

# Germplasm improvement

## Genetic resources



### International testing of rice hybrids for yield and adaptability by INGER: prospects and problems

R. C. Chaudhary and S. S. Virmani, IRRI

Because of the potential of hybrid rice and its commercial success in China, many countries in Asia, Africa, Latin America, and the Caribbean showed a keen interest in developing and using this technology. The first International Hybrid Rice Observational Nursery (IRHON) was put together in 1994 with 44 hybrids (H), 36 restorers (R), and 5 maintainers (B) developed at IRRI. This nursery was evaluated in Bangladesh (Gazipur), China (Changsha, Hangzhou), India (Coimbatore, Faizabad, Hyderabad, Kapurthala, Karnal, Mandya, Maruteru, Pantnagar), Myanmar (Yangon, Yezin), the Philippines (Los Baños, Maligaya), and Sri Lanka (Batalagoda). A number of hybrids that

could be adapted in most of these countries were identified. Hybrids IR67693H, IR69672H, IR69684H, IR69686H, and IR69689H were identified as superior and widely adapted. In the second IRHON conducted at 29 locations in 13 countries, 33 hybrids, 3 B lines, and 25 R lines developed in IRRI, China, India, and Myanmar were tested. Hybrids IR67693H, IR64616H, IR68284H, IR68877H, IR69679H, and IR70402H were identified as superior. In the third IRHON, three hybrids from a private company were also included. This nursery is now undergoing testing at 45 locations in 16 countries in Asia, Africa, and Latin America.

Superior hybrids in earlier tests produced up to 3 t ha<sup>-1</sup> more grain than the best locally adapted check varieties. Genotype  $\times$  environment ( $G \times E$ ) interaction analysis and superiority analysis helped identify the stability of the hybrids and forecast their adaptability

to untested locations. The  $G \times E$  analyses did not show a wider adaptability of the hybrids when compared with their parents or checks. INGER, through its global access to hybrids, some parental material, and test sites, can support the testing and use of hybrids and available parents in interested national agricultural systems. INGER can thus help realize the dream of interdependence, exchange, reciprocity, and sharing in a network where no country is too poor to give and no country is too rich to receive. But reservations of some breeders in sharing parental lines and seedborne problems like kernel smut (*Tilletia*) and nematodes impose restrictions. The cost of testing, breeders' rights, and intellectual property rights are some problems that still loom over the scientific community. All these problems could affect the evaluation of hybrids through the INGER mechanism. ■



### Screening rice hybrids for quality traits

N. S. Rani, M. I. Ahmed, and B. Krishnaveni, Directorate of Rice Research, Rajendranagar, Hyderabad 500030, India

In rice hybrids, characters such as lemma and palea, seed size and shape, and pericarp color do not segregate because they are inherited through maternal tissue. Endosperm translucency, chalkiness, and cooking and eating quality traits generally show genetic segregation. Rice is the only cereal consumed as unprocessed whole grain and consumers value specific appearance, taste, and cooking quality traits. Therefore, the effect of heterozygosity of  $F_1$  hybrids on grain quality is more important.

We evaluated 27 hybrids in two replications for 13 physicochemical

characteristics in the 1995 wet season harvest and using standard procedures, including physical parameters such as grain shape and size, endosperm appearance, milling, and head rice recovery (HR%). Among cooking and eating quality traits, we studied amylose content (AC%), gelatinization temperature (GT), water uptake (WU), volume expansion ratio (VER), kernel length after cooking (KLAC), and elongation ratio (ER).

Of the 27 hybrids tested, 17 belonged to long slender, 4 to long bold, 5 to medium slender, and 1 to short bold grain type. Four hybrids—URH1, IR58025A / IR54742, IR58025A / IR34686, and IR58025A / IR32809—possessed extra long grains. Except for URH1, the other three hybrids showed intermediate AC (23.6 and 25.4%). IR58025A / IR34686 exhibited a high VER (5.3). Six hybrids—IR58025A /

IR29723, 3RI-086, MTURH2020, 2RI 158, MTURH2015, and MPH517—recorded a high HR (ranging from 60.3 to 63.9%).

Eleven hybrids were in the most desirable AC range (20–25%) preferred in the Indian subcontinent. IR58025A / IR48751 and IR58025A / IR21567 had typical intermediate AC values (24.9 and 23.3%) with long slender and attractive translucent grains. Other hybrids that possessed an intermediate AC and long slender grains, but with occasional chalkiness, were PA112, HKRH1002, and IR58025A / IR48749.

