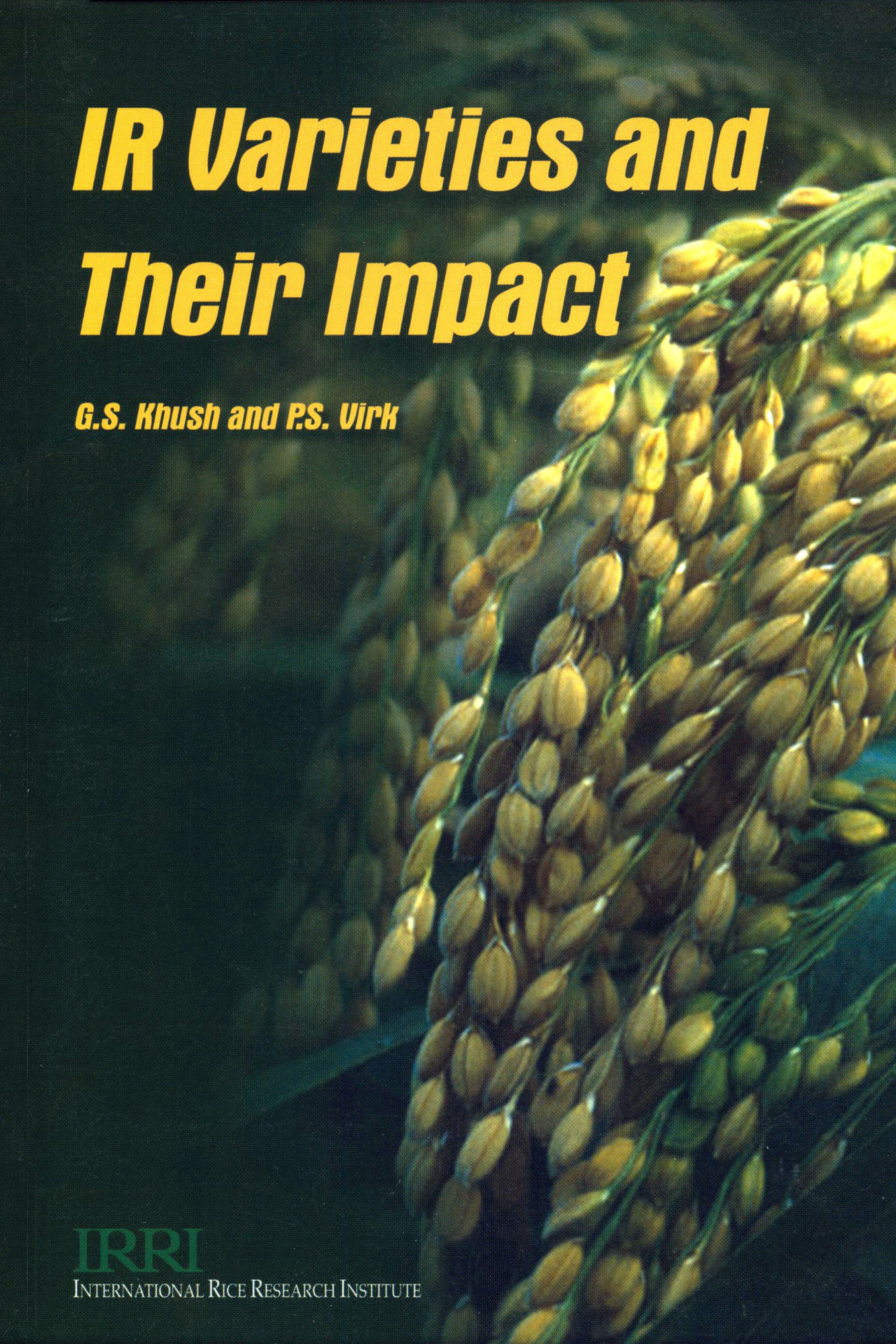
IR Varieties and Their Impact

G.S. Khush and P.S. Virk



IRRI
International Rice Research Institute

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2005

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Mailing address: DAPO Box 7777, Metro Manila, Philippines
Phone: +63 (2) 580-5600, 845-0563
Fax: +63 (2) 580-5699, 891-1292, 845-0606
Email: irri@cgiar.org
Home page: www.irri.org
Rice Knowledge Bank: www.knowledgebank.irri.org
Courier address: Suite 1009, Pacific Bank Building
6776 Ayala Avenue, Makati City, Philippines
Tel. (63-2) 891-1236, 891-1174, 891-1258, 891-1303

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Foreword

The 1960s was a decade of despair with regard to the world's ability to cope with the food-population balance, particularly in densely populated countries in the tropics and subtropics. The cultivated-land frontier was closing in most Asian countries, while population growth rates were accelerating because of rapidly declining mortality rates resulting from advancements in modern medicine and health care, and improved sanitation. International organizations and concerned professionals were busy organizing seminars and conferences to raise awareness to tackle the ensuing food crisis and to mobilize global resources to tackle the problem on an emergency basis.

Fortunately, the Rockefeller and Ford Foundations invested resources to establish centers of excellence to address problems of stagnating yields of major food crops in poor developing countries. They established the International Rice Research Institute (IRRI) in 1960 in the Philippines and, a few years later, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico. The widespread adoption of improved varieties of rice and wheat developed at IRRI and CIMMYT, respectively, initiated what came to be called the "Green Revolution." This led to major increases in food production and changed the outlook from one of despair to hope. Thanks to the adoption of improved varieties and associated management practices, large-scale famines and social and economic upheavals were averted.

Since 1966, when the first high-yielding variety of rice was released, rice area has increased only marginally from 126 to 152 million hectares (18%), whereas the average yield has increased from 2.1 to 3.9 tons per hectare (86%). World rice production increased from 257 million tons in 1966 to 600 million tons in 2000 (133%). In 2000, the average per capita food grain availability was 20% higher than in the 1960s. The resulting food security led to political stability, investments in education, infrastructure development, and industrialization. The economic miracle underway in many Asian countries was triggered by the growth in agricultural income and its equitable distribution.

Rice scientists, journalists, and historians often search for information on Green Revolution varieties of rice. This information is buried in plant breeders' field books and records of plant pathologists and entomologists. I am glad that Dr. G.S. Khush, who led IRRI's rice improvement program for 35 years, has summarized the available information in this publication on 34 IR varieties and prepared a list of 328 IR breeding lines released as 643 varieties in 75 countries. Dr. P.S. Virk, who succeeded Dr. Khush as plant breeder at IRRI, assisted him in this endeavor. I hope that this publication will serve as a source of information on varieties that had such a significant impact on food security and poverty alleviation and fostered economic development.

ROBERT ZEIGLER
Director General
IRRI

Preface

In a foreword to the book *Development and Spread of High-Yielding Rice Varieties in Developing Countries* by Dana G. Dalrymple, Dr. N.C. Brady, former director general of the International Rice Research Institute (IRRI), wrote, "The most significant technological accomplishment of this century in international agriculture is the development of high-yielding cereal crop varieties. These fertilizer-responsive food crops with a high degree of resistance to insects, pests, and diseases have provided on-farm yields far in excess of those obtainable from traditional varieties. They have given rise to the Green Revolution, which has helped many nations increase their food production in the face of a substantial increase in human population. Increased production means higher returns to many farmers and lower food costs to consumers."

Dr. Brady was, of course, referring to high-yielding varieties of rice and wheat. The purpose of this publication is to summarize the information about the development and characteristics of high-yielding rice varieties and their international acceptance. Rice improvement at IRRI is a multidisciplinary endeavor, involving plant breeders and scientists from other disciplines. Plant breeders provide leadership in developing breeding strategies to handle hybridization programs, manage breeding nurseries, select promising plants, and manage seed materials. Plant pathologists, entomologists, agronomists, and cereal chemists contribute specialized skills. They develop screening techniques for evaluating the germplasm, identify the donors for various traits, and help evaluate breeding materials. For example, plant pathologists have developed techniques for screening for resistance to blast, bacterial blight, tungro, and grassy stunt and have screened a large number of varieties from the germplasm bank. They have identified donors for resistance to these diseases. Similarly, entomologists have screened varieties for resistance to brown planthopper, green leafhopper, and stem borers. Cereal chemists have developed techniques for evaluating grain quality. Agronomists evaluate elite breeding lines for nitrogen responsiveness and yield potential.

The development of rice varieties requires a lot of time and effort. The assistance of Filipino staff in evaluating breeding materials for high-yielding varieties has been invaluable. A large volume of breeding materials could not have been handled without their dedication and commitment. Numerous breeders from national rice improvement programs who participated in various training programs gave us valuable suggestions. International distribution and evaluation of elite germplasm were facilitated through International Network for Genetic Evaluation of Rice nurseries. Numerous scientists in national agricultural research and extension systems evaluated the IRRI-bred materials and selected those suitable for their growing conditions, which were then released as varieties.

Rice is grown under four ecologies: irrigated, rainfed lowland, upland, and flood-prone. Initially, there was only one breeding program at IRRI and breeding materials were evaluated under irrigated and rainfed lowland conditions. Separate breeding programs were organized for upland, flood-prone, and rainfed lowland ecologies in 1972, 1974, and 1976, respectively. Hybrid breeding and wide hybridization programs began in 1979 and 1987, respectively. Each of these breeding programs has been handled by one breeder, with inputs from other scientists.

All the IR varieties and a vast majority of IR breeding lines released in other countries were developed in the irrigated rice breeding program and most of the IR varieties are also grown under favorable rainfed lowland conditions. Varietal improvement for unfavorable environments (rainfed lowland drought-prone, rainfed lowland submergence-prone, upland, and flood-prone) has been slow because of the diversity of growing conditions. Nevertheless, several elite breeding lines specifically developed for such conditions have been released as varieties by national rice improvement programs.

It was my good fortune to have had the opportunity to participate in one of the most successful experiments in international agricultural development. During my 35 years as a rice breeder, I had the opportunity to work with numerous scientists and administrators at IRRI and in national rice improvement programs. I shall always cherish their support and friendship. The letters IR are synonymous with superiority and success. During my working life at IRRI, I dealt with these letters on a daily and sometimes hourly basis.

GURDEV S. KHUSH

System of designating IR crosses

The system for designating crosses employs a slash (/) to indicate a single cross, two slashes (//) for the second cross, and so forth:

Cross no.	Symbol
1	/
2	//
3	///
4	/4/
5	/5/
n	/n/

Thus, if parent A is crossed to B, and the F_1 hybrid is crossed to parent C, this would be designated as

A/B//C

Backcrosses are designated by an asterisk (*) and a number indicating the contribution of the recurrent parent. The asterisk and the number are placed adjacent to the crossing symbol, which divides the recurrent and donor parents. The following examples involve one backcross:

A is the recurrent parent A*2/B
B is the recurrent parent A/2*B
A/B is the recurrent parent A/B*2/C
C is the recurrent parent A/B//2*C

IR numbers are assigned consecutively to the crosses made at IRRI just before the hybrid seeds are incubated for germination. When plant selections are made from F_2 and subsequent generations of an IR cross, numerical designations are given for each breeding line. For example, IR2061-214-3-8-2, a breeding line named IR28 in 1974, was selected from the cross IR2061. Plant selections from the F_2 of this cross (numbering 806) were grown in the pedigree nursery as F_3 rows, which were consecutively designated as IR2061-1, IR2061-2, and so on up to IR2061-806. From selection 214, three plants were selected, planted in the pedigree nursery as F_4 selections, and designated as IR2061-214-1, IR2061-214-2, and IR2061-214-3. From selection IR2061-214-3, ten plants were again selected and planted in the pedigree nursery as F_5 rows. These selections were designated as IR2061-214-3-1 up to 2061-214-3-10. From selection IR2061-214-3-8, three plant selections were made and planted in the pedigree nursery as F_6 rows. These were designated as IR2061-214-3-8-1, IR2061-214-3-8-2, and IR2061-214-3-8-3. At maturity, selection IR2061-214-3-8-2 appeared uniform and seeds of the entire row were bulk-harvested and used for yield evaluation in replicated trials and other tests. This line was evaluated in the lowland rice performance trials conducted by the Rice Varietal Improvement Group of the Philippine Seed Board, and, on the basis of its superior performance, was released as IR28.

Naming of IR varieties

Rice crosses made at IRRI are assigned a number with IR (international rice) as a prefix. Thus, the first cross made in 1962 was designated IR1 and the subsequent crosses were given consecutive numbers. As of 2005, 82,354 crosses have been made at IRRI.

IR8 was the first variety named by IRRI in 1966. It was selected from the eighth cross made in 1962. It was tested under the experimental designation of IR8-288-3. IR5 selected from the fifth cross was released in 1967. It was tested under the experimental designation of IR5-47-2. Thus, IR5 was released a year after IR8. Subsequent IR varieties were selected from the IR crosses with three or more digits. When experimental line IR532E576 was being considered for release, it was decided to assign a short varietal name rather than the cross number (e.g., 532) from which it was selected. The first proposal was to call it IR10. However, a colleague pointed out that it could be mistaken as IRI zero. It was therefore decided to name it IR20. It was also decided to give even numbers to subsequent general-purpose varieties and odd numbers to special-purpose varieties. Thus, starting with IR20, up to IR74, even numbers have been assigned consecutively to general-purpose varieties. IR29 and IR65 are glutinous and IR43 and IR45 are recommended for upland conditions.

IR8, IR5, IR20, IR22, IR24, IR26, IR28, IR29, IR30, IR32, and IR34 were named by IRRI with international announcements. Subsequently, these varieties were also approved by the Philippine Seed Board. In 1975, IRRI decided not to name any varieties but to continue to freely share breeding lines with national programs and let the national programs release the IRRI-bred lines as varieties if they so chose. The Philippine Seed Board, however, elected to retain the IR prefix for the varieties selected from IRRI-bred materials. Thus, IR36 and subsequent varieties up to IR74 were named by the Philippine Seed Board and IRRI did not have any press releases, in contrast to earlier practice.

The Philippine Rice Research Institute (PhilRice) was established in 1985 and it assumed the responsibility of nationwide testing of improved germplasm and decided to name rice varieties with a prefix of PSBRc (Philippine Seed Board Rice). Thus, all the rice varieties released in the Philippines after 1988 were given a PSBRc designation irrespective of the institution that bred the variety. Thus, PSBRc 1, PSBRc 2, PSBRc 4, PSBRc 10, PSBRc 18, PSBRc 20, PSBRc 28, PSBRc 30, PSBRc 44, PSBRc 46, PSBRc 48, PSBRc 50, PSBRc 52, PSBRc 54, PSBRc 60, PSBRc 64, PSBRc 68, PSBRc 70, PSBRc 80, PSBRc 82, PSBRc 84, PSBRc 86, PSBRc 88, PSBRc 92, PSBRc 94, PSBRc 96, and PSBRc 102 are IRRI breeding lines. However, starting in 2002, a new prefix, NSIC Rc (National Seed Industry Council Rice), replaced PSBRc. Thus, NSIC Rc 110 and NSIC Rc 112 are IRRI breeding lines. The suffix H is used for hybrid rice varieties. To date, four IRRI hybrids—PSBRc 26H, PSBRc 72H, NSIC Rc 114H, and NSIC Rc 116H—have been released as varieties in the Philippines.

Other rice-growing countries have either released IRRI improved germplasm under the IR designation or provided local names. However, the IR designation has acquired an international reputation and farmers prefer to plant improved varieties if they have the IR designation. For example, IR6-156-2 was released in Pakistan as Mehran 69, yet farmers continue to call this line IRRI6. So popular is the IR prefix in Bangladesh that any improved rice, even if bred by the Bangladesh Rice Research Institute, is called IRRI rice. The IRRI designation is even used for nonrice crops in Bangladesh if they happen to have improved characteristics. Thus, large-sized tomatoes are called IRRI tomatoes!

The breeding process

Varietal development is a complex process. It starts with setting the breeding objectives, identifying parents, and making crosses. Growing the segregating populations and their evaluation is the most laborious and technical part of the process. A vast number of breeding materials are grown and evaluated for various agronomic characteristics, grain quality, disease and insect resistance, and tolerance of abiotic stresses. The availability of high-quality data at the time of making plant selections is very important. For this purpose, the input of specialists such as plant pathologists, entomologists, cereal chemists, and agronomists is essential. Familiarity of breeders with the germplasm and their judgment in picking the "winners" are the key to the success of the breeding program. Multilocation evaluation for yield and adaptation to particular environments are the final step in breeding before varietal release. Breeders' work does not end with the release of a variety. They must produce breeder seed and work with seed-producing organizations to make sure adequate quantities of foundation and certified seed are available. As an example of the breeding process, the history of the development of IR36, a successful rice variety, is given below.

The pedigree of IR36 involves 13 landraces from six countries. The initial crosses that led to the development of IR36 were made in July 1969. IR579-48-1-2, an early-maturing line from the cross of IR8 and Tadukan, was crossed with another early-maturing line, IR747B2-6-2, from TKM6^2/TN1. IR579-48-1-2 is resistant to bacterial blight. IR747B2-6-2 is resistant to brown planthopper and stem borers. F_5 progenies of this cross designated IR1561 were resistant to bacterial blight, brown planthopper, and stem borer but were susceptible to green leafhopper and tungro and grassy stunt viruses.

