Biofertilizer Germplasm Collections at IRRI

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Contents

Foreword

The revolutionary increase in rice production in Asia over the last three decades was primarily achieved through the adoption of modern high-yielding varieties and commercial fertilizers. But many poor farmers who raise crops on nonirrigated riceland cannot afford high levels of purchased inputs. Excessive use of chemical nitrogen fertilizers also risks contaminating groundwater and the atmosphere.

Alternate technology is needed that is affordable by resource-poor farmers, contributes to sustainable productivity, and is environmentally safe. Organic fertilizers offer such an option. For centuries before the invention of chemical fertilizers, Asian rice farmers maintained relatively high yields using mineral nutrients produced on the farm—such as the aquatic fern *Azolla* and leguminous plants—as green manures.

Even without fertilizer, wetland rice yields in the tropics are higher than yields of cereals grown on dryland. This is partly due to biological nitrogen-fixing (BNF) agents indigenous in flooded soils. The germplasm of such BNF agents is useful in developing organic fertilizer technology.

IRRI began active studies on using and enhancing biological nitrogen fixation in 1976, with the support of the United Nations Development Programme (UNDP). BNF agents collected, evaluated, and maintained at IRRI include *Azolla,* blue-green algae, aquatic legumes and their symbiotic rhizobia. and free-living nitrogen-fixing bacteria.

The *Azolla* and aquatic. legumes collections are unique: no other source of a comparable size exists. The *Azolla* collection includes natural populations and sexual hybrids, *Azolla* with nonhomologous symbiotic blue-green algae, and mutants that cannot be recovered from nature. The aquatic legumes collection protects germplasm that grows in fragile wetland environments threatened by loss and genetic erosion.

Maintenance of biofertilizer germplasm requires special facilities. The Governments of Japan and Italy supported construction of a modern laboratory building to house the collection and related work. Information on the origin and cultural characteristics of the collections is stored as current data bases. Updated lists incorporating new accessions are available on request to IRRI.

The description of the biofertilizer germplasm maintained at IRRI is intended to accelerate its use and exchange among researchers all over the world. We hope it catalyzes additional collections and interest in developing sustainable rice production technology.

This report was developed by Dr. Iwao Watanabe, former head of the IRRI Soil Microbiology Division, together with Dr. Pierre Roger, IRRI visiting scientist from the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM), and Dr. J. K. Ladha, IRRI soil microbiologist, with the technical assistance of T. Ventura, S. Ardales, R. So, and G. Angelo, Prof. C. Van Hove of the University Catholique de Louvain, Belgium, collaborated in work on *Azolla,* with support by Administration Générale de la Coopération au Développement de Belgique (AGCD).

IRRI is grateful to donor countries Belgium, France, and Japan for valuable scientific and financial support that enabled the Institute to undertake the research reported. Its publication will not only help avoid duplication, but will also enable national agricultural systems to make use of *Azolla* and aquatic legumes in their regional and location-specific research.

The book was edited by Ms. Jill G. de Villa and Ms. Teresita Rola and produced by the IRRI Communication and Publications Services.

Klaus Lampe
Director General

Introduction

Rice has been selected and bred as a crop that can be grown in flooded soils under a wide range of environmental conditions.

Traditional wetland rice cultivation has sustained yields with remarkable success for thousands of' years without depleting the environment (Bray 1986). This is because flooding favors soil fertility and rice production by:

- bringing soil pH near to neutral;
- increasing availability of nutrients, especially P and Fe;
- depressing decomposition of soil organic matter, thus maintaining soil N fertility;
- stimulating N_2 fixation:
- suppressing outbreaks of soil-borne diseases;
- supplying nutrients from floodwater and irrigation water;
- depressing weed growth (especially of C_4-type weeds); and
- preventing water percolation and runoff, and soil erosion.

More than half the world's population depends on rice that grows in 146 million ha. In 1988, that land produced 492 million t of rice. In 2020, an additional 300 million t will be needed to feed the rapidly expanding human population. To meet this need, production must increase 65% within 30 yr, and must achieve that with only minimal expansion of the area cultivated (IRRI 1989).

Increased rice production should not be achieved at the expense of future generations. It should be accornplished through management that attains sustainability, maintains or enhances the quality of the environment, and conserves or enhances natural resources. As rice yields increase, nutrient management must both reduce agrochemical use and maintain or enhance soil fertility.

In low-input traditional rice cultivation, plant N originated from the soil and was replenished from the atmosphere by spontaneous biological nitrogen fixation (BNF). Research on rice nutrition has shown that even when high amounts of inorganic N fertilizer are applied, rice plants obtain 60-70% of their N from the soil. Therefore, crop intensification may affect rice soil fertility if proper N inputs do not replenish N taken up from the soil. The replenishment can be attained by a combination of the following strategies:

- increase chemical fertilizers,
- increase biological N sources such as green manure crops (including *Azolla),*
- enhance N_2 fixation by indigenous BNF agents (free-living blue-green algae [BGA] and bacteria).
- decrease N loss by proper N application and water management. and
- increase return to the soil of the biomass grown in the ricefields.

N_2-fixing agents in soil and water are natural "fertilizer factories." Promoting their growth and N_2-fixing activity is an important strategy for sustaining rice production. Biological nitrogen fixation technologies are especially important for long-term maintenance of soil fertility. The technologies are environmentally safe. If benefits such as fertilizer savings, improved soil properties, reduced pests and diseases, and reduced environmental pollution are considered, BNF technologies are often economically justifiable.

Nitrogen potential of N_2-fixing organisms in ricefields

Flooded ricefields have a wide range of macro- and microenvironments. Because the environments differ in redox potentials, physical properties, light status, and nutrient sources, they support all kinds of N_2-fixing organisms. Nitrogen-fixing organisms are either phototrophic (autotrophic) or heterotrophic. Phototrophic organisms grow in the floodwater or at the light-exposed surface of the soil. The organisms are photosynthetic bacteria, free-living BGA, and symbiotic RGA in the water fern *Azolla.* Heterotrophic N_2-fixing bacteria grow in the soil in association with crop residues or living rice roots. Some live in symbiosis with legume plants that can grow in flooded conditions.

The quantity of N_2 fixed in ricefields by these agents has been estimated with various levels of accuracy. Table 1 shows the ranges of determined values and the theoretical potential maximum.

Importance of preserving N_2-fixing organisms

For most eukaryotic organisms — especially for cultivated plants—gene erosion is a major reason for establishing germplasm banks. Our *Azolla* collection contains natural strains as well as mutants and artificial hybrids which are difficult to obtain and thus should be preserved.

Gene erosion is not a major risk in prokaryotic organisms. They are maintained primarily because of the difficulties of isolating and characterizing the strains. Considerable money and time are invested to collect and store information on strains in a data base. Any bacterial culture, including BGA, is potential experimental material. Therefore, it is important to ensure their preservation.

History of the IRRI collections

The importance of BNF in maintaining the fertility of flooded ricefields was recognized at the beginning of the 20th century. At the International Rice Research Institute (IRRI), BNF research started in 1966 with the establishment of the Soil Microbiology Division.

The *Azolla* collection was initiated in 1975 by I. Watanabe. who collected the first strain from Bicol, Philippines. T. Lumpkin donated a duplicate of his collection at the University of Hawaii. In 1987, 186 accessions from the collection of C. Van Hove (Université Catholique de Louvain [UCL], Belgium) were added. In June 1991. IRRI's collection had 501 entries; it is now the largest collection in the world.

The first hybrid strains of *Azolla* were obtained in 1985 by Do Van Cat, a Vietnamese scholar at IRRI. The University of the Philippines at Los Baños deposited putative *Azolla* hybrids,

Table 1. Range of estimates of N_2 fixed by various agents in wetland ricefields and theoretical maximum potential and assumptions (after Roger and Ladha 1990).

Component	Reported range of estimates (kg N/ha per crop)	Theoretical maximum potential (kg N/ha per crop) and assumptions
BNF associated with rice rhizosphere	1-7	40 • All rhizospheric bacteria are N_2 flxers • C flow through rhizosphere is 1 t/ha per crop • 40 mg N is fixed/g C.
BNF associated with straw	2-4 kg N/t straw	35 • 5 t of straw is applied. • 7 mg N is flxed/g of straw.
Total heterotrophic BNF	1-31	60 • All C input (2 t/crop) is used by N_2 fixers
Blue-green algae	0-80	70 • Photosynthetic aquatic biomass is composed exclusively of N_2-fixing BGA (C/N = 7) • Primary production is 0.5 t C/ha per crop
Azolla	20-150 (experimental plots) 10-50 (field trials)	224 • One Azolla standing crop is 140 kg N/ha • Two Azolla crops are grown per rice crop. Ndfa[a] is 80% (Note One dense Azolla mat at steady state allows a harvest of 4 kg Ndfa/d or 1.4 t N/ha per yr)
Legume/green manures	20-260	260 (55 d) • *Sesbania rostrata* is used as green manure. • 290 kg N/ha is accumulated in 50-60 d. Ndfa is 90%.

[a] Ndfa = N derived from the atmosphere

and biochemical methods confirmed hybridization of some accessions. In 1987, Lin Chang, a Chinese scholar, constructed the first *Azolla* strains with *Anabaena* from another species of *Azolla.* The *Azolla* collection is now being fingerprinted by zymograms in collaboration with W. Zimmerman of the University of Michigan, USA.

In 1978, P. A. Roger (Institut Français de Recherche Scientifique pour le Développement et Coopération, France-ORSTOM) initiated the collection of N_2-fixing BGA. In 1985, 65 strains of the ORSTOM collection in Senegal were transferred to IRRI. The number of accessions increased in 1986 and 1987, when field surveys of BGA in rice soils were conducted in several rice-growing countries. The collection had 204 entries in 1991. The macromorphological characteristics of the cultures in liquid and on solid media and the microscopic morphology of the strains are entered in a data base, with information on the environments from which the strains were isolated.

The collection of N_2-fixing bacteria was initiated in 1987, when improved methods were introduced for isolating and characterizing N_2-fixing bacteria from rice roots. Several strains—including a new H_2-utilizing, N_2-fixing bacterium *Pseudomonas diazotrophicus*—were isolated and described. The collection had 25 strains in 1991.

Field research on the aquatic legumes *Sesbania rostrata* and *S. cannabina* started in 1984 at IRRI's Multiple Cropping Department. *S. rostrata* was introduced to the Philippines from Senegal through a collaborative project among the Institut de Recherches Agronomiques Tropicales, Southeast Regional Center for Graduate Study and Research in Agriculture, and IRRI. National scientists donated a few *S. cannabina* accessions. J. K. Ladha of IRRI expanded the collection in 1985. Several species and ecotypes of *Sesbania* and *Aeschynomene* were obtained or collected from Asia, Africa, and Latin America. African *Aeschynomene* seeds were obtained through a collaborative program with the University of Giessen (Germany). IRRI currently maintains 86 accessions of *Sesbania, Aeschynomene,* and *Neptunia* species. Symbiotic rhizobia have been isolated and are being described.

Table 2 summarizes IRRI's collection of N_2-fixing organisms. The *Azolla* and aquatic legumes collections are intended to be comprehensive. The BGA, rhizobia, and free-living N_2-fixing bacteria collections are working collections. Original or duplicated accessions are or will be available from other organizations listed in Table 2.

Facilities

A newly constructed building houses the biofertilizer germplasm collections. Facilities for maintaining the collections are listed below:

- One 2.7-m^2 light cabinet (Conviron) used to maintain the *Azolla* collection on artificial medium.
- Two 0.8-m^2 growth cabinets (Koitotron HNL) specially designed for *Azolla* and used for experiments.
- One 9.5-m^2 algae maintenance and growth room with lighted shelves and a mass culture setup.
- One 18-m^2 incubator room for growing bacteria in the dark.
- One 12-m^2 inoculation room with two clean benches.
- One 18-m^2 thermostat-regulated glasshouse for growing *Azolla* and legumes.
- A 177-m^2 microbiology laboratory with a media preparation room.

Table 2. Summary of biofertilizer germplasm collections at IRRI.

Organism	Representative genus/species	No. of strains	Other agencies[a]
Azolla	*A. pinnata*	501 (7 species)	FAAS,UCL
Blue-green algae	*Nostoc*	204 (10 genera)	IAM-UT
N_2-fixing bacteria from rice	*Azospirillum*	25 (5 genera)	
Aquatic legumes	*Sesbania*	86 (35 species)	TNAU
Rhizobium	*Azorhizobium*	104 (23 host species)	Niftal-UH

[a]Major agencies where original or duplicated collections are or will be available. Refer to Appendix III for abbreviations.

Azolla

The *Azolla* collection contains 501 strains originating from 55 countries (Table 3. Fig. 1). About 56% of the strains are from Asia and Oceania, 4.2% from Europe, 24.8% from North and Latin America, and 7.8% from Africa. Thirty-five percent of the Asian strains are hybrids, progenies of self-fertilization, mutants, and redistributed nonindigenous strains. Sexual hybrids and algal hybrids (*Azolla* with nonhomologous *Anabaena*) are the most important accessions. These occupy 25% of the Azolla collection. The classified strains are distributed among seven species and two subspecies. *Azolla pinnata* var. *imbricata* and *A. microphylla* are the most common species. The collection is intended to be comprehensive, and to be used for applied and basic research.

Accessions are preserved in a vegetative stage. Accessions would be easiest kept as sporocarps. However, many strains do not sporulate, and progeny of sporocarps shon· genetic segregation. Thus, preservation as sporocarps is not advisable. Shoot-tip cultures can be maintained longer (2-3 mo) than vegetative cultures (14 d). All strains are being transferred to shoot-tip culture.

Identification of accessions

Taxonomy. The seven extant *Azolla* species are classified into two sections:

Section *Azolla* (formerly *Euazolla*)
- *A. filiculoides* (Lamarck 1783)
- *A. rubra* (R. Brown 1810)
- *A. mexicana* (Presl 1845)
- *A. caroliniana* (Willdenow 1810)
- *A. microphylla* (Kaulfuss 1824)

Section *Rhizosperma*
- *A. pinnata* (R. Brown 1810)
- *A. nilotica* (De Caisne [Mettenius] 1867)

Some authors combine *A. rubra* with *A. filiculoides. Azolla japonica* Nakai collected from Japan was reidentified as *A. filiculoides. Azolla pinnata* has two varieties—var. *imbricata* and var. *pinnata.* Although the identity of *A. caroliniana* is in doubt (Dunham and Fowler

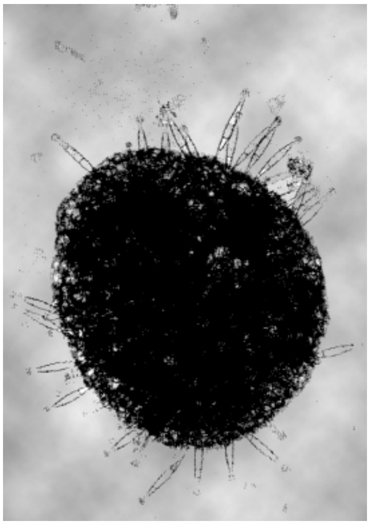
Table 3. Distribution of strains of the *Azolla* collection, June 1991.

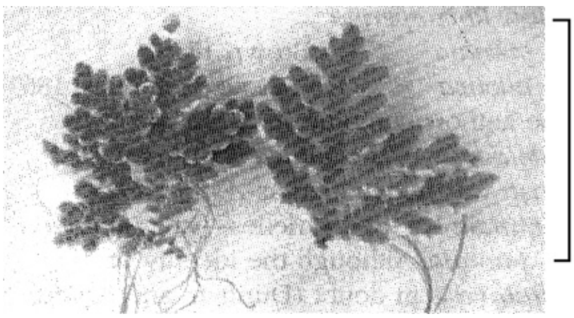
Species	Regular strains	Anabaena-free strains [a]	Hybrids obtained by		Total	Figures
			Algal transfer	Sexual hybridization		
A. caroliniana	66	1	0	0	67	1 a,b
A. filiculoides	75	13	4	6	98	1 c,d
A. mexicana	26	0	0	27	53	1 e,f
A. microphylla	55	4	19	52	130	1 g,h
A. nilotica	3	0	0	0	3	1 i
A. pinnata var. *imbricata*	91	1	0	0	92	1 j
A. pinnata var. *pinnata*	41	1	0	0	42	1 k,l,m
A. rubra	4	0	0	0	4	1 n
Unclassified (?)	11	1	0	0	12	
Total	372	21	23	85	501	

[a] *Anabaena* - free *Azolla* obtained from sexual hybrids are counted as *Anabaena* -free. Sexual hybrids include putative ones.

1a. *A. caroliniana* (Acc. no. CA 3001).

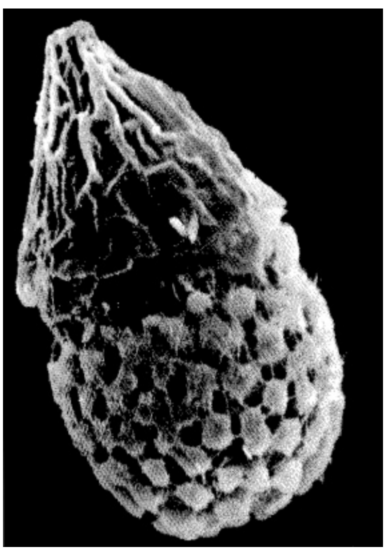
1b. Massulae in microsporocarps of *A. caroliniana* (section *Azolla).*

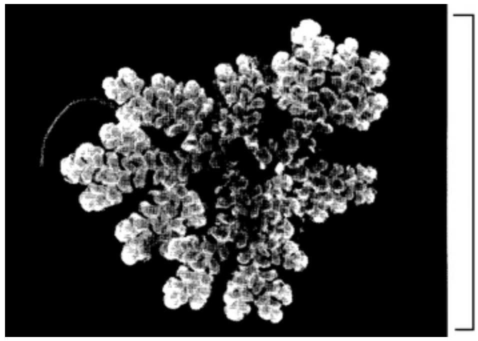




1c. *A. filiculoides* (Acc. no. FI 1001).

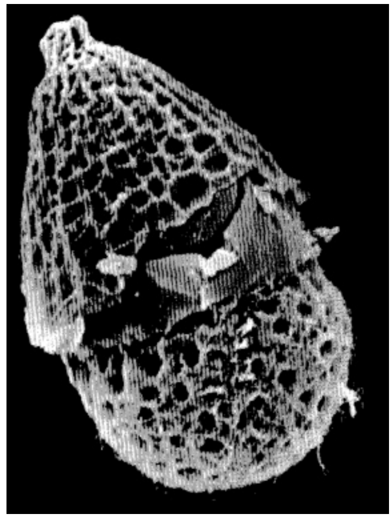
1d. Megasporocarp of *A. filiculoides*





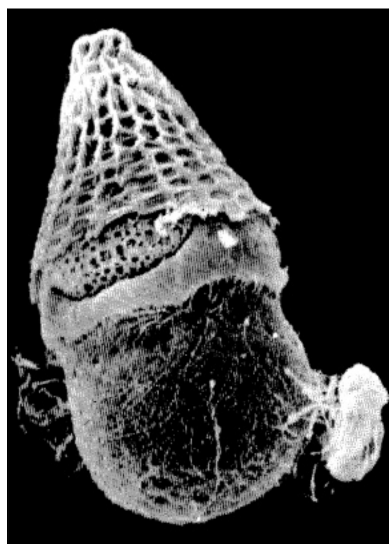
1e. *A. mexicana* (Acc no. ME 2001).

1f. Megasporocarp of *A. mexicana*

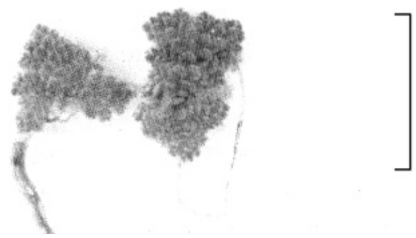


1g. *A. microphylla* (Acc. no. MI 4018).

