Philippine Rice R&D Highlights 2013

SEED TECHNOLOGY DIVISION

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SEED TECHNOLOGY DIVISION

Division Head: SR Brena

Executive Summary

Three projects were implemented by the Seed Technology Division in 2013. These projects were: 1) Seed Quality Assurance in PhilRice Seed Stock, 2) Development/Improvement of postharvest technologies for commercial seed production, and 3) Hybrid Basic Seed Production Research. Project1 consisted of 3 studies which mainly focused on field inspection of seed production areas, viability and seed vigor testing, and purity testing. Production in-charge of the field inspected was instructed to remove off-types. Stored hybrid parental lines and carry over-seed lots of TGMS hybrids were tested for viability and vigor before they were distributed. All seed lots with low germination results were set aside for commercial purposes.

The use of hermetic storage in the form of `Saklob' proved effective in maintaining seed quality than ordinary sack. Seeds of pollen parent, TG101M harvested in DS 2013 were stored in 5 kg laminated plastic sack and then piled in one ton capacity saklob. Control samples were stored in ordinary sack. The study was done to evaluate if parental lines of hybrid such as TG101M which commands high price can be safely stored in Saklob for one year under ordinary warehouse condition with minimal decline in seed quality. Hermetic storage using locally fabricated `Saklob' of TG101M resulted in higher seed viability and seed vigor than those kept in laminated sack after 7 months of storage in ordinary warehouse. Aside from high seed viability and vigor, population of storage insect pest in TG101M kept in `Saklob' was lower than those in laminated sacks. Likewise, percentage damaged seeds was also lower when parental lines were stored in Saklob. Mechanized harvesting using combine harvester of TG101M has higher viability and seed vigor. The speed or the revolution of the drum using axial flow thresher might have caused the decline in viability and vigor of the seeds. Based on the results obtained, harvesting of pollen parent of Mestiso 19 using combine was better than manual harvesting.

The last project on hybrid basic seed research focused on paired crossing, pollen evaluation, breeder seed production, genetic purity of the parental and the hybrids produced at PhilRice. The studies in the project gave attention on the breeder seed (BS) production of parental lines which is basically done in Tublay, Benguet. These BS are stored in cold room and become the main source of seed for foundation seed production in much lower elevation such as Carranglan, Nueva Ecija, Bukidnon, don Salvador Benedicto, Majayjay, Laguna, and Lucban, Quezon. Seed quality assurance of parental lines produced was verified through grow -out test (GOT).

Parental lines with 97% or higher genetic purity were always safe to be distributed. Minimal off-types will be observed in the field.

I. Seed Quality Assurance in PhilRice Seed Stock

Project Leader: SR Brena

Crop productivity is always anchored on high quality seed. All government programs aiming to attain rice self-sufficiency will be successful if the seeds disseminated for planting by farmers have high physical and genetic purity. The projects aim to develop a system of seed inspection that will ensure purity and high quality of seeds produced in all PhilRice stations.

Internal field inspection of seed production areas

SR Brena and JM Manangkil

Field inspection of PhilRice CES production areas was conducted in DS 2013. For further assessment of the purity of the inbred produced during the season, grow–out test was made in WS 2013. Thirteen inbred varieties produced in DS 2013 at PhilRice CES and two hybrid entries (one parental line and one hybrid) were tested for purity using grow-out test (GOT). The field where the varieties were planted was inspected in DS 2013. The varieties tested either passed seed certification or downgraded to a lower seed class. GOT was laid in RCBD with three replications. Five hundred plants were planted in each replicate. Purity was determined during crop growth.

Highlights:

- Genetic purity of the 13 varieties tested ranged from 96.3 to 99.9% with PSB Rc10 obtaining the lowest purity and NSIC Rc216, Rc152, Rc300 and TG101M obtaining 99.9% purity.

- NSIC Rc202H (Mestiso 19) was produced by one cooperator in Davao Oriental while TG101M was produced in CES.

Table 1. Purity of inbreds, hybrid parental line, and F1 seeds evaluated in Grow-Out Test, 2013 WS.

Variety	Seed Class	% Purity
1. NSIC Rc216	FS	99.9
2. NSIC Rc152	FS	99.9
3. NSIC Rc300	FS	99.9
4. TG101M	FS	99.9
5. NSIC Rc292	FS	99.8
6. NSIC Rc224	FS	99.8
7. NSIC Rc122	FS	99.7
8. NSIC Rc298	FS	99.7
9. Mestiso 19	F1	99.6
10. NSIC Rc302	FS	99.4
11. NSIC Rc238	FS	99.3
12. NSIC Rc302	RS	99.2
13. NSIC Rc23	FS	98.6
14. PSB Rc10	FS	96.3

Seed purity and seed viability testing of seed stock
SR Brena and JM Manangkil

Parental lines of TGMS hybrids, F1 hybrids, and inbred varieties in storage were tested for seed viability following the ISTA procedures. The test was conducted to ensure disposal of only high quality parental seeds to hybrid cooperators, seed growers, and farmers. Four hundred seeds per entry were randomly counted then divided into four sets of 100 seeds. Each set was placed on top of moist filter paper and another set was placed on top of the seeds, rolled, placed in plastic trays. Trays were enclosed to avoid drying of the samples. Counting of germinated seeds was done 7 days after seeding.

Likewise, dormancy duration in PRUPTG101M and 23 irrigated lowland varieties was determined. Selected panicles were gathered, hand-threshed, then germinated immediately. Moisture content (MC) was also monitored after threshing. Remaining samples were sun-dried until they reached the 13% MC. Samples were kept inside big plastic containers and were tested for germination bi-weekly until 90% or higher germination is achieved.

Highlights:

- 119 bags of PRUP TG101 from PhilRice Negros tested for viability in March 2013 have 95% seed viability. The S-lines

were all distributed for planting by PhilRice hybrid seed contractors.

- 62 bags of PRUPTG102 (S-lines of Mestiso 20) stored in CLSU cold storage room have 96% seed viability as tested last April 2013. These parental lines were produced at PhilRice Isabela in 2011 WS then stored in a cold storage room in February 2012.

- Another batch of 26 bags PRUPTG102 from PhilRice Isabela stored in CLSU cold storage room have 97% seed viability as tested last September 2013.

- 220 bags PRUPTG101 produced in PhilRice Isabela in DS 2013 transported to PhilRice-CES in November 2013. Bag-to-bag testing was done with average seed viability of 95%.

