Sub1 Rice News

A publication of the IRRI-Japan Project on Submergence-Tolerant Rice Varieties

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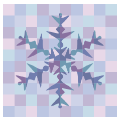
Holiday Season's Greetings

By David J. Mackill

It has been six months since the IRRI-Japan Submergence Tolerance Rice Project began its activities. Everyone involved has been busy getting things accomplished and is now excitedly anticipating next year's activities toward fulfilling our goals. I am sure 2008 will be another fruitful year for the project.



With the holidays upon us, I wish everyone a joyous Christmas and a peaceful New Year.

IRRI Scientists behind the Project on Submergence-Tolerant Rice

The project has six major activities: (1) loss and risk assessment, (2) development of a response plan, (3) technology evaluation and adaptation, (4) training programs for extension workers and researchers in NARES, (5) multiplication and distribution of new seeds, and (6) a follow-up study of the entire program. This is being implemented in six Southeast Asian countries: Cambodia, Laos, Indonesia, the Philippines, Thailand, and Vietnam. Dr. David J. Mackill, senior plant breeder and Program 1 leader of IRRI, serves as the overall team leader. The IRRI senior scientists serving as activity leaders are Dr. Robert Hijmans, GIS specialist for Activity 1; Dr. Thelma Paris, rural sociologist and gender specialist for Activity 2; Dr. Abdelbagi Ismail, plant physiologist for Activities 3 and 5; Dr. David J. Mackill for Activities 3 and 4; and Dr. Sushil Pandey, economist for Activity 6. Dr. Romeo Labios was hired through the project as project coordinator.

Dr. Yann Chemin, GIS expert, is a new postdoc fellow (PDF) of Dr. Hijmans hired through the project, and Dr. Digna Manzanilla, resource economist, is a new PDF of Dr. Pandey and Dr. Paris.

Workshop on socioeconomic aspects held

A workshop on the socioeconomic aspects of the project was held on 5-6 November in Bangkok, Thailand. This was led by Dr. Thelma Paris, Dr. Sushil Pandey, and Dr. Romeo Labios. The objectives of the workshop were to (1) develop a common approach to facilitate cross-country analysis, (2) agree on sites/information needs/collection approach, (3) discuss and agree on major modules needed for data collection, (4) identify key people to be involved, (5) agree on coordination and implementation mechanisms, and (6) develop a milestone plan.

Fifteen scientists from five Southeast Asian countries participated in the workshop: Dr. Leang Hak and Mr. Chea Sareth of the Cambodia Agricultural Research Institute (CARDI), Phnom Penh, Cambodia; Dr. Aris Hairmansis and Dr. Widyantoro of the Indonesian Center for Rice Research (ICRR), West Java, Indonesia; Mr. Vongpaphanh Manivong of the National Agriculture and Forestry Research Institute (NAFRI), Vientiane, Lao PDR; Dr. Panatda Bhekasaut and Mr. Peera Doungsoongnern of Prachinburi Rice Research Center, Prachinburi, Thailand; Dr. Varapong Chamarek of Ubon Rice Research Center, Ubon Ratchathani, Thailand; Dr. Somporn Isvilanonda and Dr. Suwanna Praneetwatakul, Dept. of Agriculture and Resource Economics, Faculty of Economics, Kasetsart University, Bangkok, Thailand; Dr. Orapin Watanesk, Bureau of Rice Research and Development, Department of Rice, Bangkok, Thailand; Mrs. Truong Thi Ngoc Chi of Cuu Long Delta Rice Research Institute (CLRRI), Cantho, Vietnam; Mrs. Phan Thi Thanh of Food Crop Research Institute (FCRI), Vietnam; Mr. Hoang Vinh of the Agricultural Science Institute for Southern Coastal Central of Vietnam (ASISOV); and Dr. Nguyen Tri Khiem, Faculty of Economics, An Giang University, Long Xuyen City, Vietnam.

Other IRRI staff who attended the workshop were Dr. Yann Chemin, Ms. Lourdes Velasco, Ms. Girlie Talonghari, and Ms. Marlyn Rala.