At about the time the cross between IR579-48-1-2 and IR747B2-6-2 was made (July 1969), another cross, between *Oryza nivara* (identified to be resistant to grassy stunt) and IR24, was made. Three backcrosses using IR24 as the recurrent parent were made. Backcross progenies were screened for resistance to grassy stunt. The third backcross was designated as IR1737. A grassy-stunt-resistant plant of IR1737 was crossed with IR156-228-1-2 in February 1971 and the cross was designated as IR2042.

An F_1 plant of IR2042 was topcrossed with a gall-midge-resistant line, CR94-13, from the Central Rice Research Institute (CRRI), Cuttack, India, in October 1971. CR94-13 is also resistant to tungro and green leafhopper and has *bph2* for resistance to brown planthopper. This cross was designated IR2071. Topcross F_1 seeds were planted in January 1972. F_1 seedlings were inoculated with grassy stunt. Resistant seedlings were transplanted in the screenhouse and F_2 seeds were harvested in April 1972. The F_2 population was grown in the field in July 1972 at the Maligaya Rice Research and Training Center (MRRTC), Muñoz, Nueva Ecija (now PhilRice). Tungro disease pressure and incidence of stem borer at Maligaya were very high. At maturity, 937 plants with resistance to tungro and stem borer were selected and planted in the F_3 pedigree nursery at IRRI in December 1972, without insecticide protection. All the F_3 rows were inoculated with bacterial blight and susceptible rows were discarded. F_3 rows were also screened for blast resistance. Rows susceptible to brown planthopper were killed because of the high insect population in the field. In March 1973, plant selections were made from the pedigree nursery rows having multiple resistance to blast, bacterial blight, green leafhopper, and brown planthopper.

In May 1973, F_4 pedigree nursery rows were grown at IRRI and exposed to high pressure of grassy stunt. F_4 pedigree nursery rows were also evaluated for resistance to bacterial blight in the field, for blast in the blast nursery, and for green leafhopper and brown planthopper in the greenhouse. An early-maturing line designated as IR2071-625-1 appeared very vigorous and showed resistance to grassy stunt. Data in the field book indicated that it was resistant to blast, bacterial blight, green leafhopper, and brown planthopper. Seeds of this line were bulk-harvested along with many other lines. The latter included a longer-duration line, IR2071-586-5.

A small seed increase of IR2071-625-1 was planted in September 1973. Since there was slight maturity segregation, 400 individual plants were selected at maturity. The plant selections were planted in progeny rows in February 1974. Plot number 252 looked uniform at maturity. This selection, designated as IR2071-625-1-252, formed the basic seed stock.

Reaction to tungro of F_5 lines of IR2071, including IR2071-625-1 and IR2071-586-5, was determined by planting at Lanrang, South Sulawesi (Indonesia), where an outbreak of tungro occurred. Both lines were resistant. F_6 lines of this cross were evaluated for gall midge resistance by planting at CRRI-Cuttack. IR2071-625-1 and IR2071-586-5 were resistant to gall midge.

Thus, by the end of 1974, multiple resistance of IR271-625-1 and IR2071-586-5 to blast, bacterial blight, grassy stunt, tungro, green leafhopper, brown planthopper, and stem borer was established. Two seasons of yield data in replicated yield trials at IRRI during 1974 showed that IR2071-625-1 had high yield potential. Analysis of grain quality showed that the line had excellent long slender and translucent grains with high milling recovery. IR2071-625-1-252 was therefore entered in the Philippine Seed Board Lowland Cooperative Performance Tests in the first season of 1975. This line outyielded all other entries in the early-maturing group of these trials during two seasons of 1975. In its March 1976 meeting, the Rice Varietal Improvement Group of the Philippine Seed Board recommended the naming of IR2071-625-1-252 as IR36. This recommendation was approved by the Seed Board in its 21st meeting in May 1976. Thus, IR36 became a Seed Board–recommended variety in the Philippines in mid-1976.

Within a year of its release in the Philippines, IR36 replaced IR26, which was the most dominant variety at that time. By 1977, a new biotype of brown planthopper had arisen, which overcame the resistance of IR26 conditioned by *Bph1*. IR36 was resistant to the new biotype as it had *bph2* for resistance.

Similarly, IR26 became susceptible to brown planthopper in Indonesia because of the emergence of a new biotype and IR36 was released in 1977.

In Vietnam, brown-planthopper-resistant varieties IR26, IR30, and IR1561-228-3-3 (all with *Bph1* for resistance) became susceptible. In the latter part of 1977, 250 tons of seed of IR36 was imported into Vietnam from the Philippines and distributed to farmers in early 1978 in a crash planting program.

IR36 was recommended for cultivation throughout India but was planted widely in Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Orissa, and West Bengal states.

IR36 was also released in China, Cambodia, Laos, Myanmar, Bhutan, Central African Republic, Gambia, Madagascar, and Mozambique. Although not recommended as a variety, it was also grown in Sri Lanka and Bangladesh during the 1980s.

During the 1980s, IR36 became the most widely grown variety of rice in the world. It was planted on about 11 million ha of irrigated and rainfed land. No other variety of rice or any other food crop has been grown that widely before. It is still grown in the Philippines, Indonesia, and India 28 years after its release.

A quinquennial review team that reviewed the research program of IRRI in 1981 remarked, "*The impact of IR36 alone would more than justify the investment in IRRI since its establishment 21 years ago.*"

Data management

From the start of rice breeding at IRRI, data have been collected on the cross histories, pedigrees, and evaluation of breeding lines. This database has been managed on a succession of computer systems through the International Rice Information System (IRIS), which is available on the Internet (www.iris.irri.org) and CD for use by any rice-breeding program (McLaren et al 2005).

Selection criteria

As mentioned above, evaluation of segregating populations and fixed elite lines for agronomic characteristics, grain quality, disease and insect resistance, and abiotic stresses requires major effort and resources. Some of the selection criteria and characteristics of IR varieties are given here.

Grain quality

The development of germplasm with superior grain quality has always received topmost priority in IRRI's breeding program. Selection is based on (1) grain size, shape, and appearance; (2) milling recovery; and (3) cooking and eating characteristics. In tropical and subtropical Asia, consumers prefer long slender and translucent or medium-long and translucent grains. Thus, selection for grain size, shape, and appearance is based on these parameters.

Most of the IR varieties have long slender or medium-long slender grains with a minimum level of chalkiness. Only IR68 has extra long grains. Translucent long or medium-long grains give high milling recovery (less grain breakage during milling). Bold, long, and chalky grains have poor milling recovery. Thousand-grain weight in the range of 20–28 g is most desirable. Table 1 gives data on grain length, shape (length/breadth ratio), chalkiness, and 1,000-grain weight of IR varieties. This table also shows the milling characteristics of IR varieties. Milling recovery of over 60% is most desirable. Actual measurements of rough (paddy) rice, brown rice, and milled rice grains also appear in Table 1.

Table 1. Grain characteristics and milling recovery of IR varieties.

	Grain characteristics				Milling recovery		
Variety	Length	Shape	Chalkiness (%)	1,000-grain weight (g)	% Hulls	% TMR[a]	% HR
IR5	Medium	Medium	10–20	21.7	23	68	54
IR8	Long	Medium	>20	30.3	22	69	54
IR20	Medium	Medium	None	19.8	21	67	62
IR22	Long	Slender	None	24.4	23	70	64
IR24	Long	Slender	10–20	27.2	21	71	66
IR26	Medium	Medium	10–20	21.2	24	68	61
IR28	Long	Slender	<10	24.4	23	70	61
IR29	Long	Slender	Opaque	22.5	25	67	62
IR30	Medium	Medium	10–20	21.8	21	71	56
IR32	Long	Slender	<10	23.1	24	66	51
IR34	Long	Slender	10–20	25.0	21	69	59
IR36	Long	Slender	<10	22.3	21	71	56
IR38	Long	Slender	>20	24.8	21	70	62
IR40	Medium	Medium	10–20	21.9	21	71	66
IR42	Medium	Medium	None	20.1	23	69	62
IR43	Long	Medium	10–20	28.4	21	72	60
IR44	Long	Slender	10–20	23.0	22	71	62
IR45	Long	Slender	>20	26.8	21	71	59
IR46	Long	Slender	None	28.9	21	68	59
IR48	Long	Slender	10–20	29.0	21	71	64
IR50	Long	Slender	None	19.4	21	70	47
IR52	Long	Slender	None	25.6	21	70	53
IR54	Long	Slender	<10	23.9	20	71	58
IR56	Long	Slender	<10	24.5	21	71	59
IR58	Medium	Medium	None	21.4	22	70	65
IR60	Long	Slender	None	20.8	20	73	66
IR62	Medium	Medium	<10	22.4	20	72	61
IR64	Long	Slender	10–20	26.3	22	70	59
IR65	Long	Slender	Opaque	24.3	22	69	51
IR66	Long	Slender	None	21.7	22	71	58
IR68	Extra long	Slender	10–20	32.6	21	70	52
IR70	Medium	Medium	>20	22.6	22	70	45
IR72	Long	Slender	<10	24.4	21	71	44
IR74	Long	Slender	10–20	23.3	22	69	60

[a]TMR = total milled rice, HR = head rice or unbroken rice grains.

The cooking and eating characteristics of rice are largely determined by the properties of starch, which makes up 90% of milled rice. Rice varieties differ in several starch properties such as amylose content, gelatinization temperature, and gel consistency. Consumers in tropical and subtropical Asia prefer rice with intermediate amylose and gelatinization temperature and soft gel consistency. Since many of the donors for disease and insect resistance used in our breeding program had high amylose content, most of the IR varieties have high amylose content. IR24 has low amylose content, IR48 and IR64 have intermediate amylose content, and IR29 and IR65 are glutinous (Table 2). Table 2 also gives data on gelatinization temperature and gel consistency. A variety with a desirable combination of intermediate amylose and gelatinization temperature and soft gel consistency is IR64. It was released in 1985 by the government of the Philippines. Its grain quality is considered superior to that of other IR varieties and it has been adopted widely in tropical and subtropical Asia. It is the most widely grown variety of rice in the world. The proportion of rice breeding materials with desirable cooking characteristics like those of IR64 increased markedly during the 1990s. Some of the IR breeding lines released by the government of the Philippines such as PSBRc 82 and NSIC Rc 110 have a desirable combination of grain quality characteristics.

Grain dormancy

A grain characteristic not related to quality is grain dormancy. A vast majority of the rice varieties grown in tropical and subtropical Asia before the Green Revolution had strong dormancy. Since a single crop of rice was grown per year in most of tropical and subtropical Asia, strong dormancy was not a problem. With the availability of short-duration, photoperiod-insensitive varieties and the development of irrigation facilities, double cropping of rice became a widespread practice in Asia. Varieties with strong dormancy were not suitable for double cropping. Therefore, varieties with weak dormancy of 3–4 weeks have been selected. Table 3 gives data on grain dormancy of IR varieties.

Disease and insect resistance

Incorporation of disease and insect resistance into improved germplasm always received priority at IRRI. Plant pathologists and entomologists developed screening techniques that were used to identify donors for resistance and for screening breeding materials. Table 4 gives the disease and insect resistance ratings of IR varieties.

Bacterial blight. The leaf clipping technique developed by Kaufman et al (1973) has been used for inoculating a large volume of breeding materials as well as for genetic investigations with bacterial blight pathogen. The dominant gene *Xa4* for resistance to bacterial blight has been incorporated in most of the IR varieties (Table 5). It conveyed resistance to the prevalent races of bacterial blight in the Philippines during the 1970s. Although new races of bacterial blight capable of overcoming *Xa4* resistance emerged in the

Table 2. Physicochemical properties of IR varieties.

Variety	Amylose content	Gelatinization temperature	Gel consistency
IR5	High	Intermediate	Soft
IR8	High	Low	Medium-hard
IR20	High	Intermediate	Medium
IR22	High	Low	Hard
IR24	Low	Low	Soft
IR26	High	Low	Soft
IR28	High	Low	Medium
IR29	Glutinous	Low	Soft
IR30	High	Intermediate	Soft
IR32	High	Intermediate	Soft
IR34	High	Low	Medium-hard
IR36	High	Intermediate	Medium
IR38	High	Intermediate	Soft
IR40	High	Intermediate	Medium
IR42	High	Low	Medium-hard
IR43	Low	Low	Soft
IR44	High	Low	Medium
IR45	High	Low	Medium
IR46	High	Intermediate	Soft
IR48	Intermediate	Low	Soft
IR50	High	Low	Soft
IR52	High	Low	Medium
IR54	High	Low	Medium
IR56	High	Low	Medium
IR58	High	Low	Hard
IR60	High	Low	Soft
IR62	High	Intermediate	Soft
IR64	Intermediate	Intermediate	Soft
IR65	Glutinous	Low	Soft
IR66	High	Intermediate	Soft
IR68	High	Low	Medium-hard
IR70	High	Intermediate	Medium
IR72	High	Intermediate	Soft
IR74	High	Low	Medium-hard

Philippines, most of the varieties with *Xa4* suffer very little damage from bacterial blight because of residual resistance. Varieties with *Xa4* also convey resistance to prevalent races of bacterial blight in China, Cambodia, Thailand, and Vietnam.

Twenty different genes for bacterial blight resistance are known and several, such as *Xa4*, *xa5*, *xa13*, and *Xa21*, have been incorporated into improved germplasm. Germplasm with these genes has been continuously shared with national breeding programs. A recent release in the Philippines

Table 3. Percent seed germination of IR varieties, grown at IRRI during the 2002 dry season, at harvest time and at 1-week intervals up to 6 weeks.

Variety	At harvest	Weeks after harvest					
		1	2	3	4	5	6
IR5	20	20	26	33	47	47	90
IR8	26	40	42	78	77	79	94
IR20	6	21	31	44	48	56	74
IR22	2	12	14	21	34	49	72
IR24	46	56	60	75	88	87	94
IR26	49	45	53	60	74	82	96
IR28	14	24	25	26	43	76	92
IR29	9	17	29	29	54	92	76
IR30	20	23	37	34	52	85	80
IR32	29	36	19	45	54	49	92
IR34	29	38	49	46	54	63	80
IR36	8	27	29	46	48	76	96
IR38	3	9	12	13	31	56	88
IR40	7	24	29	41	55	87	96
IR42	16	19	25	38	60	54	92
IR43	54	58	66	83	68	90	97
IR44	11	16	18	29	54	66	98
IR45	27	33	54	69	72	84	98
IR46	8	15	13	15	12	18	50
IR48	16	15	22	36	42	46	87
IR50	35	62	69	87	93	98	99
IR52	7	12	8	16	10	18	40
IR54	50	52	70	75	92	97	94
IR56	17	20	15	27	37	45	65
IR58	42	49	54	63	53	92	94
IR60	6	6	7	10	11	12	45
IR62	7	16	12	23	31	36	88
IR64	10	15	29	24	51	53	74
IR65	18	21	24	43	57	77	82
IR66	13	23	23	26	46	66	87
IR68	60	67	80	90	95	91	96
IR70	9	12	12	34	44	64	97
IR72	2	7	6	8	6	14	36
IR74	5	6	5	10	16	11	56

Table 4. Disease and insect reactions of IR rice varieties.

IR variety	Reaction[a]									
	Blast	Bacterial blight	Grassy stunt	Tungro	GLH[b]	BPH[c] biotype			Stem borer	Gall midge
						1	2	3		
IR5	MR	S	S	S	R	S	S	S	MS	S
IR8	MR	S	S	S	R	S	S	S	S	S
IR20	MR	R	S	MR	R	S	S	S	MR	S
IR22	S	R	S	S	S	S	S	S	S	S
IR24	S	S	S	S	R	S	S	S	S	S
IR26	MR	R	MR	MR	R	R	S	R	MR	S
IR28	R	R	R	R	R	R	S	R	MR	S
IR29	R	R	R	R	R	R	S	R	MR	S
IR30	MS	R	R	MR	R	R	S	R	MR	S
IR32	MR	R	R	MR	R	R	R	S	MR	R
IR34	R	R	R	R	R	R	S	R	MR	S
IR36	R	R	R	R	R	R	R	S	MR	R
IR38	R	R	R	R	R	R	R	S	MR	R
IR40	R	R	R	R	R	R	R	S	MR	R
IR42	R	R	R	R	R	R	R	S	MR	R
IR43	R	R	S	S	R	S	S	S	MR	S
IR44	R	R	S	R	R	R	R	S	MR	S
IR45	R	R	S	S	R	S	S	S	MR	S
IR46	R	R	S	MR	MR	R	S	R	MR	S
IR48	R	R	R	R	R	R	R	S	MR	–
IR50	MS	R	R	R	R	R	R	S	MR	–
IR52	MR	R	R	R	R	R	R	S	MR	–
IR54	MR	R	R	R	R	R	R	S	MR	–
IR56	R	S	R	R	R	R	R	R	MR	–
IR58	R	R	R	R	R	R	R	S	MR	–
IR60	R	R	R	R	R	R	R	R	MR	–
IR62	MR	R	R	R	R	R	R	R	MS	–
IR64	MR	R	R	R	R	R	MR	R	MR	–
IR65	R	R	R	R	R	R	R	S	MS	–
IR66	MR	R	R	R	R	R	R	R	MR	–
IR68	MR	R	R	R	R	R	R	R	MR	–
IR70	R	S	R	R	R	R	R	R	MS	–
IR72	MR	R	R	R	R	R	R	R	MR	–
IR74	R	S	R	R	R	R	R	R	MR	–

[a]S = susceptible, MS = moderately susceptible, MR = moderately resistant, R = resistant. Reactions were based on tests conducted in the Philippines for all diseases and insects except for gall midge conducted in India. [b]GLH = green leafhopper, [c]BPH = brown planthopper.