- 91 bags of PRUPTG102 from PhilRice-Negros produced in WS 2013 then transported to PhilRice-CES for distribution to hybrid cooperators in Mindanao for DS 2014 cropping had 88% seed viability.

- Fourteen seed lots of PRUTG102 produced in PhilRice-CMU consisting of 220 bags had 94% seed viability.

- 2451 bags of F1 hybrids tested for seed viability resulted in mixed quality seeds. 103 bags Mestiso 20 from Negros tested for seed viability in February had 96% seed viability. Another 104 bags Mestiso 19 had 93% viability during the test conducted in March 2013. The rest of the F1 hybrid tested had lower than 90% viability.

- 59 varieties of breeder seeds (BS) produced in DS 2012 equivalent to 4,910kg were tested for seed viability in February and March 2013. Nine varieties, PSB Rc4, NSIC Rc146, Rc184, Rc214, Rc130, Rc278, Rc15, Rc19 and Rc23 had low percentage seed viability. All other varieties had more than 85% seed viability. With the data obtained, production of BS can be done in the dry season only since quality can be maintained during storage.

- A total of 53 bags in 36 FS produced in WS 2012 were tested in January 2013. The average seed viability obtained was 96%.

- 997 bags from 38 RS varieties produced in WS 2013 had 88 to 98% seed viability except for the following varieties: NSIC Rc122, Rc276 and Rc278 with 84, 52, and 53% viability, respectively.

- FS carry over seed lots of DS 2012 tested in March and April 2013 consisting of 696 bags in 10 varieties had average seed viability of 91%. These non-moving seed stocks were newly released rainfed and saline varieties such as NSIC Rc272, Rc286 and Rc292.

- Eight RS varieties consisting of 306 bags produced in DS 2012 were tested for seed viability in April 2013 with average seed viability of 94%.

- 100 bags of NSIC Rc192 produced in DS 2012 downgraded to CS had 96% viability in April 2013.

- Dormancy was released in 11 varieties 28 days after harvest. The varieties were NSIC Rc170, Rc148, Rc118, Rc226, Rc302, Rc300, Rc160, Rc138, Rc122, Rc152, and PSB Rc18. Fifteen varieties required 42 days to attain 90% germination. There were 6 varieties that completely released dormancy after 56 days. These were IR60, PSB Rc80, NSIC Rc142, 140, 128, and 218.

- Among the varieties that required only 28 days to release dormancy, NSIC Rc170 exhibited 67% germination immediately after threshing. This variety has very short dormancy duration.

- Dormancy release in TG101M (pollen parent of Mestiso 19) was observed 35 days from harvest with 99% average germination.

Seed vigor testing of buffer stocks and carry-over seed lots
SR Brena and JM Manangkil

Aside from the regular seed viability testing, seed vigor test was made to assess effectively the most likely field performance of a variety. The test was done using accelerated ageing test. Four replicate samples per variety tested were subjected to 410C chamber for three days. Seeds were placed on top of fine mesh cloth attached to a circular PVC pipes. The mesh cloth containing seeds were placed on top of circular chicken wire inside a wide-mouthed plastic bottle half-full of water. The bottle is enclosed tightly. After ageing the seeds, seeds were germinated using filter paper and the procedure for seed viability was strictly followed. Varieties with high viability and high vigor results were considered high quality seeds.

Highlights:

- 119 bags of PRUP TG101 from PhilRice Negros tested for viability in March 2013 had 95% seed vigor.
- 62 bags PRUPTG102 stored in CLSU cold room had 94% seed vigor. With 96 and 94% seed viability and vigor of this parental line, the seeds had a better chance of survival when planted in the field.
- 26 remaining bags of PRUPTG102 tested in September had 97% seed vigor.
- Seed vigor of PRUPTG101 produced in Isabela in DS 2013 was 94%. These seeds were kept in Isabela warehouse from April to October and were transported to PhilRice CES in November.
- 14 seed lots of PRUPTG102 produced in PhilRice CMU in WS 2013 resulted in low seed vigor despite the high seed viability noted. The average seed vigor was only 80%. These seed lots were already disposed for 2014 DS cropping.
- Seed vigor of 103 bags NSIC Rc204H from PhilRice Negros was 95%. Since both viability and vigor test results were high, these were considered high quality seeds.
- 104 bags of NSIC Rc202H from PhilRice Negros tested in March 2013 resulted in 95% seed vigor.
- For inbred varieties tested, high seed viability obtained corresponded with high seed vigor also.

II. Development/Improvement of Postharvest Technologies for Commercial Seed Production

Project Leader: SR Brena

This project specifically aims to develop effective seed treatment protocols that will reduce storage insect damage as well as to assess quality of mechanically harvested seeds after drying and during storage

Reducing storage insect pest damaged through the use of appropriate seed storage treatment

SR Brena and JM Manangkil

The study was done to evaluate if parental lines of hybrid such as TG101M (pollen parent of Mestiso 19) can be safely stored with minimal decline in seed quality in a locally fabricated hermetic storage or Saklob for one year compared to storage under ordinary warehouse conditions.

The 1ha TG101M, or the P-lines (male parent), of Mestiso 19 was planted in DS 2013. The field was properly maintained and proper rouging was employed. Produce from three individual paddies were set aside for storage studies. Around 600 bags (1 bag= 5kg) were stored in 3 units of Saklob, each packed with 200 bags parental lines. Each Saklob unit served as a replicate. Control samples were packed in laminated 5kg-capacity bags enclosed in 50kg bag per replicate. Prior to storage, initial seed viability, vigor, moisture content, storage insect pest damage and insect pest population was determined. The same parameters were evaluated bi-monthly.

Highlights:

- Hermetic storage using locally fabricated `Saklob' of TG101M resulted in 97% both in seed viability and seed vigor than those kept in laminated sack after 7 months of storage in ordinary warehouse which obtained 92% and 94%, respectively. Moisture content remained in safe levels in both treatments.

- Other than high seed viability and vigor, the number of storage insect pests in TG101M kept in `Saklob' was lower at 28 compared to 91 found in laminated sacks. Percentage damaged seeds was also lower when parental lines were stored in Saklob.

Postharvest mechanization and its effect on seed quality
SR Brena

The 1ha TG101M planted in DS 2013 occupied three big paddies. During harvest, each paddy was divided into two. Half was harvested using rice combine harvester and the other half was harvested manually. There were replications per treatment used in the study. The use of combine offers lesser handling than manual harvesting. Moreover, manual harvesting requires more labor in hauling the harvested plants for threshing using axial flow thresher.