At the end of the workshop, participants were able to develop detailed work and financial plans for the socioeconomic component of the project in their respective countries, covering the period November 2007 to March 2009. Project scientists created a common approach to facilitate cross-country analysis, identified sites and information needs, and established major modules needed for data collection. Guidelines in the conduct of focus group discussions and participatory variety selection, as well as templates of survey instruments, were designed. As a whole, the workshop initiated a milestone plan for the socioeconomic components of the project.

A similar workshop was held on 10 December 2007 for the Philippine team at IRRI. PhilRice celebrated its institutional anniversary at the same time the workshop was held in Bangkok. This was attended by Dr. Nenita Desamero, Marc Jim Mariano, Ofel C. Malonzo, Amelita T. Angeles, Rachelle D. Acda, and Frezzel Praise J. Tadle.

News from NARES partners

Philippines

IR64-Sub1 excites Filipino farmers in submergence-prone and flash flood–prone areas

Rice variety IR64 has not been planted for a long time at our target sites in the municipality of San Antonio, Nueva Ecija, Philippines, and in many other places in the country where it used to be very popular because of its premium grain and eating quality, and its relatively high yield. IR64 was released as a variety for commercial cultivation in the Philippines in 1985 by the Philippine Seed Board. Its popularity declined because it succumbs to several diseases, and higher-yielding new varieties became available to farmers. When we introduced the IR64-Sub1 variety in our first consultation meetings and discussions on 9 and 10 August 2007 in San Antonio, the farmers, municipal agricultural officer, and agricultural technicians got excited as they saw hope in turning their idle and less productive always-submerged paddies during rainy days and the typhoon season into productive paddies once again. They became thrilled when they inquired whether the Sub1 variety can extend its submergence tolerance up to one month, and whether it could withstand drought as well. The farmers have high hopes for the introduced IR64-Sub1, as they hope to double their produce in times when they often harvest nothing because of heavy rain and typhoon-related flood damage. We hope that IR64 having the *Sub1* gene will regain its lost glory in places where it fits best and has an advantage to be cultivated in submergence-prone and flash flood–prone areas. *(Nenita V. Desamero, PhilRice)*

A brief profile of the submergence-prone target site in the Philippines for IRRI-Sub1 rice variety dissemination

Barangay Papaya, San Antonio, Nueva Ecija, is one of the two pilot sites for the initial dissemination of submergence-tolerant rice in the Philippines. The municipality of San Antonio is composed of 16 barangays with a total land area of 16,928 ha. Of the total area, 11,056 ha (65.3%) are planted to rice. Seven of the identified low-lying barangays, including Papaya, serve as a catch basin of the neighboring municipalities, Tarlac, Pampanga, and Zambales, during rainy months and the typhoon season. The low-lying rice areas in these barangays are not productive or even fit to be planted with any crop as they are fully submerged during seasons with heavy rains. In low-lying areas with poor drainage, flooding with heavy rain starts in June or July and extends to November, but may vary from September to October when typhoons and floods usually occur. With 2 to 3 days of heavy rain, or 3 to 4 days of light rain, fields remain submerged with 1–2 m water depth, for 1 to 2 weeks in August to October. With heavy rain and flood, water remains up to 1 month in the very low-lying areas. Sometimes, the very low-lying areas are submerged in December to January with very deep water, over a person's height. The floodwater with mud, called *banlig*, is most damaging to the crop. Normally, rice is cultivated at the target sites from June to October for the wet season and from November to March for the dry season.

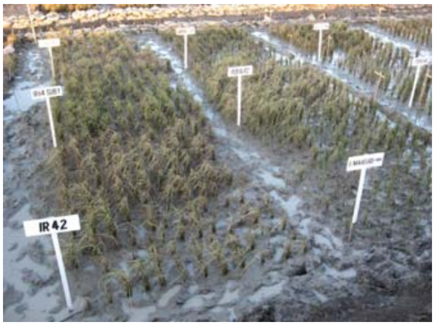
Only one successful rice crop is generally realized in target low-lying areas, with 4.0–4.5 t/ha in the dry season. Farmers who take chances with having two rice crops transplant several times during the submergence-risk period, until a good crop is established in time with the recession of floodwater, a practice termed *la chamba* by the locals. When the paddies are submerged early in the wet season, farmers wait until the water recedes and, as soon as the soil becomes visible, they transplant rice even if it is already a month late, resulting in a late harvest of November. The normal harvest month is October. If successful, 2.0–2.5 t/ha yield is produced for wet-season cropping using tall modern varieties. As soon as the water recedes in October to November, the farmers plant early-maturing varieties for their second rice crop to fully use the residual water, and escape drought in the dry-season crop. The supply of irrigation water is a problem during the dry season, which is mitigated with the use of water pumps. As the risk is high, farmers in submergence-prone areas usually do not invest a lot. They do not apply any input except seedlings in the wet-season crop. But they do invest heavily in fertilizers during the dry season. The farmers at the target site are very receptive and responsive to new technologies, particularly the use of modern varieties. *(Nenita V. Desamero, PhilRice)*