Table 5. Genes for resistance in IR varieties.

Variety	Bacterial blight[a]	Blast	Grassy stunt	*BPH*[b]	GLH[c]
IR5	*0*	*Pita*	*0*	*0*	*Glh3*
IR8	*0*	*Pi20 (Pi b, Pi k-s)*	*0*	*0*	*Glh3*
IR20	*Xa4*	*(Pi b, Pi k-s)*	*0*	*0*	*Glh3*
IR22	*Xa4*	*Pi20 (Pi b, Pi k-s)*	*0*	*0*	*0*
IR24	–	*Pi20 (Pi b, Pi k-s)*	*0*	*0*	–
IR26	*Xa4*	*Pi20 (Pi b, Pi k-s)*	*0*	*Bph1*	–
IR28	*Xa4*	*(Pi b, Pi k-s)*	*Gs*	*Bph1*	*Glh9*
IR29	*Xa4*	*(Pi b, Pi k-s, Pi z-t)*	*Gs*	*Bph1*	*Glh9*
IR30	*Xa4*	*(Pi b, Pi k-s)*	*Gs*	*Bph1*	*Glh3*
IR32	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	–
IR34	*Xa4*	*(Pi b, Pi k-s, Pi z-t)*	*Gs*	*Bph1*	*Glh9*
IR36	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	*glh10*
IR38	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	–
IR40	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	–
IR42	*Xa4*	*Pita*	*Gs*	*bph2*	*glh4*
IR43	*Xa4*	*Pi 20 (Pi b)*	*0*	*0*	–
IR44	*Xa4*	*Pita*	*0*	*Bph1*	–
IR45	*Xa4*	*(Pi b, Pi k-s)*	*0*	*Bph1*	*Glh3*
IR46	*Xa4*	*Pita, Pi 20*	*Gs*	*Bph1*	–
IR48	*Xa4*	*Pita, Pi 20*	*Gs*	*bph2*	–
IR50	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	*Glh9*
IR52	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	*Glh9*
IR54	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	*Glh9*
IR56	*0*	*Pi k*, Pita*	*Gs*	*Bph3*	*Glh9*
IR58	*Xa4*	*Pita (Pi b)*	*Gs*	*Bph3*	*Glh9*
IR60	*Xa4*	*Pita (Pi b)*	*Gs*	*Bph3*	*Glh9*
IR62	*Xa4*	*Pita (Pi b)*	*Gs*	*Bph3*	–
IR64	*Xa4*	*Pita, Pi 20*	*Gs*	*Bph1*	–
IR65	*Xa4*	*Pita (Pi b)*	*Gs*	*bph2*	*Glh9*
IR66	*Xa4*	*(Pi b, Pi k-s)*	–	*Bph3*	–
IR68	*Xa4*	*Pita (Pi b)*	–	*Bph3*	–
IR70	*Xa4*	*Pi k, Pita*	–	*Bph3*	–
IR72	*Xa4*	*Pita (Pi b)*	–	*Bph3*	–
IR74	*0*	*Pi k, Pi 20*	–	*Bph3*	–

[a]0 = no gene. [b]BPH = brown planthopper. [c]GLH = green leafhopper. – = not determined.

(PSBRc 82) has *xa5* for resistance. Isogenic lines with single genes for bacterial blight resistance have been developed in the background of IR24 (Ogawa et al 1991). Availability of these isogenic lines and closely linked molecular markers permitted the pyramiding of two, three, or even four genes into the same line through molecular marker-aided selection (Huang et al 1997). Gene-pyramided lines have been shared with national programs for incorporation of these genes into local germplasm. Singh et al (2001) have incorporated three genes in a popular local variety, PR106, through marker-aided selection.

Blast. Breeding for blast resistance has emphasized the incorporation of polygenic or quantitative resistance. For this purpose, segregating materials are evaluated in a blast nursery where numerous races of blast fungus *Pyricularia grisea* have been present over the years. Screening starts with the F_2 generation. F_2 populations are planted in the blast nursery. Seedlings with a high level of resistance and those that are highly susceptible are discarded. Only those with an intermediate reaction, with a score of 3–4 on a scale of 1–9, are selected and planted in the F_3 nursery. In subsequent generations, breeding lines are continuously screened for blast resistance by planting in a blast nursery and only those with moderate levels of resistance are advanced to the next generation. Thus, through evaluation for at least 6–7 generations in a blast nursery, breeding lines with a broad spectrum of resistance are selected. Although we did not intentionally try to incorporate major genes for resistance, genetic analysis of blast resistance (Imbe et al 2000) revealed that most of the IR varieties have one or more major genes for resistance (Table 5). Since we have used diverse parents in our hybridization program and some of those parents have major genes, these were selected because of the presence of compatible races in the blast nursery.

Tungro. Resistance to tungro has received major attention in our breeding program. Numerous parents for resistance were used in the hybridization program and segregating populations were evaluated under field conditions where tungro pressure was high, and those with field resistance to tungro were selected. A few years after widescale cultivation, these varieties became susceptible. It was then realized that the resistance of these varieties was due to their resistance to green leafhopper, the vector of the tungro pathogen. After a few years of widescale cultivation, green leafhopper populations became adapted and were able to transmit the disease. During the last ten years, we selected for resistance to the viruses themselves by crossing the tungro-resistant donors with elite lines having no genes for resistance to green leafhopper. This allowed us to select for resistance to tungro viruses and resistant varieties have been released in the Philippines (Matatag 2, Matatag 9, and NSIC Rc 110) and Indonesia (Tukad Petanu and Tukar Unda) (Khush et al 2004).

Grassy stunt. Grassy stunt virus transmitted by brown planthopper assumed epidemic proportions, especially after the brown planthopper outbreaks during the 1970s. After large-scale screening of germplasm, *Oryza nivara*, a wild species closely related to cultivated rice, was found to be resistant to this virus. It has one dominant gene for resistance (Khush and Ling 1974). This gene was transferred to *O. sativa* by four backcrosses and the resistant backcross lines were employed for developing varieties with resistance to grassy stunt. With the wide-scale adoption of resistant varieties, grassy stunt has ceased to be a problem in farmers' fields.

Green leafhopper. Numerous donors for green leafhopper have been employed in our breeding program and all the IR varieties except IR22 have a variable level of resistance (Table 4). Genes for resistance in some varieties have been identified (Table 5). Those with *Glh3* are moderately resistant, whereas those with *Glh9* are highly resistant.

Brown planthopper. IR26 released in 1973 was the first variety with resistance to brown planthopper. It has *Bph1* for resistance. However, its resistance broke down in 1976 with the development of a new biotype. Varieties with *bph2* were then released. These have been widely grown and their resistance has remained effective. In 1981, a biotype capable of overcoming resistance of *bph2* was detected in isolated areas of Mindanao (Philippines) and North Sumatra (Indonesia). This biotype has not spread to other areas. However, in anticipation of its spread to other areas, varieties with *Bph3* (Table 5) were developed and are widely grown. Varieties such as IR46 and IR64 have partial resistance to all biotypes of brown planthopper.

Gall midge. Gall midge, fortunately, does not occur in the Philippines. Thus, a large-scale breeding program for resistance to this pest was not undertaken. However, progenies from crosses of CR94-13, which is resistant to gall midge, were evaluated for resistance in cooperation with scientists of the Central Rice Research Institute, Cuttack, India, and a few IR varieties were selected for resistance (Table 4).

Stem borers. A high level of resistance to stem borers has not been found in rice germplasm. However, most of the breeding materials were grown without any insecticide protection and those with extra susceptibility to stem borers were rejected. Most of the IR varieties have moderate levels of resistance inherited from TKM6, W1263, Ptb18, and Ptb21.

Tolerance of adverse soil conditions

Many wetland and dryland rice soils have moderate to strong toxicities to or deficiencies of various minerals. This affects the performance of rice adversely. Our soil chemists evaluated elite breeding materials for tolerance of mineral toxicities and deficiencies. Since we had used diverse landraces and wild species as parents in our hybridization program, enough variability existed for tolerance of mineral toxicities and deficiencies in our elite breeding materials. Only the elite breeding lines with some degree of tolerance were considered as candidates for varietal release. As shown in Table 6, most of the IR varieties have moderate to high levels of tolerance of mineral toxicities and deficiencies. IR36 released in 1976 and IR42 released in 1977 originated from the same cross, and they are the most tolerant. This is one of the important reasons for their wide-scale adoption during the 1980s.

Table 6. Reaction of IR varieties to adverse soils.[a]

Variety	Wetland soils							Dryland soils	
	Toxicities					Deficiencies		Deficiency	Toxicities
	Salt	Alkali	Peat	Iron	Boron	Phosphorus	Zinc	Iron	Aluminum and manganese
IR5	4	6	5	6	3	5	5	4	5
IR8	4	6	5	8	4	4	4	4	4
IR20	5	7	4	5	4	3	3	4	5
IR22	5	6	4	3	3	3	3	5	5
IR24	3	5	4	3	3	3	4	3	4
IR26	5	6	6	6	3	2	6	4	3
IR28	7	5	5	4	3	3	5	6	5
IR29	6	6	4	4	3	5	3	0	4
IR30	5	6	3	3	3	3	3	0	0
IR32	5	7	5	5	3	3	5	5	5
IR34	5	3	3	3	3	3	3	0	0
IR36	3	3	3	3	3	6	3	2	2
IR38	5	5	4	5	3	3	3	5	4
IR40	5	6	4	3	3	3	3	0	0
IR42	3	4	3	4	2	2	4	5	5
IR43	4	7	5	5	4	3	3	3	3
IR44	3	5	4	4	3	3	4	4	4
IR45	4	6	5	4	3	3	4	4	4
IR46	3	3	4	4	2	5	3	4	3
IR48	4	7	5	4	2	3	5	4	3
IR50	4	4	3	5	3	3	3	4	4
IR52	3	4	3	3	3	3	3	4	5
IR54	4	5	3	5	2	2	3	4	4
IR56	3	4	3	5	3	3	4	0	0
IR58	3	4	4	4	4	4	3	0	0
IR60	3	4	4	6	3	5	5	0	0
IR62	4	5	4	3	0	4	6	0	0
IR64	3	3	4	5	4	4	4	0	0
IR65	5	5	4	4	5	5	5	0	0
IR66	5	5	0	0	0	5	4	0	0
IR68	5	5	0	3	0	4	4	0	0
IR70	4	5	0	4	0	5	5	0	0
IR72	6	5	0	3	0	5	4	0	0
IR74	4	5	0	3	0	5	5	0	0

[a]0 = no information, 1 = almost normal plant, 9 = almost dead or dead plant.

Use of IRRI's improved germplasm internationally

From the inception of IRRI's rice improvement program, the germplasm has been freely shared with national rice improvement programs. Seeds of donor varieties, early-generation breeding materials, fixed elite lines, and named varieties are sent to national program scientists at their request and through the International Network for Genetic Evaluation of Rice (INGER) nurseries. Thus, seeds of breeding materials have been sent to 87 countries irrespective of geographic location or ideology. IRRI even shoulders the cost of shipment. These materials are evaluated for adaptation to local conditions. Some are released as varieties and others are used as parents in rice breeding programs. IRRI breeding lines released as varieties internationally appear in Tables 7 and 8. Thus, 328 IR breeding lines have been released as 643 varieties in 75 countries. Numerous IR varieties and breeding lines have been used as parents in breeding programs all over the world. During the 1970s and up to the mid-1980s, many IR varieties and breeding lines were released directly by national breeding programs. However, as the national breeding programs became stronger, IR lines were used primarily as parents in local breeding programs. It is estimated that 60% of the world rice area is now planted to IRRI-bred varieties or their progenies.

Impact of the germplasm improvement program

The impact of germplasm improvement spearheaded by IRRI popularly described as the Green Revolution has led not only to major increases in food production but also to improved socioeconomic conditions and environmental sustainability.

Impact on food production

The gradual replacement of traditional varieties of rice by improved ones, together with associated improvement in farm management practices, has had a dramatic effect on the growth of rice production, particularly in Asia. Farmers harvest 5–7 tons of paddy rice per hectare from high-yielding varieties compared with 1–3 tons with traditional varieties. Since 1966, when the first high-yielding variety of rice was released, the rice harvested area has increased only marginally, from 126 to 152 million hectares (18%), whereas the average yield has increased from 2.1 to 3.9 tons per hectare (90%). World rice production increased from 257 million tons in 1966 to 600 million tons in 2000. Area planted to rice, average yields, and total production in 12 Asian countries are shown in Figure 1. Every country has had a marginal increase in area but dramatic increases in average yields and production.

Table 7. IR varieties released in different countries and local names assigned to them (in parentheses).

Variety	Country (local name)
IR5	Bangladesh (IR5), Benin (IR5), Burkina Faso (IR5), Cameroon (IR5), Côte d'Ivoire (IR5), Ghana (IR5), Guinea (IR5), Guinea-Bissau (IR5), Indonesia (PB5), Iran (Ahwaz 1), Liberia (IR5), Myanmar (Yagyaw-2), Nepal (IR5), Nigeria (Faro 23), Philippines (IR5), Rwanda (Matwa), Tanzania (IR5), Uganda (IR5), Vietnam (TN5, NN5)
IR8	Bangladesh (IR8), Benin (IR8), Brazil (IR8), Burkina Faso (IR8), Cameroon (IR8), China (IR8), Colombia (IR8), Cuba (IR8), Dominican Republic (IR8), Ecuador (IR8), Ghana (IR8), Guyana (IR8), India (IR8), Indonesia (PB8), Iraq (IR8), Kenya (IR8), Malaysia (Padi Ria), Mauritania (IR8), Mexico (Milagro Filipino), Myanmar (Yagyaw-1), Nepal (IR8), Niger (IR8), Nigeria (Faro 13), Pakistan (RRI-PAK), Panama (IR8), Peru (IR8), Philippines (IR8), Senegal (IR8), Tanzania (IR8), Togo (IR8), Venezuela (IR8), Vietnam (TN8, NN8), Zaire (IR8)
IR20	Bangladesh (BRRI-Sail), Burkina Faso (IR20), Cameroon (IR20), Gambia (IR20), Ghana (IR20), Guinea-Bissau (IR20), India (IR20), Indonesia (IR20), Myanmar (Shwe-War-Hnan), Nigeria (Faro 19), Philippines (IR20), Vietnam (IR20)
IR22	Belize (Navolato A71), Benin (IR22), Bolivia (Navolato A71), Brazil (IR22), Colombia (IR22), Costa Rica (IR22), Cuba (Navolato A71), Ecuador (INIAP-2), El Salvador (Navolato A71), Gambia (IR22), Guatemala (Navolato A71), Guyana (IR22), Honduras (Navolato A71), India (IR22), Jamaica (Navolato A71), Mexico (Navolato A71), Myanmar (Lone-Thwe-Shwe-War), Nicaragua (IR22), Niger (IR22), Paraguay (IR22), Peru (IR22), Philippines (IR22), Venezuela (IR22), Vietnam (TN22, NN22)
IR24	Cameroon (IR24), China (IR24), India (IR24/PR103), Myanmar (Shwe-War-Yin), Philippines (IR24)
IR26	China (IR26), Indonesia (IR26), Iraq (IR26), Philippines (IR26), Vietnam (IR26)
IR28	Bangladesh (BR6), Cameroon (IR28), China (IR28), Egypt (IR28), Gambia (IR28), India (IR28), Indonesia (IR28), Iran (Amol 2), Mauritania (IR28), Myanmar (Shwe-War-Lay), Philippines (IR28), Togo (IR28)
IR29	China (Ha Nuo 15), Philippines (IR29)
IR30	India (IR30), Indonesia (IR30), Nigeria (IR30), Philippines (IR30), Vietnam (IR30)
IR32	Indonesia (IR32), Madagascar (Maifimboa), Mali (IR32), Philippines (IR32), Vietnam (IR32)
IR34	India (IR34), Indonesia (IR34), Madagascar (Momokatra), Myanmar (Sin-Shwe-Thwe), Philippines (IR34), Tanzania (IR34)

continued on next page. . .

Table 7 continued.

