RESULTS U. K.
R 2	0,71 *	0,65 **	0,65 *
Yield lost in % per µmole of glucosinolate	0,99	1,30	0,56

The results from FRANCE and U. K. are similar, indicating that the correlation is strong and yield loss could vary from 0.5 % to 1.3 % per µmole of glucosinolate for the varieties studied which were in the range of 5 to 35 µmoles/g of seeds.

Breeders face a difficult challenge to produce high yielding double low lines with a glucosinolate content lower than 10 µmoles. Some preliminary data from the new lines bred by pedigree breeding with self-pollinations indicates that we are on the way to increase the yield level of the varieties in the range 5 to 10 µmoles by 8 to 10 %, but these varieties are still at least 5 % lower than the best yielding lines of the glucosinolates range from 15 to 20 µmoles.

Genetical progress in rapeseed breeding

In 1990, new double low varieties have been registered in Europe :

- EUROL and FALCON in FRANCE
- DRAGON, EUROL, IDOL, ENVOL, LIMERICK, LINCOLN, AZTEC, ROCKET in U.K.
- IDOL in DENMARK.
- OLYMP, ACCORD and IDOL in GERMANY.

Among the new double low varieties registered, we found some varieties which significantly outyield the top yielding single low varieties (table 3).

According to comments by of N. Mc DONALD (1990b) regarding the new U.K. registered varieties "ENVOL OUTPACED" top yielder FALCON with yield breaking through the old single low barrier set by BIENVENU.

Table 3 : Results from Official Trials (2 or 3 years results)

	FRANCE	U. K.	GERMANY	DENMARK
Best variety registered in 1990	EUROL	ENVOL	IDOL	IDOL
Seed yield advantage over standards	11 %	11 %	5 %	2 %
Oil yield advantage	13 %	15 %	8 %	5 %
Seed yield advantage over best single low variety	+ 6 % BIENVENU	+ 5 % BIENVENU	+ 3 % LIRAKOTTA	
GLS content	14 *	14 *	22 +	15 *

* in µmoles/g of seeds at 9 % moisture
\+ in µmoles/g of defatted meal

In FRANCE, EUROL has broken the BIENVENU barrier and surpassed it by 6 %. EUROL and ENVOL are early flowering varieties with an oil content equal to BIENVENU and over the past few years have confirmed their results in our European network. Their mean glucosinolate content of 14 µmoles make these varieties particularly interesting for the farmer.

In GERMANY, IDOL's performance is close to that of LIRAJET and LIBERATOR which in '89 broke the single low barrier of LIRAKOTTA. With the registration of IDOL as a short and early maturing variety, German farmers now have the choice of a wide range of high yielding varieties.

In DENMARK, the genetical progress for yield potential observed with IDOL is not significant whilst for oil yield IDOL brings a bonus. Moreover, as in GERMANY, IDOL is a new type which extends the range of varieties available to farmers.

The genetical progress with the new varieties released is confirmed by the results of the trials carried out in six European countries (table 4).The three best new varieties (EUROL, IDOL, ENVOL) show great adaptability between countries and give consistent results from year to year.

We have identified in our breeding programme a new experimental line, CH10. This line seems to bring a new significant step in the rapeseed breeding. Its glucosinolate content observed in our trialling network varied from 10 to 26 µmoles with a mean of 17 µmoles. It has been entered in '89-'90 and '90-'91 in the registration system of most European countries which have an interest in winter rapeseed.

Table 4 : Yield stability of the new double low varieties over years and over countries

	FRANCE			U. K.			GERMANY			DENMARK		NL	AUSTRIA
	DARMOR + BIENVENU 2			RAFAL + BIENV + ARIANA	LIBRAVO+COBRA + ARIANA		CERES			CERES		LIRA -BON	LIBRAVO
	87-88	88-89	89-90	87-88	88-89	89-90	87-88	88-89	89-90	88-89	89-90	89-90	89-90
IDOL	112	104	101	110	*	*	*	106	102	107	110	108	103
EUROL	111	110	117	104	*	*	107	106	105	107	102	104	98
ENVOL	113	106	108	116	107	110	+	107	103	+	111	+	+
CH10	115	123	115	+	*	*	109	120	109	107	115	121	119

+ : not tested

* : tested in another network

CONCLUSIONS

In a changing world, breeders have a challenge to maintain the European rapeseed crop competitive with :

a) other crops,

b) other rapeseed producing areas (old and new) which will produce at much lower cost than in the E. E. C.

c) new sources of industrial interest <hich may be attractive and fruitful for the farmers.

The yield potential must significantly increase in varieties which require low inputs. This challenge could be accomplished :

a) in the short term by varieties coming from successful pedigree breeding with self-pollination which has proved to be very effective for making great progress in a short period of time.

b) in medium and long term by hybrids.

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