The three border rows of TG101M per paddy were not included in the study. Instead, they were set aside for preliminary evaluation of seed quality when threshing was delayed by at least two days. Half of all border rows per paddy not included in the mechanization study was divided into two lots. The first lot was cut, threshed and dried within the day and the other half was gathered, placed on top of nylon net and allowed to remain in the field for two days before threshing.

Parameters gathered were initial seed viability (measured after 1 month due to seed dormancy issue); seed vigor, evaluated using accelerated ageing test; moisture content using a digital moisture meter, and seed health using blotter test. Destructive bi-monthly sampling was made to evaluate all the parameters.

Highlights:

- Harvesting of TG101M using a rice combine harvested resulted in seed viability of 97% and seed vigor of 95% compared to harvesting manually which had only 92% and 94%, respectively

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- Delayed threshing for at least two days greatly affected seed quality. After 7 days of storage in warehouse, TG101M threshed and dried immediately after harvesting had 97% seed viability and seed vigor while those whose threshing was delayed by two days had 90% and 94% seed viability and vigor, respectively.

- The occurrence of storage fungus Aspergillus flavus was influenced by the delayed operation in threshing. On the fifth month of storage, 1.5% occurrence of the fungus was observed in samples cut, threshed, and dried within the day. Delaying threshing by two days showed higher occurrence noted at 7.3%.

- The same pattern was noted on the seventh month.

III. Hybrid Basic Seed Production Research

Project Leader: SR Brena

The success and widespread adoption of hybrid rice technology besides other factors depends on the production and timely supply of genetically pure seeds to farmers. Sale and distribution of genetically pure and good quality seed will allow complete heterotic expression of hybrids in rice (Tamilkumar P., et. al., 2009). In any one particular hybrid based on cytoplasmic male sterility system (CMS), seeds of four genotypes, A-, B- and R- lines and the F1 hybrid have to be multiplied and kept pure.

The availability of genetically pure and good quality seed is a primary requirement for exploiting the full potential of hybrids. Lack of purity in parental lines and improper isolation conditions in seed production are the major causes of poor hybrid seed quality. The parental lines could get contaminated and deteriorate during the process of handling by foundation seed growers.

Relationship between pollen fertility and seed set in commercially used CMS and TGMS lines

GT Sulte, LV Guittap, TM Masajo, SH Escamos, JL Lales, and FM Xie

The presence of fertile pollen among A-line (CMS) and S-line (TGMS) is a major factor affecting the seed purity and quality in F1 commercial seed production. This could result to selfed seeds and subsequently plants that are difficult to distinguish and are unavoidably harvested. The quality of purity of the hybrid seeds will be compromised once this happens. Even though they can be monitored through laboratory pollen evaluation, it is not practical in actual large scale F1 seed production to conduct such test on individual plants.

Recently, a protocol in TGMS F1 seed production has been released that included the establishment of control plots within or in the immediate vicinity of the production area. This will measure the effect of environment on seed set, if in fact there is, and its eventual effect on the purity of the F1 seed produced. F1 seed production protocol for CMS-based hybrids does not provide for the establishment of such control plots.

The relationship between pollen fertility and seed set in male sterile lines has not been fully studied, though, in a preliminary research at Los Baños, relationship between pollen fertility/sterility and amount of selfed seeds has been observed on two commercial CMS lines. Quantifying this relationship will be very helpful in monitoring the seed purity and quality of commercial hybrid seeds. For the TGMS lines, the information will be useful in determining the proper planting time in order to determine the optimum

temperature threshold for sterility to ensure true hybridity in the F1 seed produced.

The study has the following objectives: 1) to determine the relationship of pollen fertility to seed set in commercially used CMS and TGMS lines; 2) to know the breeding behavior of plants raised from supposedly selfed seeds of commercial CMS; and 3) to determine the proper planting time for establishing SxP to ensure hybridity in TGMS two-line hybrids.

Highlights:

- Individuals in CMS lines that set seeds in 2012 wet season or season 2 (S2) samples were recorded and the seeds were planted in 2013 dry season (Season 3 or S3) to observe their sterility behavior. For the S3, trend on selfing on plants with different pollen sterility category was observed only IR58025A since selfed seeds on other CMS lines at S3 were harvested only on plants that are completely sterile.

    - IR58025A – In this CMS line, percentage of plants raised from seeds of plants that were classified as completely sterile in S1 (those exhibiting selfing) was 0 %, 5% on those classified as sterile, and 3% on those under partially sterile category. Trend showed that rate selfing of the A-line plants increases as sterility decreases from completely sterile to partially sterile. Only one or two seeds developed from the plants expressed selfing.

    - IR68897A - Percentage of plants with selfed seeds raised from individuals classified as completely sterile in S1 was 0%. It means that after season 3 the A-line plants with selfed seed in S1 were unable to produce selfed seeds in S3.

    - IR73328A - No selfing was noted on plants raised from selfed seeds in season 2 (S2).

    - Handling of plants and recording of data on sterile individuals will follow the pedigree system.

- Bi-monthly planting of the TGMS lines was done at Los Baños (an MSE site) and data on days to heading, pollen fertility, seed set, and daily minimum – maximum temperature were

recorded. Results showed that for PRUP TG101 (S-line of Mestiso 19) and PRUP TG102 (S-line of Mestiso 20), seeding for SxP seed production from October to January should be avoided since it will coincide with low temperature (Los Banos condition). The chance of selfing is much higher if crop establishment is done during the period. The critical stage or sensitive phase of panicle development if planted within the period will most likely coincide with the cooler months of the year.

- From the weather data gathered so far, mean minimum temperature during SxP production of Mestiso 19 and Mestiso 20 should not fall below 24°C from panicle initiation to two to three weeks thereafter and average daily temperature should be 27°C above.

- In December, 2013 bi-monthly planting of the TGMS-lines ended and the consolidation of data is on-going to widen the information that will clearly explain the relationship of pollen sterility to seed set in commercially CMS and TGMS lines. Table 2 shows the summary of the activity conducted from 2011 to 2013.

