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► To cite this version:

Gérard Duc, Jean Picard, Joël Leguen, Pierre Berthelem. Note on the appearance of a new nucleocytoplasmic male sterility in *Vicia faba* after mutagenesis. *Agronomie*, 1985, 5 (9), pp.851-854. hal-00884821

HAL Id: hal-00884821

<https://hal.science/hal-00884821>

Submitted on 1 Jan 1985

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Note on the appearance of a new nucleocytoplasmic male sterility in *Vicia faba* after mutagenesis

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SUMMARY

A new cytoplasm appeared in a nucleo-cytoplasmic male sterile line of *Vicia faba* with the "447" cytoplasm after mutagenesis with EMS and ethidium bromide. This new cytoplasm behaved differently when crossed with genomes that maintain or restore the 447 male sterility. The new cytoplasm also displayed instability.

Additional key words : *Field bean, instability.*

RÉSUMÉ

Note sur l'obtention d'une nouvelle source de stérilité mâle nucléo-cytoplasmique chez Vicia faba après mutagenèse.

Après traitement mutagène au M.S.E. et bromure d'éthidium appliqué à une lignée mâle stérile cytoplasmique de *Vicia faba* à cytoplasme « 447 », un nouveau cytoplasme est apparu qui se comporte différemment par rapport aux génomes restaurateurs et mainteneurs de 447 et présente de l'instabilité.

Mots clés additionnels: *Féverole, instabilité.*

I. INTRODUCTION

Several authors have mentioned the occurrence of nucleo-cytoplasmic male sterility after mutagenic treatments :

Species	Mutagenic treatment	Authors
Barley	EMS, X rays	FAVRET & RYAN (1964)
Pearl Millet	Ethidium bromide, Streptomycin, Mitomycin	BURTON & HANNA (1976-1982)
Sorghum	Colchicine	ERICHSEN & ROSS (1963)
Sugar beet	γ -rays	KINOSHITA (1976)

Modifications of a given cytoplasm by mutagenesis also occurred when lines of maize with the Texas male sterile cytoplasm were treated with γ -rays and Ethyl Methane Sulfonate (EMS) (CORNU *et al.*, 1981). These modifications concerned reversions to fertility and dissociation of the characters of sterility and susceptibility to *Helminthosporium maydis* race T. These changes could be related to modifications of the mitochondrial DNA (BERVILLE & PAILLARD, 1982).

The 447 nucleo-cytoplasmic male sterility in *Vicia faba* was discovered by BOND *et al.* (1966). The instability of this character impaired its utilization for hybrid seed production. Seeking to modify this instability of male sterility, I.N.R.A. and the A.C.V.F. group used mutagenic treatments on the 447 cell lines.

II. MATERIAL AND METHODS

The mutagenic treatment was performed in 1978 at Dijon on a male sterile line carrying the 447 cytoplasm. This line, named Ad 23/447, was selected by P. BERTHELEM (I.N.R.A., Rennes). Seeds were soaked for 6 h in a solution of EMS 0.25 ‰ + Ethidium Bromide (EB) 0.05 ‰. Plants from these seeds were grown in rows in an isolated field plot with a restorer line sown in alternate rows. This restorer line named HG 115 (selected by P. BERTHELEM) carries the monogenic dominant factor controlling restoration of fertility.

Male sterility of the line Ad 23/447 was confirmed by visual observation of one flower per plant in the isolated plot. These male sterile plants were harvested individually and hybrid progenies were sown the following year in different A.C.V.F. and I.N.R.A. stations.

Some scarce non-restored male sterile plants were then backcrossed with Ad 23 and HG 115. Their sister fertile plants were harvested after open pollination.

III. RESULTS AND DISCUSSION

Among 16 000 hybrid plants studied, 100 expressed a good male sterile phenotype and were backcrossed by the restorer line HG 115. Sister plants of these male steriles were harvested after open pollination. In only one case after either controlled crosses or open pollination were male sterile plants observed in the next generation.

This case was analysed genetically (fig. 1). The male sterile character appeared to be maternally transmitted. Some wholly male sterile progenies were obtained either after crossing with HG 115 or Ad 23. However, in most cases, some male fertile plants were also observed in progenies. The following two features indicate that we obtained a new cytoplasm.

- 1. It reacted differently from the 447 cytoplasm with the restorer genotype HG 115 and also with the maintainer nucleus of 447 (table 1).
- 2. In the case of 447 cytoplasm, the reversion toward fertility resulting from instability or restoration was

TABLE 1
Results of F₁ crosses between male sterile plants carrying the "421" cytoplasm and maintainer lines of the "447" cytoplasm. Male fertile/Male sterile segregation in progenies are indicated.
Résultats de croisements F₁ de plantes mâle stériles à cytoplasme « 421 » par les lignées mainteneuses du cytoplasme « 447 ». Disjonctions mâle fertiles-mâle stériles.

"447" maintainer lines	Main percentage of fertile plants observed in F ₁ on the "447" cytoplasm	Number of plants in F ₁ progenies on the "421" cytoplasm of phenotype Male fertile/Male sterile	
Ad 23	0	0	11
		0	9
NY	0	14	4
		8	5
135	0	3	12
123	2	22	18
		6	23
241	10	2	18
		2	15
249	10	1	23
		1	20

permanent : no male sterile plants could be found in selfed progenies from these male fertile plants. In the case of this new cytoplasm, sterile plants could be found in the progenies from selfing.

This new cytoplasm was named 421. In common with the induced modification of the Texas cytoplasm reported by CORNU *et al.* (1981) it showed instability of the sterile character in progenies. This instability was

Figure 1
History of the 421 cytoplasm in Vicia faba. Male fertile-male sterile segregations in progenies.
Historique du cytoplasme 421 chez Vicia faba. Les disjonctions de

plantes mâle fertiles-mâle stériles dans les descendance sont indiquées. Il s'agit de descendance en fécondation libre, autofécondation ou croisement par un mainteneur de 447 (x Ad 23) ou restaurateur de 447 (x HG 115).

still noticed even after 4 generations of backcrossing (fig. 1). Instability could be explained by somatic segregation of some heterogeneity in the population of cytoplasmic organelles.

Future studies engaged by Dr BOUTRY in Louvain-la-Neuve (Belgium) will characterize the mitochondria in

the 421 cytoplasm. Up to now, no satisfactory restorer line of 421 is known and A.C.V.F. members are searching for them.

Reçu le 4 janvier 1985.

Accepté le 9 mai 1985.

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