Variety	Country (local name)
IR36	Bhutan (IR36), Cambodia (IR36), Central Africa Republic (IR36), China (IR36), Gambia (IR36), India (IR36, Narendra 2), Indonesia (IR36), Laos (IR36), Madagascar (Tsy Milofika), Mozambique (IR36), Myanmar (IR36), Philippines (IR36), Vietnam (NN3A, IR36)
IR38	Indonesia (IR38), Laos (IR38), Philippines (IR38), Vietnam (IR38)
IR40	Mauritania (IR40), Philippines (IR40)
IR42	Cambodia (IR42), Cameroon (IR42), Ghana (IR42), India (IR42/Au 2), Indonesia (IR42), Malaysia (IR42), Mali (IR42), Mozambique (IR42), Myanmar (Pyilonechantha), Niger (IR42), Nigeria (IR42), Philippines (IR42), Senegal (IR42), Tanzania (IR42), Vietnam (NN4B, IR42)
IR43	Argentina (IR1529), Bolivia (Saavedra 5), Brazil (Dimante Bra), Cuba (IR1529), Mexico (IR1529), Peru (NIR1), Philippines (IR43)
IR44	Philippines (IR44)
IR45	Philippines (IR45)
IR46	Brazil (Pasagro 102), Cameroon (IR46), Chad (IR46), Côte d' Ivoire (IR46), Indonesia (IR46), Mozambique (IR46), Nigeria (IR46), Philippines (IR46), Togo (IR46)
IR48	Indonesia (IR48), Mozambique (IR48), Peru (PA-3), Philippines (IR48), Vietnam (NN5B, IR48)
IR50	Cambodia (IR50), India (IR50), Indonesia (IR50), Madagascar (Malaky), Mauritania (IR50), Mozambique (IR50), Myanmar (Shwe Thwe Yin), Philippines (IR50)
IR52	Bolivia (Saavedra), Indonesia (IR52), Mozambique (IR52), Philippines (IR52)
IR54	China (Qiquizao 25), Gambia (IR54), Indonesia (IR54), Kenya (IR54), Malaysia (IR54), Mozambique (IR54), Philippines (IR54), Tanzania (IR54)
IR56	Indonesia (IR56), Philippines (IR56)
IR58	Philippines (IR58), Sierra Leone (Rok33), Tanzania (IR58)
IR60	China (IR60), Philippines (IR60), Vietnam (IR60A)
IR62	India (IR62), Indonesia (IR62), Philippines (IR62)

continued on next page. . .

Table 7 continued.

Variety	Country (local name)
IR64	Bhutan (IR64), Burkina Faso (FKR42), Cambodia (IR64), China (IR64), Ecuador (INIAP11), Gambia (IR64), India (IR64), Indonesia (IR64), Mauritania (IR64), Mozambique (IR64), Philippines (IR64), Vietnam (OM89)
IR65	Indonesia (IR65), Philippines (IR65)
IR66	Cambodia (IR66), India (IR66), Indonesia (IR66), Laos (IR66), Philippines (IR66), Vietnam (IR66)
IR68	Indonesia (IR68), Philippines (IR68), Vietnam (IR68)
IR70	Indonesia (IR70), Philippines (IR70)
IR72	Cambodia (IR72), China (Guojidao 72), Indonesia (IR72), Laos (IR72), Myanmar (Yezin 1), Philippines (IR72), Vietnam (IR72)
IR74	Indonesia (IR74), Philippines (IR74)

Table 8. IR lines released as varieties in different countries.

IRRI line	Name given
Afghanistan	
IR62871-166-2-2	Baghlan 98
Argentina	
IR841-63-5	IR841
IR1529-430-3	IR1529
Australia	
IR661-1-170-1-3	IR661
Bangladesh	
IR5-47-2	IR5
IR8-288-3	IR8
IR272-4-1	Mala
IR532-1-176	Chandina
IR532-E576	BRRI-Sail (IR20)
IR578-15-2	BAU 63 (Varasha)
IR2053-87-3-1	BR7
IR2061-214-3-8-2	BR6 (IR28)
IR2071-199-3-6	BR15 (Mohini)
IR2793-80-1	BR16 (Shahi Balam)
IR33380-7-2-1-3	BRRI Dhan 34
IR44595-70-2-2-3	BR26
IR54791-19-2-3	BRRI Dhan 36 (BR 36)
IR69690H	BRRI Dhan Hybrid 1
Belize	
IR579-160-2	Novolato A71
IR822-81-2	CR 1113
Benin	
IR5-47-2	
IR8-288-3	
IR442-2-58	IR442
IR579-160-2	
IR937-55-3	
IR1529-680-3	
IR2042-178-1	
Bhutan	
IR2071-625-1-252	IR36
IR18348-36-3-3	IR64
IR20913-B-26-2-2-3	IR20913
IR20913-B-60	
IR61328-1-136-2-1-2-3	Bajo Kaap 2
IR61331-2-148-B	Bajo Kaap 1
Bolivia	
IR579-160-2	Novolato A71
IR1529-430-3	Saavedra 5
IR2042-178-1	
IR2053-206-1-3	
IR5853-118-5	Saavedra (IR52)
Brazil	
IR8-288-3	
IR442-2-58	BR-2
IR579-160-2	IR22
IR665-4-5-5	IR665
IR841-63-5	IR841
IR841-67-1-2	Empasc 104
IR930-31	IRGA 408
IR1529-430-3	Dimante Bra
IR2058-78-1-3-2-3	Pesagro 102
IR8208-146-1	Pesagro 101
IR11248-52-2-3-3	J266
Brunei	
IR841-85-1-1	BR1
IR49517-23-2-2-3-3	BR2
IR51672-115-2-3-1-3	BR3
Burkina Faso	
IR5-47-2	
IR8-288-3	
IR532-E576	
IR1529-680-3	IR1529
IR13240-108-2-2-3	FKR44
IR18348-36-3-3	FKR42
IR21015-80-3-3-1-2	FKR30
Burundi	
IR841-85-1-1	
Cambodia	
IR2071-586-5-6-3	IR42
IR2071-625-1-252	IR36
IR9224-117-2-3-3-2	IR50
IR13429-150-3-2-1-2	Kru
IR18348-36-3-3	IR64
IR32307-107-3-2-2	IR66
IR35366-90-3-2-1-2	IR72
IR43342-10-1-1-3-3	Santepheap1
IR45411-40-2-1	Santepheap2
IR48525-100-1-2	Irkesar
IR48525-100-1-2-1	Rohat
IR49817-SRN-44-B-1-2	Sarika
IR49830-7-1-2-1-3	Popoul
IR56383-35-3-2-1	Chul'Sa
IR57259-9-2-1-3	Baray
IR62037-71-3-1-1-3	Rumpe
IR65610-105-2-5-2-2-2	Senpidao
Cameroon	
IR5-47-2	
IR8-288-3	
IR532-E576	

Table 8 continued.

IRRI line	Name given
IR661-1-140-3-2	
IR2058-78-1-3-2-3	IR46
IR2061-214-3-8-2	IR28
IR2061-522-6-9	
IR2071-586-5-6-3	
IR7167-33-2-3	IR7167
IR9129-K4	
Central Africa Republic	
IR2071-625-1-252	IR36
Chad	
IR2058-78-1-3-2-3	IR46
IR47701-6-6-1	
China	
IR8-288-3	IR8
IR661-1-140-3-2	IR24
IR841-67-1-2	Youfeng 162
IR841-85-1-1	Zhong Yin 85
IR1541-102-7	IR26
IR1561-228-3	32 Xuan 5
IR2061-214-3-8-2	IR28
IR2061-464-2-4-5	Minnuo 580
IR2061-464-4-14-1	Ha Nuo 15
IR2071-625-1-252	IR36
IR5853-162-1-2-3	Qiquizao 25 (IR54)
IR9129-102-2	Guojiyouzhan
IR9965-48-2	Waiyin 35
IR13429-299-2-1-3	IR60
IR15853-89-7	N90
IR18348-36-3-3	IR64
IR19274-26-2-3-1-2	Xiang Zao Xian No. 15
IR19274-28-2-2-1	86-70
IR21015-80-3-3-1-2	N304
IR21929-12-3-3	Minkang 108
IR28125-79-3-3-2	Gui 713
IR35366-90-3-2-1-2	Guojidao 72 (IR72)
IR64446-7-10-5	Dianchao 1
IR64446-7-10-5	Dianchao 3
IR69097-AC2-1	Dianchao 2
Colombia	
IR8-288-3	
IR579-160-2	IR22
IR930-31	Cica 4
Congo D. R.	
IR46375-CPA-19-3-1	
IR47686-18-6-1	
IR47686-64-1-1	
Costa Rica	
IR579-160-2	IR22

IRRI line	Name given
IR822-81-2	CR 1113
Côte dỈvoire	
IR5-47-2	
IR160-25-1	CS 2
IR253-16-1	CS 3
IR262-7-1	CS 1
IR1529-680-3	
IR1561-228-3	IR1561
IR2058-78-1-3-2-3	IR46
Cuba	
IR8-288-3	
IR160-27-4-3	
IR480-5-9-3-3	
IR579-160-2	Novolato A71
IR880-25	
IR930-2-6	Naylamp
IR1529-430-3	IR1529
Dominican Republic	
IR8-288-3	
IR930-31	Avance 72
IR2153-276-1-10	Juma 62
Ecuador	
IR8-288-3	
IR579-160-2	INIAP-2
IR930-31	INIAP-6
IR1545-339-2-2	IR1545
IR18348-36-3-3	INIAP-11
Egypt	
IR579-48-1	Sakha 1
IR841-85-1-1	Egyptian Yasmine
IR1561-228-3	Sakha 2
IR1626-203	Giza 181
IR2061-214-3-8-2	IR28
El Salvador	
IR579-48-1	NILO 11
IR579-160-2	Novolato A71
IR822-81-2	CR 1113
Fiji	
IR480-5-9	Ajral
IR1539-156	Bilo
Gambia	
IR442-2-58	IR442
IR532-E576	
IR579-160-2	IR22
IR1529-680-3	
IR2061-214-3-8-2	IR28

Table 8 continued.

IRRI line	Name given
IR2071-625-1-252	
IR5853-162-1-2-3	IR54
IR18348-36-3-3	IR64
IR28128-45-3-3-2	
Ghana	
IR-47-2	
IR8-228-3	
IR442-2-58	
IR532-E576	IR20
IR578-95-1-3	
IR1529-680-3	
IR1750-F5B-5	GR20
IR1820-210-2	Tamale 1
IR2071-586-5-6-3	IR42
IR3273-P339-2	Grug6
Guatemala	
IR579-160-2	Novolato A71
Guinea	
IR5-47-2	
Guinea-Bissau	
IR5-47-2	
IR442-2-58	
IR532-E576	
Guyana	
IR8-288-3	
IR579-160-2	IR22
IR1052	Variety “R”
IR1055	Variety “S”
IR44624-127-1-2-2-3	Guyana 91
Haiti	
IR10147-113-5-1	Amina
Honduras	
IR579-160-2	Novolato A71
IR822-81-2	CR 1113
India	
IR5-114-3	Pankaj
IR8-288-3	IR8
IR442-2-24	Pani Dhan 1
IR442-2-50	
IR442-2-58	Pani Dhan 2
IR532-E576	IR20
IR579-48-1	Palman 579
IR579-97-2-2-1	Rajinder Dhan 201
IR579-160-2	IR22
IR661-1-140-3-2	IR24 (PR103)
IR665-79-2	PR106
IR930-67-2-2	Sita
IR1561-216-6-2	Prasad
IR1721-14	Paiyur 1
IR1846-284-1	V.L. Dhan
IR2061-213-2-17	IR34
IR2061-214-3-8-2	IR28
IR2071-586-5-6-3	IR 42 (AU 2)
IR2071-625-1-252	IR36, Narendra 2
IR2153-159-1-4	IR30
IR3941-45-PLP-2B	Himalaya 741
IR9201-30-1-3-1-3	Prabhat
IR9202-25-1-3	CTH3
IR9224-117-2-3-3-2	IR50
IR9763-11-2-2-3	Pant Dhan 10
IR9884-54-3	
IR10781-75-3-2	KHP-2 (Karnataka Hill Paddy-2)
IR13427-45-2	PY3 (Bharatthidasan)
IR13525-43-2-3-1-3-2	IR62
IR17492-18-10-2-2-2	CO 45
IR18348-36-3-3	IR64
IR19661-150-2-2-1	HKR120
IR19728-9-3-2	Pant Dhan 6
IR21820-154-3-2-2-3	ADT38
IR21820-154-3-2-2-3	
IR28224-66-3-2	PR109
IR32307-107-3-2-2	IR66
IR44595-70-2-2-3	ASD20
IR46330	Narendra Usar-3 (NDRK 1)
IR57540 (CN10355-61)	Bhudeb
Indonesia	
IR5-47-2	IR5
IR8-288-3	IR8
IR532-E576	IR20
IR841-85-1-1	Bengawan Solo
IR1541-102-7	IR26
IR2058-78-1-3-2-3	IR46
IR2061-213-2-17	IR34
IR2061-214-3-8-2	IR28
IR2070-423-2-5-6	IR38
IR2070-747-6-3-2	IR32
IR2071-586-5-6-3	IR42
IR2071-621-2-3	Asahan
IR2071-625-1-252	IR36
IR2153-159-1-4	IR30
IR2307-247-2-2-3	Semeru
IR4570-83-3-3	IR48
IR4744-295-2-3	Tajum
IR5657-33-2-2-3	Citanduy
IR5853-118-5	IR52
IR5853-162-1-2-3	IR54
IR9224-117-2-3-3-2	IR50

Table 8 continued.

IRRI line	Name given
IR11141-6-1-4	PAD4
IR11288-B-B-69-1	Selilin
IR11288-B-B-118-1	PAD3
IR13429-109-2-2-1	IR56
IR13525-43-2-3-1-3-2	IR62
IR13543-66	Kelara
IR15529-253-2-2	Bahbalon
IR18348-36-3-3	IR64
IR19661-131-1-3-1-3	Barumun
IR19743-46-2-3-3-2	Jangkok
IR21015-196-3-1-3	IR65
IR28128-45-3-3-2	Dodokan
IR28224-3-2-3-2	IR68
IR28228-12-3-1-1-2	IR70
IR31892-100-3-3-3-3	Celebes
IR32307-107-3-2-2	IR66
IR32453-20-3-2-2	IR74
IR35366-90-3-2-1-2	IR72
IR39357-71-1-1-2-2	
IR52952-B-B-3-3-2	Dendang
IR59552-21-3-2-2	Kalimas
IR59682-132-1-1-2	Tukad Balian
IR60819-34-2-1	Bandoyudo
IR68305-18-1	Tukad Unda
IR69726-116-1-3	Tukad Petanu
Iran	
IR5-47-2	Ahwaz 1 (IR5)
IR2061-214-3-8-2	Amol 2 (IR28)
IR62871-175-1-10	Fajr
IR62871-264-3-4	Sahel
Iraq	
IR8-288-3	IR8
IR1541-102-7	IR26
Jamaica	
IR579-160-2	Novolato A71
Kenya	
IR8-288-3	
IR579-48-1	
IR1561-228-3	
IR2793-80-1	IR2793
IR5853-162-1-2-3	IR54
Korea	
IR667-98	Tongil
Laos	
IR253-100	IR253
IR789-98	IR789
IR848-120	IR848
IR2070-423-2-5-6	IR38
IR2071-625-1-252	IR36
IR8423-132-6-2-2	CR203
IR32307-107-3-2-2	IR66
IR35366-90-3-2-1-2	IR72
IR43069-UBN-507-3-1-2-2	Niaw Thadokkham 1
IR43070-UBN-501-2-1-1-1	Niaw Thadokkham 4
IR43086-UBN-505-2-3-1	Phone Ngam 1
IR46463-CPA-5-2-1-1	Thasano 1
IR49766-KKN-52-B-2-3	Namtane 1
Liberia	
IR5-47-2	
IR1416-131-5	Suakoko 12
IR4422-98-3-6-1	IR4422
Madagascar	
IR2061-213-2-17	Momokatra (IR34)
IR2070-747-6-3-2	Maifimboa (IR32)
IR2071-625-1-252	Tsy Milofika (IR36)
IR8866-82-1-3-1-3	Mazana (X1228)
IR9224-117-2-3-3-2	Malaky
IR9830-26-3-3	Kelimirefaka
IR15579-24-2	Mailaka
IR20913-B-160	Rojovo (X1289)
IR21015-80-3-3-1-2	Mahadigny
IR21363-13-2-2	Mahadignirano
IR25579-135-3	Rojomena
IR28128-45-3-3-2	Mananoro
Malawi	
IR1561-250-2-2	Changu
Malaysia	
IR5-250	SM 1
IR5-278	Bahagia
IR8-288-3	Padi Ria (IR8)
IR789-59-3-1	Masria
IR2071-586-5-6-3	IR42
IR5853-162-1-2-3	IR54
IR8192-200-3-3-1	Lemayan
Mali	
IR269-26-3-3-3	
IR442-2-58	
IR1529-680-3	
IR1561-228-3	IR1561
IR2070-747-6-3-2	IR32
IR2071-586-5-6-3	
Mauritania	
IR8-288-3	
IR442-2-58	

Table 8 continued.