Alternative mating system in the production of nucleus seeds in the three-line hybrids

GT Sulte, LV Guittap, and TM Masajo

In the Philippines, five classes of seed, produced in a step-wise manner, are generally recognized: nucleus, breeder, foundation, registered, and F1 commercial seed. The basic or purest of the seeds, which are the nucleus and breeder seeds of the A-, B-, and R-lines, are produced by plant breeders who are responsible for the maintenance of the genetic purity. To produce nucleus seeds, breeders carefully select and examine individual plants and make crosses painstakingly by hand to make sure that the genetic identity of the parental lines is maintained (Masajo, 2007). Part of the hand crossed seeds is sown the following season to establish the evaluation nursery and select the best pairs that produce typical, uniform and stable progeny. Remaining part of the paired cross seeds will be used to establish the seed increase nursery. Based on the observations made in the evaluation nursery, corresponding A and B pairs in the seed increase nursery that passed the standards will be harvested as nucleus seeds. Maintenance and evaluation of cytoplasmic male sterile lines and their maintainers is essential in implementing the hybrid rice breeding program based on CMS system (Virmani, etal. 1997).

Therefore, it is necessary to produce pure nucleus and breeder seed of parental lines. However, though this step is essential in ensuring purity and maintaining genetic identity of the hybrid parentals, it is costly and time-consuming. Thus, there is a need to develop other means to lessen the frequency of conducting paired crosses while keeping the purity of the CMS and maintainer lines of three-line hybrids.

A study was initiated to further look into the effectiveness of having control only of individual female parents (A-individuals) in breeder seed production. Individual A-line plants were examined for trueness and for pollen sterility before pollination (open pollination). Results so far obtained showed that selection of individual CMS plants in breeder seed production plots resulted in seeds higher in purity than breeder seeds grown under natural pollination. Seed purity approaches that of nucleus seed. This scheme if introduced in hybrid breeder seed production will lessen the need for time consuming and numerous pair crossing, hence, reduce the cost of hybrid seeds. This study is being conducted to confirm previous results and to look into the possibility of selecting only individual female parents in nucleus seed production. This possible alternative mating scheme in producing nucleus seeds may help reduce the cost of producing basic seeds of hybrids. Lower cost of seed will attract more farmers to grow hybrid rice.

Highlights:

- Parentals of public released hybrids were used in the study. The CMS- and maintainer lines were IR58025A&B (Mestizo 1 and Mestiso 38) and IR68897A&B (Mestiso 3, 7, 26, 29 and 32). The population of commercially used A and B lines was established in the field, following a lay-out as in breeder seed production. Each individual A-line plant was examined for trueness and any off-type observed was rogued as soon as it was noticed. At the onset of flowering, before pollination (open pollination), pollen sterility of each A line was checked by microscopic evaluation using iodine potassium iodide (IKI) solution as stain. Sterility of each A-line plant was further checked by bagging a panicle as it emerges to check on possible selfing, if there was any. Only the A line plants that are completely sterile by pollen examination were allowed to remain and be pollinated with the B line. Individuals showing fertility were rogued along with off-type plants before anthesis. Likewise, all A line plants that set seeds in bagged panicle were removed at harvest. Only seeds from completely sterile plants based on pollen examination and seed set were harvested and processed.

- Purity and identity of the seeds (“nucleus seeds”) derived from experimental mating scheme were tested in 2013 wet season.

To widen the comparison of seeds from the proposed mating scheme, the purity of breeder and foundation seeds with the standards set by NSQCS was compared in field experiment (Table 2). Two-factor factorial experiment was done with plots laid out in a randomized complete block design in five replications. The genotypes and seed classes were the treatments. The purity, heading date, percent of pollen and spikelets sterility were observed and evaluated. The pollen sterility was observed under the microscope under 10x10 magnifications and used 1% of Iodine Potassium Iodide (IKI) as staining solution. Spikelet sterility was scored by bagging the primary tiller of plants from the sampling sites before anthesis. At maturity, the number of filled and unfilled spikelets was counted to compute the percentage of spikelet sterility.

- Genetic and physical purity of "AMS-derived nucleus seeds" were compared to the nucleus seeds produced conventionally and to breeder and foundation seeds based on NSQCS standards. The result is summarized in Table 3. For IR58025A, the purity of AMS-derived nucleus seeds produced from the wet season and dry season was 99.24% and 99.13%, respectively, while the purity of nucleus seeds produced conventionally was 99.21%. As expected based on the NSQCS standards, breeder and foundation seeds have lower purity (99.08% and 98.55%).

- Also, IR68897A showed the same purity pattern. AMS-derived nucleus seed from the dry season had the highest purity at 99.19%. On the other hand, nucleus seed derived conventionally showed 99.13% purity while the AMS-derived nucleus seed from wet season was less pure at 99.06%. NSQCS tagged breeder and foundation had 99.03% and 98.90% purity, respectively.

- Several agro-morphological characteristics such as days to heading, pollen sterility and plant height were also recorded for comparison (Table 4. Days to 50% heading ranged 86-87 days for all of the seed classes compared in IR58025A. On the other hand, the AMS-derived nucleus seed of IR68897A flowered in 76 and 77 days after seeding while days to 50% heading of the rest of seed classes was 78 days. The % pollen sterility of all the seeds classes of IR58025A compared ranged from 99.08% to 99.54%. Highest pollen sterility was observed from the AMS-derived seeds than seeds from other sources. For IR68897A, pollen sterility ranged from 99.32% to 99.66%. Plant height as expected did not vary within seed classes from

the two CMS-line tested. For IR58025A, plant height ranged from 93 to 95 cm while IR68897A was 88 to 89 cm.

Table 2. Sources of different seed classes used to compare with AMS-derived nucleus seeds. IRRI-CES, Los Banos, Laguna.

CMS-Line	Seed Class	Year/Season Harvested
IR58025A	Nucleus seed	2010 Dry Season
	Breeder seed	2011 Dry Season
	Foundation seed	2009 Wet Season
IR68897A	Nucleus seed	2010 Dry Season
	Breeder seed	2011 Dry Season
	Foundation seed	2009 Wet Season

Table 3. Comparison of the genetic purity of AMS-derived seeds with the different seed classes. IRRI-CES, Los Banos, Laguna. 2013 Wet Season.