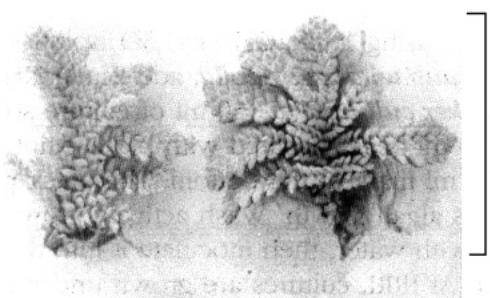
1h. Megasporocarp of *A. microphylla*



1i. *A. nilotica.*

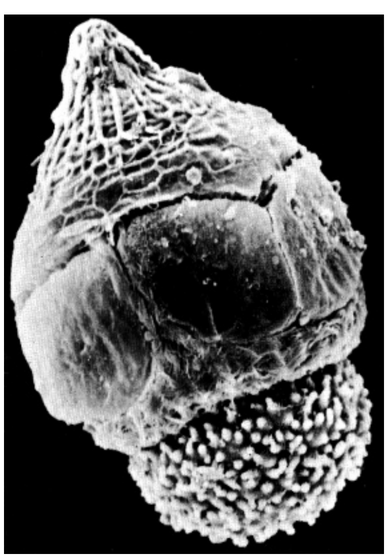


1j. *A. pinnata* var. *imbrcata* (Acc no. PI 0005)

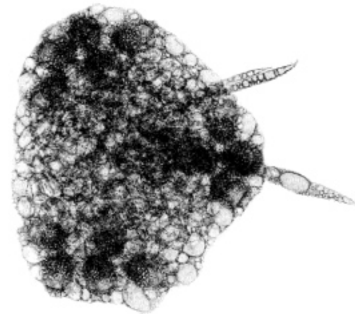


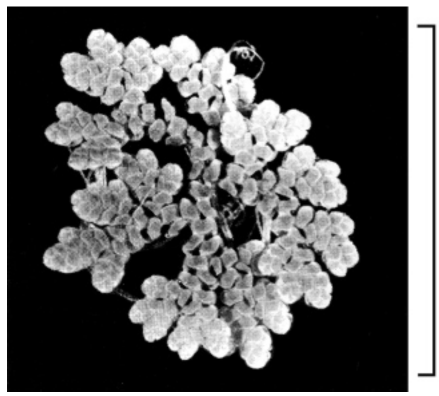
1k. *A. pinnata* var. *pinnata* (Acc. no. PP 7001).

1l. *Megasporocarp* of *A. pinnata* var. *pinnnata*



1m. Massulae in microsporocarps of *A. pinnata* var. *pinnata* (section Rhizosperma).





1n. *A. rubra* (Acc. no RU 6502)

1987), we retain this species name until taxonomists clarify its status. Species identification among *A. microphylla*, *A. mexicana,* and *A. caroliniana* is often difficult and still controversial. Until further work merits reclassification, IRRI scientists retain the identification provided by the original collectors of specimens of these three species.

Table 4 presents the key used to identify *Azolla.*

Code. Strains are named according to a two-letter. four-digit code. Accessions from UCL have 5 as the second digit (e.g., PI 0501, FI 1501 etc.).

The current code is IRRI's origin code, with the addition of the two-letter species identifier prefix and leading zeros to make a four-digit number.

Table 5 presents IRRI's codification of accesions.

Strains of *A. japonica,* previously considered as belonging to *A. rubra* (RU 6003-RU 6009), have been identifiedas *A. filiculoides* and transferred to the 1000 series.

Anabaena cells always originate from the female parent. Hence the accession numbers of hybrids are based on the female parent. For example, hybrid MI 4028 (*A. microphylla* × *A. filiculoides*) is grouped under *A. microphylla.*

Table 4. Identification key for *Azolla.*

1. Trichomes present on leaves as well as rhizomes 2

1. Trichomes present only on leaves. 3

  2. Individual plant deltoid or triangular . . . . *A pinnata* var *imbricata*

  2. Lateral branches regularly pinnate. secondary or tertiary branches scattered along the plant periphery. . . *A. pinnata* var. *pinnata*

  2. Plants somewhat ascending, roots in clusters on the rhizome nodes, sporocarps in clusters of four. . . . . *A. nilotica*

3 Trichomes single-celled, glochidia with few or no septae 4

3. Trichomes with 2 or 3 cells, glochidia with several septae . . . . *A mexicana, A. caroliniana, A. microphylla*

  4. Trichomes clearly protruding . . . . *A. filiculoides*

  4. Trichomes less protruding . . . . *A. rubra*

Table 5. Codes for IRRI's *Azolla* accessions.

Species identifier	Accession number	Species or subspecies
PI	>0 and <1000	*A. pinnata* var. *imbricata*
FI	>1000 and <2000	*A. filiculoides*
ME	>2000 and <3000	*A. mexicana*
CA	>3000 and <4000	*A. caroliniana*
MI	>4000 and <5000	*A. microphylla*
NI	>5000 and <6000	*A. nilotica*
RU	>6000 and <7000	*A. rubra*
PP	>7000 and <8000	*A. pinnata* var. *pinnata*
XX	>8000	Unclassified

Conservation methods

Azolla are maintained in the vegetative stage because a few strains form sporocarps. To maintain a healthy collection of strains in the vegetative state, growth conditions must be adapted to all species and strains.

Liquid medium for Azolla *culture.* Components of the liquid medium for *Azolla* culture are presented in Table 6.

Preparation of the liquid medium requires trace elements solution and Fe-EDTA solution.

1. To prepare the trace elements solution, dissolve each trace element compound in a small amount of water taken from 500 ml of deionized distilled water. Combine the dissolved compounds, and make up to 500 ml. To prevent precipitation, add 10-15 ml 6N H_2SO_4. Make up to 1 liter volume with deionized distilled water.
2. To prepare the Fe-EDTA solution, dissolve EDTA in 268 ml of 1N KOH. Add $FeSO_1 \cdot 7H_2O$ and dilute to 1 liter. Aerate overnight or stand until a stable reddish brown ferric complex is formed. The pH should be 5.5. Store in an amber bottle.
3. To prepare the liquid culture, add 1 ml of trace elements solution (prepared from no. 1), 1 ml each of the P, K, Ca, and Mg dissolved in deionized water (see Table 6), and 0.1 ml Fe-EDTA per liter of deionized water. Stir after each addition. Adjust pH to 5.5 using 1N NaOH or H_2SO_4 solution. For *Anabaena* -free *Azolla,* add 2 mM NH_4NO_3.

Table 6. Components of liquid medium for *Azolla* culture.

Element/ trace element	Final concentration (ppm)	Reagent	Stock solutions (g/liter deionized water)
P	20	$NaH_2PO_4 \cdot H_2O$	89.0
K	40	K_2SO_4	89.1
Ca	40	$CaCl_2 \cdot 2H_2O$	147.0
Mg	40	$MgSO_4 \cdot 7H_2O$	405.3
Fe	0.50	$FeSO_4 \cdot 7H_2O$	24.9
		EDTA $C_{10}H_6O_8N_2$	26.1
Mn	0.50	$MnCl_2 \cdot 4H_2O$	1.80
Mo	0.15	$Na_2MoO_4 \cdot 2H_2O$	0.38
B	0.20	H_3BO_3	1.14
Zn	0.01	$ZnSO_4 \cdot 7H_2O$	0.04
Cu	0.01	$CuSO_4 \cdot 5H_2O$	0.04
Co	0.01	$CoCl_2 \cdot 6H_2O$	0.04

Beaker culture. Put 150 ml of culture solution in a 250-ml beaker coated with black paint from the 150 ml mark to the bottom. The black paint prevents algal growth. Wash actively growing *Azolla* with water, then inoculate it into the beaker. At IRRI, cultures are grown under artificial light with fluorescent lamps and incandescent lamps at 15 klx. The air temperature is maintained at 26°C under light and at 18°C in the dark, the photoperiod at a 12-h day, and relative humidity at 70-75%. Replace media 2-3 wk after washing the *Azolla.*

Shoot-tip culture. After washing healthy fronds. cut off 5-mm fragments that include meristems and several leaves. Enclose cut fronds in a small net bag and wash with running tap water for 30 min. Sterilize with 2% NaOCl and 1% Triton X 100 solution for 3 min. Wash with sterile water ten times. Inoculate 15-20 pieces of the cut tip portion into a 50-ml flask with 20 ml IRRI *Azolla* medium and 0.5% agar. For *Anabaena-free Azolla,* add 2 mM NH_4NO_3.

Incubate at 26/18°C under 5 klx. After 2-3 mo growth, cut the top portion of the Azolla frond and inoculate again into another medium. If it fails to grow, try adjusting the sterilization time.

Regulated culture in liquid medium (UCL method). The UCL adapted an 8-m^2 room as a growth chamber containing a culture tank that can accommodate the collection. The ceiling is covered with a rack of 60 neon tubes (TL23, 40 watts) and 42 tungsten lamps (40 watts). For 10 h/d. the lights provide 16 klx. equivalent to 265 $\mu E/m^2$ per s measured at the level of the *Azolla* culture (corresponding to 440 J/cm^2 per d). The temperature is maintained at 25/18°C and the humidity at 55-70%. The temperature of the culture medium varies between 22 and 16°C.

To maintain the water level and nutrient concentration and to avoid desiccation of *Azolla* fronds attaching on the inner wall of the containers, a single culture tank is used for all strains (Fig. 2). The level of the medium is automatically adjusted. Each collection is kept in a small strainer, placed in a hole of the tank cover lid.

The design is composed of a tank with *Azolla* strains enclosed in individual nets, and a buffer tank for medium. A centrifuge pump ensures the flow and constant level of the medium with minimum disturbance through an antifoam screen. Losses from evapotranspiration are compensated with demineralized water brought in through a constant level device. The level of the medium in the main tank is maintained by the wall, which serves as an overflow. The nutrient solution that flows to the buffer tank through the outflow tube is filtered on a screen covered with cotton wool. The cotton is replaced when needed.

Algal development in the culture solution is limited by the 10-mm thick tinted altuglass and by opaque tubings. The tank lids have regularly spaced holes to support individual strainers. Strainers are made of a nylon net 75 mm in diameter glued on a rigid ring. The strainers are commercially available nylon tea bags. The very fine mesh of the nylon screens stops sporocarps from growing into the medium, but allows ion exchanges in the solutions.

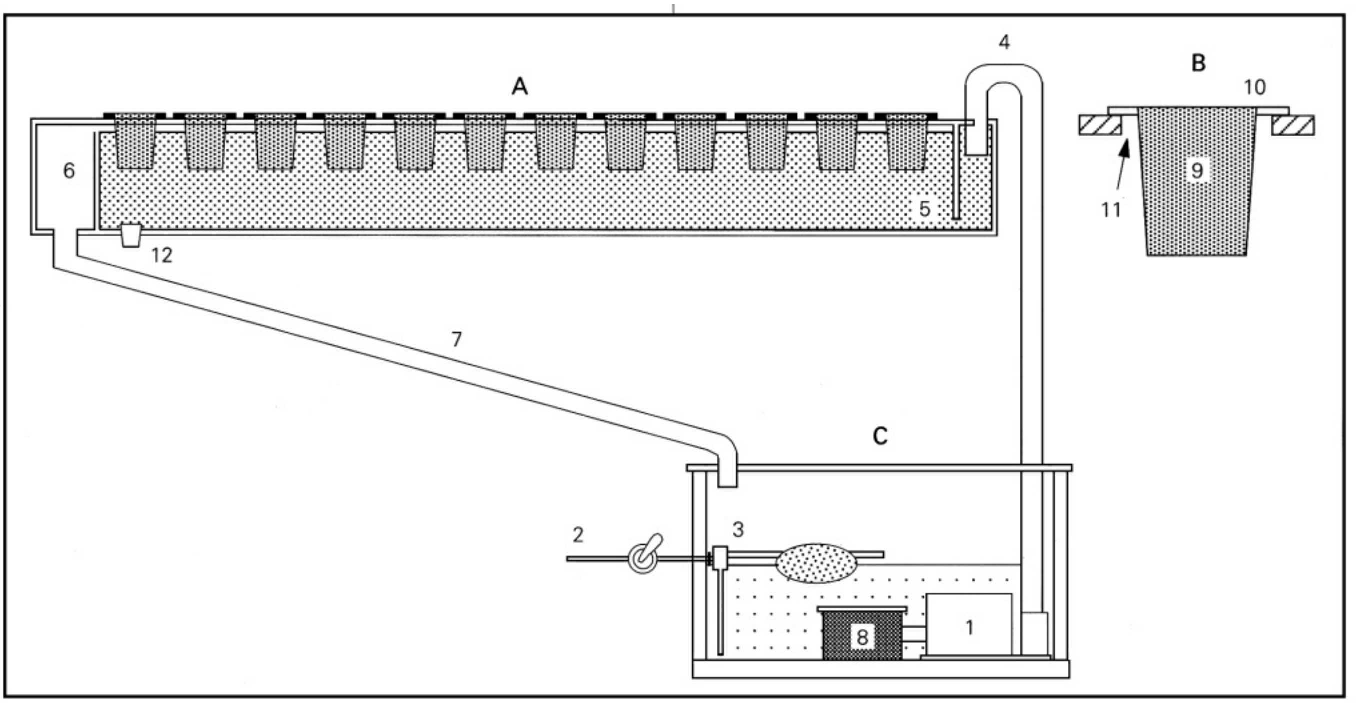
The culture solution is the Hoagland solution modified by substituting KC1 and $CaCl_2$ for KNO_3 and $Ca(NO_3)_2$ and diluting by adding 2 parts of the medium to 3 parts water.

The culture medium and filters are replaced every 4 wk and excess *Azolla* biomass is thinned. The culture medium in the main tank is drained by releasing the stopper.

Collecting, transporting, and mailing

Appendix I explains documentation required for sending strains to or receiving them from IRRI.

Because *Azolla* is sensitive to desiccation, samples should be transported as fresh material.



2. Design for the regulated culture of *Azolla* (UCL method). A = culture tank in 10-mm tinted aluminum (3600 x 600 x 120 mm, 200 liters); B = culture net; C = buffer tank (600 x 400 x 200 mm, 40 liters); 1 = centrifuge pump (EHEIM model 1036; flow rate 1 liter/s), 2 = input of demineralized water; 3 = constant level device; 4 = culture medium input; 5 = antifoam screen; 6 = medium outflow; 7 = outflow tube; 8 = filter (hydrophilic cotton); 9 = nylon mesh (0.1 mm^2); 10 = PVC ring (88-72 mm diam); 11 = hole in the tinted altuglass lid (72 mm diam); 12 = stopper.

Take great care to eliminate excess water surrounding *Azolla*. Otherwise they will rot quickly. They should not be exposed to high temperatures.

In the field, collect a handful of *Azolla,* press it firmly in your hand or drain carefully on toilet paper. Discard the paper and put the sample in a petri dish or a plastic bag. Seal and maintain in a cool place until you reach your final destination. If well-drained and sealed, *Azolla* can survive in the vegetable compartment of a refrigerator for at least 2 wk.

During long-distance travels, keep *Azolla* samples in hand-carried baggage. When in airplanes or in hotels, store samples in a refrigerator.

Azolla samples prepared as described above and sent by airmail may survive for 10 or more days, depending on the transport conditions. Courier service may be preferable.

Some characteristics of *Azolla* strains

For a complete list of IRRI's *Azolla* collection, see pages 37-51. Table 7 gives partial information on some strains in the collection. A data base of *Azolla* characteristics is being prepared.

Table 7. Information on some of IRRI's *Azolla* strains.

Representative strains (strains with confirmed identification)

IRRI Acc No	Species and subspecies
PI 0005	*A. pinnata* var. *imbricata*
PP7001	*A. pinnata* var. *pinnata* (from Australia)
PP7501	*A. pinnata* var. *pinnata* (from Africa)
FI 1001	*A. filiculoides*
ME2001	*A. mexicana*
CA3001	*A. caroliniana*
MI 4018	*A. microphylla*
NI 5001	*A. nilotica*
RU6501	*A. rubra* (from New Zealand)

High temperature-sensitive (sensitive to temperatures more than 33°C)

Many accessions of *A. filiculoides* and *A. rubra*

High temperature - tolerant

Most productive strains in Los Baños. MI 4018, MI 4510, CA 3511, and CA 3514

Most productive strains in Senegal: PI 0502, PI 0503, PI 0520, and MI 4030

Large plant

NI5001

High N content (more than 4% N)

MI 4028 and MI 4030

Al^{+3}- tolerant (tolerance observed at 8 ppm Al^{+3}, pH 3.7)

PP 7000 series

Low N content (less than 2.5% N)

PP 7001-PP 7004

Low tolerant (less than 0.08% P)

PI 0023, PP 7001-PP 7004. *Azolla* section strains are less tolerant, but strains MI 4138 and MI 4073 are tolerant.

Insect-tolerant

PP7001

Desication-tolerant (recover easily after dry season or winter)

CA3001

Easily sporulating

Most productive strains in Baguio, Philippines: PI 0001, PI 0002, PI 0003, PI 0004, PI 0005, PI 001 1, PI 0013, PI 0029, PI 0038, PI 0039, PI 0044, PI 0049, PI 0056, PI 0064, PI 0070, PI 0080, FI 1001, FI 1040, FI 1540, ME 2001, ME 2002, ME 2007, ME 2012, ME 2014, ME 2024, ME 2025, ME 2026, ME 2027, CA 301 9, CA 351 0, CA 3512, CA 3522, MI 4014, MI 4018, MI 4021, MI 4028 (male only), MI 4030 (male only) MI 4034, MI 4052, NI 5001, NI 5501, PP 7001 (male only). and PP 7517

Blue-green Algae

The blue-green algae (BGA) collection contains 204 strains from 21 countries. About 45% of the strains are from Africa and 40% are from Asia (Table 8, Fig. 3). The strains are classified into 12 taxa. *Nostoc, Anabaena,* and *Calothrix* are the predominant genera. The working collection contains selected strains that are representative of ricefield BGA. The collection's primary purpose is to make available a range of reference strains for field and laboratory experiments and for developing a simplified classification for agronomical and ecological studies. Therefore most strains are kept as unialgal material. Only a few axenic strains obtained from other laboratories (mainly the Pasteur Institute in France) are maintained.

Identification of accessions

Taxonomy. Traditional classifications (Geitler 1930-32, Desikachary 1959), based almost entirely upon morphological features, seldom help identify BGA species and, sometimes, genera. Taxonomists have not resolved BGA identification problems. New methods are tentative and are rarely compatible with routine treatment of the numerous soil samples required in ecological and agronomic studies.

For the BGA collection, we have adopted the classification of Rippka et al (1979). This classification is limited to genera and uses morphological criteria directly observed on laboratory cultures. *Aphanothece, Nostoc,* and *Gloeotrichia* form mucilaginous colonies of defined shape. This characteristic is associated with resistance to grazing (Grant et al 1985) and therefore has major ecological significance in ricefields. Thus we have added *Gloeotrichia* to the genera recognized by Rippka.

We have also retained the original genus names of two frequently mentioned "historical species" — *Tolypothrix tenuis* and *Westiellopsis prolifica.* According to Rippka et al, these strains should be classified as *Calothrix* and *Fischerella,* respectively.

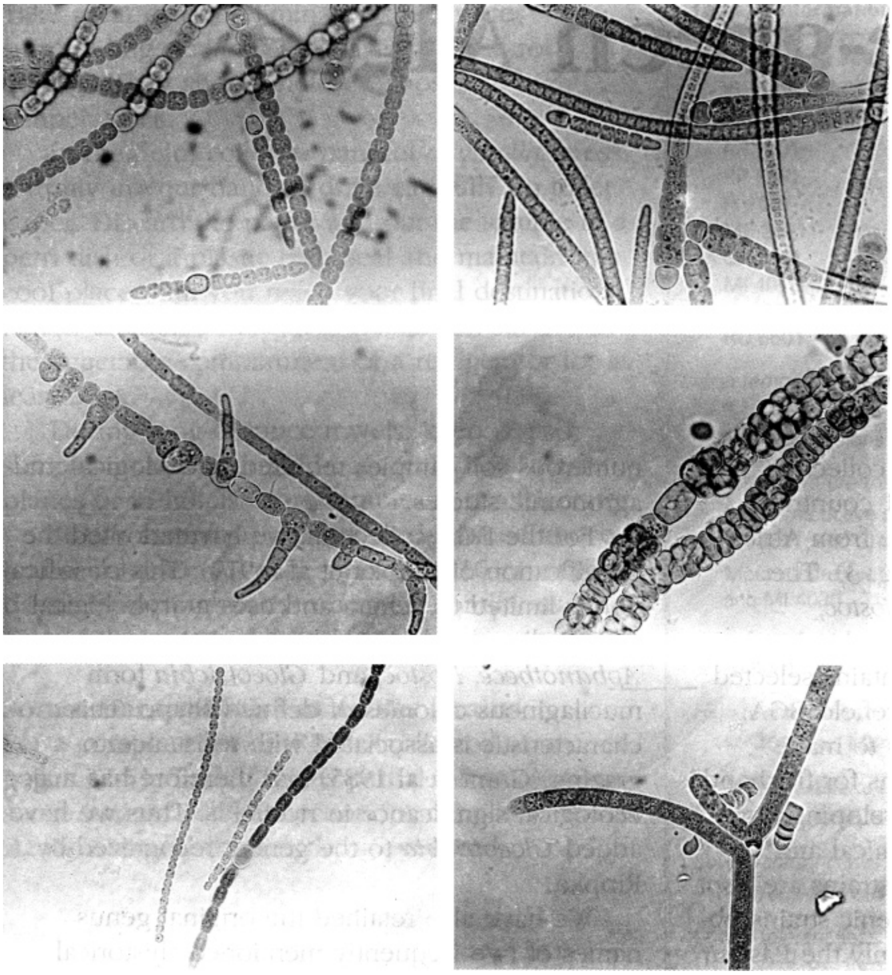
We use the following definitions and criteria to identify the genera of the collection's N_2-fixing BGA:

Unicellular· N_2-fixing group

- *Aphanothece*—unicellular strains that grow on BG-11 medium without N. Forms

Table 8. Number and origin of the blue-green algae collection. IRRI, 1991.