On-station submergence screening at PhilRice

The Philippine Rice Research Institute (PhilRice) conducted on-station submergence screening of five submergence-tolerant varieties (IR64-Sub1, Swarna Sub-1, Samba Mahsuri Sub-1, PSBRc 68, and FR13A) and four intolerant varieties (IR64, IR42, PSBRc 82, and NSICRc 146) on 2 October 2007. This was the second set of tests done at PhilRice. The first test was done in July 2007 when similar entries of the second test were included. A field water reservoir was used in conducting the experiment, with the source of water being an irrigation canal of the National Irrigation Administration (NIA) and excess murky and cloudy water from nearby rice fields.

In the first submergence screening, plants were submerged continuously for 14 days. All plants did not survive, including IR64-Sub1. The second test was done after assessing and evaluating what happened in the first test. This time, the plants were submerged for 10 days and gave good results. The tolerant lines and varieties were distinguishable from the performance of the intolerant check varieties. The water temperature, EC, pH, and water level were monitored every day as in the first test. Sampling of plants after submergence was done at 5, 7, and 9 days. The tank was drained after 10 days of submergence. Two plants per entry per replicate were taken as samples. Scoring was done a day after draining the water.

On-farm experiments will start in the second week of January 2008. The team had already identified farmers who will participate in the planting of IR64-Sub1 for seed increase for wet-season planting. One-half hectare is allotted to a mother trial and 20 participating farmers will constitute the baby trial in a submergence-prone area of San Antonio, Nueva Ecija. On the other hand, the team is also considering giving IR64-Sub1 a popular local name. The Department of Agriculture (DA) is supporting the dissemination of IR64-Sub1 to provide Filipino farmers in flood-prone areas with production alternatives as far as a variety suited to their ecosystem is concerned. *(Norvin Manigbas, PhilRice)*



Performance of rice varieties after 10 days of submergence in PhilRice CES.

South-Central Vietnam

The total area planted to rice in South-Central Vietnam in 2005 was 467,800 ha, with total production of 2,191.5 tons. The yield average is 47.9 quintals/ha. Flooding frequently hit Vietnam's central region, especially in four provinces, Quang Nam, Quang Ngai, Binh Dinh, and Phu Yen. Survey results in these provinces for 1998-2005 indicated that the total rice area damaged by flooding was 144,956 ha.

Some submergence-tolerant rice varieties being evaluated both on-farm and on-station in South-Central Vietnam are IR64-Sub1, Swarna Sub-1, Samba Mahsuri Sub-1, and OM4900. (*LD Hoe, ASISOV-VAAS)*

North Vietnam

The Red River Delta is the flat plain formed by the Red River and its tributaries joining in the Thai Binh River in northern Vietnam. The 15,000-km^2 delta is well protected by a network of dikes. It is an agriculturally rich area and is densely populated. Most of the land is devoted to rice cultivation.

The entire delta region is no more than 3 meters above sea level, and much of it is 1 m or less. The area is subject to frequent flooding: in some places, the high-water mark is 14 m above the surrounding countryside. Dikes and canals protect the delta from floodwater. In this case, rain water in the field is pumped out by a pumping station. However, the capacity of the pumping station is usually lower than the demand. Thus, rice fields are submerged two times annually. The first is at the end of May, when rice plants just finish their heading stage. The second is from early July to the end of August and this is the rainy season, when submergence is serious, with the water level from 30 to 90 cm over 5 to 15 days. Rice varieties cultivated in this area could not survive submergence. About 80% of the rice plants die, with yield of about 3–4 t/ha, and farmers spend much on production (with costs increasing 30–40%). Consequently, the farmers in this area are usually poorer than others.