IRRI line	Name given
IR1529-680-3	
IR1561-228-3	IR1561
IR2061-214-3-8-2	IR28
IR2070-414-3-9	
IR9224-117-2-3-3-2	IR50
IR13240-108-2-2-3	
IR18348-36-3-3	IR64
Mexico	
IR8-288-3	Milagro Filipino
IR160-27-4-3	Sinaloa A68
IR579-160-2	Novolato A71
IR837-16-2	Bamoa A75
IR837-46-2	Piedras Negras A74
IR1529-430-3	IR1529
IR2053-205-2-6-3	
IR3941-25-1	Cotaxtla A90
IR10120-7-2-1	Sureste A90
Mozambique	
IR2058-78-1-3-2-3	IR46
IR2071-586-5-6-3	
IR2071-625-1-252	
IR4570-83-3-3	
IR5853-118-5	IR52
IR5853-162-1-2-3	IR54
IR9224-117-2-3-3-2	
IR18348-36-3-3	IR64
Myanmar	
IR5-47-2	Yagyaw-2 (IR5)
IR8-288-3	Yagyaw-1 (IR8)
IR532-E576	Shwe-War-Hnan (IR20)
IR570-18-32	Kyawzeya
IR579-160-2	Lone-Thwe-Shwe-War (IR22)
IR661-1-140-3-2	Shwe-War-Yin (IR24)
IR747-B2-6-3	IR747
IR751-592	Shwe Thwe Lay
IR1529-680-3	Yarsabea5 (Yar5)
IR2061-213-2-17	Sin-Shwe-Thwe (IR34)
IR2061-214-3-8-2	Shwe-War-Lay (IR28)
IR2071-586-5-6-3	Pyilonechantha (IR42)
IR2071-625-1-252	IR36
IR9224-117-2-3-3-2	Shwe Thwe Yin (IR50)
IR13240-108-2-2-3	Theedatyin
IR21836-90-3	Hmabi-2
IR21841-91-2-3-3	Hmabi-3
IR21848-65-3-2	Sin-Ekari-4
IR35366-90-3-2-1-2	Yezin 1 (IR72)
IR41985-111-3-2-2	Yadana Aung (PSBRc 4)
IR59673-93-2-3-3	Aye Wan

IRRI line	Name given
Nepal	
IR5-47-2	IR5
IR8-288-3	IR8
IR400-29-9	Parwanipur 1
IR2061-628-1-6-4-3	Laxmi
IR2071-124-6-4	Sabitri
IR2298-PLP-B3-2	Himali
IR3941-4-PLP-2B	Kanchan
IR3941-48-PLP-2B	Himalaya 741
IR7151-60-3-3	Chaite 1
IR8423-156-2-2-1	Radha 4
IR9729-67-3	Chaite 3
Nicaragua	
IR579-48-1	IR100
IR579-160-2	IR22
IR665-4-5-5	IR665
IR822-81-2	CR 1113
Niger	
IR8-288-3	
IR269-26-3-3-3	
IR579-160-2	
IR1529-680-3	IR1529
IR2071-586-5-6-3	
IR3273-P339-2	
Nigeria	
IR5-47-2	FARO 23
IR8-288-3	FARO 13
IR269-26-3-3-3	
IR532-E576	FARO 19
IR578-95-1-3	
IR627-1-31-4-3-7	FARO 22
IR665-79-2	FARO 27
IR790-35-5-3	FARO 7
IR2035-120-3	
IR2058-78-1-3-2-3	IR46
IR2061-288-3-9	
IR2071-586-5-6-3	IR42
IR2153-159-1-4	IR30
IR3273-P339-2	
IR4422-98-3-6-1	
Pakistan	
IR6-18	Shadad
IR6-156-2	Mehran 69 (IRRI6)
IR8-288-3	IRRI-PAK
IR841-36-2	Abbasi 72
IR2053-261-2-3	DR83
IR9782-44-3-3-3	IR9
IR15323-78-1-3-1	Sada Hayat
IR28128-45-3-3-2	Pakhal

Table 8 continued.

IRRI line	Name given
Panama	
IR8-288-3	
IR822-81-2	CR 1113
Papua New Guinea	
IR532-E208	N.G. 6637
IR19661-23-3-2-2	Nari Rice 1
IR47686-6-2-2-1	Nari Rice 12
IR48563-22-3-2-3	Nari Rice 3
Paraguay	
IR579-160-2	IR22
IR822-81-2	CR 1113
Peru	
IR8-288-3	
IR442-2-50	Huallanga
IR579-160-2	IR22
IR930-2-6	Naylamp
IR930-31	Chancay
IR1529-430-3	NIR1
IR4570-83-3-3	PA-3
Philippines	
IR5-47-2	IR5
IR8-288-3	IR8
IR532-E576	IR20
IR579-160-2	IR22
IR661-1-140-3-2	IR24
IR1529-430-3	IR43
IR1541-102-7	IR26
IR2035-242-1	IR45
IR2058-78-1-3-2-3	IR46
IR2061-213-2-17	IR34
IR2061-214-3-8-2	IR28
IR2061-464-4-14-1	IR29
IR2070-414-3-9	IR40
IR2070-423-2-5-6	IR38
IR2070-747-6-3-2	IR32
IR2071-586-5-6-3	IR42
IR2071-625-1-252	IR36
IR2153-159-1-4	IR30
IR2863-38-1-2	IR44
IR4570-83-3-3	IR48
IR5853-118-5	IR52
IR5853-162-1-2-3	IR54
IR9202-25-1-3	PSBRc 92
IR9224-117-2-3-3-2	IR50
IR9752-71-3-2	IR58
IR9763-11-2-2-3	Tsiresindrano
IR9884-54-3-1	PSBRc 48
IR10147-113-5-1-1-5	PSBRc 1
IR13149-71-3-2	Trese Katorse
IR13429-109-2-2-1	IR56
IR13429-299-2-1-3	IR60
IR13525-43-2-3-1-3-2	IR62
IR18348-36-3-3	IR64
IR21015-196-3-1-3	IR65
IR25976-12-2-2-2-1-1	PSBRc 46
IR28224-3-2-3-2	IR68
IR28228-12-3-1-1-2	IR70
IR32307-107-3-2-2	IR66
IR32453-20-3-2-2	IR74
IR32809-26-3-3	PSBRc 2
IR35366-90-3-2-1-2	IR72
IR41431-68-1-2-3	PSBRc 60
IR41985-111-3-2-2	PSBRc 4
IR47686-30-3-2	PSBRc 5
IR50404-57-2-2-3	PSBRc 10
IR51500-AC11-1	PSBRc 50
IR51672-62-2-1-1-2-3	PSBRc 18
IR52713-2B-8-2B-1-2	PSBRc 88
IR54068-B-60-1-3-3	PSBRc 102
IR55423-1	NSIC Rc 9 (Apo)
IR56381-139-2-2	PSBRc 28
IR57301-195-3-3	PSBRc 20
IR57515-PMI-8-1-1-SRN-1-1	PSBRc 68
IR58099-41-2-3	PSBRc 30
IR59469-B-B-3-2	PSBRc 44
IR59552-21-3-2-2	PSBRc 64
IR59682-132-1-1-2	PSBRc 52
IR60267-11-2-2-1	PSBRc 70
IR60819-34-2-1	PSBRc 54
IR61336-4B-14-3-2	PSBRc 94
IR61608-3B-20-2-2-1-1	PSBRc 96
IR61920-3B-22-1-1	NSIC Rc 106
IR61979-138-1-3-2-3	Angelica
IR62141-114-3-2-2-2	PSBRc 80
IR64616H	PSBRc 26H
IR64683-87-2-2-3-3	PSBRc 82
IR65185-3B-8-3-2	PSBRc 84
IR65195-3B-13-2-3	PSBRc 86
IR68284H	PSBRc 72H
IR68305-18-1-1	Matatag 3
IR69726-29-1-2-2-2	Matatag 2
IR71606-1-1-4-2-3-1-2	NSIC Rc 110
IR72102-4-159-1-3-3-3	NSIC Rc 112
IR73885-1-4-3-2-1-6	Matatag 9
IR75207H	NSIC Rc 114H
IR75217H	NSIC Rc 116H
Rwanda	
IR5-47-2	Matwa
Senegal	
IR8-288-3	

Table 8 continued.

IRRI line	Name given
IR442-2-58	
IR1529-680-3	
IR1561-228-3	
IR2071-586-5-6-3	
IR2823-399-5-6	
IR13240-108-2-2-3	Sahel 108
Sierra Leone	
IR5-198-1-1	Rok-6
IR3273-P339-2	
IR4422-98-3-6-1	IR4422
IR9752-71-3-2	Rok33
Solomon Islands	
IR747-B2-6-3	GPL 1
IR1614-138-3-1	GPL 2
Sri Lanka	
IR262-43-8	IR262
IR532-1-18	IR532
Sudan	
IR2053-206-1-3	IR2053
Tanzania	
IR5-47-2	
IR8-288-3	
IR2061-213-2-17	
IR2071-586-5-6-3	
IR5853-162-1-2-3	IR54
IR9752-71-3-2	
Thailand	
IR253-4	RD 2
IR43070-UBN-501-2-1-1-1	Niaw Ubon 2
IR62558-SRN-17-2-1-B	Surin 1
Togo	
IR8-288-3	
IR442-2-58	
IR841-85-1-1	
IR1529-680-3	
IR2042-178-1	
IR2058-78-1-3-2-3	
IR2061-214-3-8-2	IR28
Uganda	
IR5-47-2	
IR2793-80-1	IR2793
United States	
IR841-85-1-1	Jasmine 85

IRRI line	Name given
Venezuela	
IR8-288-3	
IR579-160-2	IR22
IR665-79-2	Araure 3
Vietnam	
IR5-47-2	TN5, NN5 (IR5)
IR8-288-3	TN8, NN8 (IR8)
IR532-E576	TN20 (IR20)
IR579-160-2	TN22, NN22
IR1529-680-3	TN 73-1
IR1541-102-7	IR26
IR1561-228-3	TN 73-2, NN23
IR1820-210-2	IR1820
IR2031-354-2	V12
IR2070-199-3-6-6	NN8A
IR2070-423-2-5-6	IR38
IR2070-734-5-4	NN4A
IR2070-747-6-3-2	IR32
IR2071-119-3-4	NN5A
IR2071-586-5-6-3	NN4B, IR42
IR2071-625-1-252	NN3A, IR36
IR2151-96-1-5-3	IR2151
IR2153-26-3-5-6	IR2153
IR2153-159-1-4	IR30
IR2153-276-1-10	
IR2307-247-2-2-3	NN6A
IR2797-1-5-3	NN3B
IR2823-399-5-6	NN2B
IR3478-136-24-2-1	
IR4570-83-3-3	NN5B, IR48
IR4625-269-4-2	OM85
IR8423-132-6-2-2	CR203
IR9129-169-3-3-3	MTL 36
IR9129-192-2-3-5	NN7A
IR9224-73-2-2-3	OM33
IR9729-67-3	IR9729
IR9782-111-2-1-2	OM90, MTL 63
IR13240-10-1	NN9A
IR13240-108-2-2-3	TN108, MTL 58
IR13429-299-2-1-3	IR60A
IR15579-166	IR15579
IR17433-1	MTL 60
IR17494-32-3-4	IR17494
IR18077-3-1	MTL 50
IR18189-2-3-2	MTL 54
IR18348-36-3-3	OM89 (IR64)
IR19728-9-3-2-3-3	MTL 61
IR19735-5-2-3-2-1	OM83
IR19746-11-3-3	CN2
IR19960-131-3-3-3-3	IR19660
IR21015-80-3-3-1-2	OM86
IR22082-41-2	XI 12

Table 8 continued.

IRRI line	Name given
IR25588-7-3-1	OM88
IR27325-63-2-2	OM87
IR28224-3-2-3-2	IR68
IR28527-1-1-2	MTL 64
IR29723-143-3-2-1	MTL 83
IR29725-76-3-3-2	MTL 68
IR31802-48-2-2-2	OM87-1
IR31868-64-2-3-3-3	OM87-9
IR32307-107-3-2-2	IR66
IR32429-47-3-2-2	OM86-9
IR33059-26-2-2	IR33059
IR35366-90-3-2-1-2	IR72
IR35546-17-3-1-3	OM90-9
IR39323-110-5-2-2	MTL 85
IR42859-3-3-1-1	MTL 93
IR44505-70-2-2-3	CN44
IR44595-70-2-2-3	OM90-2
IR47686-1-4-B	LC88-66
IR47686-1-5-1-1	LC88-67-1
IR49459-50-1-2-3-1	MTL 137
IR49517-23-2-2-3-3	IR49517
IR50401-77-2-1-2	MTL 88
IR50404-57-2-2-3	MTL 87
IR50404-96-1-1-3-3	IR50404
IR51673-172-1-3	IR51673
IR53936-97-2-2-3-3	MTL 119
IR54742-23-19-16-10-3	MTL 110
IR54751-2-34-10-6-2	MTL 103
IR54751-2-41-10-5-1	MTL 105
IR54751-2-44-15-2-2	MTL 114
IR54751-2-44-15-24-3	MTL 98
IR56279-C2-99-3-2-3-2	MTL 141
IR56450-28-2-2	MTL 99
IR58099-51-3-1	MTL 139
IR59606-119-3	OMCS 94
IR59656-113-1-2	MTL 157
IR59673-93-2-3-3	MTL 147
IR62028-25-2-2-1	MTL156
IR62032-189-3-2-2	IR62032
IR62065-27-1-2-1	MTL145
IR64724-195-1-2-2-1	MTL 241
IR65610-24-3-6-3-2-3	MTL 233
IR66707	IR66707A
IR68077-64-2-2-2-2	MTL 250
IR73678-6-9-B	AS996
Zaire	
IR8-288-3	
Zimbabwe	
IR400	

Impact on food security

In many rice-growing countries, the growth in rice production has outstripped the rise in population, leading to a substantial increase in cereal consumption and calorie intake per capita. During 1965-1990, the daily calorie supply in relation to the requirement improved from 81% to 120% in Indonesia, from 86% to 110% in China, from 82% to 99% in the Philippines, and from 89% to 94% in India (UNDP 1994). The increase in per capita availability of rice and decrease in the cost of production per ton of output contributed to a decline in the real price of rice, in both domestic and international markets. The unit cost of production is about 20–30% lower for high-yielding varieties than for traditional varieties of rice (Yap 1991) and the price of rice adjusted for inflation is 40% lower than in the mid-1960s (Fig. 2). The decline in food prices has benefited the urban poor and rural landless, who are not directly involved in food production but who spend more than one-half of their income on food grains. As net consumers of grain, small and marginal farmers, who are dominant rice producers in most Asian countries, have also benefited from the downward trend in real prices of rice.