Genus	Africa		Asia		Europe	Other regions	Total	Figure
	Senegal	Others	Philippines	Others				
Anabaena	13	5	7	15	5	5	50	3a
Calothrix	23	2	11	7	1	1	45	3b
Fischerella	4	2	4	3	1	0	14	3c,d
Gloeotrichia	0	0	2	0	0	0	2	
Nodularia	0	0	0	1	0	0	1	
Nostoc	28	9	12	17	4	1	71	3e
Scytonema	1	3	1	4	0	0	9	3f
Tolypothrix	0	0	0	2	1	0	3	
N_2-fixing	69	21	37	49	12	7	195	
Non-N_2-fixing	8	0	0	0	1	0	9	
Total	77	21	37	49	13	7	204	



3a. *Anabaena* sp. (Ab 18 Ns). Width of the hormogonia is similar to that of the mature filament (left photo).

3b. *Calothrix* sp. (Cx 11 Sn). Note the terminal heterocyst and the tapering of the filaments. The hormogonia are markedly thinner than the apical end of the mature trichomes (right photo).

3c. *Fischerella* sp. (Fi 09 XX). Note the true ramifications. Prlmary axes are uniseriate in this young culture (left photo).

3d. *Fischerella* sp. (Fi 04 Mr). Note the pluriseriate primary axis and the angular heterocyst (right photo)

3e. *Nostoc* sp. (Ns 13 Ph). The hormogonia are markedly thinner than the mature filament. This strain is characterized by hormogonia that elongate greatly before thickening. Thus, cultures may appear to be a mixture of two strains (left photo).

3f. *Scytonema* sp. (Sc 01 SL). Note the geminate ramifications and the angular heterocysts (right photo).

mucilaginous macrocolonies on agar medium. In situ, forms floating mucilaginous macrocolonies.

Anabaena group

- *Anabaena* — heterocystous strains, nonbranching, with a thin mucilaginous sheath usually visible in ordinary microscopy only with coloring agents. Hormogonia are the same size as the trichome. In situ, forms a fragile film at the surface of the water or grows within the floodwater; does not form mucilaginous colonies of definite shape.
- *Nodularia* — *Anabaena* with disk-shaped vegetative cells.
- *Cylindrospermum* — *Anabaena* with heterocysts exclusively terminal at both ends of the trichome; akinetes always adjacent to heterocyst.

Nostoc group

- Heterocystous strains, nonbranching, with a thin or thick mucilaginous sheath usually visible in ordinary microscopy only with coloring agents. Hormogonia are thinner than the mature filament. In situ, forms mucilaginous macrocolonies of definite shape.

Strains originally identified as *Wollea* are inclucled in this group.

Calothrix group

- *Calothrix* — heterocystous strains with false branching, polarity, frequently tapering. A dense sheath of variable thickness is usually visible in ordinary microscopy without coloring agent. *Calothrix* forms velvet-like patches on agar medium. In situ, grows adpressed on soil or epiphytically. *Aulosira* is included in this group.
- *Gloeotrichia* —similar to *Calothrix,* but forms mucilaginous colonies of definite shape in situ. When grown on $BG\text{-}11_0$, ussually loses its ability to form mucilage and looks like a *Calothrix.* Strains classified as *Gloeotrichia* were identified when collected as colonies in the field.

Scytonema group

Have square heterocysts, both geminate and Y-shaped False branching. A dense sheath of variable thickness is usually easily visible with ordinary microscopy without preparation. No polarity and usually no tapering. Hormogonia are the same width as the trichome. Frequently forms penicillate colonies on agar medium. In situ, grows adpressed on soil or epiphytically. We have not observed growth visible to the naked eye in a ricefield.

Fischerella group

Includes all heterocystous strains with true branching. Often forms penicillate colonies on agar medium. In situ, grows adpressed on soil or epiphytically. We have not observed growth visible to the naked eye in a ricefield.

Code. Strains are named with a six-character code (e.g., Ab 05 Sn). The first two letters indicate the taxon (genus or group). The second and third digits refer to ranking number within the taxon. The last two letters indicate the country of origin. Thus Ab 05 Sn means *Anabaena* number 05 originating from Senegal. Because of controversial aspects of BGA taxonomy, we do not use species names. Codes for taxa and locations are in Talk 9.

Information about the strains. We compiled information on the BGA collection in a set of six interconnected HyperCard stacks for Apple Macintosh computer.

The main stack (called "Collection," currently 236 K) provides information on the strains. Each card corresponds to a strain and includes, when available:

— information on the origin, the history of the strain. and its original environment:
— description of cultures in liquid and on solid media, and as seen under a microscope; and
— additional notes and bibliographic references on the strain or its environment.

The stack called "Describe" (200 K) is an on-screen tool for establishing standardized macro- and micromorphological descriptions of the strains.

The "Keys" stack (160 K, 69 cards) provides on-screen taxonomic keys for BGA genera encountered in ricefields.

The "Glossary" stack (53 K) provides definitions of specific terms or concepts, including terms used to describe BGA in the stack "Describe."

Table 9. Taxon and location codes for blue-green algae.

Genus	Abbreviation	Location	Abbreviation
Anabaena	Ab	Australia	Au
Calothrlx	Cx	Austria	As
Fischerella	Fi	Canary Islands	Cn
Gioeotrichia	Gl	Cnina	Ch
Oscillatoria	Os	Chile	Cl
Nostoc	Ns	Egypt	Eg
Lyngbia [a]	LP	England	En
Nodularia	Nd	India	In
Phormidium [a]	LP	Iran	Ir
Plectonerna [a]	LP	Japan	JP
Pseudanabaena	Ps	Madagascar	Mr
Scytonema	Sc	Malaysia	Ms
Synechococcus	Sy	Mali	Ml
Tolypothrix	Tx	Netherlands	Ns
		Portugal	Pr
		Philippines	Ph
		Senegal	Sn
		Sri Lanka	SL
		Sweden	Sw
		Thailand	Th
		USA	US
		Unknown	XX

[a] Lyngbia, Phormidium, Plectonema (LPP) group.

The "Methods" stack (25 K) provides information on routine methods for BGA.

The "Sites" stack (24 K) provides information on the environments from which the strains originate.

The stacks are user-friendly, with on-screen help and many features that can easily be learned while experimenting with the program.

The blue-green algae culture collection at IRRI, a booklet available from IRRI's Soil Microbiology Division, describes the BGA strains and the methods for isolating, culturing, and conserving them.

Conservation methods

All strains are maintained by subculturing in liquid media and on agar slants. Some unialgal strains (including those frequently used in inoculation experiments) are also maintained as soil-based, dry-powdered inocula.

Culture media. The most useful media for isolating and culturing BGA from ricefields are BG-11 (Rippka et a1 1979) and its N-free modification BG-11_0 used for N_2-fixing strains. Stock solutions are listed in Table 10.

Prepare *BG-11 media for non-N_2 -fixing BGA* (nonselective) as follows:

- *Liquid medium:* Dilute 5 ml of stock solutions 1-7 and 1 ml of oligoelement solution to 1 liter. Autoclave for 15 min at 120°C.

Table 10. Stock solutions for BG-11 and BG-11_0 media for BGA (Stanier et al 1971).

Stock solutions (g/liter) (Concentrated 200 times)		Solution of oilgoelements (g/liter) (concentrated 1000 times)	
$NaNO_3$	300.0	H_3BO_3	2.86
K_2HPO_4	8.0	$MnCl_2 \cdot 4H_2O$	1.81
$MgSO_4 \cdot 7H_2O$	15.0	$NaMoO_4 \cdot 2H_2O$	0.39
$CaCl_2 \cdot 2H_2O$	7.2	$CuSO_4 \cdot 5H_2O$	0.079
NH_4 citrate Fe(III)	1.2	$Co(NO_3)_2 \cdot 6H_2O$	0.0494
+ citric acid	1.2		
$Na_2EDTA \cdot 2H_2O$	0.2		
Na_2CO_3	4.0		

- *Solid medium for petriplates and agar slants:* Add 1% Bacto agar to the liquid medium.

Prepare the *liquid medium for mass BGA culture* ($Na_2CO_3 \times 5$) as follows:

Using 5 ml/liter of solutions 1-6, 25 ml/liter of solution 7, and 1 ml/liter of the oligoelement solution, prepare the medium in a 4-liter flask and transfer after sterilization into a 20-liter reagent bottle. Sterilize the reagent bottles in a hot air oven at 160 °C for 2 h. Before inoculating BGA, bubble the medium with CO_2-enriched air until clear (pH 7-7.4).

To prepare *BG-11_0 media for N_2-fixing BGA,* omit Solution 1.

Conservation by subculturing. For liquid cultures, the medium level in the flask should be low enough to allow a good supply of CO_2. We use 100 ml of medium in 250-ml erlenmeyer flasks or 50 ml in 125-ml flasks, corresponding to about 2 cm of medium.

Generally, BGA grow slowly—24-h generation times are common. To avoid too frequent transfers, use very small inocula. Transfer when necessary (usually once every 2 mo) by inoculating a loopful of culture into 100 ml medium in a 250-ml erlenmeyer flask. Keep newly inoculated flasks under dim light for 24 h and then place 25 cm below 20-watt fluorescent tubes in open shelves at laboratory temperature. Keep the old cultures until the new culture is established. Examine cultures weekly for color changes, especially bleaching, and contaminations.

For agar slant, we use BG-11 and BG-11_0 solidified with 1% Bacto agar.

Strain properties may change during repetitive subculturing after long-term cultivation under laboratory conditions. Some of the collection's strains have abnormal cells.

Conservation as dry material. Because BGA resists desiccation, it can be preserved as dried material. Three methods are listed below—two for long-term conservation, one primarily for mailing. However, methods of preservation by desiccation are not fully established.

To conserve soil-based inoculum, produce soil-based inocula in erlenmeyer flasks or on petri plates, on soil previously autoclaved at 120 °C for 30 min for 3 consecutive days. Dry the material at room temperature and keep at laboratory temperature in plastic bottles. When the strain is needed, plate suspension-dilutions of the algal flakes on petri dishes. Grow isolated colonies in a liquid medium.

BGA grown by this method have high viability. Of 70 strains tested, 67 regrew after 20 mo. However about 30% of the strains were contaminated with soil algae—mostly diatoms. Thus, soil must be thoroughly sterilized.

To *conserve* as *dry powder,* harvest by decanting BGA that was produced in mass culture. Dry at room temperature.

This method successfully conserved all 10 strains of heterocystous BGA that we tested for long-term conservation. Dried and powdered cultures regrew after 8 yr of storage.

The *conserve on paper strips,* decant cultures grown in 125-ml erlenmeyer flasks and deposit on 1 × 5-cm strips of sterile Whatman chromatography paper no. 3. Dry the paper strips in a sterile hood at room temperature and place them in sealed polyethylene bags to avoid contamination or absorption of humidity.

For long-term conservation, this method is less efficient than soil-based inocula or dried and powdered cultures. Of 136 N_2-fixing strains, 30 were lost after 16 mo of storage; 129, after 30 mo. However, the method is very convenient for mailing.

Sending and reviving blue-green algae

Appendix 1 explains documentation required for sending strains to and receiving them from IRRI.

Upon request, IRRI will mail strains, the booklet, and copies of the HyperCard stacks with descriptions of and information about the strains. Strains of BGA are provided free of charge, but IRRI requires acknowledgment in papers that report experiments using these strains. HyperCard stacks are provided free on receipt of two 3½-in double-sided diskettes. The stacks are not protected and can be modified. They must be used with a Macintosh computer, a hard disk, and the HyperCard 2 program.

We send cultures as dried material on paper strips because they remain viable for several months and are easily mailed and revived in liquid medium.

To preserve the strains on paper, see page 14.

To regrow the strains, place about 1 cm of the paper in a 50-ml erlenmeyer flask with 1 cm of BG-11_0 medium. After 1 d in the laboratory without direct illumination, place the flask under continuous fluorescent light (about 600 lx). Remove the paper material as soon as algal growth is visible.

Some characteristics of blue-green algae strains

See pages 53-59 for a complete list of IRRI's RGA collection.

Table 11 presents some strain characteristics.

Table 11. Characteristics of some BGA strains.

Strains that produce homogeneous growth in liquid cultures			
Ab 04 Eg	Ab 05 Sn	Ab 07 Ch	Ab 25 Ch
Ab 26 Sn	Ab 29 Sn	Ab 30 Sn	Ab 32 SL
Ab 34 Sn	Ab 38 Sn	Ab 41 Sn	Ab 45 Pr
Ab 46 Sn	Ab 51 XX	Ns 11 Ph	Ns 15 Ph
Ns 29 As	Ns 34 Sn	Ns 38 Sn	
Strains that form macrocolonies in vitro			
Ns 20 Mr	Ns 21 Ph	Ns 27 Th	Ns 39 Sn
Ns 51 Sn	Ns 50 Sn	Sc 01 SL	Sc 02 SL
Sc 04 Sn	Sc 05 Ph		
Strains from saline environments			
Ab 18 Ns	Ab 21 In	Ns 70 Ml	Cx 25 As
Cx 37 Sn	Cx 39 Sn	Fi 15 As	Ns 30 As
Ns 34 Sn	Ns 69 Sn		
Strains studied in inoculation experiments			
Tx 02 Jp	Fi 09 XX	Ab 50 SL	Ab 25 Ch
Fi 08 Ph			
N-excreting strain (derepressed mutant)			
Ab 52 XX			

Aquatic Legumes–Rhizobia

The Soil Microbiology Division of IRRI collects seeds of aquatic legumes that can be used as green manure or fodder crops in flooded ricefields. Three genera of aquatic legumes are known — *Aeschynomene, Neptunia,* and *Sesbania.* No other organization collects primarily aquatic legumes. IRRI has 45 accessions of *Aeschynomene,* with 44 known and 1 unidentified species; 2 accessions of *Neptunia;* and 39 accessions of *Sesbania,* with 35 known and 4 unidentified species.

We isolated 104 strains of symbiotic rhizobia that were associated with 23 host legumes (Table 2, p. 3). In addition to the isolated strains. we store 66 reference Rhizobiaceae strains from other sources.

Identification of accessions

Because the identification of aquatic legumes species requires special skills, the unidentified accessions were sent to the Royal Botanical Gardens at Kew, England. (See Allen and Allen [1981, Gillet et a1 [1971], and Anonymous [1954] for literature in identifying *Sesbania* and *Aeschynomene* species.)

Recent Rhizobiaceae classifications include three genera — *Rhizobium, Bradyrhizobium,* and *Azorhizobium.* Rhizohia collections isolated from the stem nodules of *Sesbania* and *Aeschynomene* include all genera. Species or genus identification of these isolates is in progress.

Aquatic legumes are named using a 5-digit code. The first digit indicates the genus (1—*Aeschynomene,* 2 — *Sesbania,* and *3—Neptunia*). The second digit refers to the nodulation pattern/location (1 — root nodules, 2 — root and submerged stem. 3—root and stem [sparse], and 4—root and stem [profuse]). The last three digits indicate the original accession number of the seeds.

Conservation methods

Seeds are refrigerated. Plants are grown periodicallv for seed production. *Rhizobium* strains are preserved under lyophilized conditions.

Sending accessions to IRRI

Appendix I explains documentation required for sending accessions to or receiving them from IRRI.

IRRI welcomes contributions that augment the collection. At least 4-wk advance notice is needed to obtain the required import permit.

Depositors who want their material identified should send IRRI a herbarium specimen of plant material prepared as follows:

Select a good flowering branch free from disease. Wash the root portion thoroughly to remove soil and sand particles. Neatly spread out all plant parts (such as leaves and flowers). If necessary, prune to prevent overlapping, leaving the basal portion to indicate leaf positions.

For ventilation, place the specimen between sheets of absorbent paper or newspaper and corrugated cardboard. Place the specimen equidistant from all sides of the bundle. Press sides uniformly together with two plywood frames which are tied by straps. Daily for 6-10 d (depending on the weather). tighten the straps and change the blotters. The drying process may be hastened by placing the press under the sun or in a drying chamber.

After the specimen is pressed and dried, fix it on a mounting sheet. Place one labeled specimen per sheet. Send seeds with the sample, as they may be required for identification. Mature seeds should be dried, placed in a packet. and mounted with the specimen.

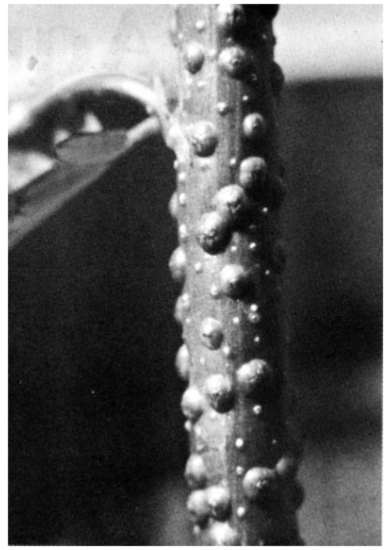
Some characteristics of the legume and rhizobia accessions

See pages 61-62 for a complete list of IRRI's aquatic legumes collection and page 63 for the rhizobia collection.

Legume stem nodulation. Many *Sesbania* and *Aeschynomene* species have nodules on the stems. Nodulation appears in three patterns.

- Type A—profuse nodulation (Fig. 4) all over the stem (S. *rostrata, A. afraspera, A. nilotica).*
- Type B—sparse nodulation on the aerial stem but good nodulation on the submerged portion (*A. aspera, A. cilita, A. denticulata, A. evenia, A. indica, A. pratensis, A. rudis, A. schimperi, A. scabra, A. sensitiva, A. tambacoundensis).*
- Type C—no nodulation on the aerial stem and sparse nodulation on the submerged stem (*A. crassicaulis, A. ptundii, A. villosa, A. elaphroxylon, S. sesban, S. emerus, S. speciosa, S. javanica, Neptunia oleracea).*

Recommended accessions for green manure. Sesbania cannabina #21044 and S. *rostrata* #24027 or #24062 are fast-growing, high N_2 fixers. *S. rostrata* is more tolerant of flooding than is *S. cannabina. S. cannabina* is slightly more tolerant of drought. N_2 fixation of *S. rostrata* is more tolerant of combined N than that of *S. cannabina.* The period of flowering in Los Baños ranges from 33 d (short-day season) to 132 d (long-day season) for *S. rostrata,* and 37 to 80 d for *S. cannabina. S. rostrata* needs seed scarification but *S. cannabina* does not.



4. Stem nodules of *Aeschynomene afraspera.*

Some characteristics of the bacterial symbionts. Azorhizobium caulinodans ORS 571 is the first strain obtained from *S. rostrata* stem nodules, and is used widely by many genetic studies. Strain 46 is similar to ORS 571. Except for *A. americana,* strains of rhizobia from *Aeschynomene* can produce bacteriochlorophyll a under light-aerobic and heterotrophic conditions. *Aeschynomene* and *S. rostrata* rhizobia can fix N_2 in free-living conditions with no additional requirements of combined N.

Free-living N_2-fixing Bacteria

The collection has 25 strains of N_2-fixing bacteria that were isolated at IRRI from the roots, stems, and decaying straw of wetland rice. *Pseudomonas diazotrophicus* IRBG 183 is registered as ATCC 35402. In addition, IRRI maintains 90 reference strains (20 genera) of N_2-fixing and non-N_2-fixing bacteria obtained from other sources. IRRI does not collect pathogenic bacteria.

Conservation, mailing, and revival

All strains are preserved under lyophilized conditions, and are sent from IRRI as lyophilized cultures in ampules.

To open the ampules, heat the tip of the vial in a flame. Add a few drops of water on the hot tip to crack the glass. Strike with a file or pencil to remove the tip. Carefully remove the cotton plug with sterile forceps. With a Pasteur pipette, aseptically add 0.3-0.4 ml of liquid medium to the freeze-dried material. Mix well and transfer the mixture to a test tube of the recommended medium.

The collection

See page 65 for a complete list of IRRI's collection of free-living N_2-fixing bacteria.

Identification of *Azospirillum P. diazrotrophicus, Klebsiella planticola,* and *Enterobacter cloacae* were established by using cultural methods, immunological methods, and analysis of quinone and fatty acids. The species of IRBG numbers 226, 202, 205, 207, and 208 are not identified.

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APPENDIX I

Quarantine Requirements

As an international organization hosted by the Republic of the Philippines. IRRI complies with national regulations for the export and import of living material (Presidential Decree No. 1433, 1978, Bureau of Plant Industry Quarantine Administrative Order No. 1 Series of 1981).

