The winter oilseed rape restored hybrids : current state and prospects

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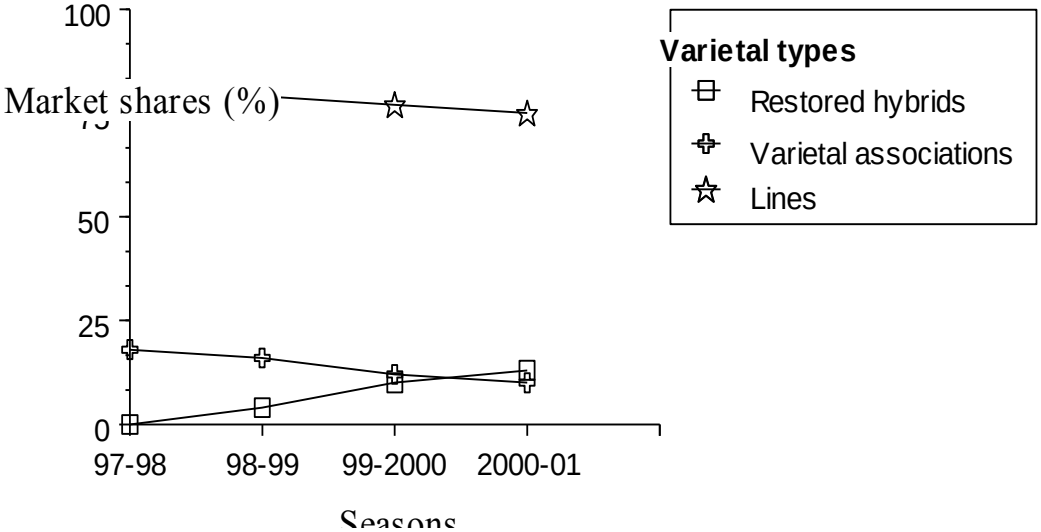
Since early nineties, the arrival of the first hybrid materials has contributed to diversify varietal offers in oilseed rape. Today, four varietal types are available : lines, varietal associations, mixed hybrids and restored hybrids.
SYNERGY, the first hybrid line composite available was registered in 1994.
The use of hybrids is particularly interesting because of the productivity increase in comparison to lines, which is linked to heterosis effects. The interest of restored hybrids in comparison with varietal associations lies in the fact that pollination security is identical to lines. Among the different hybridation systems which allow the development of restored hybrids, two found market outlets : the German hybridation system from the NPZ Lembke Company and the Ogu-INRA hybridation system.
Presently, four points have to be considered for the future use and development of restored hybrids in France : varietal offer and market shares, grain yield, logding risks and seed quality.

I. Market shares

The analysis of market shares for the different varietal types over the last four seasons in France (figure 1) shows that classical lines hold a majority of 77% of market shares.
Both varietal associations and restored hybrids account for about 25% of market shares today.
For the first time, this highlights that the restored hybrid market shares seem to exceed those reached by varietal associations.

Figure 1 : Market shares of the different varietal types in France.



In Europe, the situation is about the same, whereby classical lines represent 75% of market shares and hybrid types 15 to 25% of market shares. Concerning Europe's restored hybrids, the NPZ hybridation system is the main hybridation system in use.

Following their availability in 1996, the varietal offer for restored hybrids remains limited :

- PRONTO, which uses the NPZ hybridation system, was registered in 1996 in Germany and available in France in 1997,
- the second variety was ELITE, registered in Denmark and Italy in 1998.

Today, in France, the restored hybrids represent about ten varieties, that is to say 13% of the whole varietal offer. Among these varieties (table 1), three are NPZ restored hybrids : PRONTO, BANJO and TALENT. Six Ogu-INRA hybrids were registered in 2000, mainly on the Community Catalogue.

The first Ogu-INRA hybrids registered in France with a glucosinolate seed content below eighteen micromoles per gramme are LUTIN and EXTRA. LUTIN is a distinct semi-dwarf type.

Table 1 : Restored hybrids offer in France.

NPZ-Lembke	**Ogu-INRA**
PRONTO (Germany - 1996)	ELITE (Denmark, Italy - 1998)
BANJO (Denmark - 1996)	OLBEL (Italy - 1998)
TALENT (Austria - 1999)	LUTIN (France - 1999)
	BORNEO (UK - 2000)
	ELVIS (Italy - 2000)
	ESTEREL (Italy - 2000)
	EXPRIM (Denmark - 2000)
	EXTRA (France - 2000)
	ROYAL (UK - 2000)

There are, in fact, three reasons to explain the low registration rate in France :

- grain yield of restored hybrids is still insufficient compared to control varieties, which are leading lines,
- today, many hybrids, and in particular the NPZ hybrids, cannot access to the French Catalogue due to homogeneity problems for the parental lines,
- the Ogu-INRA restoration system has a very safe and convenient CMS. However, male fertility restoration is linked to a higher glucosinolate seed content ; hybrids developed with this system have a five to ten micromoles per gramme higher glucosinolate seed content compared to their parental lines.

Nevertheless, if the number of oilseed rape lines proposed for registration in France has remained around 70% over the last three years, a marked increase in restored hybrids has been recorded and today, this type represents 25 to 30% of the total number (table 2).

Table 2 : Evolution of the number of oilseed rape varieties proposed for registration in France.