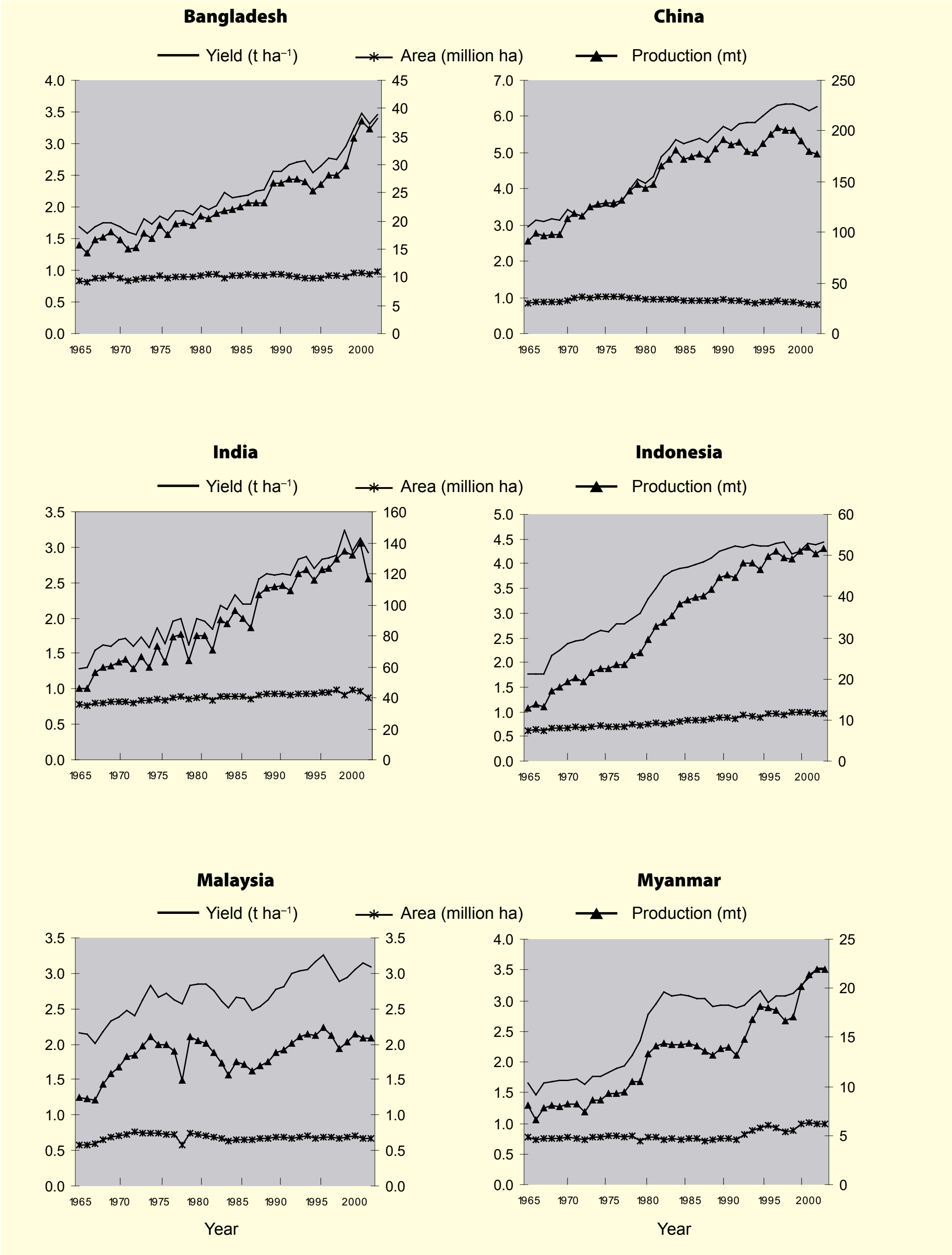
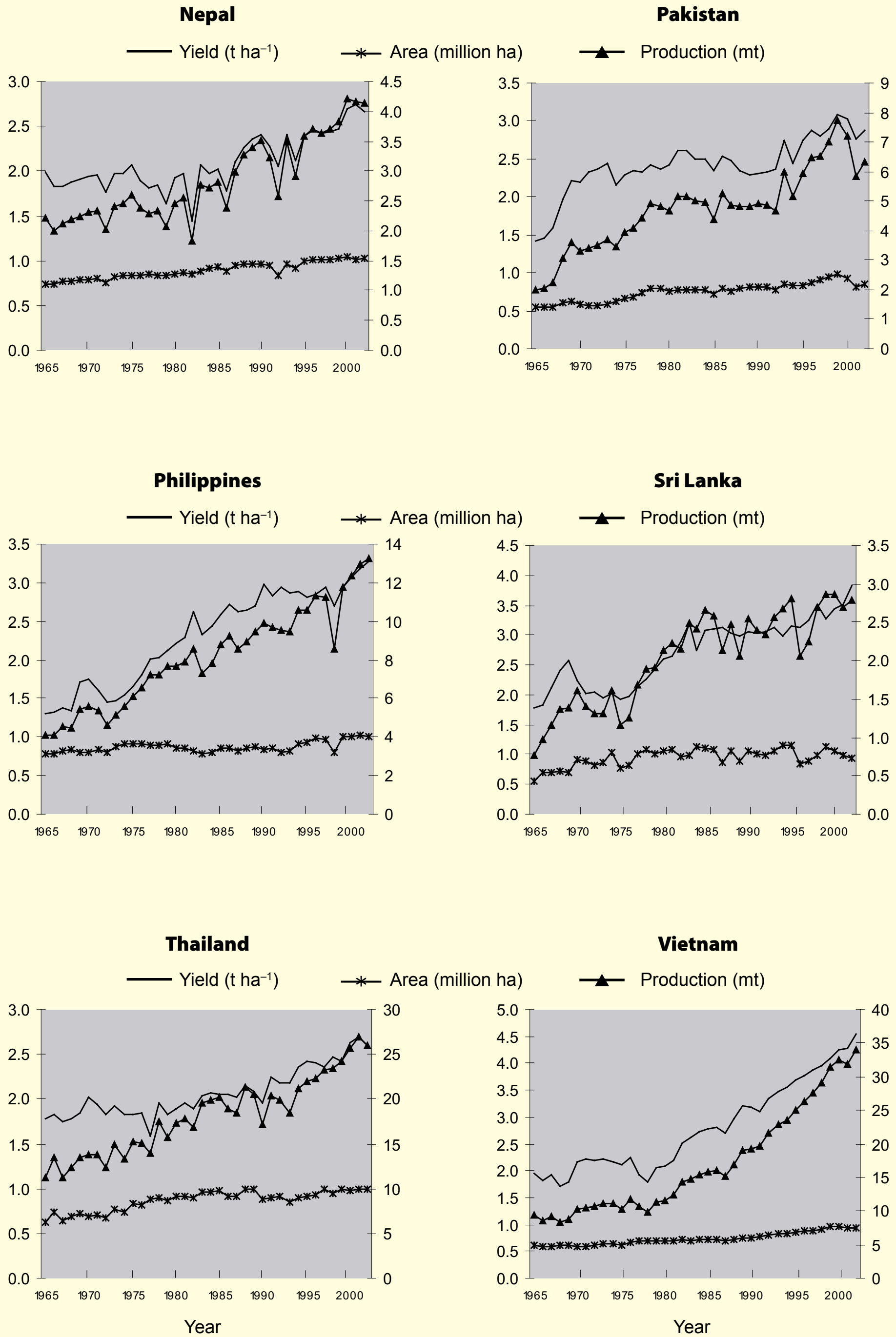


Fig. 1. Rice production (mt), area (million ha), and yield (t ha^{-1}) from 1965 to 2002 in major rice-growing countries. Numbers to the left refer to yield and numbers to the right refer to both area and production.


Nepal
Pakistan
Yield (t ha⁻¹)
Area (million ha)
Production (mt)
Philippines
Sri Lanka
Thailand
Vietnam
Year
Year

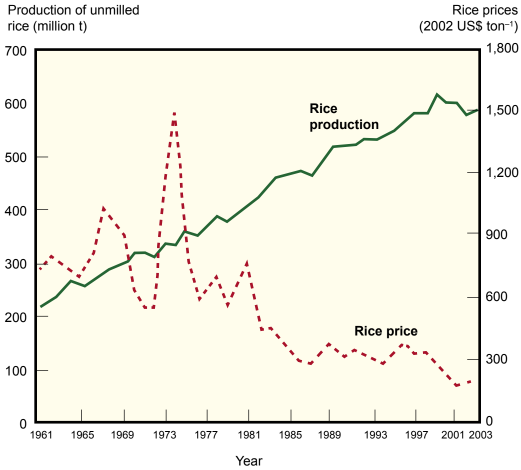


Fig. 2. Trends in world rice production and price (1961–2003).

Impact on landless workers

The diffusion of high-yielding varieties has also contributed to a growth in income for rural landless workers (Hayami et al 1978, Hossain 1998). High-yielding varieties require more labor per unit of land because of increased intensive care in agricultural operations and harvesting of a larger output. The labor requirement has also increased because of the higher intensity of cropping, which has been made possible by the reduction in crop growth duration. As farm income increases, better-off farm households substitute leisure for family labor and hire more landless workers to do the work. The marketing of a larger volume of produce and an increased demand for nonfarm goods and services, resulting from higher farm income, have generated additional employment in rural trade, transport, and construction activities. The economic miracle under way in many Asian countries was triggered by the growth in agricultural income and its equitable distribution, which helped expand the domestic market for nonfarm goods and services.

Impact on environmental sustainability

In sharp contrast to the rich countries, where more of the environmental problems have been urban and industrial, the critical environmental problems in most low-income developing countries are still rural, agricultural, and poverty based. More than half of the world's very poor live on lands that are environmentally fragile and they rely on natural resources over which they have little control. Land-hungry farmers resort to cultivating unsuitable areas, such as erosion-prone hillsides and semiarid areas where soil degradation is rapid, as in tropical forests, where crop yields on cleared fields drop sharply after just a few years.

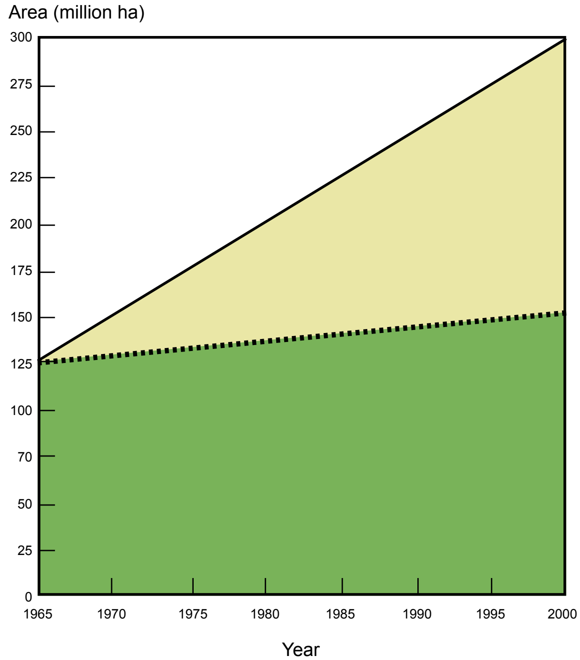


Fig. 3. Actual area planted to rice ( ) and the additional area that would have been required to produce the 2000 level of production at the yield level of 1965 ( ).

The widespread adoption of high-yielding varieties has helped most Asian countries meet their growing food needs from productive lands, and thereby has reduced pressure to open up more fragile lands. If 1961 yields prevailed today, three times more land in China and two times more land in India would be needed to equal the 2000 rice harvest. If Asian countries attempted to produce a 1990 harvest at the yield levels of the 1960s, most of the forests, woodlands, pastures, and range lands would have disappeared, and mountainsides would be eroded, with disastrous consequences for upper watersheds and productive lowlands, the extinction of wildlife habitats, and the destruction of biodiversity. As an example, to produce the 2000 world rice production of 600 million tons at the yield levels of 1965, 135 million hectares more land would be required (Fig. 3).

The availability of cereal varieties with multiple resistance to diseases and insects reduced the need for the application of insecticides and facilitated the adoption of integrated pest management practices. Reduced insecticide use helps (1) enhance environmental quality, (2) improve human health in farming communities, (3) make more safer foods available, and (4) protect useful fauna and flora (Khush 1999).

Varietal description

As mentioned earlier, 11 IR varieties (IR5 up to IR34) were first released by IRRI and subsequently by the Philippine Seed Board and many other countries. Twenty-three IR varieties (IR36 up to IR74) were released by the Philippine Seed Board and later by several other countries. These 34 IR varieties have been grown in most of the rice-growing countries and have been used as parents in hybridization programs. Thus, they appear in the ancestry of numerous varieties developed by national rice improvement programs. We often receive inquiries about the breeding history and characteristics of these varieties. We have therefore summarized the relevant information about each IR variety in the following pages. We hope that this information will be useful for posterity.

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IR5

Parentage

Peta/Tangkai Rotan

Breeding history

The IR5 cross was made in the dry season of 1962, while the segregating F_2 and F_3 generations were grown during 1963. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries in 1964. The most promising lines were tested in an observational yield trial (OYT) and replicated yield trial (RYT) during 1965-66.

Experimental line designation	IR5-47-2	
Year of release in Philippines	1967	
Agronomic data	Days to maturity	134
	Plant height (cm)	129
	Tiller number $hill^{-1}$	13
	Grain yield (dry season) (kg ha^{-1})	4,837
	Grain yield (wet season) (kg ha^{-1})	2,421
	Seed germination at harvest (%)	20
	Seed germination after 6 wk (%)	90
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Susceptible
	Tungro	Susceptible
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Moderately susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	26.3
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Medium
	Grain shape	Medium
	1,000-grain weight (g)	21.7
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	22.9
	% Total milled rice	67.6
	% Head rice	53.8
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Brown spots
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	8.10
Rough rice width (mm)	3.18
Seed coat (bran) color	White

Adaptation

IR5 is suited to rainfed areas.

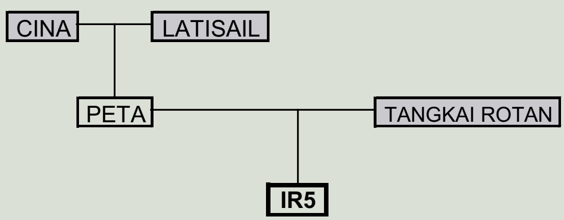
Tolerance of problem soils

IR5 is tolerant of salinity and boron toxicity.

Countries of release

Bangladesh, Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Guinea-Bissau, Indonesia, Iran, Liberia, Myanmar, Nepal, Nigeria, Philippines, Rwanda, Tanzania, Uganda, Vietnam

Pedigree of IR5.



Ultimate landraces
TANGKAI ROTAN, CINA, LATISAIL

IR8

Parentage

Peta/Dee-geo-woo-gen

Breeding history

The IR8 cross was made in the dry season of 1962, while the segregating F_2 generation was grown during 1963. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries in 1963 and 1964. The most promising lines were evaluated in OYT and RYT during 1965.

Experimental line designation	IR8-288-3	
Year of release in Philippines	1966	
Agronomic data	Days to maturity	130
	Plant height (cm)	93
	Tiller number hill^{-1}	13
	Grain yield (dry season) (kg ha^{-1})	4,564
	Grain yield (wet season) (kg ha^{-1})	2,784
	Seed germination at harvest (%)	26
	Seed germination after 6 wk (%)	94
Reaction to diseases	Blast	Susceptible
	Bacterial blight	Susceptible
	Tungro	Susceptible
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	26.8
	Gelatinization temperature	Low
	Gel consistency	Medium hard
	Grain length	Long
	Grain shape	Medium bold
	1,000-grain weight (g)	30.3
	Chalkiness (%)	>20
	Endosperm type	Nonwaxy
	% Hulls	21.9
	% Total milled rice	68.7
	% Head rice	53.5
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.10
Rough rice width (mm)	3.24
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

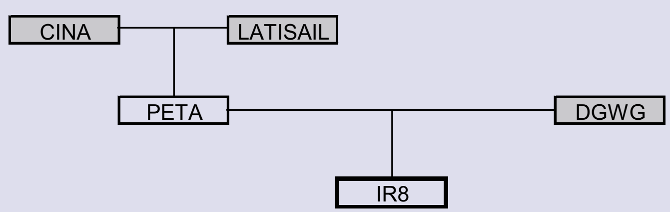
Tolerance of problem soils

IR8 is tolerant of salinity and boron toxicity and phosphorus and zinc deficiency.

Countries of release

Bangladesh, Benin, Brazil, Burkina Faso, Cameroon, China, Colombia, Cuba, Dominican Republic, Ecuador, Ghana, Guyana, India, Indonesia, Iraq, Kenya, Malaysia, Mauritania, Mexico, Myanmar, Nepal, Niger, Nigeria, Pakistan, Panama, Peru, Philippines, Senegal, Tanzania, Togo, Venezuela, Vietnam, Zaire

Pedigree of IR8.



Ultimate landraces
DEE GEO WOO GEN, CINA, LATISAIL

IR20

Parentage

IR262-24-3/TKM6

Breeding history

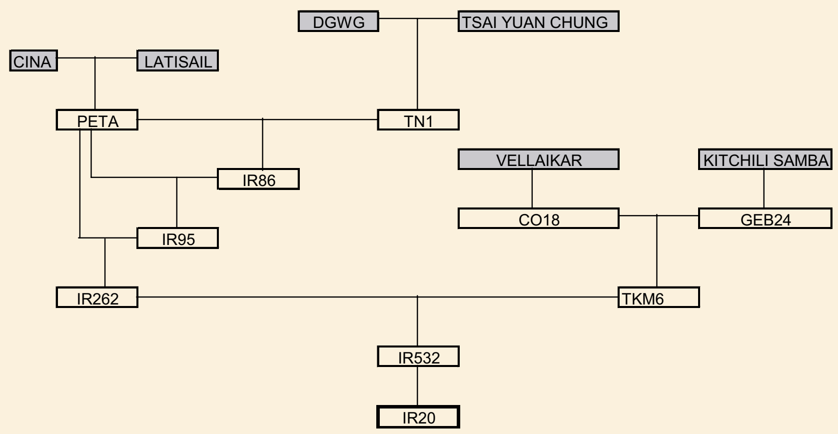
The IR532 cross was made in 1965, while the segregating F_2 and F_3 generations were grown during 1966. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries during 1967. The most promising lines were evaluated in OYT and RYT during 1968.

Experimental line designation	IR532-E576	
Year of release in Philippines	1969	
Agronomic data	Days to maturity	125
	Plant height (cm)	107
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,413
	Grain yield (wet season) (kg ha^{-1})	3,168
	Seed germination at harvest (%)	6
	Seed germination after 6 wk (%)	74
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Moderately resistant
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	26
	Gelatinization temperature	Intermediate
	Gel consistency	Medium
	Grain length	Medium
	Grain shape	Slender
	1,000-grain weight (g)	19.8
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	67.3
	% Head rice	61.8
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	8.10
Rough rice width (mm)	2.44
Seed coat (bran) color	White

Adaptation	IR20 is suited to irrigated and rainfed lowland areas.
Tolerance of problem soils	IR20 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.
Countries of release	Bangladesh, Burkina Faso, Cameroon, Gambia, Ghana, Guinea-Bissau, India, Indonesia, Myanmar, Nigeria, Philippines, Vietnam

Pedigree of IR20.



Ultimate landraces
VELLAIKAR, KITCHILI SAMBA, CINA, LATISAIL, DEE GEO WOO GEN, TSAI YUAN CHUNG

IR22

Parentage	IR8/TADUKAN
Breeding history	The IR579 cross was made in 1966 and the segregating F_2 generation was also grown during 1966. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1967 and 1968. The most promising lines were evaluated in OYT and RYT during 1968.