To obtain strainsfrom IRRI, the following process is required:

1. Request the desired germplasm from IRRI's Soil Microbiology Division. If *Azolla,* legumes, or bacteria are desired, ask IRRI to provide you with a copy of the request form appropriate to the organism (for samples, see Figs. 5, 6, and 7). Complete the form and return it to IRRI. If the country to which the material is being sent requires an import permit for strains sent by IRRI, send the required import documents with the request.
2. Soil Microbiology Division prepares the material. Leguminous seeds are first sent to IRRI's Seed Health Unit where they are examined for seed sanitary condition. All material is sent to the Plant Quarantine Office (PQO) for inspection, with an application form for inspection and phytosanitary certification attached. PQO issues the Phytosanitary Certificate which must accompany all exported germplasm material. Figure 8 lists information IRRI requires to complete the application form for inspection and phytosanitary certification. Send this information with the request form.
3. IRRI requires at least 2 wk to grow the requested material and have certification accomplished.

To send strains to IRRI, write to the Soil Microbiology Division, providing information about the strains to be sent. Figure 9 lists information IRRI needs to complete the Philippine government's Permit to Import Plants. After receiving this information, IRRI will apply for the import permit. One permit is required for each batch sent to us. The permit must be included in the parcel of germplasm material sent to IRRI.

***AZOLLA* GERMPLASM COLLECTION**
Soil Microbiology Division
The International Rice Research Institute
Los Baños, Laguna, Philippines

To : Division Head, Soil Microbiology Date ____________________

From : ____________________
Name of requester

We request the following *Azolla* samples from your collections:

Quantity	Species/strain no.	Purpose	Date needed	Availability

For IRRI use only

Approved by: ____________________
Division Head

____
Signature of requester

Prepared by: ____________________
Research Assistant

____
Date

____
____
____
Organization and Address

5. Azolla request form.

LEGUMINOUS GREEN MANURE GERMPLASM COLLECTION
Soil Microbiology Division
The International Rice Research Institute
Los Baños, Laguna, Philippines

Date ____________________

We request the following green manure seeds:

Quantity	Genus	Species	Accession no.
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______

Purpose:

____
____
____

Requested by:

Name ____________________

Organization and Address

Import permit

Number: ____________________
Country: ____________________
Date: ____________________
Issuing authority: ____________________

Phytosanitary certificate

For IRRI use only

Approved by:

____
Soil Microbiologist

____
Division Head/Soil Microbiology

Prepared by:

____
Research Assistant

____
Date

6. Leguminous green manure request form.

BACTERIAL GERMPLASM RESOURCES
Soil Microbiology Division
The International Rice Research Institute
Los Baños, Laguna, Philippines

To : Division Head, Soil Microbiology Date ______________________

From : ______________________
Name of requester
____
____
____
Organization and Address

We request the following bacterial cultures:

Quantity	**Genus**	**Species**	**Strain**

Purpose:

____
____
____

For IRRI use only

Approved by:

____
Soil Microbiologist

____
Division Head/Soil Microbiology

Prepared by:

____
Research Assistant

____
Date

7. Bacteria request form.

1. Common name of requested specimen ______________________________
2. Scientific name of requested specimen ______________________________
3. Quantity requested (specify no. of pieces for plants, and weight in kg for plant products) ______________________________
4. Name and address of consignee ______________________________
5. Port of entry ______________________________
6. Means of conveyance ______________________________
7. Flight or voyage no. ______________________________
8. Departure date ______________________________
9. Import permit no., or additional declaration or treatment if needed ______________________________

8. Information required for IRRI to complete the application form for inspection and phytosanitary certification.

1. Common name of requested specimen ______________________________
2. Scientific name of requested specimen ______________________________
3. Quantity requested (specify no. of pieces for plants, and weight in kg for plant products) ______________________________
4. Origin or source of specimen (Name, address and country) ______________________________
5. Purpose of importation ______________________________
6. Port of entry ______________________________
7. Means of conveyance ______________________________
8. Flight or voyage no. ______________________________
9. Expected date of arrival ______________________________

9. Information IRRI requires to complete the application form for the permit to import plants or plant products.

APPENDIX II
Collections at IRRI

The IRRI collections described in previous chapters are listed in Appendices IV to VIII. The Azolla and aquatic legumes collections are intended to be as complete as possible. The BGA, rhizobia, and free-living N_2-fixing bacteria collections are working collections. Original codes, country of origin, location and origin, source and year of collection are recorded as provided by donor. Abbreviations (except in codes) are defined in Appendix III.

Azolla

Legend

Code 1	Current code used at IRRI
Code 2	Code previously used by IRRI or by original source.
Country of origin	Country where specimen was collected. 0 unknown origin 1 questionable origin
Location and/or Origin	Location where specimen was originally collected (as per information of donor); for hybrids, the original code by source (in italics). AO *Anabaena* outside the plant cavity during part of the growth cycle.
Source	Organization which or person who provided IRFU with the specimen.
Year	Year collected by original source and acquired by IRRI. Where the year of acquisition is different from the year of collection, acquisition year is in parenthesis—e.g., 1976(86)

Notes: Abbreviations:

AF	*Anabaena* -free
AH	algal hybrid
MU	mutant
SH	sexual hybrid
SP	progeny after sexual propagation. As all algal hybrids (AH) and sexual hybrids (SH) are also SP, SP is not indicated for them.

Blue-green Algae

Year is the year the strain was isolated and the year it was acquired by IRRI. The year of acquisition is in parenthesis where it differs from the year of isolation.

Rhizobia

Abbreviation:

UNID	Unidentified
SN/WLRS	Stem nodule from plant grown in wetland rice
RN/WLRS	Root nodule from plant grown in wetland rice
RN/DLRS	Root nodule from plant grown in dryland rice

APPENDIX III

Abbreviations

ADRAO	Association pour le Developpement de la Riziculture en Afrique de l'Ouest
ADUL	Accession de l'Université de Louvain
AGCD	Administration Générale de la Coopération au Développement, Belgium
ATCC	American Type Culture Collection, USA
BNF Res. Ctr,	Biological Nitrogen Fixation Resource Center, Thailand
BRRI	Bangladesh Rice Research Institute, Bangladesh
CAAS	Chinese Academy of Agricultural Sciences, China
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CNPAF	Centro Nacional de Pesquisa de Arroz e Feijao, GoianIa, Brazil
CRRI	Central Rice Research Institute, Cuttack, Orissa, India
cs	Culture solution
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSSRI	Central Soil Salinity Research Institute, India
DA	Department of Agriculture (or national equivalent)
ENS	Ecole Normale Superieure, Bamako, Mali
FAAS	Fujian Academy of Agricultural Sciences, China
FAO	Food and Agriculture Organization (United Nations)
GH	Greenhouse
GTZ	Deutsche Gesselschaft für Technische ZusammenarbeIt, Germany
Hunan AAS	Hunan Academy of Agricultural Sciences, China
IAEA/FAO	International Atomic Energy Agency/ Food and Agriculture Organization (United Nations)
IAM-UT	Institute of Applied Microbiology, The University of Tokyo, Japan
IB China	Institute of Botany, Academia Sinica, Beijing, China
IBS	Institute of Biological Sciences, University of the Philippines at Los Baños, Philippines
IITA	International Institute of Tropical Agriculture, Nigeria
IRBG	IRRI Bacterial germplasm
IRGA	Instituto Rio Grandense do Arroz, Rio Grande do Sul, Brazil
IRRI	International Rice Research Institute, Los Baños, Philippines
KFSC	Kenya Forestry Seed Center, Kenya
LB	Los Baños, Philippines
NAAP	National Azolla Action Program, University of the Philippines at Los Baños, Philippines
NCRB	National Center for Research in Biotechnology, Indonesia
NIAB	National Institute of Atomic Biology, Faisalabad, Pakistan
Niftal-UH	Nitrogen Fixation of Tropical Legumes Projects, The University of Hawaii, USA
ORSTOM	Institut Français de Recherche Scientifique pour le Développement et Coopération (Office de la Recherche Scientifique et Technique Outre-Mer·) France
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines
TNAU	Tamil Nadu Agricultural University, India
UCL	Université Catholique de Louvain. Belgium
UPLB	University of the Philippines at Los Baños
UPMN	IRRI field location

APPENDIX IV

Azolla Collection

(as of June 1991)

IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
A. pinnata var. *imbricata* (PI)							
PI 0001	Bicol 1	-	Philippines	Santo Domingo, Albay	IRRI	1975	-
PI 0002	Malaysia	-	Malaysia	Bumbong Lima, Butterworta	IRRI	1977	-
PI 0003	Bogor 1	-	Indonesia	Bogor, Java	IRRI	1977	-
PI 0004	Banawe 1	-	Philippines	Ifugao	IRRI	1977	-
PI 0005	Bangkok	-	Thailand	Bangkok	T. Lumpkin	1977	-
PI 0006	DAT 15	-	Thailand	Bangkok	DA Thaiand	1977	-
PI 0010	Sri Nagor	-	Bangladesh	Sri Nagor, Dhaka	BRRI	1978	-
PI 0011	Tangail	-	Bangladesh	Tangail	BRRI	1978	-
PI 0013	Khumaltar	-	Nepal	Lalitpu r	DA Nepal	1978	-
PI 0017	V. Green 1	-	Vietnam	Haroi		1978	-
PI 0018	V. Green 2	-	Vietnam	Haroi	DA Vietnam	1979	-
PI 0019	V. Purple	-	Vietnam	Haroi	DA Vietnam	1979	-
PI 0020	V. Wild	-	Vietnam	La Van, Thai Vinh	DA Vietnam	1979	-
PI 0021	P.T. Zhu	-	China	Fuijeng	FAAS	1978	-
PI 0022	Tancheng	-	China	Tancheng, Shandong	FAAS	1979	-
PI 0023	Cuttack 1	-	India	Cuttack, Orissa	CRRI	1978	-
PI 0024	Florldab 2	-	Philippines	Florida blanca, Pampanga	IRRI	1980	-
PI 0025	I. Coast 1			Reclassified , see PP 7006			
PI 0026	Senegal 2			Reclassified , see PP 7007			
PI 0029	Changsha	-	China	Changsha	Hunan AAS	1980	-
PI 0031	Yi Ling	-	China	Yi Ling	FAAS	1980	-
PI 0032	Jianci	-	China	Jianci	FAAS	1980	-
PI 0033	Nanchun	-	China	Nanchun - Xujien	FAAS	1980	-
PI 0034	Majayjay	-	Philippines	Majayjay Laguna	IRRI	1980	-
PI 0036	Cagayan	-	Philippines	Minanga Norte, Iguig, Cagayan	IRRI	1980	-
PI 0037	Viet. T. G-2	-	Vietnam	Long Dinh Province	DA Vietnam	1980	-
PI 0038	Viet. T. G-3	-	Vietnam	Tien Gieng, Long Dinh Province	DA Vietnam	1980	-
PI 0039	MIA-Aus.	-	Australia	Grifitn New South Wales	IRRI	1980	-
PI 0040	Garut 1	-	Indonesia	Garut City, West Java	IRRI	1980	-
PI 0043	Soc Trang	-	Vietnam	Soc Trang, Han Giang	DA Vietnam	1981	-
PI 0044	T. Nadu	-	India	TNAU, Coimbatore	TNAU	1981	-
PI 0048	Hangzhou 1	-	China	Fuzhou, Fujian	FAAS	1982	-
PI 0049	var. India	-	China	Fuzhou, Fujian	FAAS	1982	-
PI 0056	NIAB	-	Pakistan	Pakistan	NIAB	1982	-
PI 0058	B. Lima-1	-	Malaysia	Bumbong Lima	IRRI	1983	-
PI 0063	Tacloban	-	Philippines	Tacloban, Leyte	IRRI	1983	-
PI 0064	Hunnasgiriya	-	Sri Lanka	Hunnasgiriya	S. Kulasooriya	1984	-
PI 0065	Sigiriya	-	Sri Lanka	Sigiriya	S. Kulasooriya	1984	-
PI 0066	Debbokawa	-	Sri Lanka	Debbokawa	S. Kulasooriya	1984	-
PI 0067	Kotmale	-	Sri Lanka	Kotmale	S. Kulasooriya	1984	-
PI 0068	Tissa	-	Sri Lanka	Tissa	S. Kulasooriya	1984	-
PI 0070	Dan-shui	(CAPI 7)	Taiwan	Dan-shui	T. Lumpkin	1984	-
PI 0072	Java	(IEPI 1)	Indonesia	Java (supplied by Becking)	T. Lumpkin	1984	-

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
PI 0074	Bogor 2	(IEPI 2)	Indonesia	Bogor	T. Lumpkin	1984	-
PI 0079	Chisato	(JNPI 1)	Japan	Chisato, Mie	T. Lumpkin	1984	-
PI 0080	IITA 2	(NAPI 1)	Nigeria	IITA via Taichung	T. Lumpkin	1984	-
PI 0084	Okinawa 1	-	Japan	Iriomote Island, Okinawa	T. Lumpkin	1984	-
PI 0090	Quezon, Pal.	-	Philippines	Malatgao, Quezon, Palawan	I. Grant	1985	-
PI 0091	Kiangan	-	Philippines	Kiangan, Ifugao	I. Grant	1985	-
PI 0095	Iwahig			Reclassified, see PP 7017			
PI 0097	KK-YS	AF-1	USA	C. Kettering Lab., Ohio *(From antibiotics)*	G. Peters	1985	AF
PI 0101	Queensland	9B	Australia	Warwick, Queensland	G Denning	1986	-
PI 0102	Okinawa 2	9C	Japan	Okinawa	O. Mochida	1987	-
PI 0103	PPBS1	-	Thailand	100 km NE of Bangkok *(tetraploid)*	J. Bogner	1971(91)	-
PI 0501	Zaire 1	ADUL 6	1	-	-	1977(87)	-
PI 0502	PI 0023 a	ADUL 7	India	Cuttack	P. Pande	1978(87)	-
PI 0503	Murdoch	ADUL 12	Australia	Murdoch	M. Dilworth	1978(87)	-
PI 0504	Zaire 2	ADUL 13	1	-	-	1978(87)	-
PI 0505	PI 0023 b	ADUL 19	1	-	-	1984(87)	-
PI 0506	Zaire 3	ADUL 21	1	-	-	1978(87)	-
PI 0507	Helidon	ADUL 2	1	-	-	1979(87)	-
PI 0508	Cargelligo	ADUL 31	1	-	-	1979(87)	-
PI 0509	Senegal 2	ADUL36	1	-	-	1982(87)	-
PI 0510	C- 15	ADUL 85	Thailand	Muang *(C-15)*	N. Boonkerd	1984(87)	-
PI 0511	C- 24	ADUL 86	Thailand	Muang *(C-24)*	N. Boonkerd	1984(87)	-
PI 0512	NE- 5	ADUL 87	Thailand	Muang *(NE-5)*	N. Boonkerd	1984(87)	-
PI 0513	NE- 6	ADUL 88	Thailand	Tatpanon *(NE-6)*	N. Boonkerd	1984(87)	-
PI 0514	NE- 7	ADUL 89	Thailand	Nikomkamsoi *(NE-7)*	N. Boonkerd	1984(87)	-
PI 0515	NE- 8	ADUL 90	Thailand	Varinchamrab *(NE-8)*	N. Boonkerd	1984(87)	-
PI 0516	NE- 13	ADUL 91	Thailand	Muang *(NE-13)*	N. Boonkerd	1984(87)	-
PI 0517	NE- 14	ADUL 92	Thailand	Muang *(NE-141)*	N. Boonkerd	1984(87)	-
PI 0518	Norshingdi	ADUL 95	Bangladesh	Norshingdi	S. Sattar	1984(87)	-
PI 0519	Cuttack 2	ADUL 100	India	Cuttack	P. Singh	1984(87)	-
PI 0520	Mangalore	ADUL 133	India	Mangalore	K. Shankar	1984(87)	-
PI 0521	B. Seral	ADUL 134	Malaysia	Bagan Seral	A. Zakaria	1984(87)	-
PI 0522	K- 7	ADUL 151	Malaysia	Bumbong Lima, Kedah	R. Abubakar	1985(87)	-
PI 0523	K- 8	ADUL 152	Malaysia	Titi Serong, Perak *(K-8)*	R. Abubakar	1985(87)	-
PI 0524	K- 5	ADUL 153	Malaysla	Air Hitam, Kedah *(K-5)*	R. Abubakar	1985(87)	-
PI 0525	K- 3	ADUL 154	Malaysla	Kampong Dedap, Kedah *(K-3)*	R. Abubakar	1985(87)	-
PI 0526	K- 2	ADUL 155	Malaysia	Yan besar, Kedah *(K-2)*	R. Abubakar	1985(87)	-
PI 0527	Munich 1	ADUL 156	0	Munich, Germany	-	1985(87)	-
PI 0528	Selangor	ADUL 158	Malaysia	Sekingan, Selangor *(S-1)*	R. Abubakar	1985(87)	-
PI 0529	Singapore	ADUL 164	Singapore	-	U. of Singapore	1985(87)	-
PI 0530	Corée	ADUL 194	Corea	-	C. Dixon	1986(87)	-
PI 0531	Ball	ADUL 55	Indonesia	Bali	?	1983(87)	-
PI 0532	PI 0005 ?	ADUL 137	Thailand	Bangkok	C. Dixon	1985(87)	-
PI 0533	PI 0044 ?	ADUL 125	India	Coimbatore	S. Kannaiyan	1984(87)	-
PI 0534	PI 0064 ?	ADUL 76	Sri Lanka	Hunnasgiriya	S. Kulasooriya	1984(87)	-
PI 0535	PI 0065 ?	ADUL 75	Sri Lanka	Sigiriya	S. Kulasooriya	1984(87)	-
PI 0536	PI 0066 ?	ADUL 78	Sri Lanka	Debokkawa	S. Kulasooriya	1984(87)	-
PI 0537	PI 0067 ?	ADUL 77	Sri Lanka	Kotmale	S. Kulasooriya	1984(87)	-

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
PI 0538	PI 0068 ?	ADUL 79	Sri Lanka	Tissa	S. Kulasooriya	1984(87)	-
PI 0539	PI 0081 ?	ADUL 74	Sri Lanka	Peradeniya	S. Kulasooriya	1984(87)	-
PI 0540	China 4	ADUL 233	China	Putian	C. Van Hove	1989(90)	-
PI 0541	China 5	ADUL 234	China	Guangzhou	C. Van Hove	1989(90)	-
A. filiculoides (FI)							
FI 1001	GDR	-	Germany	East Germany	IB China	1979	-
FI 1005	Hamburg 1	-	Germany	Hamburg	H. Scharpenseel	1980	-
FI 1006	Hamburg 2	-	Germany	Hamburg	H. Scharpenseel	1980	-
FI 1007	Walka Lake	-	USA	Walka Lake Mineral Co., Nevada	D. Rains	1981	-
FI 1008	Cranmore	-	USA	Sutter Co., California	D. Rains	1981	-
FI 1009	CALI CA 007			Reclassified, see ME 2008			
FI 1010	Lima 1	-	Peru	Lima, *PUFF1*	CIAT	1982	-
FI 1012	Portsmouth	AF-2	UK	Portsmouth Polytechnic, England	K. Fowler	1984	AF
FI 1013	Parana1			Reclasslfled, see ME 2009			
FI 1014	CIAT 2			Reclasslfled, see ME 2010			
FI 1015	Osaka 2			Reclasslfled, see ME 2011			
FI 1016	Lima 2	(PUFF 1)	Peru	Lima	T. Lumpkin	1984	-
FI 1017	M-1Z			Reclassified, see ME 2012			
FI 1018	M-2Z			Reclasslfled, see ME 2013			
FI 1019	M-3Z			Reclassified, see ME 2014			
FI 1020	RARZ			Reclasslfled, see ME 2015			
FI 1021	CAMZ			Reclasslfled, see ME 2016			
FI 1022	IRZ			Reclassified. see ME 2017			
FI 1023	CAYZ			Reclasslfled, see ME 2018			
FI 1024	YAHZ			Reclasslfled, see ME 2019			
FI 1025	CARZ			Reclasslfled, see ME 2020			
FI 1026	LA			Reclassfled, see ME 2021			
FI 1027	CIAT 1			Reclasslfled, see ME 2022			
FI 1028	MBGZ			Reclasslfled, see ME 2023			
FI 1030	Hampshire 1	AF-4	UK	Greywell, Hampshlre, England	J Ladha	1985	AF
FI 1031	Hampshire 2	AF-5	UK	Fordingbridge, Hampshire, England	J. Ladha	1985	AF
FI 1032	A(-)1001	AF-6	Philippines	*From megaspore of FI 1001,* IRRI	Lin Chang	1985	AF
FI 1034	Af(+)301	-	China	*From megaspore of FI 301,* Azolla Center	Lin Chang	1986	SP
FI 1035	Afma	AH-I	Philippines	*From megaspore of FI 301 and algae of MI 347* (from Chlna)	Lln Chang	1986	AH
FI 1036	Af(-)301	AF-8	Philippines	*From megaspore of FI 301* (from China)	Lin Chang	1986	AF
FI 1037	Affa	AH-2	Philippines	*From megaspore and algae of two Fi 1034*	Lin Chang	1986	AH
FI 1038	Afma(o)	AH-3	Philippines	*From female FI 1036 (AF) and algae of MI 4031*	Lin Chang	1986	AH
FI 1039	Affa(o)	AH-4	Philippines	*From female FI 1036 (AF) and algae of FI 1034*	Lin Chang	1986	AH
FI 1040	Hunang	-	China	*From megaspore of FI,* Hunang	Xiao	1987	SP
FI 1041	Rio Grande 1	AF-14	Brazil	Rio Grande Sul (CNPAF 6)	I. Watanabe	1987	AF
FI 1042	Parana 2	CNPAF31	Brazil	Parana	I. Watanabe	1987	-
FI 1043	Palmital	-	Brazil	Palmital Goia	I. Watanabe	1987	-
FI 1044	UPMN #4018-FI	AF-15	Philippines	*From FI spores in* UPMN *MI 4018 plot (mixed)*	M. Lapiz	1988	AF