CMS-Line	Seed class	Season Harvested	Purity (%) Based on Grow-out Test
IR58025A	"AMS-derived" Nucleus seed	2011 Wet Season	99.24
IR58025A	"AMS-derived" Nucleus seed	2012 Dry Season	99.13
IR58025A	Nucleus seed	2010 Dry Season	99.21
IR58025A	Breeder seed	2011 Dry Season	99.08
IR58025A	Foundation seed	2009 Wet Season	98.55
IR68897A	"AMS-derived" Nucleus seed	2011 Wet Season	99.06
IR68897A	"AMS-derived" Nucleus seed	2012 Dry Season	99.19
IR68897A	Nucleus seed	2010 Dry Season	99.13
IR68897A	Breeder seed	2011 Dry Season	99.03
IR68897A	Foundation seed	2009 Wet Season	98.90

Table 4. Comparison of agro-morphological characteristics (days to heading, pollen sterility and plant height) of AMS-derived seeds with different seed classes. IRRI-CES, Los Banos, Laguna. 2013 Wet Season.

CMS-Line	Seed Class	Season Harvested	Days to 50% Heading	Pollen Sterility (%)	Plant Height (cm)
IR58025A	"AMS-derived" Nucleus seed	2011 Wet Season	86	99.08	94.8
IR58025A	"AMS-derived" Nucleus seed	2012 Dry Season	87	99.54	93.4
IR58025A	Nucleus seed	2010 Dry Season	86	99.18	93.6
IR58025A	Breeder seed	2011 Dry Season	87	99.24	94.0
IR58025A	Foundation seed	2009 Wet Season	87	99.12	95.0
IR68897A	"AMS-derived" Nucleus seed	2011 Wet Season	76	99.32	89.4
IR68897A	"AMS-derived" Nucleus seed	2012 Dry Season	77	99.48	88.8
IR68897A	Nucleus seed	2010 Dry Season	78	99.44	89.2
IR68897A	Breeder seed	2011 Dry Season	78	99.38	88.8
IR68897A	Foundation seed	2009 Wet Season	78	99.66	88.6

Characterization of commercial CMS lines for stability in pollen sterility

LV Guittap, EE Sajise, GT Sulte, TM Masajo, FMing Xie and JL Lales

The use of hybrids is a proven technology in increasing rice yields in the Philippines and elsewhere. To date, over 40 hybrids have already been released by the National Seed Industry Council (NSIC) where majority are based in the cytoplasmic male sterility (CMS) system. Among these, 11 are considered public hybrids which utilize as female parents 5 different CMS or A lines. These are IR58025A (A-line of Mestizo 1 and Mestiso 38), IR68897A (A-line of Mestizo 3, 7, 26, 29 and 32), IR73328A (A-line of Mestiso 21, 25 and 31), PR2A (A-line of Mestiso 16), and PR3A (A-line of Mestiso 17). However, problems on the stability of the pollen sterility trait are often being observed. Over the years, data compiled at Los Baños showed, as compared to other CMS lines, low percentage of completely sterile plants in the IR58025A populations as determined by microscopic examination of the pollen using IKI stain. Such unstable pollen sterility expression is likewise observed in IR73328A, the A line of the released hybrids, Mestiso 21, 25 and 31. The purity and stability of the A-line is a very important factor in CMS-based system because of its effect on seed purity and quality of F1 commercial seed. Quantifying pollen sterility is therefore vital in measuring the stability of commercial CMS lines. Knowledge on stability of commercially used CMS lines will be very helpful in monitoring the purity and quality of the AXB and AXR seed production in the field. This can also be used as a basis in breeding and improvement of CMS lines in the future. Likewise, characterization of important agro-morphological characters and flowering behavior would yield information needed by breeders, seed producers and production specialists, and seed quality inspectors.

Highlights:

- Populations of three commercially used CMS lines (IR58025A, IR68897A, and IR73328A) were established for the study. At the onset of flowering, each CMS line was checked for sterility through microscopic evaluation of the pollen. Stability of completely sterile (CS), sterile (S) and partially sterile (PS) CMS lines were tested by backcrossing about 20 plants to its corresponding B-lines. All progenies of the backcrosses will be crossed with the same B-line for the next three generations to monitor stability of pollen sterility in the backcrossed CMS individuals.

    - Backcrossing of A-lines to corresponding B-lines derived from the previous season was continued to observe the stability of different plants with varied fertility score (Table 5.). For 2013 wet season, backcrossing (BC3) of IR68897A and IR58025A was done. A total of 10 CS, 16 S, and 15 PS A-line plants were backcrossed to IR6889AB. Similarly, for IR58025A, 11 CS, 13 S, and 14 PS were lifted and crossed with the corresponding B-line. The seeds harvested from BC3 will be assembled together with the materials previously generated from BC1 and BC2 for evaluation of trueness, sterility and uniformity.

    - For IR73328A, 16 CS, 15 S and 10 PS individuals were backcrossed to IR58025B (BC2). The seeds harvested from backcrossing (BC2) will be raised to observe pollen sterility of the progenies and then cross again to the corresponding B-line to generate BC3.

- Monthly planting of the CMS lines was conducted to observe stability of pollen sterility with reference to the month it was established. The CMS lines were also characterized for important agronomic and flowering characteristics.

    - On the average, the recorded days-to-50%-heading of IR58025A was 88 days (from April 2012 to April 2013) which ranged from 85-96 days. For IR73328A and IR68897A, the average days-to-50%-heading was 80 days during the one year period ranging from 75 to 91 days. The variation of recorded days to flowering for the

commercially-used CMS lines was between 11 days (for IR58025A) to 15 days (IR73328A and IR68897A).

- Other important morphological characteristics such as days-to-50%- heading and plant height were also observed in the monthly planting (Table 6.), For the plant height, IR73328A was the tallest at 100 cm. This is one of the reasons why this line is not performing well during seed production since it is taller than its maintainer line. The plant height of IR58025A and IR68897A was recorded at 92cm and 77 cm, respectively. Tiller number of the three CMS-lines was 15.

- Anthesis for all of the CMS lines starts from 9:00 a, m, and ends at 11:30 a.m. For IR58025A and IR73328A, the start of flowering is around 9:30 a. m. while on IR68897A, it begins earlier at 9:00 am. The duration of anthesis lasted for about two hours on all the CMS lines.

- Pollen sterility and seed set evaluation were also observed from the monthly planting of the CMS-lines (Table 7). IKI staining method was used to evaluate pollen and the computation of percent pollen sterility was based from SES published by IRRI. For all of the CMS lines tested, pollen sterility ranged from 99.86% to 100% during the year of observation.