Experimental line designation	IR579-160-2	
Year of release in Philippines	1969	
Agronomic data	Days to maturity	120
	Plant height (cm)	98
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,241
	Grain yield (wet season) (kg ha^{-1})	3,315
	Seed germination at harvest (%)	2
	Seed germination after 6 wk (%)	72
Reaction to diseases	Blast	Susceptible
	Bacterial blight	Resistant
	Tungro	Susceptible
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Susceptible
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	26.1
	Gelatinization temperature	Low
	Gel consistency	Hard
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.4
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	22.5
	% Total milled rice	70.4
	% Head rice	63.6
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Glabrous
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.00
Rough rice width (mm)	2.52
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

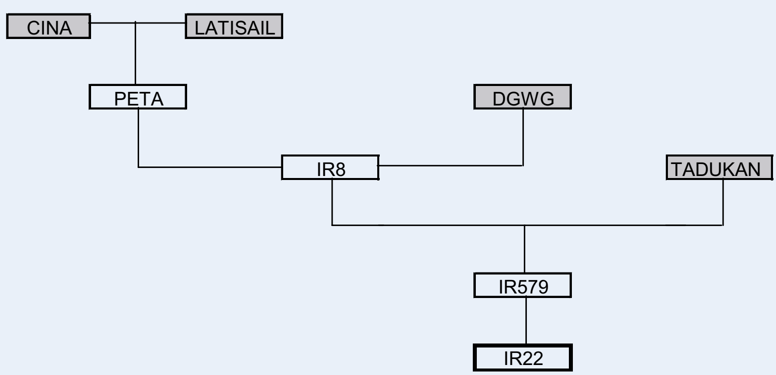
Tolerance of problem soils

IR22 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.

Countries of release

Belize, Benin, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Gambia, Guatemala, Guyana, Honduras, India, Jamaica, Mexico, Myanmar, Nicaragua, Niger, Paraguay, Peru, Philippines, Venezuela, Vietnam

Pedigree of IR22.



Ultimate landraces
TADUKAN, DEE GEO WOO GEN, CINA, LATISAIL

IR24

Parentage

IR8/IR127-2-2

Breeding history

The IR661 cross was made in the dry season of 1966 and the segregating F_2 generation was also grown during the same year. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1967 and 1968. The most promising lines were evaluated in OYT and RYT during 1969-70.

Experimental line designation	IR661-1-140-3	
Year of release in Philippines	1971	
Agronomic data	Days to maturity	125
	Plant height (cm)	97
	Tiller number $hill^{-1}$	13
	Grain yield (dry season) (kg ha^{-1})	5,160
	Grain yield (wet season) (kg ha^{-1})	3,354
	Seed germination at harvest (%)	46
	Seed germination after 6 wk (%)	94
Reaction to diseases	Blast	Susceptible
	Bacterial blight	Susceptible
	Tungro	Susceptible
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	17.6
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	27.2
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21.3
	% Total milled rice	71
	% Head rice	66.3
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Short and partly awned
Rough rice length (mm)	9.32
Rough rice width (mm)	2.56
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

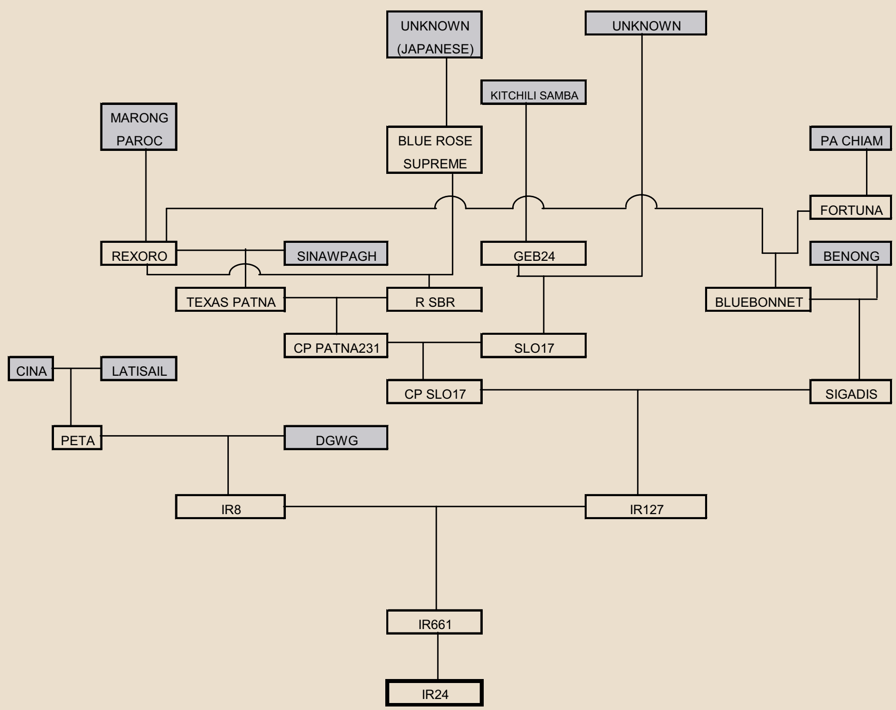
Tolerance of problem soils

IR24 is tolerant of salinity, alkalinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

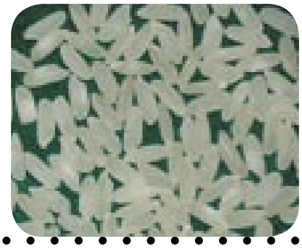
Cameroon, China, India, Myanmar, Philippines

Pedigree of IR24.



Ultimate landraces
DEE GEO WOO GEN, CINA, LATISAIL, BENONG, MARONG PAROC, Unknown, KITCHILI SAMBA, PA CHIAM, SINAWPAGH, UNKNOWN (JAPANESE)

IR26



Parentage

IR24/TKM6

Breeding history

The IR1541 cross was made in 1969, while the segregating F_2 and F_3 generations were grown during 1970. Progenies of the succeeding, F_4 and F_5 generations were evaluated in pedigree nurseries during 1972. The most promising lines were evaluated in RYT during 1973.

Experimental line designation	IR1541-102-7	
Year of release in Philippines	1973	
Agronomic data	Days to maturity	125
	Plant height (cm)	96
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,028
	Grain yield (wet season) (kg ha^{-1})	4,196
	Seed germination at harvest (%)	49
	Seed germination after 6 wk (%)	96
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Moderately resistant
	Grassy stunt	Moderately resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	25.7
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Medium
	Grain shape	Slender
	1,000-grain weight (g)	21.2
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	23.9
	% Total milled rice	67.6
	% Head rice	60.6
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	8.28
Rough rice width (mm)	2.68
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

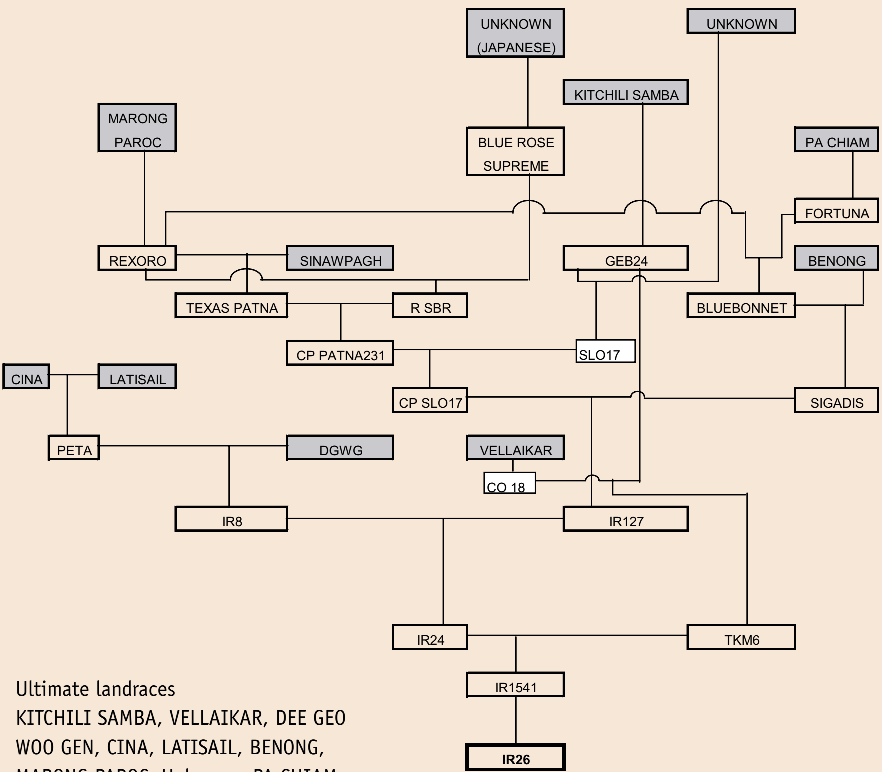
Tolerance of problem soils

IR26 is tolerant of boron toxicity and phosphorus deficiency.

Countries of release

China, Indonesia, Iraq, Philippines, Vietnam

Pedigree of IR26.



Ultimate landraces
KITCHILI SAMBA, VELLAIKAR, DEE GEO WOO GEN, CINA, LATISAIL, BENONG, MARONG PAROC, Unknown, PA CHIAM, SINAWPAGH, UNKNOWN (JAPANESE)

IR28

Parentage

IR833-6-2-1-1/
IR1561-149-1//IR24*4/*O. nivara*

Breeding history

The IR2061 cross was made in 1971 and the segregating F_2 generation was also grown during 1971. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1972 and 1973. The most promising lines were evaluated in OYT and RYT during 1973-74.

Experimental line designation	IR2061-214-3-8-2	
Year of release in Philippines	1974	
Agronomic data	Days to maturity	107
	Plant height (cm)	103
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,330
	Grain yield (wet season) (kg ha^{-1})	3,675
	Seed germination at harvest (%)	14
	Seed germination after 6 wk (%)	92
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	26.2
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.4
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	22.9
	% Total milled rice	69.5
	% Head rice	61.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.58
Rough rice width (mm)	2.48
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

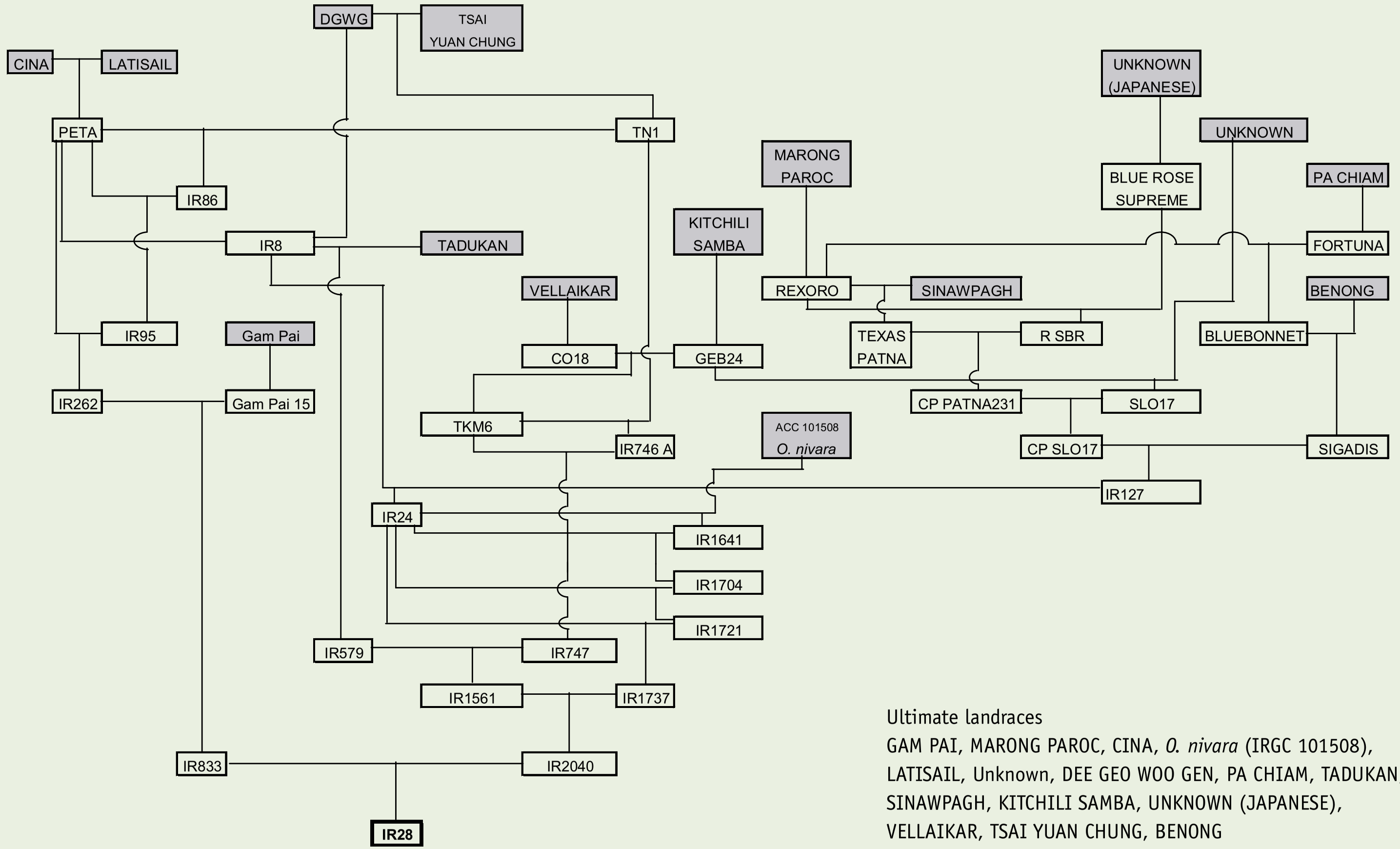
Tolerance of problem soils

IR28 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.

Countries of release

Bangladesh, Cameroon, China, Egypt, Gambia, India, Indonesia, Iran, Mauritania, Myanmar, Philippines, Togo

Pedigree of IR28.



Ultimate landraces
GAM PAI, MARONG PAROC, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, DEE GEO WOO GEN, PA CHIAM, TADUKAN, SINAWPAGH, KITCHILI SAMBA, UNKNOWN (JAPANESE), VELLAIKAR, TSAI YUAN CHUNG, BENONG

IR29

Parentage

IR833-6-2-1-1/
IR1561-149-1//IR24*4/*O. nivara*

Breeding history

The IR29 cross was made in 1971 and the segregating F_2 generation was also grown during 1971. Progenies of the succeeding F_3, F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1972 and 1973. The most promising lines were evaluated in OYT and RYT during 1974.

Experimental line designation	IR2061-464-4-14-1	
Year of release in Philippines	1974	
Agronomic data	Days to maturity	116
	Plant height (cm)	97
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	4,464
	Grain yield (wet season) (kg ha^{-1})	3,020
	Seed germination at harvest (%)	9
	Seed germination after 6 wk (%)	76
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	1.0
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	22.5
	Chalkiness	Opaque
	Endosperm type	Waxy
	% Hulls	25.4
	% Total milled rice	66.5
	% Head rice	61.5
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.38
Rough rice width (mm)	2.60
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

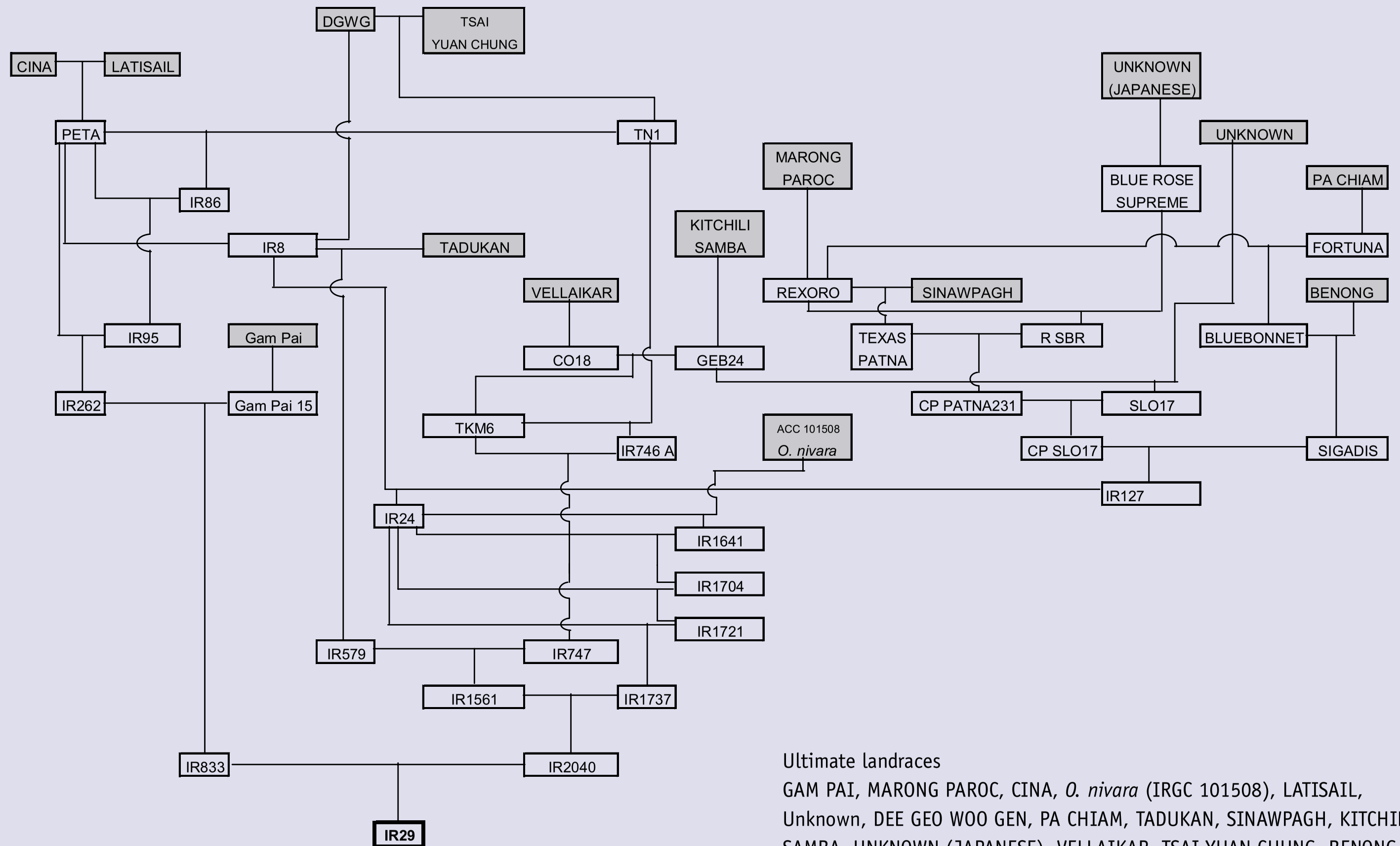
Tolerance of problem soils

IR29 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.

