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HYBRIDIZATION AND MALE STERILITY IN RICE

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In consideration of the good reulsts obtained with hybrid varieties for irrigated rice in China, the same breeding method should be experienced for other types of rice growing and for different regions. Cytoplasmic and nuclear new male sterile lines necessary for the commercial production of hybrid seeds and composite populations may be found in the progeny of hybrids between cultivated rice and African species of *Oryza*. The pollen fertility observation of hybrids could facilitate their identification.

INTRODUCTION

Rice breeding has been very successful during the last few decades and yields have been raised dramatically in many parts of the world. The most important step was the production and utilization of hybrid varieties in China for exploitation of heterosis on a large scale. Nevertheless, several problems must be solved for more extensive application of hybrid technology, e.g., small number and poor quality of male sterile and restorer lines and low efficiency of the available pollinators.

The most important challenge is probably the gaps persisting among different rice growing regions, cultural types, and farming methods. As Virmani *et al.* pointed out, the extra cost of hybrid seeds must be paid for by increased yield, but the extra economic gain is correlated with initial yield level.

The use of interspecific hybridization is very limited in rice compared with most other important crops. However, *Oryza glaberrima* and some African wild rice can be sources of important characters for the cultivated varieties like tolerance to disease and environmental stresses. Besides, they are potential source of male sterile cytoplasm, of sterility and restoration genes, and genes controlling the level of allogamy, which are necessary for the production of commercial hybrids.

Hybrid Sterility

Hybridization between *O. sativa* and related African species is not recent. *O. glaberrima* is the most frequently used species because of its broad genetic diversification stemming from its long history of domestication and cultivation in several parts of West Africa. *O. brathii* and *O. longistaminata* are less involved in crossing programs. The level and nature of pollen and seed sterlity chromosome pairing at meiosis and meiotic irregularities are rather similar in all these hybrids. The genomes of these cultivated and wild species are highly homologous and transfer of genes is thus possible among them through introgression. Several experiments have the possibility of recovering fertile lines after backcrossing.

The majority of the F_I hybrids between *O. sativa* and *O. longistaminata* are almost completely sterile when isolated from foreign pollinators and their own pollen is sterile at the flowering time. But the presence of fertile plants in the vicinity of the hybrids and artificial pollination by one of the parents lead to a variable levels of seed setting.

The factors responsible for sterility in these interspecific hybrids are certainly complex and probably similar to those acting in indica/japonica hybrids. Japanese researchers postulated a "one locus sporogametophytic interaction" model with two sterility genes (Sano *et al.*, 1974) Sano(1983) proposed a third locus S_3 affecting pollen differentiation in heterozygous plants, but without influence on megaspore evolution, in order to explain the male sterility of a hybrid between *O. sativa* and *O. longistaminata*. Nevertheless, it seems difficult to present a general mechanism for all the observed cases, cytoplasmic factors are obviously involved, since large differences have been observed between reciprocal hybrids(Bouhermont *et al.* ,1985).

Utilization of Male Sterility

The frequent sources of male sterile lines in rice are hybrids between different species or unrelated varieties belonging to the species. In rice, the male sterility has been obtained in japonica/indica hybrids after hybridization between cultivated and wild rice (*O. spontanea*) and in *O. longistaminata*. Some of these male sterile lines have nuclear controls, in the others, sterile cytoplasm is also involved. Both types have or could have important application in rice breeding.

In China, cytoplasmic male sterility was used for rice growing quickly after the discovery of the first sterile lines in 1970 and of good restorer genes in 1973. Since 1978 about 6 million ha of hybrid rice have been planted, giving 20-30% yield increase (Lin *et al.*, 1980). Other male sterile cytoplasm and restorer genes have been isolated In several countries. These lines exhibit differences in agronomic characteristics and in the manifestation of sterility (Yong, 1983). Some of them produce viable pollen grains at high temperatures. Some characters could be modified by introgression from other varieties but identification of new sterile cytoplasm should certainly be very useful, particularly for other tropical regions and for dry land rice. In the present finding cross V20 x IR36 was found best restorer lines which can be used for hybrid. rice production. (Table-1).

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Nuclear male sterility has been observed in the progeny of several hybrids. These lines are not useful for the commercial production of hybrid seeds and have no application yet in rice breeding. Nevertheless, the presence of some of them in a mixture of varieties could increase the frequency of recombination between them and lead to the utilization of composite population (Rutger *et al.,* 1980).While pure lines and F_1 hybrids between homozygous parents are desirable in many regions, their low flexIbility is a limiting factor on small farms particularly in Africa, where water control in the fields is rarely possible. Further, environmental conditions widely differ according to the seasons and from place to place.

CONCLUSION

Identification of new male sterile lines of rice is an important goal for several reasons. A broader diversity of the cytoplasm and genotype is necessary for the utilization of F_1 varieties in various countries and for different types of rice growing. In addition to cytoplasmic types, nuclear male sterility could have application under some conditions. On the other hand, the expression of cytoplasmic male sterility is variable, as in other crops, the male sterility of some lines of rice is due to indehiscent anther or is temperature dependent. These types would be useful, because they can be maintained through self-pollination.

Hybrids between *O. sativa* and African species of *Oryza* are potential source of new cytoplasmic and nuclear male sterility.

On the other hand, some of the hybrids, namely those involving *O. longistiminata* can be further used to increase the allogamy of varieties selected for the production of hybrid seeds or composite populations.

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TABLE-1: Data on pollen fertility percentage in F_1 hybrids and their male parents.

1.	V20 x Jaya	51
	Jaya	84
2.	V20 x IR36	87
	IR36	82
3.	V20 x IR34	62
	IR34	80
4.	V20 x IET 7256	76
	IET 7256	72
5.	Z97 A x Kiran	76
	Kiran	75
6.	Z97 A x Ratna	44
	Ratna	74
7.	Z97 A x BIET 45C	44
	BIET 45C	70
8.	V20A x IR20	19
	IR20	69
9.	*O. longistaminata* x Jagannath	01
	Jagannath	88
10.	*O. longistaminata* x BR8	01
	BR8	82