- Seed set was determined by bagging panicles on the onset of flowering. It was observed that for IR58025A, seed set occurred (0.4%-2.2%) on the plants established during September, October and November wherein the flowering is during the mid-December, January, and February. For IR73328A, seed set was observed only on the entries established in July (0.3 %) and February (0.19%) and none on other months.

Table 5. Number of paired crosses made and evaluated each season from 2012 dry season to 2013 wet season.

Parental line	Season											
	S0			S1 (BC1)			S2 (BC2)			S3 (BC3)		
Pollen score	CS	S	PS	CS	S	PS	CS	S	PS	CS	S	PS
IR68897A and B	20	20	20	17	19	18	9	16	15	10	16	15
IR58025A and B	20	20	20	11	13	14	11	13	14	11	13	14
IR73328A and B	20	20	20	17	16	10	16	15	10	On-going		
Total (n)	60	60	60	45	48	42	36	44	39			

Table 6. Agronomic characteristics of commercially used CMS-lines established from April 2012-April 2013.

Parental line	Days to 50% heading		Plant height (cm)	Tiller No.
	Range	Average		
IR58025A	85-96	88	92	15
IR68897A	76-91	80	77	15
IR73328A	75-90	80	100	15

Table 7. Pollen sterility and seed set of commercially-used CMS-lines established from April 2012-April 2013.

Parental lines	IR58025A		IR68897A		IR73328A	
Date of establishment	Pollen sterility (%)	Seed set (%)	Pollen sterility (%)	Seed set (%)	Pollen sterility (%)	Seed set (%)
Apr-12	100.00	0	100.00	0	100.00	0
May-12	100.00	0	99.98	0	99.99	0
Jun-12	100.00	0	99.99	0	100.00	0
Jul-12	100.00	0	100.00	0	99.92	0.3
Aug-12	99.86	0	100.00	0	99.97	0
Sep-12	99.98	0.4	99.97	0	100.00	0
Oct-12	99.95	0.3	99.99	0	99.96	0
Nov-12	99.98	2.2	99.93	0	100.00	0
Dec-12	100.00	0	100.00	0	100.00	0
Jan-13	100.00	0	99.94	0	100.00	0
Feb-13	100.00	0	100.00	0	99.98	0.19
Mar-13	99.98	0	99.99	0	100.00	0
Apr-13	100.00	0	100.00	0	99.99	0
Range	**99.86 - 100**	**0 - 2.2**	**99.93 - 100**	**0**	**99.92 - 100**	**0-.3**

Nucleus and breeder seed production of new recommended hybrid varieties

GT Sulte, LV Guittap, EE Sajise, TM Masajo, JL Lales, and FM Xie

The hybrid rice technology has proved to be effective in increasing production of rice in the country and elsewhere. To date more than 40 hybrids have so far been released by the National Seed Industry Council (NSIC) of which about 20, developed by IRRI, PhilRice, and UPLB, are considered public hybrids. Five of these hybrids are popular and are widely grown by farmers. Several newly-released hybrids have been identified as potential replacement for the currently grown hybrids. These hybrids include Mestiso 29 (NSIC Rc244H), Mestiso 31 (NSIC Rc248H), Mestiso 32 (NSIC Rc250H) and Mestiso 38 (NSIC Rc262H). Upon release of a hybrid variety, seed production of parents and F1 should follow in order to popularize and commercialize the hybrid. Likewise, protocols on basic and F1 seed production methods for the new hybrids should be studied and established in order to give proper recommendations to hybrid seed growers. The project has the following objectives:

a) Check purity and genetic identity of component (parental) lines in NSIC Rc248H (Mestiso 31), NSIC Rc250H (Mestiso 32), and NSIC Rc262H (Mestiso 38)

b) Characterize the two new NSIC hybrids released and the component parents based on agro-morphological and grain characters.

c) Develop protocol on the method of basic seed production of the parents and the F1 seed of Mestiso 31, Mestiso 32 and Mestiso 38.

d) Field test the seed production protocols developed for Mestiso 31, Mestiso 32 and Mestiso 38.

e) Do initial seed increase of the parents of Mestiso 31, Mestiso 32 and mestizo 38 to anticipate popularization and commercialization?

Highlights:

- Seed purification and multiplication of the parent lines of Mestiso 31 and Mestiso 32 were done in 2013 wet season. Since the seeds of IR68897A and B (CMS- and maintainer line of Mestiso 32) and IR73328A and B (A and B line of Mestiso 31) are already available, only the original seed of IR73013R was requested from IRRI. IR73013R is the restorer line of both Mestiso 31 and Mestiso 32. From the seeds received, a

germplasm file was processed and packed for storage to serve as future reference and seed stock.

- During the 2013 wet season, seed purification and multiplication for IR73013R was conducted. A source population was established and from there 500 plants were selected and individual plants were labelled. For each entry, about 5 grams were processed for plant-to-row evaluation for the 2014 dry season. Another 20 grams from each plant were bulked for breeder seed production the following season. The remaining seeds were stored as seed file.

- Initial data on the days to 50% heading of the restorer line was recorded. The heading dates of the corresponding CMS- and maintainer line were also noted to have a basis in formulating a seed production protocol for testing in 2014 dry season. Table 8 shows the number of days to 50% days to heading. Based on the preliminary data for Mestiso 31, the restorer line should be seeded 3 days advance than the CMS- line. For Mestiso 32 synchronization, A-line is planted 8 days earlier than the restorer line. This synchronization will be tested in 2014 dry season. Initial F1 seed production will also be undertaken to evaluate the performance of the hybrid variety.

Table 8. Number of days to 50% heading of Mestiso 31 and Mestiso 32 parentals.

Component lines	Days to 50% heading
Mestiso 31	
IR73328A	79
IR73328B	79
IR73013R	82
Mestiso 32	
IR58025A	90
IR58025B	90
IR73013R	82

- Aside from the 2 hybrid varieties, purification of the component lines of Mestiso 29 and Mestiso 38 were also undertaken. During the season PR34202R (restorer line of

Mestiso 29), about 300 panicles of true-to-type plants were selected and will be evaluated in head-to-row this coming dry season. Also towards the end of the season, the restorer line of a PhilSCAT-PhilRice variety Mestiso 38 was requested. The R-line is currently planted for the establishment of source population. Mestiso 38 is one of the hybrids being considered for?