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
FI 1045	China	-	China	*May be the same as FI 1040 (?)*	I. Watanabe	1988	-
FI 1046	PM 103	-	UK	Hampshire, Romsey, England	K. Fowler	1988	-
FI 1047	1038 - S - 1	-	Philippines	*From spores of FI 1038 (KG10)*	M. Tenorlo	1988(89)	SP
FI 1048	1036 - S - 1	AF-18	Philippines	*From spores of FI 1036 (KG10)*	M. Tenorio	1988(89)	AF
FI 1049	FAFM 3	AF-22	Philippines	*From FI 7032 (Chlna) x MI 4018* (China)	Tang Long Fei	1989	AF
FI 1050	FAFM 4	AF-23	Philippines	*From FI 1032* (China) *x MI 4018* (IRRI)	Tang Long Fei	1989	AF
FI 1051	Italy 3	-	Italy	Instituto di Microbiologia, Firenzi	Favilli	1989	-
FI 1052	France 3	-	France	Southern France, North of Lyon	P. Roger	1989	-
FI 1053	1038x1001-1	XX 8021	Philippines	*From FI 1038 (KG10) x FI 1001 (GH) - normal*	M. Tenorio	1989	SP
FI 1054	1038x1001-2	XX 8022	Philippines	*From FI 1038 (KG10) x FI 1001 (GH) - AF?*	M. Tenorio	1989	SP
FI 1055	1038x1001-3	XX 8023	Philippines	*From FI 1038 (KG10) x FI 1001 (GH) - normal*	M. Tenorio	1989	SP
FI 1056	1038x1001-4	XX 8024	Philippines	*From FI 1038 (KG10) x FI 1001(GH) - normal*	M. Tenorio	1989	SP
FI 1057	1038x1001-5	XX 8025	Philipplnes	*From FI 1038 (KG10) x FI 1001 (GH) - normal*	M. Tenorio	1989	SP
FI 1058	1038x1001-6	XX 8026	Phllhpplnes	*From FI 1038 (KG10)* x *FI 1001 (GH) - normal*	M. Tenorio	1989	SP
FI 1059	1038x1001-7	XX 8027	Philippines	*From FI 1038 (KG 10) x FI 1001 (GH) -normal*	M. Tenorio	1989	SP
FI 1060	AVC-A-2	SH-75	Vietnam	*From spores of FI 1001 x MI 4018 (V2)*	Do Van Cat	1990	SH
FI 1061	FI 1035-MU	138	China	*Mutant from FI 1035 (by gamma ray)*	FAAS	1990	MU
FI 1062	1001x4061-1	XX 8003 AF-19	Philippines	*From spores of 1001* (GH) x *4061* (UPMN)	M. Tenorio	1989	AF
FI 1063	1001x4061-2	XX 8004 AF-20	Philippines	*From spores of 1001* (GH) *x* 4061 (UPMN)	M. Tenorio	1989	AF
FI 1064	1001x4061-3	XX 8005	Philippines	*From spores of 1001* (GH) x 4061 (UPMN) - normal	M. Tenorio	1989	SP
FI 1065	1001x4061-4	XX 8006	Phlllppines	*From spores of 1001* (GH) *x* 4061 (UPMN) - normal	M. Tenorio	1989	SH
FI 1066	1001x4061-5	XX 8007	Philipplnes	*From spores of 1001* (GP) x 4061 (UPMN) - AO	M. Tenorio	1989	SH
FI 1067	1001x4061-6	XX 8008	Phillppines	*From spores of 1001* (GH) x 4061 (UPMN) - AO	M. Tenorio	1989	SH
FI 1068	1001x4061-7	XX 8009	Philippines	*From spores of 1001* (GH) x 4061 (UPMN) - AO	M. Tenorio	1989	SH
FI 1069	1001x4061-8	XX 8010	Philippines	*From spores of 1001* (GH) x 4061 (UPMN) - AO	M. Tenorio	1989	SH
FI 1070	1001x4061-9	XX8011 AF-24	Philippines	*From spores of 1001* (GH) x 4061 (UPMN) - AO	M. Tenorio	1989	AF
FI 1501	Belgium 1	ADUL 1	Belgium	Harchies	A. Lawalree	1977(87)	-
FI 1502	France 1	ADUL 3	0	Dijon Bot. Garden, France	C. Van Hove	1977(87)	-
FI 1503	Belglum 2	ADUL 4	Belgium	Damme	C. Van Hove	1977(87)	-
FI 1504	Belgium 3	ADUL 5	Belgium	Harchles	C. Van Hove	1977(87)	-
FI 1505	SAF1	ADUL 9	S. Africa	Verwoerd Dam	D. Toerien	1978(87)	-
FI 1506	Belgium 4			Reclassified, see PP 7532			
FI 1507	Colombia 2	ADUL 40	Colombia	Zipaquira	Y. Lopez	1983(87)	-

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IRRI code	Code 1	Code 2	Country of origin	Location and/or origin	Source	Year	Note
FI 1508	Brazil 3	ADUL 67	Brazil	Morretes (A. Costa) *CNPAF-31/PR-3*	M. Fiore	1983(87)	-
FI 1509	Belgium 5	ADUL 97	Belgium	Louvain-la-Neuve	C. Van Hove	1984(87)	-
FI 1510	HG-3	ADUL 103	Mexico	Hidalg (*in + N medium*) *(CP-HG-3)*	R. fer-Cerrato	1984(87)	-
FI 1511	France 2	ADUL 107	0	Paris Bot. Garden, France	C. Van Hove	1984(87)	-
FI 1512	SAF2	ADUL 112	S. Africa	Fouriespruit	N. Groobellaar	1984(87)	-
FI 1513	Belgium 6	ADUL 122	Belgium	Louvain-la-Neuve	C. Van Hove	1984(87)	-
FI 1514	SAF 3	ADUL 126	S. Africa	Karoo	Karoo Director	1984(87)	-
FI 1515	Italy 1	ADUL 127	0	Pisa University, Italy	S. Banotto	1984(87)	-
FI 1516	Colombia 3	ADUL 128	Colombia	Bogota	O. Legrand	1984(87)	-
FI 1517	SAF 4	ADUL 139	S. Africa	Johannesburg	M. Spencer	1985(87)	-
FI 1518	Sweden	ADUL 142	0	Lund Bot Gard , Sweden	-	1985(87)	-
FI 1519	Tubingen	ADUL 143	0	Tubingen Univ., Germany	-	1985(87)	-
FI 1520	UK-1	ADUL 145	0	Oxford Bot. Gard., UK	-	1985(87)	-
FI1521	UK-2	ADUL 146	0	Cruickshank Bot. Gard., UK	-	1985(87)	-
FI 1522	Zurich	ADUL 148	0	Zurich Bot. Gard., Switzerland	-	1985(87)	-
FI 1523	Munich 2	ADUL 157	0	Munich, Germany	-	1985(87)	-
FI 1524	Victorville	ADUL 159	USA	-	-	1985(87)	-
FI 1525	Karlsruh	ADUL 160	0	Karlsruh Bot. Gard., Germany	-	1985(87)	-
FI 1526	Kiel U.	ADUL 161	0	Kiel Univ., Germany	-	1985(87)	-
Fi 1527	Tristan	ADUL 162	UK	Tristan de Cunha, St Helena	J. Dickson	1985(87)	-
FI 1528	Gutenberg	ADUL 166	0	Gutenberg Bot Gard , Germany	-	1985(87)	-
FI 1529	Greece	ADUL 167	Greece	Pondolivado	T. Raus	1985(87)	-
FI 1530	Ireland	ADUL 168	Ireland	Dublin	J. Akeroyd	1985(87)	-
FI1531	Fuzhou 2	ADUL 170	China	Fuzhou	C. Van Hove	1985(87)	-
FI 1532	Colombia 4	ADUL 171	Colombia	Bogota	Y. Lopez	1985(87)	-
FI 1533	Colombia 5	ADUL 172	Colombia	Bogota	Y. Lopez	1985(87)	-
FI 1534	Hangzhou 2	ADUL 173	China	Hangzhou (From Germany)	C. Van Hove	1985(87)	-
FI 1535	Hangzhou 3	ADUL 174	China	Hangzhou (From Germany)	C. Van Hove	1985(87)	-
FI 1536	Bolivia	ADUL 176	Bolivia	Titicaca	S. Charlier	1985(87)	-
FI 1537	Portugal	ADUL 177	Portugal	Casal do Redinho	Coimbra Univ.	1985(87)	-
FI 1538	Canada	ADUL 178	0	Montrea Bot. Garden, Canada	N. Cornellier	1985(87)	-
FI 1539	(FI 1002)	ADUL 184	USA	Hawaii *IAEA/FAO (BR-H-CF)*	D. Eskew	1985(87)	-
FI 1540	Aus - Uru	ADUL 185	Uruguay	Montevideo *IAEA/FAO (URU)*	D. Eskew	1985(87)	-
FI1541	Aus - Ger	ADUL 186	0	Gemany *IAEA/FAO*	D. Eskew	1985(87)	-
FI 1542	Germ 1	ADUL 190	0	Germany		1985(87)	-
FI 1543	Germ 2	ADUL 191	0	Germany		1985(87)	-
FI 1544	Italy 2	ADUL 169	0	Hanbury Bot. Garden, Genova, Italy		1985(87)	-
FI 1545	FI 1016	ADUL 81	Peru	Lima	C. Van Hove	1984(87)	-
FI 1546	FOZ	ADUL 216	Portugal	Figuera da Foz	A. Tamer	1988(88)	-
FI 1547	Tihange	ADUL 209	Belgium	Piscimeuse, Tihange *(XX 8501)*	C. Van Hove	1987(87)	-
FI 1603	Tanabe-Cho2	(JNRR 2)	Japan	Tanabe-cho, Tsuzuki-gun, Kyoto-fu	T. Lumpkin	1984	-
FI 1607	Chikugo		Japan	Chikugo, Furuoka	I. Watanabe	1986	-
Fi 1608	Matsue		Japan	Matsue	I. Watanabe	1986	-
FI 1609	1603-S-1		Philippines	*From sporocarp of FI 1603*	M. Lapiz	1988(89)	SP

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
A. mexicana (ME)							
ME 2001	California		USA	Graylodge, California	D. Rains	1978	
ME 2002	Guyana 1		Guyana	Guyana	D. Rains	1981	
ME 2003	Guyana 2		Guyana	Guyana	D. Rains	1981	
ME 2004	Guyana 3		Guyana	Guyana	D. Rains	1981	
ME 2007	BRGL	Thailand	USA	C. Kettering Lab., Ohio	I. Watanabe	1987	
ME 2008	CALI CA 007	FI 1009	Colombia	CIAT, Cali	CIAT	1982	
ME 2009	Parana 1	FI 1013	Brazil	Parana, Lat. 25° 05' S, Long. 50° 05' W	T. Lumpkin	1984	
ME 2010	CIAT 2	FI 1014	Colombia	CIAT, Cali	T. Lumpkin	1984	
ME 2011	Osaka 2	FI 1015	Japan	From Dr. Seto, Osaka	T. Lumpkin	1984	
ME 2012	M-1Z	FI 1017	Colombia	Monteria	W. Zimmerman	1985	
ME 2013	M-2Z	FI 1018	Colombia	Monteria	W. Zimrnerman	1985	
ME 2014	M-3Z	FI 1019	Colombia	Monteria	W. Zimmerman	1985	
ME 2015	RARZ	FI 1020	Colombia	Leticia	W. Zimrnerman	1985	
ME 2016	CAMZ	FI 1021	Colombia	Leticia	W. Zimmerman	1985	
ME 2017	IRZ	FI 1022	Colombia	Leticia	W. Zimmerman	1985	
ME 2018	CAM	FI 1023	Colombia	Leticia	W. Zimmerman	1985	
ME 2019	YAHZ	FI 1024	Colombia	Leticia	W. Zimmerman	1985	
ME 2020	CARZ	FI 1025	Colombia	Leticia	W. Zimmerman	1985	
ME 2021	LA	FI 1026	USA	Lake Alice, Florida	W. Zimmerman	1985	
ME 2022	CIAT 1	FI 1027	Colombia	Cali	W. Zimrnerman	1985	
ME 2023	MBGZ	FI 1028	USA	Missouri Bot. Garden, Missouri	W. Zirnmerman	1985	
ME 2024	UPLB - 1	SH-5	Philippines	*UPLB (ME 2001 X MI 4018)- MI 4053*	P. Payawal	1987	SH
ME 2025	Marajo 1	CA 3009	Brazil	Marajo Is., Arari River, Para' *(BLCC 28)*	T. Lumpkin	1984(85)	
ME 2026	Solimoes 4	CA 3010	Brazil	Solimoes River *(BLCC 18)*	T. Lumpkin	1984(85)	
ME 2027	UPLB -2- 3(1)	SH-7	Philippines	*UPLB (ME 2002 x ME 2024) (line 3),* IBS *(1)*	P. Payawal	1988(89)	SH
ME 2028	UPLB -2- 1	SH-15	Philippines	*UPLB (ME 2002 x ME 2024) (line 1), in cs.,* IBS	P. Payawal	1990	SH
ME 2029	UPLB -2- 2	SH-16	Philippines	*UPLB (ME 2002 x ME 2024) (line 2), in cs.,* IBS	P. Payawal	1990	SH
ME 2030	UPLB -2- 3(2)	SH-17	Philippines	*UPLB (ME 2002 x ME 2024) (line 3), in cs.,* IBS *(2)*	P. Payawal	1990	SH
ME 2031	UPLB -2- 4	SH-18	Philippines	*UPLB (ME 2002 x ME 2024) (line 4), in cs.,* IBS	P. Payawal	1990	SH
ME 2032	UPLB -2- 5	SH-19	Philippines	*UPLB (ME 2002 x ME 2024) (line 5), in cs.,* IBS	P. Payawal	1990	SH
ME 2033	UPLB -2- 6	SH-20	Philippines	*UPLB (ME 2002 x MI 2024) (line 6), in cs.,* IBS	P. Payawal	1990	SH
ME 2034	UPLB -2- 7	SH-21	Philippines	*UPLB (ME 2002 x ME 2024) (line 7), in cs.,* IBS	P. Payawal	1990	SH
ME 2035	UPLB -9	SH-22	Philippines	*UPLB (ME 2024 x MI 4003) (line 1), in cs.,* IBS	P. Payawal	1990	SH
ME 2036	UPLB -10	SH-23	Philippines	*UPLB (ME 2024 x MI 4008) (line 1), in cs..* IBS	P. Payawal	1990	SH
ME 2037	UPLB -1- F2-1	SH-60	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 1), in cs.,* IBS	P. Payawal	1990	SH
ME 2038	UPLB -1- F2-2	SH-61	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 2), in cs.,* IBS	P. Payawal	1990	SH
ME 2039	UPLB -1- F2-3	SH-62	Philippines	*UPLB (ME2024 x ME2024) (F2-line 3), in cs.,* IBS	P. Payawal	1990	SH

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
ME 2040	UPLB-1-F2-4	SH-63	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 4), in cs.,* IBS	P. Payawal	1990	SH
ME 2041	UPLB-1-F2-5	SH-64	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 5), in cs.,* IBS	P. Payawal	1990	SH
ME 2042	UPLB-1-F2-6	SH-65	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 6), in cs.,* IBS	P. Payawal	1990	SH
ME 2043	UPLB-1-F2-7	SH-66	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 7), in cs.,* IBS	P. Payawal	1990	SH
ME 2044	UPLB-1-F2-8	SH-67	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 8), in cs.,* IBS	P. Payawal	1990	SH
ME 2045	UPLB-1-F2-9	SH-68	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 9), in cs.,* IBS	P. Payawal	1990	SH
ME 2046	UPLB-1-F2-10	SH-69	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 10), in cs.,* IBS	P. Payawal	1990	SH
ME 2047	UPLB-1-F2-11	SH-70	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 11), in cs.,* IBS	P. Payawal	1990	SH
ME 2048	UPLB1-F2-12	SH-71	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 12), in cs.,* IBS	P. Payawal	1990	SH
ME 2049	UPLB1-F2-13	SH-72	Philippines	*UPLB (ME 2024 x ME 2024) (F2-line 13), in cs.,* IBS	P. Payawal	1990	SH
ME 2050	UPLB1-F2-4+	SH-73	Philippines	*UPLB (ME 2024 x ME 2024) (F2 - pH 4 tolerant)*	P. Payawal	1990	SH
ME 2051	UPLB1-F2-9+	SH-74	Philippines	*UPLB (ME 2024 x ME 2024) (F2 - pH 9 tolerant)*	P. Payawal	1990	SH
ME 2052	MA 201	SH-80	China	*Hybrid from FAAS (ME x FI)*	I. Watanabe	1990(91)	SH
ME 2501	Mexico 3	ADUL 232	Mexico	Mexico City (X4)	R. Caudales	1989(90)	-
ME 2502	X9	ADUL 235	USA	New Orleans (X9)	R. Caudales	1989(90)	-
ME 2503	X10	ADUL 236	USA	Illinois (X10)	R. Caudales	1989(90)	-
A. caroliniana (CA)							
CA 3001	Ohio	-	USA	Ohio	D. Rains	1978	-
CA 3002	Madison	-	USA	Madison, Wisconsin	D. Rains	1981	-
CA 3003	MN #3001	-	Philippines	UPMN, IRRI, Los Baños, Laguna	IRRI	1982	-
CA 3004	Treinta y tres	-	Uruguay	Treinta y tres	D. Rains	1982	-
CA 3005	Fuzhou 1	-	China	Fuzhou, Fujian	FAAS	1982	-
CA 3006	Solimoes 1	(BLCC3)	Brazil	Solimoes River, Manaus	T. Lumpkin	1984	-
CA 3007	Solimoes 2	(BLCC20)	Brazil	Solmoes R, Iranduba, Amazonas	T. Lumpkin	1984	-
CA 3008	Solimoes 3	(BLCC22)	Brazil	Solimoes R., Manaus, Amazonas	T. Lumpkin	1984	-
CA 3009	Marajo 1			Reclassified, see ME 2025			
CA 3010	Solimoes 4			Reclassified, see ME 2026			
CA 3011	Solimoes 6	(BLCC21)	Brazil	Solimoes R., Iranduba, Amazonas	T. Lumpkin	1984	-
CA 3012	Guaiba	-	Brazil	Guaiba, Rio Grande do Sul	T. Lumpkin	1984	-
CA 3013	Igarape	(BLCC25)	Brazil	Negro River, Iranduba, Amazonas	T. Lumpkin	1984	-
CA 3014	Catalao	(BLCC23)	Brazil	Catalao, Amazonas	T. Lumpkin	1984	-
CA 3015	IRGA	(BLCC 1)	Brazil	IRGA, Rio Grande do Sul Amazonas	T. Lumpkin	1984	-
CA 301 6	S. Cataria	CNPAF 57	Brazil	Santa Cataria	I. Watanabe	1987	-
CA 301 7	Rio Grande 2	CNPAF 5	Brazil	Rio Grande Sul	I. Watanabe	1987	-
CA 301 8	Goias	AF-16	Brazil	Goias	I. Watanabe	1987	AF
CA 3019	Mandangwa	-	Philippines	Mandangwa, Misamis Oriental	R. Oliveros	1988	-