In November, a quick survey was done involving farmers in lowland areas of five provinces in the Red River Delta (Hai Duong, Hung Yen, Thai Binh, Nam Dinh, and Ninh Binh) to find out what the farmers need and what we can do for them. All are looking for varieties that can survive submergence. We hope that the *Sub1* rice project can meet the demand of farmers in this region. *(Pham Thien Thanh, FCRI-VAAS)*

South Vietnam

Two submergence-tolerant rice varieties (IR64-Sub1 and Swarna Sub-1) and one local check (OM4900) were evaluated in three locations of South Vietnam: Thanh An town, Vinh Thanh District; Cuu Long Rice Research Institute (CLRRI), Can Tho City; and Agricultural Research Center for the Plain of Reeds (ARC), Moc Hoa, Long An Province. The experiment consisted of three replications.

In Vinh Thanh District, the trials in the farmer's field were planted on 12 September 2007 but, before flowering stage, the field was flooded for about 45 days. All three varieties died.

At CLLRI, IR64-Sub1 was harvested on 5 December, after 105 days. Yield averaged 3.4 t/ha. Swarna Sub-1 had not been harvested at the time of this report.

At ARC, Moc Hoa, another local variety, VND 95-20, was included as a local check. Sowing was done on 5 December 2007. *(Nguyen Thi Lang and Nguyen Cao Quan Binh, CLRRI)*

Screening procedures for tolerance of complete submergence

Pamplona A., Ella E., Singh S., Vergara G.V., Ismail A., and Mackill D.

The following procedures can be used for determining tolerance of rice after flooding.

A. Flooding tolerance at vegetative stage (greenhouse screening)

I. Materials
a. Seedboxes (15 × 21 inches or 38 × 53 cm) or pots and greenhouse concrete tanks that would allow maintenance of floodwater depth of >1 m.
b. Garden soil.
c. Germinated rice seedlings (incubated in petri plates lined with moistened coarse filter paper at 30 °C for 3 days in the dark).
d. IR42 seeds (as susceptible check), FR13A, IR40931, IR49830 (*Sub1* donors as tolerant checks, use any one).

II. Procedures
a. Place soil into the seedboxes or concrete bed, use row spacing of not less than 1 cm, then label the entries according to the layout.
b. Select well-germinated rice seeds and sow (20–30 seeds/row) not more than 1 cm below the soil surface. Record the number of seedlings per entry. The number of seedlings usually sown is 20 per row and replicated trials are made.
c. After sowing one row, cover the seedlings with sieved garden soil.
d. Grow the seedlings for another 14 to 21 days. Water plants and weed regularly. Plant height (14–21-d-old plants) usually measures around 25 to 35 cm at the start of submergence. Do not fertilize seedlings.
e. Measure plant height (from soil base to tip of longest leaf) before and after submergence for data on plant elongation. Monitor greenhouse and floodwater temperatures and other floodwater conditions (dissolved O_2, light penetration, and pH) as needed.
f. Start the submergence from 1100 to 1400 to allow the plants to photosynthesize. Check water depth daily and add and maintain water to completely submerge the plants.
g. Observe IR42 (susceptible check) seedlings starting from day 6 of submergence (or day 8 of submergence when older seedlings are used before submergence) by taking out some IR42 seedlings from the tank and checking whether the plants become soft at the growing point (shoot-root) junction.
h. Open the outlets when 70% to 80% of the IR42 materials show injury. De-submergence is preferably started after lunch and ended in late afternoon at around 1700 when light intensity is low, thus minimizing postsubmergence injury. Also, to minimize lodging, slowly drain the tank when the water level is at seedling height by closing one or two outlets.

III. Scoring of survival
a. Per entry, record the number of seedlings used (X) and also the number of survivors 21 days after de-submergence (Y). Survivors should have produced at least one new green leaf.
b. Percentage survival is then calculated. Divide (Y) by (X), then multiply by 100.