Hybrid and nucleus and breeder seed production

LV Guittap, GT Sulte, TM Masajo, SH Escamos, JE Hernandez, JL Lales, and FM Xie

Successful commercial exploitation of hybrids in highly autogamous cereal crops like rice depends on the extent of superiority of hybrids over existing popular inbred varieties and the ease at which F1 seeds could be economically produced. It would take good-performing hybrids and an organized and efficient system of seed production and distribution to popularize and commercialize hybrid varieties. Like all hybrids involving inbred parental lines, genetic purity of the parents must be maintained to produce quality hybrid seeds in commercial quantities every time it is required. Pure, true-to-type and high quality seed is essential for the successful implementation of the government's hybrid rice commercialization program. This project at PhilRice Los Baños was assigned the responsibility to produce and distribute basic seeds of released public hybrids. These are the hybrids bred by IRRI and PhilRice, tested in the NCT and released as varieties by the National Seed Industry Council (NSIC). The project is jointly implemented by PhilRice Los Baños in collaboration with UPLB and IRRI.

Highlights:

- During the 2013 wet season, selection of TGMS parents was conducted. About 1,000 plants each of PRUP TG101 and PRUP TG102 were selected at male fertile environment (MFE) in Tublay, Benguet for evaluation at Los Baños, a male sterile environment site (MSE).

- Evaluation nurseries were established to check the trueness, uniformity and sterility of the A-line (from pair crosses). From the evaluation nurseries, , about 200 IR73328A and B were evaluated wherein 86 entries were identified as completely sterile and true-to-type, thus, they can be used to raise nucleus seeds in the coming season. For nucleus seed production, PRUP TG101 and PRUP TG102 were grown in Tublay,

  Benguet during the season where 165kg and 285kg seeds were harvested, respectively. In the case of CMS-hybrids,

entries that passed from the evaluation nursery during the 2013 dry season were used to be raised as nucleus seeds. The parentals were IR68897A and B and IR58025A and B wherein about 5kg each were harvested and processed.

- During the period, 435kg of processed A-line with corresponding B-line, and 90kg of R-line foundation seeds of CMS-based hybrids were applied for NSQCS seed certification (Table 1). About 275kg of TG102M was produced and submitted to NSQCS for seed multiplication.

- F1 seed production was also undertaken to supply seeds needed for research, technology promotion, and field demonstrations. New hybrid varieties Mestiso 25 and Mestiso 26 were tested in small plots to produce F1 for testing. About 4kg F1 seeds of each variety were produced.

- Amount of breeder seeds of hybrid parents produced and distributed in the period from June to November 2013 is also shown in Table 1. Breeder seeds of CMS-based hybrid parentals distributed were mainly for foundation seed production while the S- and P-lines dispatched were for SxP or F1 seed production of Mestiso 19 and 20. S and P foundation seed production at PhilRice Los Baños is in support of DA-PhilRice TGMS hybrid promotion program.
- Sufficient amount of breeder seeds of hybrid parentals of public released hybrids are kept in the cold storage rooms at Seed Processing and Storage Facility at Los Banos. They are distributed to accredited hybrid seed growers on request. Total hybrid parental breeder and F1 seeds in storage are as follows: 945kg of A-line, 792kg of B-line, 306kg of R-line, 270kg of S-line, 105 kg of P-line and 88kg of F1 seeds. All seeds in storage have high germination (> 85%) and are certified by the NSQCS.

Assessing purity and genetic identity of hybrid parental and certified F1 seeds of public released hybrids

LV Guittap, GT Sulte, TM Masajo, SH Escamos, FMing Xie and JL Lales

Low genetic purity of F1S seeds is still a problem and a major concern in hybrid rice commercialization program. Despite the efforts on seed certification being implemented by the NSQCS and training being conducted by PhilRice on hybrid seed production, complains regarding purity of certified hybrid seed and parentals are still being received. Mixtures and lack of uniformly in the crop discourage farmers from growing hybrids.

Good performing hybrids and availability of pure high quality seed in commercial quantities are the requirements for successful hybrid programs.

"Grow-out test" is an effective method to check the purity of the hybrid parentals and F1 seeds. However, it is not being conducted by NSQCS due to resource limitations and the relatively long period of evaluation required. Thus, this study is conducted to assess the genetic purity and determine trueness of the hybrid parent lines and certified F1 seed produced at PhilRice.

Highlights:

- Breeder and foundation seeds of public hybrid parents were evaluated in grow-out test during the 2013 wet season. Also F1 hybrid seeds of Mestiso 21, 25 and 26 were included in the tests. Seeds that were tested for purity were produced by the Nucleus and Breeder Seed Production (NBSP) Project, PBDO Los Banos, and PhilRice CMU.

- For the S-line of Mestiso 19, two (2) foundation seed lots and one (1) breeder seed lot were evaluated during the season. The foundation seeds produced at Lucban, Quezon had a purity of 99.4% while those produced in Majayjay, Laguna recorded 98.1%. The breeder seed produced in Tublay, Benguet on the other hand is 99% pure. The pollen parent (TG101M) produced by BDO-LB had a purity of 100%. The recorded days to 50% heading of PRUP TG101 is from 96-98 days while TG102M flowered 91 days after seeding. Uniform crop stand was recorded in the grow-out test of PRUP TG101 breeder seeds produced by PhilRice Los Baños in the MFE sites in Carranglan, Nueva Ecija and Tublay, Benguet and Majayjay, Laguna. Heading was uniform so with other agro-morphological features (i.e. height, leaf angle, tillering, etc).

- Purity of PRUP TG102 (Mestiso 20) from four (4) lot sources ranged from 98.0-99.5%. The highest purity was recorded from the lot harvested in Carranglan, Nueva Ecija (99.5%). Same as the other pollen parent, TG101M was 100% pure. On the average, the recorded days to 50% heading of the Mestiso 20 S-line is 96 days during the wet season. Crop raised from seeds from the four sources have uniform plant type and are true-to-type with minimum variation in heading dates. Based on pollen evaluation using IKI stain, almost all of the S-line were sterile with negligible percentage of partially fertile to fertile.