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CA 3020	PM 303	-	Netherlands	Friesland	K. Fowler	1988	-
CA 3021	PKS	-	-	-	P. Singh	1990	-
CA 3022	3522x4061-1	XX 8012	Philippines	*From spores of 3522 (BSU)* x *4061* (UPMN) *- normal*	M. Tenorio	1989	SH
CA 3023	3522x4061-2	XX 8013	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) *- normal*	M. Tenorio	1989	SH
CA 3024	3522x4061 -3	XX 8014	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) *- normal*	M. Tenorlo	1989	SH
CA 3025	3522x4061-4	XX 8015	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) *- normal*	M. Tenorlo	1989	SH
CA 3026	3522x4061 -5	XX 8016	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) *- normal*	M. Tenorio	1989	SH
CA 3027	3522x4061-6	XX 8017	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) - normal	M. Tenorio	1989	SH
CA 3028	3522x4061 -7	XX 8018	Philippines	*From spores of 3522* (BSU) x *4061* (UPMN) *- normal*	M. Tenorlo	1989	SH
CA 3501	Colombia 1	ADUL 39	-	-	-	1982(87)	-
CA 3502	Egypt	ADUL 42	0	Moshtohor University, Egypt	C. Myttenaere	1983(87)	-
CA 3503	Marajo 2	ADUL 43	Brazil	Marajo Island *CNPAF-26/PA-1*	C. Van Hove	1983(87)	-
CA 3504	Solimoes 7	ADUL 44	Brazil	Solimoes River *CNPAF-19/AM-2*	C. Van Hove	1983(87)	-
CA 3505	Negro R.	ADUL 45	Brazil	Negro River *CNPAF-24/AM-1*	C. Van Hove	1983(87)	-
CA 3506	Marajo 3	ADUL 46	Brazil	Marajo Island *CNPAF-27/PA-2*	C. Van Hove	1983(87)	-
CA 3507	Surinam 1	ADUL 48	Surinam	Boxel	H. Lardinois	1983(87)	-
CA 3508	Surinam 2	ADUL 73	Surinam	Ornamibo	H. Lardinois	1984(87)	-
CA 3509	IR Ca ?	ADUL 84	0	BNF Center, Bangkok, Thailand	N. Boonkerd	1984(87)	-
CA 3510	TAB-I	ADUL 101	Mexico	Tabasco *(CP-TAB-1)*	R. Cerrato	1984(87)	-
CA 3511	VER-2	ADUL 102	Mexico	Veracruz *(CP-VER-2)*	R. Cerrato	1984(87)	-
CA 3512	Peru	ADUL 106	Peru	Zana	N. Ramirez de Jimenez	1984(87)	-
CA 3513	Zimbabwe	ADUL 109	0	Causeway Bot. Garden, Zimbabwe	T. Muller	1984(87)	-
CA 3514	CA ?	ADUL 113	1	-	-	1984(87)	-
CA 3515	Surinam 3	ADUL 118	Surinam	Coronie	H. Lardinois	1984(87)	-
CA 3516	Township	ADUL 130	USA	-	S. Schmitt	1984(87)	-
CA 3517	Bhromiri	ADUL 149	0	Chiangmai University, Thailand *(AME-4)*	A. Bhromiri	1985(87)	-
CA 3518	Brazil 5	ADUL 196	Mali	Kogoni Rice Res. Center (From Brazil)	C. Van Hove	1986(87)	-
CA 3519	Mexico 1	ADUL 201	Mexico	Oluactitan, Tucta, Tabasco	J. Micha	1987(87)	-
CA 3520	Mexico 2	ADUL 202	Mexico	Oaxicaque, Tucta	J. Micha	1987(87)	-
CA 3521	Atlantic	ADUL 205	Guyana	Atlantic Gardens (Georgetown)	C. Van Hove	1987(87)	-
CA 3522	Burma	ADUL 206	Guyana	Burma	C. Van Hove	1987(87)	-
CA 3523	Fyrish	ADUL 208	Guyana	Fyrlsh	C. Van Hove	1987(87)	-
CA 3524	Nether 1	ADUL 27	Netherlands	-	E. Ohoto	1979(87)	-
CA 3525	Rwanda 3	ADUL 189	0	Cyili Rice Research Centre, Rwanda	C. Van Hove	1985(87)	-
CA 3526	Brazil 6	ADUL 195	Mali	Kogoni Rice Res. Center (From Brazil)	C. Van Hove	1986(87)	-
CA 3527	CA 3001	ADUL 8	USA	Southeastern US	G. Peters	1978(87)	-
CA 3528	CA 3006	ADUL 56	Brazil	Solimoes River *CNPAF-3/AM-0*	M. Flore	1983(87)	-
CA 3529	CA 3007	ADUL 59	Brazil	Solimoes River *CNPAF-20/AM-S*	M. Flore	1983(87)	-
CA 3530	CA 3008	ADUL 61	Brazil	Solimoes River *CNPAF-22/AM-5*	M Fiore	1983(87)	-

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CA 3531	ME 2025	ADUL 64	Brazil	Marajo Island *CNPAF-28/PA-3*	M. Fiore	1983(87)	–
CA 3532	ME 2026	ADUL 58	Brazil	Solimoes River *CNPAF-I8/AM-1*	M. Fiore	1983(87)	–
CA 3533	CA 3011	ADUL 60	Brazil	Solimoes River *CNPAF-21/AM-4*	M. Fiore	1983(87)	–
CA 3534	CA 3012	ADUL 57	Brazil	Guaiba *CNPAF-5/RS-1*	M. Fiore	1983(87)	–
CA 3535	CA 3013	ADUL 63	Brazil	Negro River *CNPAF-25/AM-8*	M. Fiore	1983(87)	–
CA 3536	CA 3014	ADUL 62	Brazil	Negro River *CNPAF-23/AM-6*	M. Fiore	1983(87)	–
CA 3537	Banaue 3	ADUL 214	0	IRRI Station, Banaue, Ifugao, Philippines	C. Van Hove	1987(88)	–
CA 3538	Banaue 4	ADUL 215	0	IRRI Station, Banaue, Ifugao, Philippines	C. Van Hove	1987(88)	–
CA 3539	Hollande	ADUL 228 a	0	Leyden Bot. Garden, Netherlands	W. Zimmerman	1988(88)	–
CA 3540	Thailand	ADUL 22	1	*(PP 7502)*	–	1979(87)	–
CA 3541	PRM	ADUL 228 b	USA	Manale, Puerto Rico	R. Caudales	1988(90)	–
A. microphylla (MI)							
MI 4001	Paraguay 1	–	Paraguay	–	D. Rains	1981	–
MI 4003	Paraguay 6	–	Paraguay	–	D. Rains	1981	–
MI 4009	Paraguay 13	–	Paraguay	–	D. Rains	1981	–
MI 4014	Paraguay 20	–	Paraguay	–	D. Rains	1981	–
MI 4017	Paraguay 24	–	Paraguay	–	D. Rains	1981	–
MI 4018	Paraguay 26	–	Paraguay	–	D. Rains	1981	–
MI 4021	Galapagos 1	–	Ecuador	Santa Cruz Island, Galapagos I.	T. Lumpkin	1982	–
MI 4022	UPMN #4017	–	Philippines	UPMN, IRRI, Los Baños, Laguna	IRRI	1982	–
MI 4024	Galapagos 3	–	Ecuador	Galapagos Is.	N. Gunapala	1985	–
MI 4025	A(-) 4018	AF-10	Philippines	*From female of MI 4078,* IRRI	Lin Chang	1985	AF
MI 4026	A(+) 20X	–	China	Fuzhou	Lin Chang	1985	–
MI 4027	A(-) 20X	AF-11	China	Fuzhou	Lin Chang	1985	AF
MI 4028	AVC-B-1	SH-1	Philippines	*(MI 4018 x FI 1001) Algae* (+)	Do Van Cat	1985	SH
MI 4029	AVC-B-2	AF-12/ SH-2	Philippines	*(MI 4018 x FI 1001) Algae* (-)	Do Van Cat	1985	AF
MI 4030	AVC-B-3	SH-3	Philippines	*(MI 4018 x FI 1001) Algae* (+)	Do Van Cat	1985	SH
MI 4031	Am(+) 347	–	China	*From megaspore of MI 347,* Azolla Center	Lin Chang	1986	SP
MI 4032	Amma	AH-5	Philippines	*From megaspore of MI 347 and algae of MI 347* (from China)	Lin Chang	1986	AH
MI 4033	Amfa	AH-6	Philippines	*From megaspore of MI 347 and Anabaena of FI 301* (from China)	Lin Chang	1986	AH
MI 4034	Am(-) 347	AF-13	Philippines	*From spores of MI 347, AF* (from China)	Lin Chang	1986	AF
MI 4035	Amfa-1	AH-7	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4036	Amfa-2	AH-8	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4037	Amfa-3	AH-9	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4038	Amfa-4	AH-10	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4039	Amfa-5	AH-11	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
MI 4040	Amfa-6	AH-12	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4041	Amfa-7	AH-13	Phillppines	*From a single Amfa sporeling* IRRI	Lin Chang	1987	AH
MI 4042	Amfa-8	AH-14	Philippines	*From a single Amfa sporeling* IRRI	Lin Chang	1987	AH
MI 4043	Amfa-9	AH-15	Philippines	*From a single Amfa sporeling* IRRI	Lin Chang	1987	AH
MI 4044	Amfa-10	AH-16	Philippines	*From a single Amfa sporeling* IRRI	LIn Chang	1987	AH
MI 4045	Amfa-11	AH-17	Philippines	*From a single Amfa sporeling,* IRRI	Lin Chang	1987	AH
MI 4046	G2	AH-18	Philippines	*From Amma by grafting,* IRRI	Lin Chang	1985(87)	AH
MI 4047	G3	AH-19	Philippines	*From Amma by grafting,* IRRI	LIn Chang	1985(87)	AH
MI 4048	G4	AH-20	Philippines	*From Amma by grafting,* IRRI	Lin Chang	1985(87)	AH
MI 4049	G5	AH-21	Philippines	*From Amma by grafting,* IRRI	Lin Chang	1985(87)	AH
MI 4050	G8	AH-22	Philippines	*From Amma by grafting,* IRRI	Lin Chang	1985(87)	AH
MI 4051	A.C	AH-23	Philippines	*From inoculated lab-grown algae by Bai*	Lin Chang	1985(87)	AH
MI 4052	RONG PING 3	SH-4	China	*Hybrid from FAAS (MI x FI), (?)*	C. Ramirez	1987	SH
MI 4053	UPLB - 1			Reclassified, see ME 2024			
MI 4054	Bala	CNPAF73	Brazil	Baia	I. Watanabe	1987	
MI 4055	UPMN #4018-MI	-	Philippines	*From MI spores in UPMN MI 4018 plot (mixed)*	M. Lapiz	1987(88)	SP
MI 4056	4018-P-C	-	Philippines	*Parent MI 4018 of MI 4025* (UPMN to phytotron)	Lin Chang	1987(88)	-
MI 4057	4018-LB-1	-	Philippines	*Parent MI 4018 of WE 2024* (Baguio to LB)	P. Payawal	1987(88)	-
MI 4058	Koronadal 1	-	Philippines	Koronadal, South Cotabato	R. Oliveros	1988	-
MI 4059	Koronadal 2	-	Philippines	Koronadal, South Cotabato	R. Oliveros	1988	-
MI 4060	Koronadal 3	-	Phllipplnes	Koronadal, South Cotabato	R. Oliveros	1988	-
MI 4061	UPMN #4018	-	Phillppines	UPMN plot of MI 4018, IRRI, Los Baños, Laguna	M. Lapiz	1988	-
MI 4062	PAR-Red-1	-	Paraguay	2 km E from Yparacai to Altos	I. Watanabe	1988	-
MI 4064	PAR-Red-3	-	Paraguay	86 km along Ruta Trans Chaco	I. Watanabe	1988	-
MI 4065	PAR-Red-4	-	Paraguay	175 km along Ruta Trans Chaco	I. Watanabe	1988	-
MI 4067	PAR-Green-6	-	Paraguay	393 km along Ruta Trans Chaco	I. Watanabe	1988	-
MI 4068	PAR-Green-7	-	Paraguay	1 km W from Roma Pata, Boqueron	I. Watanabe	1988	-
MI 4069	PAR-Green-8	-	Paraguay	Campo Esperanza, 22 km E-SE from Roma Plata, sporulating	I. Watanabe	1988	-
MI 4070	PAR-Green-9	-	Paraguay	Laguna Isla Poi, Pres. Hayes (near edge of 2-x-0.5 km pond)	I. Watanabe	1988	-
MI 4072	PAR-Green-11	-	Paraguay	30 km N - Ruta Trans Chaco Toledo, Boqueron	I. Watanabe	1988	-
MI 4073	PAR-Red-12	-	Paraguay	192 km along Ruta Trans Chaco	I. Watanabe	1988	-
MI 4074	PAR-Red-13	-	Paraguay	20 km N from Cor. Oviedo 20 km S from Carayao along road to San Pedro	I. Watanabe	1988	-
MI 4075	PAR-Red-14	-	Paraguay	Edge of Logo Cañada, S - SE from Nuevo Italia, sporulating	I. Watanabe	1988	-
MI 4076	4053-GH	-	Philippines	*From spores of MI 4053 (GH-surface soil)*	M. Lapiz	1988	SP

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
MI 4077	UPMN4061 - Decom.1	4061-Feb	Philippines	*From spores of decomp. MI 4061,* (UPMN), lab to *phytotron*	M. Lapiz	1988	SP
MI 4078	UPMN4061 - Decom.2	4061-A	Philippines	*From spores of decomp. MI 4061,* (UPMN), *phytotron grown*	M. Lapiz	1988	SP
MI 4079	UPMN4061 - Decom.3	4061-Mar	Philippines	From spores of decomp. MI 4061, (UPMN), *phytotron grown*	M. Lapiz	1988	SP
MI 4080	GH4061 - Decom.1	4061-B	Philippines	*From spores of decomp. MI 4061, (GH)*	M. Lapiz	1988	SP
MI 4081	B9-4018-MI	-	Philippines	*From spores of MI from B9 - FI 100 plot (mixed FI-MI)*	M. Lapiz	1988	SP
MI 4082	4018-LB-2	-	Philippines	*From MI 4018 - UPLB collection (c/o Payawal) (taken May 88)*	M. Lapiz	1988	-
MI 4083	UPLB 4 -3(1)	SH-8	Philippines	*Hybrid from UPLB (MI 4018 x ME 2008) (line 3) in cs., (batch 1)*	P. Payawal	1988(89)	SH
MI 4084	UPLB 5 - 1 (1)	SH-9	Philippines	*Hybrid from UPLB (MI4018 x CA3004)* (line 1) in cs., IBS *(batch 1)*	P. Payawal	1988(89)	SH
MI 4085	UPLB 8 - 3(?)	SH-10	Philippines	*Hybrid from UPLB (MI4003xME2024) (line3?) in cs., (batch 1)*	P. Payawal	1988(89)	SH
MI 4086	UPLB 6 - 1 (1)	SH-11	Philippines	*Hybrid from UPLB (MI4003xCA3004) (line1) in cs., (batch 1)*	P. Payawal	1988(89)	SH
MI 4087	RONG PING 1	SH-12	China	*Hybrld from: FAAS (MI x FI)*	I. Watanabe	1989	SH
MI 4088	RONG PING 2	SH-13	China	*Hybrld from: FAAS (MI x FI)*	I. Watanabe	1989	SH
MI 4089	RONG PING 3(B)	SH-14	China	*Hybrld from: FAAS (MI x FI)*	I. Watanabe	1989	SH
MI 4090	GREEN - 4018-S-1	- -	Philippines	*From spores of MI 4018 (Conviron - KG101 green, in N + medium*	M. Lapiz	1988(89)	SP
MI 4091	PINK - 4018-S-1	- -	Philippines	*From spores of MI 4018 (Conviron - KG10) w/ pink tips, in +N med.*	M. Lapiz	1988(89)	SP
MI 4092	G(+N) - 4018-S-1	- -	Philippines	*From spores of MI 4018 (Conviron -KG10) yellowish tips, in +N med.*	M. Lapiz	1988(89)	SP
MI 4093	P(+N) 4018-S-1	- -	Philippines	*From spores of MI 4018 (Conviron - KG10) yellowish w/ pink tips*	M. Lapiz	1988(89)	SP
MI 4094	UPMN4061 - Decom.4	-	Philippines	*From spores of decomp. MI 4061* (UPMN shed), *in +N med.*	M. Lapiz	1988(89)	SP
MI 4095	UPMN4061- Decom.5	-	Philippines	*From spores of decomp. MI 4061* (UPMN) shed	M. Lapiz	1988(89)	SP
MI 4096	UPMN4061 - Decom.6	- -	Philippines	*From spores of decomp. MI 4061* (UPMN shed)	M. Lapiz	1988(89)	SP
MI 4097	La Union	-	Philippines	*From spores - La Union, NAAP*	M. Lapiz	1988(89)	SP
MI 4098	UPLB - 3 - 1	SF-24	Philippines	*UPLB (MI 4018 x ME 2024) (line 1),* IBS	P. Payawal	1990	SH
MI 4099	UPLB - 3 - 2	SH-25	Philippines	*UPLB (MI 4018 x ME 2024) (line 2),* IBS	P. Payawal	1990	SH
MI 4100	UPLB - 3 - 3	SH-26	Philippines	*UPLB (MI 4018 x ME 2024) (line 3),* IBS	P. Payawal	1990	SH
MI 4101	UPLB - 3 - 4	SH-27	Philippines	*UPLB (MI 4018 x ME 2024) (line 4),* IBS	P. Payawal	1990	SH
MI 4102	UPLB - 3 - 5	SH-28	Philippines	*UPLB (MI 4018 x ME 2024) (line 5),* IBS	P. Payawal	1990	SH
MI 4103	UPLB - 3 - 6	SH-29	Philippines	*UPLB (MI 4018 x ME 2024) (line 6),* IBS	P. Payawal	1990	SH
MI 4104	UPLB - 3 - 7	SH-30	Philippines	*UPLB (MI 4018 x ME 2024) (line 7),* IBS	P. Payawal	1990	SH
MI 4105	UPLB - 3 - 8	SF-31	Philippines	*UPLB (MI 4018 x ME 2024) (line 8),* IBS	P. Payawal	1990	SH

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MI 4106	UPLB - 4 - 1	SH-32	Philippines	*UPLB (MI 4018 x ME 2008) (line 1),* IBS	P. Payawal	1990	SH
MI 4107	UPLB - 4 - 2	SH-33	Philippines	*UPLB (MI 4018 x ME 2008) (line 2), IBS*	P. Payawal	1990	SH
MI 4108	UPLB - 4 - 3(2)	SH-34	Philippines	*UPLB (MI 4018 x ME 2008) (line 3),* IBS *(batch 2)*	P. Payawal	1990	SH
MI 4109	UPLB - 5 - 1(2)	SH-35	Philippines	*UPLB (MI 4018 x CA 3004) (line 1),* IBS *(batch 2)*	P. Payawal	1990	SH
MI 4110	UPLB - 5 - 2	SH-36	Philippines	*UPLB (MI 4018 x CA 3004) (line 2),* IBS	P. Payawal	1990	SH
MI 4111	UPLB - 5 - 3	SH-37	Philippines	*UPLB (MI 4018 x CA 3004) (line 3),* IBS	P. Payawal	1990	SH
MI 4112	UPLB - 6 - 1(2)	SH-38	Philippines	*UPLB (MI 4003 x CA3004) (line 1),* IBS *(2)*	P. Payawal	1990	SH
MI 4113	UPLB - 6 - 2	SH-39	Philippines	*UPLB (MI 4003 x CA 3004) (line 2),* IBS	P. Payawal	1990	SH
MI 4114	UPLB - 6 - 3	SH-40	Philippines	*UPLB (MI 4003 x CA 3004) (line 3),* IBS	P. Payawal	1990	SH
MI 4115	UPLB - 6 - 4	SH-41	Philippines	*UPLB (MI 4003 x ME 3004) (line 4),* IBS	P. Payawal	1990	SH
MI 4116	UPLB - 7 - 1	SH-42	Philippines	*UPLB (MI 4007 x ME 2024) (line 1),* IBS	P. Payawal	1990	SH
MI 4117	UPLB - 7 - 2	SH-43	Philippines	*UPLB (MI 4007 x ME 2024) (line 2),* IBS	P. Payawal	1990	SH
MI 4118	UPLB - 7 - 3	SH-44	Philippines	*UPLB (MI 4007 x ME 2024) (line 3),* IBS	P. Payawal	1990	SH
MI 4119	UPLB - 7 - 4	SH-45	Philippines	*UPLB (MI 4007 x ME 2024) (line 4),* IBS	P. Payawal	1990	SH
MI 4120	UPLB - 7 - 5	SH-46	Philippines	*UPLB (MI 4007 x ME 2024) (line 5),* IBS	P. Payawal	1990	SH
MI 4121	UPLB - 7 - 6	SH-47	Philippines	*UPLB (MI 4007 x ME 2024) (line 6),* IBS	P. Payawal	1990	SH
MI 4122	UPLB - 7 - 7	SH-48	Philippines	*UPLB (MI 4007 x ME 2024) (line 7),* IBS	P. Payawal	1990	SH
MI 4123	UPLB - 7 - 8	SH-49	Philippines	*UPLB (MI 4007 x ME 2024) (line 8),* IBS	P. Payawal	1990	SH
MI 4124	UPLB - 7 - 9	SH-50	Philippines	*UPLB (MI 4007 x ME 2024) (line 9),* IBS	P. Payawal	1990	SH
MI 4125	UPLB - 7 - 10	SH-51	Philippines	*UPLB (MI 4007 x ME 2024) (line 10),* IBS	P. Payawal	1990	SH
MI 4126	UPLB - 7 - 11	SH-52	Philippines	*UPLB (MI 4007 x ME 2024) (line 11),* IBS	P. Payawal	1990	SH
MI 4127	UPLB - 7 - 12	SH-53	Philippines	*UPLB (MI 4007 x ME 2024) (line 12),* IBS	P. Payawal	1990	SH
MI 4128	UPLB - 7 - 13	SH-54	Philippines	*UPLB (MI 4007 x ME 2024) (line 13),* IBS	P. Payawal	1990	SH
MI 4129	UPLB - 7 - 14	SH-55	Philippines	*UPLB (MI 4007 x ME 2024) (line 14),* IBS	P. Payawal	1990	SH
MI 4130	UPLB - 8 - 1	SH-56	Philippines	*UPLB (MI 4003 x ME 2024) (line 1),* IBS	P. Payawal	1990	SH
MI 4131	UPLB - 8 - 2	SH-57	Philippines	*UPLB (MI4003 x ME 2024) (line 2),* IBS	P. Payawal	1990	SH
MI 4132	UPLB - 11	SH-58	Philippines	*UPLB (MI 4007 x MI 4018) (line 1),* IBS	P. Payawal	1990	SH
MI 4133	UPLB - 12	SH-59	Philippines	*UPLB (MI 4007 x MI 4003) (line 1),* IBS	P. Payawal	1990	SH

