

BUL3*09

Winter rapeseed breeding.

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The main lines of research concern :

- the yield improvement with the creation of pure lines and the study of hybrid varieties ;
- the improvement of yield regularity, mainly by breeding disease-resistant lines ;
- the improvement of seed quality by breeding OO-varieties.

Such research programs are carried out in cooperation with private breeding stations (SERA-SEM), professional organizations (CETIOM) and research-workers from the different departments of INRA, CNRS and Universities.

1 — Yield improvement.

1. Creation of rapeseed pure lines.

These lines are bred and fixed by genealogical breeding or haplodiploidization (HD). Double haploids are obtained by anther culture applied to F1 or back cross progenies in creation schemes of OO-lines. Production of such doubled haploids has been improved by a better mastery of the colchicine doubling technique (utilization of P07 at 1 %), but it will only be really valorized when it can be applied to a scheme of recurrent selection aiming at improving a OO-population for all agronomic characteristics.

Presently, HD is being used for breeding addition lines in the progeny of interspecific crosses (*B. napus* × *B. nigra* × *Sinapis alba*), for the fixation of characters with simple determinism on male fertile or male sterile material, and also in a comparative program of breeding methods (single seed descent, genealogical selection and HD).

On the other hand, alloplasmic lines (cytoplasms from different species and fertile or sterile cybrids obtained by protoplast fusion) are being created to study the cytoplasmic effects on the agronomic and technological value of lines (Coll. G. PELLETIER and C. PRIMARD).

2. Creation of hybrid varieties.

Mr. LEFORT-BUSON's original studies gave us the possibility to apprehend heterosis in winter rapeseed : yield gain of 20 to 30 % in comparison with the best line, interest of European × Asiatic

combinations, relationship between heterosis and certain divergence indexes... Our main present objective consists in finding good hybrid combinations answering the quality requirements of the seed and needs of disease resistance, and above all in establishing a production system of hybrid seeds.

Different sources of genic sterility (TAKAGI, SCHANGHAI) are under study for the production of experimental hybrids and their utilizations in schemes of recurrent selection. But most sustained efforts bear on the research of an operational system of cytoplasmic male sterility (CMS). CMSs under study are of different origins :

— of *intraspecific origin* : CMSs obtained from crosses with BRONOWSKI or HOKURIKU. Breeding aims at obtaining male sterile lines, maintained by backcrosses, and protoplast fusions. The utilization of such systems depends on the stability of this male sterility and the percentage of cross fertilization which can be obtained in production devices of hybrid seeds, knowing that a certain amount of non hybrids could be accepted. The Polima system is also under study : stability and search for restorers.

— of *interspecific origin* : CMS discovered by ANAND in *B. juncea* (stability, search for restorers) and CMS obtained by DICKSON from the *B. nigra* × *B. oleracea* cross. The latter is stable, but often presents a reduction in female fertility. Selection consists in improving female fertility and obtaining maintainers due to the absence of maintainers for *nigra* sterility in *B. napus*.

— of *intergeneric origin* : (R. PELLAN-DE-LOURME) CMS *Diplotaxis muralis* (HINATA), for which 2 maintainers were bred, and CMS *Raphanus sativus* (OGURA). Radish-rape cybrids (G. PELLETIER and C. PRIMARD) form the subject of a selection for nectariferous secretions, a male fertile restoration and the improvement of female fertility in restored plants. All this material is also studied by electronic microscopy (Coll. J.P. GOURET) and from the cytoplasmic DNA point of view (Coll. F. VEDEL).

Production studies of hybrid seeds performed in cooperation with J. MESQUIDA are carried out on the cybrids of the OGURA system in relation

with the quantity of secreted nectar and the quality of sugars (Coll. M.H. PHAM-DELEGUE). The same plant material is also used to study 'mixed' varieties (mixture of x % of male sterile hybrids F1 and of $(1-x)$ % of pollinating lines) to estimate the valorization possibilities of this male sterile system without restoration because of presently encountered difficulties in obtaining restoring lines.

2. Improvement of yield regularity.

1. Disease Resistance (in cooperation with H. BRUN).

— *Rape Crown Canker (Phoma lingam)*: studies deal with the resistance variability at the adult stage under conditions of natural contamination and with the resistance improvement at the stage 'plantlet' from interspecific crosses with *B. nigra* and *B. juncea*. This material selected at the cotyledonary stage is being followed on the cytogenetic level (additive lines: A.M. CHEVRE and J. JAHIER) and will form the subject of biochemical studies (Coll. J.F. BOUSQUET).

— *Cylindrosporium concentricum*: An open field test under conditions of half-artificial conditions was perfected. It gives the possibility to study variability in rapeseed and to breed resistant OO-low lines.

— *Alternaria Black Spot (Alternaria brassicae)*: early tests and on spikes are being used to study variability in rapeseed and related species. The better behaviour of white mustards (*Sinapis alba*) led BRUTOR and CARINE (C. PRIMARD) to work on protoplast fusion. The progeny of these hybrids is being studied to create additive lines (A.M. CHEVRE) and for the resistance-transfer to rapeseed.

— *Sclerotinia Stem Rot (Sclerotinia sclerotiorum)*: Open field tests underlined the better behaviour of certain lines from Japan. Artificial contaminations (ascospores and mycelium) are applied to these lines to confirm this result, independently of the effect 'earliness'. Exploitation possibilities of this resistance will be apprehended by creating double haploids from crossing these parents and OO-low winter rapeseeds.

2. Triazine Resistance.

A back cross scheme was used to transfer triazine resistance from turnip to rapeseed. The obtained alloplasmic lines present a yield reduction of about 20 %. This material will form the subject of physiological studies (Coll. A.M. TRIBOI).

3. Lodging Resistance.

A dwarfing parent was obtained by chemical mutagenesis. The semi-dominant dwarf character was transferred to different lines. This material will be studied on the level of yield formation and nitrogen valorization.

4. Drought Resistance.

An original study is being carried out in cooperation with N. VARTANIAN. It concerns the genetic variability of resistance to a water stress in rapeseed and related species (production of short tuberous roots).

The variety behaviour is also observed towards resistance to *Heterodera schachtii* (Coll. A. CAUBEL), clubroot (G. THOMAS) and *Dalia brassicae*. (Coll. E. BRUNEL).

3. QUALITY IMPROVEMENT.

Important studies bear on the utilization of the near infrared reflection for the quantitative analysis of oil, proteins and above all glucosinolates in whole seeds. The quite encouraging results which have been obtained especially for glucosinolates with a network device demand confirmations on filter devices.

A new theme of research concerns the elaboration of analytical methods for choline esters and the study of genetic variability in *Brassicae* (Coll. F. LARHER).

But the main programme concerns the selection of OO-lines by genealogical selection and the conversion of highly yielding O-lines (for example, BIENVENU) in OO-form with glucosinolate contents lower than the future European norms (20 μ moles in the seed). Material from the 2nd and 3rd back-cross with BIENVENU is being selected for all the above mentioned agronomic characters, among which *Phoma lingam* and *Cylindrosporium*-resistance. Lines (B2Fx) which were multiplied in 1985-1986 are under study in the framework of multilocal experiments.