Hybrids MPH517, 3RI 160, and PMS10A / IR48725 possessed endosperm translucency and high HR. Hybrids with desirable starch properties (intermediate AC) and translucent grains with moderate HR were IR58025A / IR29723, IR58025A / IR34686, IR58025A / IR55838, and

IR58025A / IR21567. But the last two hybrids also possess long slender and attractive grains, moderate HR, and a high VER, a good combination of quality traits. ■



### Studying comparative suitability of CMS lines

M. I. Ahmed, S. Singh, B. C. Viraktamath, M. S. Ramesha, and C. H. M. Vijayakumar, Directorate of Rice Research, Rajendranagar, Hyderabad 500030, India

Parental lines constitute the first and foremost step in a hybrid breeding program. In this context, developing a commercially viable cytoplasmic male sterile (CMS) line is considered to be a highly cumbersome process. In fact, the belated success of hybrid rice technology in India was basically due to the nonavailability of a CMS line suited to the tropics. Over the years, a large number of male sterile lines with different cytotertility sources have been developed in India and elsewhere. Only a few—such as IR58025A and IR62829A—are now used commercially in India. They possess all the essential traits—complete and stable male sterility, high outcrossing rate, better grain quality, easy restorability, good combining ability, and adaptability—of a commercially viable CMS line. Some 64 CMS lines from India, China, Malaysia, and IRRI were evaluated along with IR58025A, IR62829A, and standard checks in the wet season of 1995 and 1996 and dry season of 1994 and 1995 to assess their comparative suitability for commercial use. The CMS lines, along with their corresponding maintainers, were grown for maintenance and evaluation for their floral traits such as pollen sterility, panicle and stigma exertion, outcrossing rate, duration and angle of glume opening, growth duration, number of effective tillers, spikelets panicle<sup>-1</sup>, grain type, adaptability, and pigmentation (if any). Each CMS line was characterized for all the traits individually. The final value was

obtained by adding together the weighted score allotted to a CMS line for all these traits. This single final value on a 1 to 9 scale indicated the line's practical utility.

Only 11 lines were found to be equally better for all the characters studied than IR58025A and IR62829A: four CMS lines (IR68280A, IR68897A, IR68899A, and IR69628A) from IRRI, two (DRR2A and DRR3A) from the Directorate of Rice Research, and one each from China (9601A), Malaysia (MH-841A), IARI (Pusa 5A), Cuttack (CRMS 31A), and Faizabad (NDCMS 7A). Some of the promising CMS lines were IR67684A, IR68890A, IR68902A, IR68279A, IR68895A, and CRMS 6A. About 31 lines possess one or two good characters and can be used for specific purposes. All Chinese lines, for example, are useful as cytotertility sources to convert promising maintainers into new CMS lines. The remaining 16 lines have one or more drawbacks and will need further improvement. The promising CMS lines are now being studied for their combining ability and use in breeding programs. ■



### Identifying a new long-duration CMS line (APMS 5A) for coastal regions

R. V. Kumar, P. V. Satyanarayana, and M. S. Rao, Andhra Pradesh Agricultural University, Agricultural Research Station, Maruteru 534122, India

Several male sterile lines developed in India belong to the early- to medium-duration group. Hybrids developed using these male sterile lines are also of early to medium growth duration. These hybrids are not suitable for cultivation during the wet season, particularly in the coastal areas of Andhra Pradesh, where long-duration varieties are predominantly grown. We need to develop long-duration rice hybrids to increase rice productivity and fit them into the cropping system. An effort was made to develop long-duration (145-150 d) and stable local

cytoplasmic male sterile (CMS) lines. Several testcrosses were made using local long-duration elite lines and IRRI CMS lines to screen the elite varieties for their maintaining or restoring ability. A few long-duration maintainer lines were identified based on pollen and spikelet sterility. MTU4870 was therefore selected and successfully converted into a local cytotestile line in the background of a wild abortive source of cytoplasm through the backcross breeding technique. This line was designated as APMS5A.

APMS5A is a long-duration (145-150 d) line with tolerance for brown planthopper, bacterial leaf blight, rice tungro virus, and sheath blight. It also possesses a sturdy culm. It has a comparable angle of spikelet opening duration (190 min), angle of spikelet opening (31°C), stigma exertion, and natural outcrossing potential (12%) with the popular CMS line IR58025A. APMS5A, a 100% sterile line, is the first long-duration CMS line developed in India with desirable floral and agronomic traits. A few effective restorers were also identified. APMS5A will facilitate the development of long-duration rice hybrids suitable for cultivation in the coastal areas. ■



### Wide hybridization for diversification of CMS in rice

N. T. Hoan, N. P. Sarma, and E. A. Siddiq, Directorate of Rice Research, Rajendranagar, Hyderabad 500030, India

To identify new sources of male sterility-inducing cytoplasm within the A genome of genus *Oryza*, 132 interspecific crosses involving accessions of four wild (*O. rufipogon*, *O. nivara*, *O. barthii*, and *O. longistaminata*) and two cultivated species (*O. sativa* and *O. glaberrima*) were effected. Accessions possessing sterility-inducing cytoplasm were identified following reciprocal and F<sub>2</sub> backcross methods and advanced through substitution backcrossing to develop cytoplasmic