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
MI 4134	AVC-B-4	SH-76	Vietnam	*From spores of MI 4018 x FI 1001 (V1)*	Do Van Cat	1990	SH
MI 4135	AVC - C - 1	SH-77	Vietnam	*From spores of MI 4018 x Mi 4028 (V3)*	Do Van Cat	1990	SH
MI 4136	AVC-C-2	SH-78	Vietnam	*From spores of MI 4018 x Mi 4028 (V4)*	Do Van Cat	1990	SH
MI 4137	China 2	SH-79	China	*Hybrid from MI x ME*	FAAS	1990	SH
MI 4138	China 3 - MU	088	China	*Mutant from MI (by gamma ray)*	FAAS	1990	MU
MI 4139	Tabasco	Mexn 6	Mexico	Tabasco (by R. Cerrato and R.Q. Lizaola)	W. Zimmerman	1990	-
MI 4501	Brazil 1	ADUL 65	Brazil	Paraiso do Norte *CNPAF-29/PR-1*	M. Fiore	1983(87)	-
MI 4502	Brazil 2	ADUL 66	Brazil	Querencia do Norte *CNPAF-30/PR-2*	M. Fiore	1983(87)	-
MI 4503	Brazil 4	ADUL 68	Brazil	Cambara *CNPAF-32/PR-4*	M. Fiore	1983(87)	-
MI 4504	(MI 4023)	ADUL 69	Ecuador	Galapagos Is.	T. Lumpkin	1983(87)	-
MI 4505	IRRI MI	ADUL 83	0	BNF Res. Center, Bangkok, Thailand	N. Boonkerd	1984 (87)	-
MI 4506	SIN-4	ADUL 104	Mexico	Sinaloa *(CP-SIN-4)*	R. Cerrato	1984(87)	-
MI 4507	Corriv.	ADUL 207	Guyana	Corriverton	C. Van Hove	1987(87)	-
MI 4508	SH-6	ADUL 211	0	-	C. Van Hove	1987(87)	SH
MI 4509	PP-135?	ADUL 212	0	IRRI, Los Baños, Laguna, Philippines	C. Van Hove	1987(87)	-
MI 4510	MI 4061	ADUL 175	Paraguay	IRRI, Los Baños, Laguna, Philippines	C. Van Hove	1985(87)	-
A. nilotica (NI)							
NI 5001	Sudan 1	-	Sudan	Kosti	T. Lumpkin	1982	-
NI 5002	Sudan 2	-	Sudan	Kosti	T. Lumpkin	1989	-
NI 5501	Burundi 1	ADUL 15	Burundi	Bujumbura	J. Bouharmont	1978(87)	-
A. rubra (RU)							
RU 6003	Tanahe-Cho 2			Reclassified, see FI 1603			
RU 6007	Chikugo			Reclassified, see FI 1607			
RU 6008	Matsue			Reclassified, see FI 1608			
RU 6009	6003-S-1			Reclassified, see FI 1609			
RU 6501	NZE1	ADUL 2	New Zealand	North Island *(in + N medium)*	E. Campbell	1977 (87)	-
RU 6502	Victoria 1	ADUL 163	Australia	Victoria	-	1985 (87)	-
RU 6503	NZE 2	ADUL 200	New Zealand	Between Lumsden & Kingston	A. Van Hove	1986 (87)	-
RU 6504	NLE 3	ADUL 204	New Zealand	2 km south of Hunterville *(in + N medium)*	A. Van Hove	1986 (87)	-
A. pinnata var. *pinnata* (PP)							
PP 7001	Australla 1	-	Australia	Kakadu Northern Park, Northern Territory	N. Yatazawa	1982	-
PP 7002	Red Lily	-	Australia	Red Lily	IRRI	1982	-
PP 7003	Kakadu	-	Australia	Kakadu National Park	IRRI	1982	-
PP 7004	Fog Dam	-	Australia	Fog Dam	IRRI	1982	-
PP 7005	Australla 2	-	Australia	-	IRRI	1984	-
PP 7006	I. Coast 1	PI 0025	Ivory Coast	-	IITA	1980	-
PP 7007	Senegal 1	PI 0026	Senegal	-	ORSTOM	1980	-

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
PP 7016	France 4	-	France	Botanical Garden of Lyon, origin (?)	P. Roger	1989	-
PP 7017	Iwahig	PI 0095	Philippines	Iwahig, Palawan	I. Grant	1985	-
PP 7501	I. Coast 2	ADUL 14	Ivory Coast	Bouake	Y. Nguessan	1978(87)	-
PP 7502	Thailand			Reclassified, see CA 3540			
PP 7503	Niger	ADUL 33	Niger	Niamey	E. Boudouresque	1980(87)	-
PP 7504	I. Coast 3	ADUL 34	Ivory Coast	Bouake	J. Bouharmont	1982(87)	-
PP 7505	PP ?	ADUL 35	1	-		1982(87)	-
PP 7506	Sierra L1	ADUL 38	Sierra Leone	-	C. Dixon	1982(87)	-
PP 7507	Zaire 4	ADUL 47	Zaire	Simisimi	L. Pauwels	1983(87)	-
PP 7508	IITA 3	ADUL 49	Nigeria	Ibadan	C. Van Hove	1983(87)	-
PP 7509	Nigeria 1	ADUL 51	Nigeria	Moor plantation	C. Van Hove	1983(87)	-
PP 7510	Nigeria 2	ADUL 52	Nigeria	Badeggi	C. Van Hove	1983(87)	-
PP 7511	Senegal 3	ADUL 53	Guinea-Bissau	Contuboel	H. Diara	1983(87)	-
PP 7512	Zaire 5	ADUL 105	Zaire	Kisantu	B. Bruyneel	1984(87)	-
PP 7513	Blanchet.	ADUL 110	Australia	Blanchetown, (*in + N medium*)		1984(87)	-
PP 7514	Zaire 6	ADUL 111	Zaire	Nsele	B. Bruyneel	1984(87)	-
PP 7515	I. Coast 4	ADUL 120	-	Ivory Coast	Y. Nguessan	1984(87)	-
PP 7516	I. Coast 5	ADUL 124	Ivory Coast	Idessa	Y. Nguessan	1984(87)	-
PP 7517	Botswana	ADUL 129	Botswana	Okavango	P. Smith	1984(87)	-
PP 7518	Benin 1	ADUL 132	Benin	Cotonou	M. Verhoyen	1984(87)	-
PP 7519	Sierra L2	ADUL 135	Sierra Leone	-	C. Dixon	1985(87)	-
PP 7520	Sierra L3	ADUL 136	Sierra Leone	-	C. Dixon	1985(87)	-
PP 7521	BF - 1	ADUL 140	Burkina Faso	Niofila *(BF-2)*	J. Sawadogo	1985(87)	-
PP 7522	BF - 2	ADUL 141	Burkina Faso	Hippopotamus Pound (BF-3)	J. Sawadogo	1985(87)	-
PP 7523	Griffith	ADUL 144	Australia	CSIRO	Griffith	1985(87)	-
PP 7524	Perth	ADUL 147	Australia	Perth	E. Bennett	1985(87)	-
PP 7525	AF-17	ADUL 165	Australia	Victoria	H. Aston	1985(87)	AF
PP 7526	Rwanda 1	ADUL 188	Rwanda	Kirirambogo	C. Van Hove	1985(87)	-
PP 7527	Zaire 7	ADUL 197	Zaire	Bukavu	J. Micha	1986(87)	-
PP 7528	Baquineda	ADUL 203	Mali	Baguineda	T. Traore	1987(87)	-
PP 7529	Madagas. 10	ADUL 210	Madagascar	Antananarivo	H. Naveau	1987(87)	-
PP 7530	Rwanda 2	ADUL 187	Rwanda	Rwamagana	C. Van Hove	1985(87)	-
PP 7532	Belgium 4	ADUL 11	0	Jifi Center, Belgium	J. Jurdan	1978(87)	-
PP 7533	PP 7001	ADUL 138	Sierra Leone	ADRAO - Rokupr (From Australia)	C. Dixon	1985(87)	-
PP 7534	Banaue 5	ADUL 213	0	IRRI station, Banaue, Ifugao, Philippines	C. Van Hove	1987(88)	-
PP 7535	Andapa	ADUL 237	Madagascar	Andapa	E. Lourtie	1989(90)	-
Unclassified (XX)							
XX 8001	Vera Cruz	CNPAF48	Mexico	Vera Cruz	I. Watanabe	1987	-
XX 8002	Madagas.11	-	Madagascar	Betafo	I. Watanabe	1988	-
XX 8003	1001 x 4061-1			Reclassified, see FI 1062			
XX 8004	1001 x 4061-2			Reclassified, see FI 1063			
XX 8005	1001 x 4061-3			Reclassified, see FI 1064			

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IRRI code	Code 1	Code 2	Country of origin	Location and/or *origin*	Source	Year	Note
XX 8006	1001x4061-4			Reclassified, see FI 1065			
XX 8007	1001x4061-5			Reclassified, see FI 1066			
XX 8008	1001x4061-6			Reclassified, see FI 1067			
XX 8009	1001x4061-7			Reclassified, see FI 1068			
XX 8010	1001x4061-8			Reclassified, see FI 1069			
XX 8011	1001x4061-9			Reclassified, see FI 1070			
XX 8012	3522x4061-1			Reclassified, see CA 3022			
XX 8013	3522x4061-2			Reclassified, see CA 3023			
XX 8014	3522x4061-3			Reclassified, see CA 3024			
XX 8015	3522x4061-4			Reclassified, see CA 3025			
XX 8016	3522x4061-5			Reclassified, see CA 3026			
XX 8017	3522x4061-6			Reclassified, see CA 3027			
XX 8018	3522x4061-7			Reclassified, see CA 3028			
XX 8019	4061x1001-1	AF-21	Philippines	*From spores of 4061* (UPMN) *x 1001* (GH)	M. Tenorio	1989	AF
XX 8020	4061X1001-2	–	Philippines	*From spores of 4061* (UPMN) *x 1001* (GH) - nomal	M. Tenorio	1989	SP
XX 8021	1038x1001-1			Reclassified, see FI 1053			
XX 8022	1038x1001-2			Reclassified, see FI 1054			
XX 8023	1038x1001-3			Reclassified, see FI 1055			
XX 8024	1038x1001-4			Reclassified, see FI 1056			
XX 8025	1038x1001-5			Reclassified, see FI 1057			
XX 8026	1038x1001-6			Reclassified, see FI 1058			
XX 8027	1038x1001-7			Reclassified, see FI 1059			
XX 8028	Jalapa	Mexn 2	Mexico	Veracruz Jalapa (by R. F. Cerrato & R. Q. Lizaola)	W. Zimmerman	1990	-
XX 8029	Oaxaca	Mexn 4	Mexico	Oaxaca (by R. F. Cerrato & R. Q. Lizaola)	W. Zimmerman	1990	-
XX 8030	Texmelucan	Mexn 8	Mexico	Texmelucan (by R. F. Cerrato & R. Q. Lizaola)	W. Zimmerman	1990	-
XX 8031	Veracruz - B	Mexn 11	Mexico	Veracruz 1 (by R. F. Cerrato & R. Q. Lizaola)	W. Zimmerman	1990	-
XX 8032	Xochimilco	Mexn 13	Mexico	Distrito Federal, Xochimilco (by R. F. Cerrato & R. Q. Lizaola)	W. Zimmerman	1990	-
XX 8033	IAEA - 1	-	Austria	*Parent of XX 8034 and XX 8035* (CA 3001?)	H. Brunner	1990	-
XX 8034	IAEA - 2	-	Austria	IAEA, *Mutant (by gamma ray) 0.6% NaCl resistant/ 1.2% tolelarant*	H. Brunner	1990	MU
XX 8035	IAEA - 3	-	Austria	IAEA, *Mutant (by gamma ray) Al tolerant (80 µmoles Al2(SO4)3), pH 4*	H. Brunner	1990	MU

APPENDIX V

Blue-green Algae Collection

(as ofJune 1991)

IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
ANABAENA						
Ab 01 Ch	*A. azollae*	China	-	*Azolla* frond	Bai Ke-zhi	(1982)
Ab 02 Ph	-	Philippines	Pitan, Banaue,	Ricefield Ifugao	P. Roger	1982
Ab 03 In	*A. azollae*	India	Banaras Hindu University	*Azolla* frond	J. Ladha	(1988)
Ab 04 Eg	*A.* sp. Egypt 1	Egypt	Nile delta	Ricefield	F. Ghazal	1987
Ab 05 Sn	-	Senegal	Riniao	Ricefield	Roger & Reynaud	1972(85)
Ab 06 US	*A.* sp. CA US	USA	-	-	C. van Baalen	(1979)
Ab 07 Ch	*A. cylindrica*	China	-	-	Bai Ke-zhi	(1 982)
Ab 08 US	ATCC 22664	USA	-	-	J. Newton	(1982)
Ab 09 En	*A. flos-aquae*	UK	England	-	-	(1 982)
Ab 10 Th	-	Thailand	Sakhon Nakhon	Ricefield	P. Roger	1985
Ab 11 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P. Roger	1982
Ab 12 Ph	-	Phllipplnes	Luisiana, Laguna	Ricefield	P. Roger	1983
Ab 13 In	A. sp. L-31	India	-		J. Thomas	(1982)
Ab 14 Ms	-	Malaysia	Tikang Batu, Kedah	Ricefield	P. Roger	1983
Ab 15 Ms	-	Malaysia	Teroi, Kedah	Ricefield	P. Roger	1983
Ab 16 Ms	-	Malaysla	Kuala Kurau, Perak	Ricefield	P. Roger	1983
Ab 17 US	A. sp.	USA	-	Ricefield	J. Newton	(1 982)
Ab 18 Ns	*A. oscillarioides*	Netherlands	-	Saline marsh soil	-	1982
Ab 19 Pr	-	Portugal	-	Marsh soil	P. Roger	1983
Ab 20 Ph	-	Philippines	Lawig, Lamut, Ifugao	Ricefield	P. Roger	1982
Ab 21 In	*A. subcylindrica*	India			J. Thomas	(1 980)
Ab 22 Ph	-	Philippines	Luisiana, Laguna	Ricefield	P. Roger	1979
Ab 23 Ph	-	Philippines	IRRI	Ricefield	P. Roger	1979
Ab 24 Mr	-	Madagascar	Manitsy Expt. Stp.	Ricefield	P. Roger	1986
Ab 25 Ch	*A. variabilis*	China	-	-	Bai Ke-zhi	(1 980)
Ab 26 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	<1 977(85)
Ab 29 Sn	-	Senegal	Bambey	Upland, nonrice	P. Roger	1973(85)
Ab 30 In	*A. cycadae*	India	Banaras Hindu University	Cycas	J. Ladha	(1988)
Ab31 Sn	-	Senegal	Bambey	Upland, nonrice	P. Roger	1973(85)
Ab 32 SL	MAH 21	Sri Lanka	-	-	S. Kulasooriya	(1986)
Ab 33 Mr	-	Madagascar	Betafo	Ricefield	P. Roger	1986
Ab 34 Sn	-	Senegal	Casamance	Ricefield	Roger & Reynaud	1974(85)

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
Ab 35 Sn	-	Senegal	Casamance	Ricefield	Roger & Reynaud	1974(85)
Ab 36 Sn	-	Senegal	Casamance	Ricefield	Roger & Reynaud	1974(85)
Ab 37 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Ab 38 Sn	-	Senegal	Fanaye	-	Roger & Reynaud	1974(85)
Ab 40 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	1974(85)
Ab 41 Sn	-	Senegal	Ntiago	Ricefield	Roger & Reynaud	1974(85)
Ab 42 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	1974(85)
Ab 43 Th	-	Thailand	Sakhon Nakhon	Ricefield	P. Roger	1985
Ab 44 MI	*Cylindro* sp.	Mali	ENS, Bamako	Ricefield	T. Traore	1975(85)
Ab 45 Pr	-	Portugal	-	Fresh water pond	P. Roger	1983
Ab 46 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	1974(85)
Ab 47 XX	PCC 7120	-	-	-	R. Rippka	(1983)
Ab 48 En	PCC 7122	UK	England	Fresh water pond	R. Rippka	1939(83)
Ab 49 SL	KGT 004	Sri Lanka	-	-	S. Kulasooriya	(1986)
Ab 50 SL	NSL	Sri Lanka	-	Ricefield	S. Kulasooriya	(1979)
Ab 51 US	ATCC 29413	-	-	-	-	(1988)
Ab 52 US	SA-1	-	-	-	-	(1988)
CALOTHRiX						
Cx 01 Th	-	Thailand	-	Ricefield	P. Roger	1985
Cx 02 SL	KGT 005	Sri Lanka	-	-	S. Kulasoorlya	(1986)
Cx 03 Sn	*C. scopulorum*	Senegal	-	-	Roger & Reynaud	1976(85)
Cx 04 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Cx 05 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Cx 06 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Cx 07 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Cx 08 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Cx 09 Sn	-	Senegal	Bambey Expt. Statlon	Upland, nonrice	P Roger	1972(85)
Cx 10 Sn	-	Senegal	Bambey Expt. Statlon	Upland, nonrice	P. Roger	1972(85)
Cx 11 Sn	-	Senegal	Riniao	Ricefield	P. Reynaud	1972(85)
Cx 12 SL	KGT 066	Sri Lanka	-	-	S. Kulasooriya	(1986)
Cx 13 Sn	-	Senegal	Vinding	Ricefield	Roger & Reynaud	1972(85)
Cx 14 Sn	-	Senegal	M'Bane	Ricefield	Roger & Reynaud	1972(85)
Cx 15 MI	-	Mali	ENS, Bamako	Ricefield	P. Roger	1972(85)

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
Cx 16 Sn	-	Senegal	-	-	Roger & Reynaud	1972(85)
Cx 17 Sn	-	Senegal	-	-	Roger & Reynaud	1972(85)
Cx 18 Cl	PCC 7102	Chile	La Perdata, Antofagasta	-	R. Rippka	1972(85)
Cx 19 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Cx 20 Ph	-	Philippines	Apalnga'oh, Banaue,Ifugao	Ricefield	P. Roger	1982
Cx 21Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Cx 22 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P.Roger	1982
Cx 23 Cn	-	Spain	Canary Is	-	P. Reynaud	<1984(85)
Cx 24 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Cx 25 As	-	Austria	Neusiedlersee	Solonetz	P. Roger	1988
Cx 26 Ph	-	Philipplnes	Calauan, Laguna	Ricefield	P. Roger	1985
Cx 27 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Cx 28 Sn	-	Senegal	-	-	Roger & Reynaud	1977(85)
Cx 29 Ph	-	Philippines	Palao, Kiangan, Ifugao	Ricefield	P. Roger	1982
Cx 30 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P. Roger	1982
Cx31 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P.Roger	1982
Cx 32 Ph	-	Philippines	IRRI, Los Baños, Laguna	Ricefield	P. Roger	1979
Cx 33 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Cx 34 Ph	-	Philippines	Apalnga'oh. Banaue, Ifugao	Ricefield	P. Roger	1982
Cx 35 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Cx 36 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Cx 37 Sn	-	Senegal	Retba Lake	Saline wetland	Roger & Reynaud	1975(85)
Cx 38 Ms	-	Malaysia	Kuala Kurau, Perak	Ricefield	P. Roger	1983
Cx 39 Sn	-	Senegal	Retba Lake	Saline wetland	Roger & Reynaud	1975(85)
Cx 40 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1975(85)
Cx 41 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1975(85)
Cx 42 Ms	-	Malaysia	Penang	Ricefield	P. Roger	1983
Cx 43 Ms	-	Malaysia	Penang	Ricefield	P. Roger	1983
Cx 44 Sn	-	Senegal	Riniao	Ricefield	Roger & Reynaud	<1977(85)
Cx 45 In	ARM 68	India	-	Ricefield	B. Kaushik	(1989)