B. Flooding tolerance at vegetative stage (in field conditions)

I. Materials
a. Deep pond tanks that would allow maintenance of floodwater depth at 1.5 m for a given duration for submergence experiments and normal field blocks for nonsubmerged control. A separate RCBD experiment could be conducted for submerged and nonsubmerged (control) trials.
b. Germinated seedlings (incubated in petri plates lined with moistened coarse filter paper at 30 °C for 3 days in the dark).
c. Checks: normal healthy seeds of *Sub1* donors (FR13A, IR40931, IR49830, or mega-variety *Sub1* lines; use any as tolerant checks), IR42 (as intolerant check), parental lines.

II. Procedures
a. Healthy seeds of all cultivars are sown in unfertilized normal soil in nursery trays using 3 seeds per hole (each hill measures 1.5 × 1.5 × 2.5 cm) or in seed boxes with spacing of 4 cm or in a seedbed with normal nursery-raising practices.
b. Prepare the land in the field. Apply molluscicide after the first and second harrowing.
c. Apply nitrogen, phosphorus, potash, and zinc at 30:30:30:5 kg/ha as basal 1 day before transplanting.
d. Transplant 14-d-old seedlings into the field at 20 × 20 cm^2 spacing, with 2 seedlings per hill. Transplant ten extra rows of IR42 (at least 250 total hills) on one side of the deep ponds to observe the extent of damage of the sensitive check to be used as a guide to determine when to end the submergence treatment. Ensure 100% plant population before submergence by transplanting in missing hills.
e. Allow transplanted seedlings to grow normally in the field for another 14 days. Count the number of plants before submergence. Measure plant height (from soil base to tip of longest leaf) before and after submergence.
f. Afterward, for the submergence treatment, start filling the ponds with water to a depth of 1 to 1.25 m. Flooding can be started at noon to give plants enough time to photosynthesize in the morning. Maintain desired water depth by adding additional water regularly to completely submerge plants. Ensure normal water depths (5–7 cm) for the nonsubmerged (control) ponds.
g. Monitor daily floodwater conditions in the submergence tanks in the morning (0700-0800) and in the afternoon (1300-1400) and at various depths during submergence.
h. Randomly uproot 10 plants of IR42 after 7 days of submergence daily from the extra rows to observe the extent of damage and to decide on the proper time to terminate the submergence treatment (approximately 10–14 d for moderate stress and 16–19 d for severe stress).
i. Minimize algal growth by partially removing algae from the water surface daily using a small fish net filter. Extra care should be taken when scooping the algae to minimize disturbance of floodwater. Hand weeding, snail control, and plant protection measures should be adopted when needed.
j. Open the outlets when IR42 check materials become soft at the growing point (shoot-root junction). De-submergence is preferably started after noon.
k. Allow the field to remain without water for 3–4 days. Afterward, fill it with not more than 1–2 cm of water for another 15–20 days; then increase the water to a normal 5–7 cm.

III. Scoring of survival
a. Record the number of hills (X) 1 d prior to submergence in a marked 5.2-m^2 area in the center of each plot. Record the number of survivors (Y) 21 d after de-submergence by counting the surviving hills that were able to produce at least one new leaf from the same marked area.
b. Percentage survival is then calculated. Divide (Y) by (X), then multiply by 100.

Upcoming activities

16 January 2008. Philippine Department of Agriculture–IRRI Forum on Submergence Rice Technologies. IRRI, Los Baños, Laguna.

21 January to 1 February 2008. Marker-assisted selection: theory, practice, and application, course at IRRI HQ, Los Baños, Laguna. (Contact person: Dr. Darshan Brar, d.brar@cgiar.org.)

29-31 January 2008. IRRI-Japan Submergence Project Review and Planning Meeting, Institute of Agricultural Sciences for South Vietnam, Ho Chi Minh City, Vietnam.

14-25 April 2008. Training Workshop on Participatory Approach to Upscaling the Adoption of Submergence-Tolerant Rice, IRRI HQ, Los Baños, Laguna, Philippines.

For more information, contact
Dr. David J. Mackill, program leader, d.mackill@cgiar.org

Dr. Romeo V. Labios, project coordinator, r.labios@cgiar.org