	Total number	**Lines**	**Varietal associations**	**Mixed hybrids**	**Restored hybrids**
1996	43	33	8	1	2
1997	52	30	8	5	9
1998	57	43	7	1	6
1999	60	39	2	2	17
2000	55	39	2	0	14
2001	55	39	2	0	14

II. Grain yield

As far as grain yield is concerned, trial results show an improvement in restored hybrid performances : according to registration trials (table 3), after four years, the ratio of restored hybrids which are more productive than the control line Capitol has increased from about 20 to 70% over the two last years.
Concurrently, grain yield differences between the line Capitol and the restored hybrids are higher, up to 6 deciton per hectare.

Table 3 : Results of registration trials in France.

	Number of restored hybrids > Capitol	Grain yield difference (t/ha)
1997	1/6	+0.19
1998	1/6	+0.14
1999	13/18	+0.05 to +0.39
2000	11/15	+0.08 to +0.62

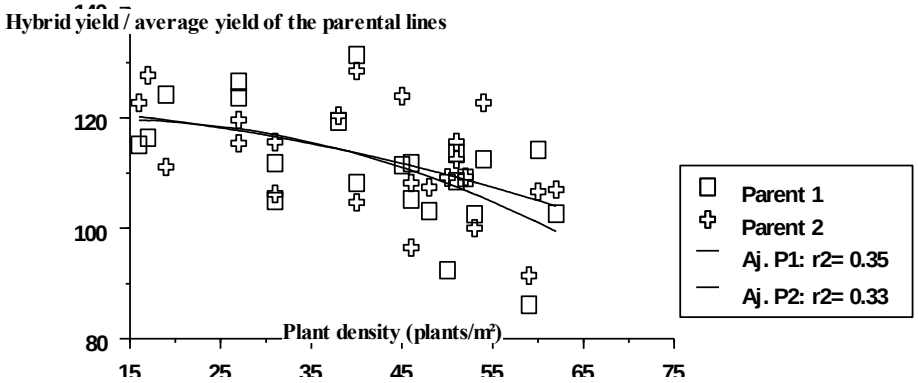
Likewise, the results of the restored hybrids from CETIOM network are encouraging (table 4) : if blackleg stem canker and lodging have decreased the performances of ELITE, the grain yield level of restored hybrids has been competitive with classical lines in many situations.

Table 4 : Average grain yield results of restored hybrids from the CETIOM post-registration network - (100=lines average grain yield).

	Restored hybrids	South	West	Center, East, North
97-98-99	PRONTO	104	107	103
1998	CCWH011	121	111	110
1999	ELITE	101	103	98
2000	EXTRA	109	105	111

In 1998, work on the Ogu-INRA restored hybrid CWH001 and its two parental lines showed that the ratio between hybrid yield and yield of the parental lines, that is to say the heterosis effect on grain yield, may be estimated at 120% (figure 2).

Figure 2 : Relation between plant density and heterosis effect on grain yield for the CCWH011 Ogu-INRA restored hybrid (1998).



Consequently, this heterosis effect leads to a more important vegetative development of the hybrid and, when plant density increases, the heterosis effect on yield is reduced. This reduction can be related to increased lodging risks of this hybrid compared to its parental lines.

II. Lodging risks

Concerning lodging risks, hybrid materials show a higher nitrogen absorption during autumn, with an increased plant height and an enhanced vigour ; conversly, in the spring, lodging susceptibility is increased.

To reduce these risks, several solutions need to be considered :

- as shown in the case of the CWH001 restored hybrid, a decrease in plant density at the end of winter may be beneficial. Other results seem to consolidate these findings, but work on cultural practices must be continued.
- hybrid materials presenting a lodging risk, it is important for farmers to take precautions regarding the use of regulators. The adjustement of regulators to conditions is necessary.
- Another solution is given by the arrival of semi-dwarf hybrid types. This feature is derived from a mutation ; dwarf lines are used as female parents and crossed with a male restorer line ; the hybrid obtained is semi-dwarf.

LUTIN is the first semi-dwarf restored hybrid available in Europe.
Last season's trials conducted in France according to farmers' practices and with larger plots than usual showed that, with 1.1 to 1.4 meter high, this varietal type showed an excellent lodging resistance, facilitating harvest and chemical treatments.
Furthermore, this hybrid is penalized by a low grain yield : about 15% lower than classical varieties in registration trials.
Nevertheless, this varietal type is a very interesting innovation. Several new semi-dwarf restored hybrids have been proposed for registration in France and experimentation must be continued.

III. Seed quality

NPZ restored hybrids generally produce seed glucosinolate contents which are among the lowest of winter oilseed rape varieties offered for sale. In the case of Ogu-INRA restored hybrids, one of the main difficulties is an increase in the glucosinolate level linked to fertility restoration. The first generations of Ogu-INRA restored hybrids registered on the Community Catalogue have contents varying between 20 to 25 micromoles per gramme. This problem could be solved by several breeders and two Ogu-INRA restored hybrids have already been registered in France with glucosinolate seed contents inferior to 16 micromoles per gramme.

In conclusion, all the results from different networks carried out in France or in Europe underlined a significant increase in grain yield productivity linked to hybrid utilization. Concerning restored hybrids, although holding a limited share of the present European market, several interesting prospects are in favour of this varietal type. These prospects meet farmer's expectations :

- for the last two years, an important increase in the number and yield performances of the restored hybrids proposed for registration has been recorded,
- restored hybrids with low glucosinolate seed content have already been obtained,
- work on cultural practices such as plant density are in progress,
- and semi-dwarf hybrids open up new possibilities.

Lastly, it is highly probable that additional increases in grain yield can be reached by working on parental line combination ability.