- Three (3) CMS lines were evaluated in grow-out test (IR58025A, IR68897A, and IR73228A) during the period. The purity of the A-lines produced by NBSP ranged from 99.68% to 99.81%. On the other hand, IR68897A produced by PhilRice CMU was 98.64% pure. The corresponding maintainer lines and the restorer lines of Mestiso 1 (IR34686R), Mestiso 25 (IR73885R), and Mestiso 26 (SRT3R) had 100% purity. Pollen evaluation showed that most of the spikelets evaluated were classified as sterile. Partially fertile plants were observed from the two entries of IR68897A. Also, 1% fertile spikelets were noted on the A-line IR73328A. All CMS-lines in grow-out test during the season were uniform in height and number of days to flowering

- F1 seeds of Mestiso 21, Mestiso 25 and Mestiso 26 produced at PhilRice Los Baños and Mestiso 29 from PhilRice CMU in 2013 dry season were tested for purity (Table 3). Mestiso 21 had a purity of 98.25%. On the other hand Mestiso 29, a PhilRice-bred hybrid, recorded 99.61% purity. The newly-produced hybrids from IRRI Mestiso 25 and Mestiso 26 produced from previous season were 97.27% and 99.71% pure, respectively.

Germplasm conservation and maintenance at PhilRice Los Baños

LV Guittap, WB Abonitalla, GT Sulte, EE Sajise, LM Perez, TM Masajo, TH Borromeo and SG Bon

Germplasm conservation and maintenance at Los Baños is a joint activity of PhilRice Los Baños and UPLB. Materials are processed and stored in the Seed Processing and Seed Storage facility at the branch. Germplasm materials are characterized using the standard descriptors prescribed for rice. Seeds are multiplied and accessions with low viability are rejuvenated. Seed processing and packaging in aluminum sachet is an ongoing activity. Duplicate samples are shared with the germplasm bank at CES. Main users of the collection are breeders at UPLB and the hybrid breeding project at LB branch. The collection should also be available to staff at CES and the branches on request. The germplasm materials maintained at the station include a total of 2182 accessions consisting of 1600 varietal collections (mostly traditional varieties) and 582 selections and elite lines. Wide hybridization derived lines, TGMS lines, promising hybrid pollen parents, and highly selected NCT lines are in the collection. Also stored at PhilRice Los Baños are the parental lines of public released hybrids. The accessions are maintained in short-term storage at 15°C and 50% to 60% RH. The seeds are currently being processed for medium-term storage in freezers. It is essential to develop/upgrade the system of handling germplasm materials

since breeding depends on good seed management, with seed and data retrieval system properly in place. Conservation and maintenance guarantee seed availability anytime for the use of breeders. Similarly, original seeds should be securely kept to serve as check in case problems in identity arise and as back-up seed file. Moreover, breeders require not only the seeds but also information on the germplasm presented in a manner that will allow them to identify lines potentially useful to their programs. Data on characterization and evaluation are the essential link between conservation and use of stored germplasm.

Continuity and long-term program is essential in the conservation and maintenance of germplasm. Germplasm work at PhilRice Los Baños will be implemented in synchrony with the activities and procedures done at CES genebank. It is important that PhilRice management of the germplasm resources at CES and the branches are integrated. Thus, the project aims: a) to conserve and keep safe seed germplasm collection and working materials in variety development; b) to seed increase and/or regenerate seeds of accessions ensuring the maintenance and availability; c) to characterize and evaluate the collection to facilitate effective utilization and to identify accessions with important desirable traits; and d) to develop, in collaboration with CES genebank, sound seed and data retrieval system useful to the breeders.

Highlights:

- During the season, a total of 364 lines were added to the collection. Four (4) of the lines were from hybrid program, 34 from inbred yield trials, and 326 from inbred observational nursery.

- Packaging for TGMS parentals was done at IPB using aluminum foil. A total of 73 accessions were packed in aluminum foil (17 lines for TGMS parentals and 56 lines for three-line hybrids). Manual sorting and weighing of seeds of 65 SN lines was also done. Likewise, viability testing for 65 SN lines was conducted. Germination test is on-going.

- About 40 lines were requested by breeders from the TGMS project. Four (4) SN lines (SN 754, SN 757, SN 768 and SN 844) were forwarded to the TGMS Breeding Project for research purposes. In the same period, 35 wide hybridization derived materials (WON lines) were given to BYB program at PhilRice CES.

- Storage conditions, mainly temperature and relative humidity were regularly monitored. Seed viability of the collection is also being checked to determine accessions needing

rejuvenation. The seed storage room was always kept pest-free.

Identification of best location for SxP seed production
SR Brena, N Mabayag, and I Boholano

Successful SxP seed production of NSIC Rc202H and 204H has been established in Davao Oriental and Davao del Norte in 2012. Commercial scale SxP seed production in these areas is done every season. However, SxP seed production in other areas, such as in Agusan, Midsayap, and South Cotabato where AxR seed production was possible, has not yet been fully explored to make SxP seed production successful.

SxP trials in Cotabato, Agusan and South Cotabato were done in DS and WS2013. Trials in Cotabato and Agusan were conducted in PhilRice stations. The trial in South Cotabato was tied up with the Timig ng Binhian ng South Kotabato.

Highlights:

- Seed yield obtained in Agusan and Midsayap was low during dry season 2013 trial. In South Cotabato, the yield was higher than 500kg/ha. Trials in the three sites resulted in high seed yield obtained in the control plot. The yield obtained did not pass as F1. However, when the seeds were planted in farmers' field, there was no problem observed due to selfing.

- For 600kg seed yield SxP seed production to pass certification, the control plot yield should be equal to or lower than 70g.

- In WS 2013 trials in Agusan and Midsayap, seed yield of Mestiso 19 reached almost 700kg with very low seed yield in the control plot. These bags of F1 passed seed certification. Both SxP seed production of Mestiso 19 and 20 planted in PhilRice-Agusan failed to pass seed certification. Despite the high seed yield obtained in the SxP area, the control plot yield of Mestiso 20 reached 870gm. The control plot yield of Mestiso 19 was more than a kilogram.

- There was failure in isolation of the control plot which resulted in the high percentage seed set.

- The trial made in South Cotabato in WS 2013 had high seed yield in the SxP area but seed yield of the control plot failed to satisfy the control plot seed yield standard. The problem was failure in isolation.

- The successful venture into SxP seed production of either Mestiso 19 and Mestiso 20 is very successful in Mindanao. However, the venture in areas in Mindanao failed due to the failure of meeting the 100m distance isolation of the control plot from adjacent rice production areas.

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
$mtha^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

List of Tables

Department of Agriculture

PhilRice

PHILIPPINE RICE RESEARCH INSTITUTE

We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologoies so farmers can produce enough rice for all Filipinos.

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 57 agencies and 70 seed centers strategically located nationwide.

To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-suffiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environment Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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