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
FISCHERELLA						
Fi 01 Sn	-	Senegal	Djibelor	Ricefield	Roger & Reynaud	1974(85)
Fi 02 SL	KGT 059	Sri Lanka	-	-	S. Kulasoorlya	(1986)
Fi 03 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Fi 04 Mr	-	Madagascar	Betafo	Ricefield	P. Roger	1986
Fi 05 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P. Roger	1982
Fi 06 Ph	-	Philippines	Palao, Kiangan, Ifugao	Ricefield	P. Roger	1982
Fi 07 Sn	-	Senegal	-	-	Roger & Reynaud	1974(85)
Fi 08 Ph	-	Philippines	Lawig, Lamut Ifugao	Ricefield	P. Roger	1982
Fi 09 XX	*Aulosira*	-	-	-	-	(1979)
Fi 10 Ph	-	Philippines	Palao, Kiangan, Ifugao	Ricefield	P. Roger	1982
Fi 11 Th	-	Thailand	Sampaton Expt. Station	Ricefield	P. Roger	1985
Fi 12 Sn	-	Senegal	Bambey Expt Station	Upland, nonrice	P. Roger	1972(85)
Fi 13 Cn	-	Spain	Canary Is.	Upland soil	P. Reynaud	<1984(85)
Fi 14 In	*Hapalosiphon*	India	-	-	R. Kaushik	(1989)
Fi 15 Au	Fi Austria 2a	Austria	Neusiedlersee	-	P. Roger	1988
GLOEOTRICHIA						
Gl 01 Ph	G. sp.	Philippines	Los Baños, Laguna	Ricefield	M. Martinez	(1983)
Gl 02 Ph	G. sp.	Philippines	Los Baños, Laguna	Ricefield	M. Martinez	(1983)
LPP GROUP						
LP 01 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	1977(85)
NODULARIA						
Nd 01 Ms	-	Malaysia	Kuala Kurau, Perak	Ricefield	P. Roger	1983
NOSTOC						
Ns 01 Ms	-	Malaysia	Kuala Kurau, Perak	Ricefield	P. Roger	1983
Ns 02 SL	TAM 21	Sri Lanka	-		S. Kulasoorlya	1986
Ns 03 Ms	-	Malaysia	Simpai Lima, Perak	Ricefield	P. Roger	1983
Ns 04 Ms	-	Malaysia	Penang	Ricefield	P. Roger	1983
Ns 05 SL	UG 027	Sri Lanka	-	-	S. Kulasoorlya	(1986)
Ns 06 Ms	-	Malaysia	Teroi, Kedah	Ricefield	P. Roger	1983
Ns 07 Ph	N. sp. A	Philippines	Los Baños, Laguna	Ricefield	M. Martinez	(1983)
Ns 08 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Ns 09 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Ns 10 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
Ns 11 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P. Roger	1982
Ns 12 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Ns 13 Ph	-	Philippines	Pitan, Banaue, Ifugao	Ricefield	P. Roger	1982
Ns 14 Sn	-	Senegal	-	Ricefield	Roger & Reynaud	1974(85)
Ns 15 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Ns 16 Ph	-	Philippines	Apalnga'oh, Banaue, Ifugao	Ricefield	P. Roger	1982
Ns 17 Mr	-	Madagascar	Belanitra Expt. Station	Ricefield	P. Roger	1986
Ns 18 Mr	-	Madagascar	Belanitra Expt. Station	Ricefield	P. Roger	1986
Ns 19 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 20 Mr	-	Madagascar	Belanltra Expt. Station	Ricefleld	P. Roger	1986
Ns 21 Ph	*N. commune*	Philippines	Mangatarem, Pangasinan	Ricefield	P. Roger	1986
Ns 22 Eg	-	Egypt	Sakha	Ricefield	F. Ghazal	1987
Ns 23 Mr	-	Madagascar	Belanitra Expt Station	Ricefield	P. Roger	1986
Ns 24 Th	-	Thailand	-	Ricefield	P. Roger	1985
Ns 25 In	N. sp. K	India	-	-	P. Singh	(1982)
Ns 26 Ir	-	Iran	-	Ricefield	P. Roger	1985
Ns 27 Th	-	Thailand	-	Ricefield	P. Roger	1985
Ns 28 Ir	-	Iran	-	Ricefield	P. Roger	1985
Ns 29 As	-	Austria	Neusiedlersee	Saline gley	P. Roger	1988
Ns 30 As	-	Austria	Neusiedlersee	Saline gley	P. Roger	1988
Ns 31 As	-	Austria	Neusiedlersee	Solonchak	P. Roger	1988
Ns 32 As	-	Austria	Neusiedlersee	Solonetz	P. Roger	1988
Ns 33 SL	PED 24	Sri Lanka	-	-	S. Kulasooriya	1986
Ns 34 Sn	-	Retba	Senegal Lake	Saline wetland	Roger & Reynaud	1976(85)
Ns 35 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 36 Ph	-	Palao, Kiangan, Ifugao	Philippines	Ricefleld	P. Roger	1982
Ns 37 Ir	-	Iran	-	Ricefleld	P. Roger	1985
Ns 38 Sn	-	Richard	Senegal Toll	Ricefleld	Roger & Reynaud	1975(85)
Ns 41 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 42 Au	PCC 73102	Australia	-	-	R. Rippka	(1983)
Ns 43 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 44 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 45 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 46 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
Ns 47 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1977(85)
Ns 48 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 49 Ms	-	Malaysia	Simpai Lima, Perak	Ricefield	P. Roger	1983
Ns 50 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 51 Sn	-	Senegal	-	-	Roger & Reynaud	1985
Ns 52 Eg	N. sp. Eg 42	Egypt	Nile delta	Ricefield	F. Ghazal	1988(90)
Ns 53 Eg	N. sp. Eg 63	Egypt	Nile delta	Ricefield	F. Ghazal	1988(90)
Ns 54 Eg	N. sp. Eg 69	Egypt	Nile delta	Ricefield	F. Ghazal	1988(90)
Ns 55 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1974(85)
Ns 56 Ph	-	Philippines	Pitan, Banaue, lfugao	Ricefield	P. Roger	1982
Ns 57 Ph	-	Philippines	Pitan, Banaue, lfugao	Ricefield	P. Roger	1982
Ns 58 Ms	-	Malaysia	Penang	Ricefield	P. Roger	1983
Ns 59 Sn	-	Senegal	Richard Toll	Ricefield	P. Roger	1970(85)
Ns 60 Sn	-	Senegal	Barnbey Expt. Station	Upland nonrice	P. Roger	1973(85)
Ns 61 Sn	-	Senegal	Djibelor	Ricefield	Roger & Reynaud	1974(85)
Ns 62 Ms	-	Malaysia	Teroi, Kedah	Ricefield	P. Roger	1983
Ns 63 Sn	-	Senegal	Richard Toll	Ricefield	Roger & Reynaud	1974(85)
Ns 64 SL	ULP 001	Sri Lanka	-	Ricefield	S. Kulasooriya	(1986)
Ns 65 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 66 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Ns 67 Sn	-	Senegal	Fanaye	Ricefield	Roger & Reynaud	1975(85)
Ns 68 Sn	-	Senegal	Senegal	-	Roger & Reynaud	<1977(85)
Ns 69 Sn	-	Senegal	Retba Lake	Saline wetland	Roger & Reynaud	<1977(85)
Ns 70 MI	-	Mali	ENS, Bamako	Ricefield	P. Roger	1976(85)
Ns 71 Ph	*A. variabiiis*	Philippines	Los Baños, Laguna	Ricefield	M. Martinez	(1980)
OSCILLATORIA						
Os 01 Sn	-	Senegal	Bambey Expt. Station	Upland, nonrice	P. Roger	1972(85)
Os 02 Sn	-	Senegal	Riniao	Ricefield	Roger & Reynaud	1985
Os 03 Sw	PCC 7515	Sweden	-	-	R. Rippka	(1983)
Os 04 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
PSEUDOANABAENA						
Ps 01 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)

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IRRI code	Original code/name	Country of collection	Location	Environment	Source	Year
SCYTONEMA						
Sc 01 SL	AMB 056	Sri Lanka	-	-	S. Kulasooriya	(1986)
Sc 02 SL	KGT 064	Sri Lanka	-	-	S. Kulasooriya	(1986)
Sc 03 Eg	-	Egypt	Nile delta	Ricefield	P. Roger	1987
Sc 04 Sn	-	Senegal	Riniao	Ricefield	Roger & Reynaud	1975(85)
Sc 05 Ph	-	Philippines	IRRI, Los Baños, Laguna	Ricefield	P. Roger	1982
Sc 06 Th	-	Thailand	Sampatong Expt. Station	Ricefield	P. Roger	1989
Sc 07 SL	AM6 020	Sri Lanka	-	-	S. Kulasooriya	(1986)
Sc 08 Mr	-	Madagascar	Manjakandriana	Ricefield	P. Roger	1986
Sc 09 Mr	-	Madagascar	Manjakandriana	Ricefield	P. Roger	1986
SYNECHOCOCCUS						
Sy 01 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Sy 02 Sn	-	Senegal	-	-	Roger & Reynaud	<1977(85)
Sy 03 Sn	*C. coharens*	Senegal	-	-	Roger & Reynaud	<1977(85)
TOLYPOTHRIX						
Tx 01 As	-	Austria	Neusiedlersee	Solonetz	P. Roger	1988
Tx 02 Jp	*T. tenuis*	Japan	-	Ricefield	A. Watanabe	(1978)
Tx 03 Ms	-	Malaysia	Penang	Ricefield	P. Roger	1983

APPENDIX VI
Aquatic Legumes Collection
(as of June 1991)

IRRI no.	Species	Former designation	Origin	Source (donor organization)
Aeschynomene				
11009	*A. fluminensis* Vell.	-	Colombia	University of Florida, USA
11012	*A. americana* Linn.	-	USA	University of Florida, USA
11045	*A. americana* Linn.	-	USA	CIAT, Cali, Colombia
11077	*A. americana* Linn.	-	Colombia	CIAT, Cali, Colombia
11081	*A. fluminensis* Vell.	-	Colombia	CIAT, Cali, Colombia
11149	*A. fluminesis* Vell.	-	Colombia	University of Giessen, Germany
12001	*A. villosa* Mart.	-	Mexico	University of Florida, USA
12002	*A. sensitiva* Swarzt	-	Brazil	University of Florida, USA
12005	*A.* sp.	-	Australia	University of Florida, USA
12059	*A. schimperi* Hochst ex A. Rich.	*A. uniflora*	Madagascar	IRRI - Madagascar Project
12080	*A. sensitiva* Swarzt	-	Colombia	CIAT, Cali, Colombia
12145	*A. crassicaulis* Harms	-	Senegal	ORSTOM, Dakar, Senegal
12146	*A. cristata* Vatke	-	Zaire	University of Giessen, Germany
12148	*A. elaphroxylon* Taub.	-	Burundi	University of Giessen, Germany
12155	*A. rudis* Benth.	-	Colombia	ORSTOM. Dakar, Senegal
12156	*A. schimperi* Hochst ex A. Rich.	-	Senegal	ORSTOM, Dakar, Senegal
13157	*A. sensitiva* Swarzt	-	Senegal	ORSTOM, Dakar, Senegal
12159	*A. villosa* Mart.	-	Venezuela	ORSTOM, Dakar, Senegal
13003	*A. denticulata* Rudd	-	Brazil	University of Florida, USA
13006	*A. pratensis* Donn. Smith	-	Brazil	University of Florida, USA
13010	*A. evenia* W.F. Wright	-	Brazil	University of Florida, USA
13015	*A. scabra* G. Don	-	Zimbabwe	University of Florida, USA
13016	*A. indica* Linn.	-	China	FAAS, Fuzhou, China
13019	*A. indica* Linn.	-	India	
13020	*A. aspera* Linn.	-	Sri Lanka	University of Florida, USA
13058	*A. indica* Linn.	*A. schimperi*	Madagascar	IRRI-Madagascar Project
13066	*A. scabra* Linn.	*A.* sp.	Tanzania	
13071	*A. indica* Linn.	*A.* sp.	Philippines	IRRI, Los Baños, Philippines
13078	*A. ciliata*	-	Colombia	
13079	*A. indica* Linn.	-	Colombia	CIAT, Cali, Colombia
13144	*A. ciliata*	-	Senegal	University of Giessen, Germany
13147	*A. denticulata* Rudd	-	Venezuela	ORSTOM, Dakar, Senegal
13150	*A. indica* Linn.	-	Senegal	University of Giessen, Germany
13151	*A. indica* Linn.	-	Senegal	University of Giessen, Germany
13154	*A. pratensis* Donn. Smith	-	Senegal	ORSTOM, Dakar, Senegal
13158	*A. uniflora* E. Mey.	-	Zaire	University of Giessen, Germany
13167	*A. ciliata*	-	Guinea	University of Giessen, Germany
13168	*A. indica* Linn.	-	Senegal	University of Giessen, Germany
13169	*A. indica* Linn.	-	Guinea	University of Giessen, Germany
14040	*A. nilotica* Taub.	-	Senegal	University of Giessen, Germany
14054	*A. afraspera* J. Leonard	-	Senegal	University of Giessen, Germany
14142	*A. afraspera* J. Leonard	-	Gambia	University of Giessen, Germany
14143	*A. afraspera* J. Leonard	-	Guinea	University of Giessen, Germany
14152	*A. nilotica* Taub.	-	Mali	ORSTOM, Dakar, Senegal
14153	*A. nilotica* Taub.	-	Zaire	University of Giessen, Germany
Sesbania				
21035	*S. cannabina* Linn. & Merrill	*S. sesban* 85-26	China	CAAS, China
21036	*S. cannabina* Linn. & Merrill	*S. sesban* Jiang Jiao 10	China	CAAS, China
21037	*S. cannabina* Linn. & Merrill	*S. sesban* Yian 171	China	CAAS, China
21038	*S. cannabina* Linn. & Merrill	*S. sesban* K-132	China	CAAS, China
21044	*S. cannabina (Retz.) Poir*	*S. aculeata*	India	

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IRRI no.	Species	Former designation	Origin	Source (donor organization)
21056	*S. bispinosa* (Jacq.) W. F. Wright	*S.* sp	Madagascar	IRRI-Madagascar Project
21057	*S. bispinosa* (Jacq.) W. F. Wrigh t	*S.* sp	Madagascar	IRRI-Madagascar Project
21072	*S. sesban* Linn. & Merrill	-	Kenya	KFSC, Kenya
21074	*S. cannabina* (Retz.) Poir	*S.* sp. (chizea)	China	
21076	*S. cannabina* (Retz.) Poir	*S.* China type	China	
21090	*S. sesban* Linn. & Merrill	-	Thailand	BNF Research Center, Thailand
21092	*S. cannabina* (Retz.) Poir	*S. aculeata*	Thailand	BNF Research Center, Thailand
21097	*S. exaltata* (Raf.) Cory	-	Egypt	IRRI-Egypt Project
21098	*S. varadero*	-	Cuba	
21099	*S. spiritus*	-	Cuba	
21126	*S. macrantha* Welw. ex Phill & Huch	-	Kenya	KFSC, Kenya
21127	*S. sesban* Linn. & Merrill	-	India	CSSRI, India
21128	*S. cannabina* (Retz.) Poir.	-	India	CSSRI, India
21131	*S.* sp.	-	El Salvador	
21132	*S. cannabina* (Retz.) Poir	-	Japan	Dr. Fujita
21161	*S.* sp.	-	Zaire	University of Giessen, Germany
21163	*S.* sp.	-	Zaire	University of Giessen, Germany
21164	*S. tedraptera* Hochst. ex Baker	-	Kenya	ORSTOM, Dakar, Senegal
21165	*S. cannabina*	-	India	University of Giessen, Germany
21171	*S.* sp.(tree)	-	Zaire	University of Giessen, Germany
22026	*S. speciosa* Taub	-	Indonesia	NCRB, Indonesia
22060	*S.* sp	-	Brazil	
22073	*S. speciosa* Taub	*S. sesban*	Nigeria	IITA, Ibadan, Nigeria
22091	*S. javanica* Miquel	-	Thailand	BNF Research Center, Thailand
22093	*S. sesban* Linn & Merrill	-	Philippines	SEARCA, Philippines
22100	*S. emerus*	-	Cuba	
22170	*S. pachycarpa* D.C.	-	Zaire	University of Giessen, Germany
22173	*S. speciosa* Taub	-	Malaysia	University of Giessen, Germany
24027	*S. rostrata* Brem. & Oberm	-	Senegal	IITA, Ibadan, Nigeria
24043	*S. rostrata* Brem & Oberm	*S. punctata*	Madagascar	IRRI-Madagascar Project
	S. rostrata Brem. & Oberm.	*S. punctata*	Madagascar	IRRI-Madagascar Project
24062	*S. rostrata* Brem. & Oberm.	-	Senegal	University of Giessen, Germany
24070	*S. rostrata* Brem. & Oberm.	-	Not know	A.T. Padre
	S. rostrata Brem. & Oberm	-	Gambia	University of Giessen, Germany
Neptunia				
32160	*N. oleracea*	-	China	ORSTOM, Dakar, Senegal
32172	*N. oleracea*	-	Thailand	Dr. I. Watanabe

APPENDIX VII

Rhizobia Collection

(as of June 1991)

Legume host of isolation	Symbiont	Other strains	Representative strain (IRBG)	Other designation	Source of isolation
Aeschynomene afraspera	UNID	2, 5, 211-219	3	-	SN/WLRS
A. americana	UNID	1. 6, 7	77	(Am4)	RN/WLRS
A. aspera	UNID	103, 161-167	102	-	RN/WLRS
A. denticulata	UNID	-	231	-	SN/WLRS
A. evenia	UNID	232-234	229	-	SN/WLRS
A. indica	UNID	90-93, 220-224	86	-	SN/WLRS
A. nilotica	UNID	-	230	-	RN/WLRS
A. pratensis	UNID	124-128	120	(2.2.5)	SN/WLRS
A. rudis	UNID	228	107	-	SN/WLRS
A. scabra	UNID	88-89	87	-	SN/WLRS
A. schimperi	UNID	105-106	104	-	SN/WLRS
A. sensitiva	UNID	114-122	109		SN/WLRS
Indigofera tinctoria	UNID	111-113	110	(1-3)	RN/DLRS
Neptunia oleracea	UNID	-	227	(NP1)	SN/WLRS
Sesbania cannabina	UNID	59-62, 71-76	74	(A9)	RN/WLRS
S. rostrata	*Azorhizobium*	8-10, 15-19, 23, 25, 29-39	46	(TOS6)	SN/WLRS
S. sesban	UNID	66, 70	64	(S4)	RN/WLRS
S. speciosa	UNID	-	4	-	RN/WLRS

APPENDIX VIII

Free-living N_2-fixing Bacteria Collection

(as of June 1991)

Genus/species	Representative strain (IRBG)	Other designation	Other strains	Source of isolation
Azospirillum lipoferum	179	34H	IRBG 180, IRBG 181, IRBG 182	Wetland rice root
Azospirillum sp.	36	H4	36H4, 36H7	Wetland rice root
Klebsiella planticola	185	LL4	-	Wetland rice root
Enterobacter cloacae	194	IR5-23	IRBG 191 to IRBG 197	Rice rhizosphere
Pseudomonas diazotrophicus	183	H8	-	Wetland rice root
Pseudomonas sp.	226	SGBP	-	Wetland rice root
Rhodopseudomonas sp.	205	S4-11	IRBG 206	Wetland rice soil
Rhodopseudomonas sp.	202	R1-2	IRBG 203, IRBG 204	Wetland rice root
Rhodopseudomonas sp	207	STB4	-	Decomposing straw
Rhodopseudomonas sp.	208	RH3-6	-	Rice rhizosphere

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