Countries of release

China, Philippines

Pedigree of IR29.



Ultimate landraces
GAM PAI, MARONG PAROC, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, DEE GEO WOO GEN, PA CHIAM, TADUKAN, SINAWPAGH, KITCHILI SAMBA, UNKNOWN (JAPANESE), VELLAIKAR, TSAI YUAN CHUNG, BENONG

IR30

Parentage

IR1541-102-6-3/IR20*4/*O. nivara*

Breeding history

The IR2153 cross was made in the dry season of 1972, while the segregating F_2 and F_3 generations were also grown during 1972. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries during 1973. The most promising lines were evaluated in RYT during 1974.

Experimental line designation	IR2153-159-1-4	
Year of release in Philippines	1974	
Agronomic data	Days to maturity	111
	Plant height (cm)	96
	Tiller number $hill^{-1}$	15
	Grain yield (dry season) (kg ha^{-1})	5,267
	Grain yield (wet season) (kg ha^{-1})	3,514
	Seed germination at harvest (%)	20
	Seed germination after 6 wk (%)	80
Reaction to diseases	Blast	Moderately susceptible
	Bacterial blight	Resistant
	Tungro	Moderately resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	25.6
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Medium
	Grain shape	Slender
	1,000-grain weight (g)	21.8
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	70.6
	% Head rice	56.1
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	8.66
Rough rice width (mm)	2.64
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

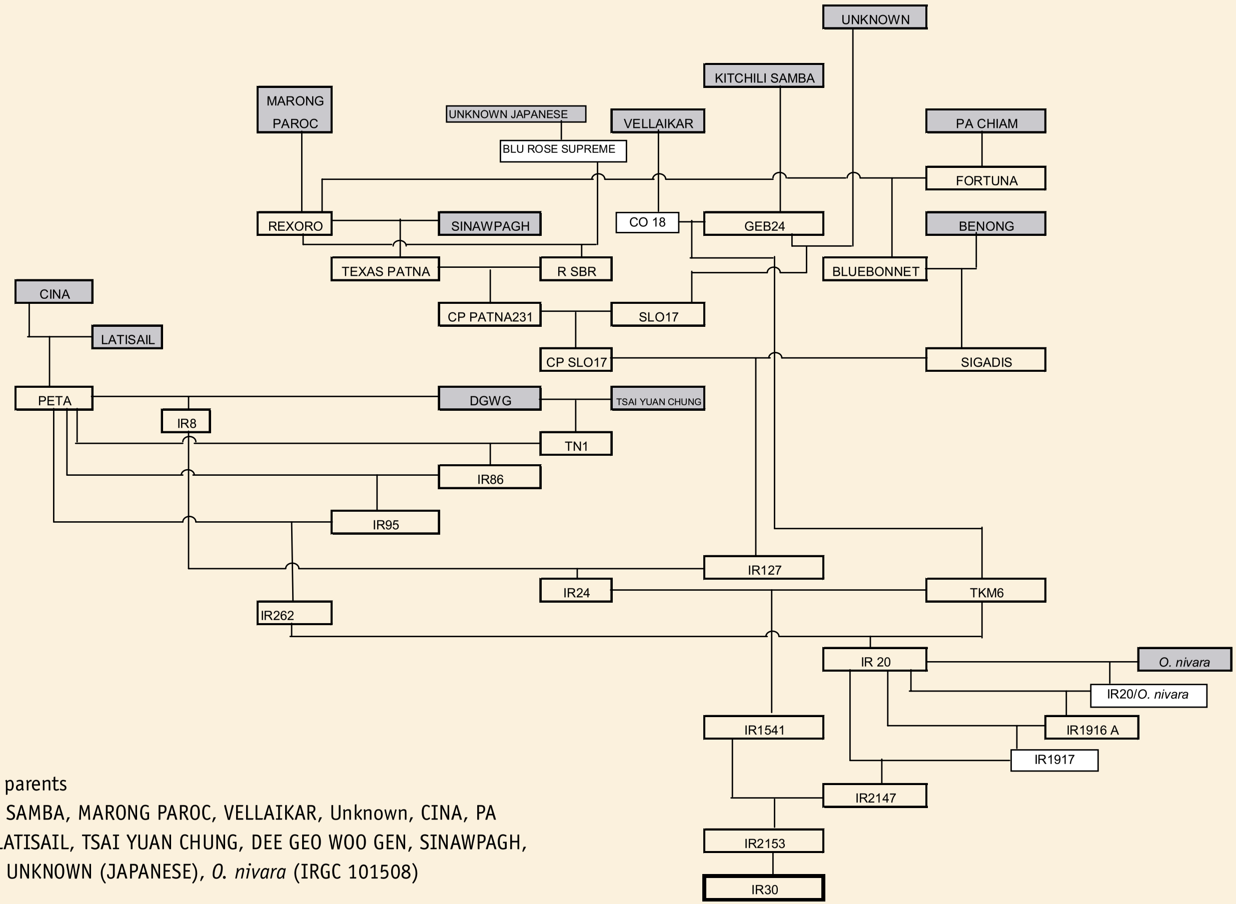
Tolerance of problem soils

IR30 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.

Countries of release

India, Indonesia, Nigeria, Philippines, Vietnam

Pedigree of IR30.



Ultimate parents
KITCHILI SAMBA, MARONG PAROC, VELLAIKAR, Unknown, CINA, PA CHIAM, LATISAIL, TSAI YUAN CHUNG, DEE GEO WOO GEN, SINAWPAGH, BENONG, UNKNOWN (JAPANESE), *O. nivara* (IRGC 101508)

IR32

Parentage

IR20*2/*O. nivara*
CR94-13

Breeding history

The IR2070 cross was made in 1972 and the segregating F_2 and F_3 generations were also grown during 1972. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1973 and 1974. The most promising lines were evaluated in RYT during 1974.

Experimental line designation	IR2070-747-6-3-2	
Year of release in Philippines	1975	
Agronomic data	Days to maturity	133
	Plant height (cm)	102
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,535
	Grain yield (wet season) (kg ha^{-1})	3,394
	Seed germination at harvest (%)	29
	Seed germination after 6 wk (%)	92
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Moderately resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Resistant
Grain quality	% Amylose	26.4
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	23.1
	Chalkiness (%)	<10
	Endosperm type	Nonwaxy
	% Hulls	23.5
	% Total milled rice	65.8
	% Head rice	51
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.52
Rough rice width (mm)	2.66
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

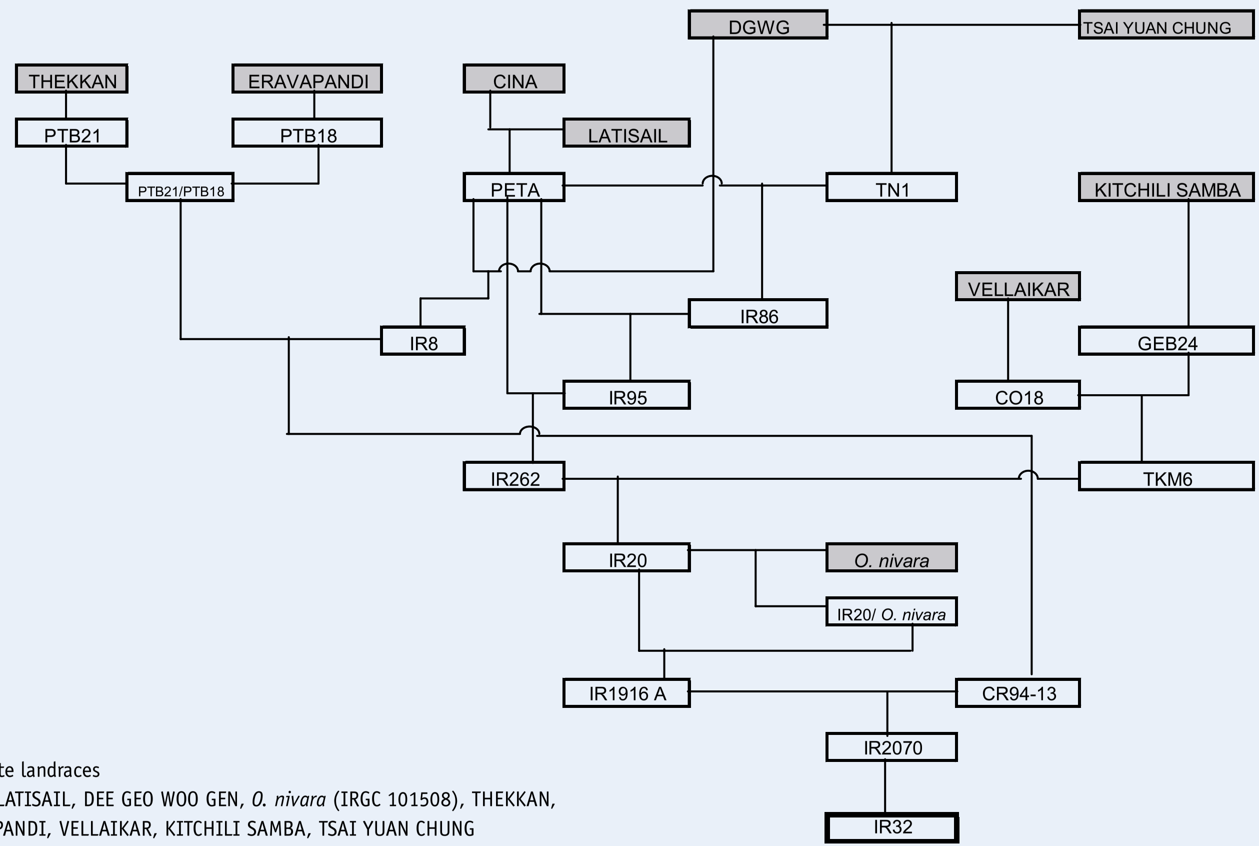
Tolerance of problem soils

IR32 is tolerant of boron toxicity and phosphorus deficiency.

Countries of release

Indonesia, Madagascar, Mali, Philippines, Vietnam

Pedigree of IR32.



Ultimate landraces
CINA, LATISAIL, DEE GEO WOO GEN, *O. nivara* (IRGC 101508), THEKKAN, ERAVAPANDI, VELLAIKAR, KITCHILI SAMBA, TSAI YUAN CHUNG

IR34

Parentage	IR833-6-2-1-1 IR1561-149-1//IR24*4/*O. nivara*
Breeding history	The IR2061 cross was made in 1971 and the segregating F_2 generation was also grown during 1971. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1972 and 1973. The most promising lines were evaluated in OYT and RYT during 1974.

Experimental line designation	IR2061-213-2-17	
Year of release in Philippines	1975	
Agronomic data	Days to maturity	127
	Plant height (cm)	124
	Tiller number hill^{-1}	13
	Grain yield (dry season) (kg ha^{-1})	5,355
	Grain yield (wet season) (kg ha^{-1})	2,215
	Seed germination at harvest (%)	29
	Seed germination after 6 wk (%)	80
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	26.6
	Gelatinization temperature	Low
	Gel consistency	Medium hard
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	25
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	20.9
	% Total milled rice	69
	% Head rice	59
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.82
Rough rice width (mm)	2.64
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

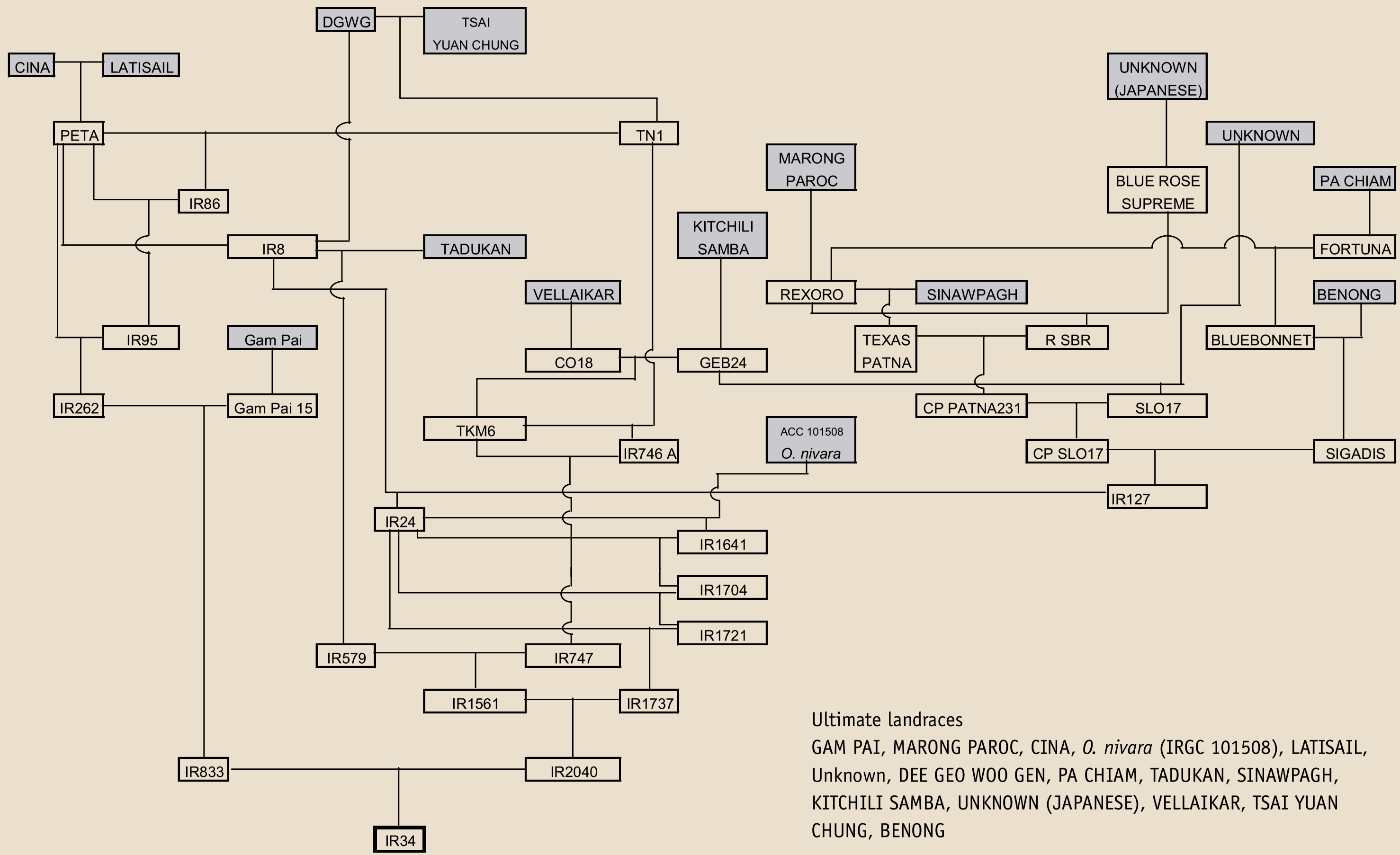
Tolerance of problem soils

IR34 is tolerant of salinity, alkalinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

India, Indonesia, Madagascar, Myanmar, Philippines, Tanzania

Pedigree of IR34.



Ultimate landraces

GAM PAI, MARONG PAROC, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, DEE GEO WOO GEN, PA CHIAM, TADUKAN, SINAWPAGH, KITCHILI SAMBA, UNKNOWN (JAPANESE), VELLAIKAR, TSAI YUAN CHUNG, BENONG

IR36

Parentage

IR1561-228-1-2/IR1737
CR94-13

Breeding history

The IR2071 cross was made in 1971 and the segregating F_2 and F_3 generations were planted during 1972. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1973 and 1974. The most promising lines were evaluated in RYT trials during 1974-75.

Experimental line designation	IR2071-625-1-252	
Year of release in Philippines	1976	
Agronomic data	Days to maturity	111
	Plant height (cm)	90
	Tiller number $hill^{-1}$	16
	Grain yield (dry season) (kg ha^{-1})	5,863
	Grain yield (wet season) (kg ha^{-1})	3,691
	Seed germination at harvest (%)	8
	Seed germination after 6 wk (%)	96
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Resistant
Grain quality	% Amylose	25.4
	Gelatinization temperature	Intermediate
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	22.3
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	71.0
	% Head rice	56.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.64
Rough rice width (mm)	2.48
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

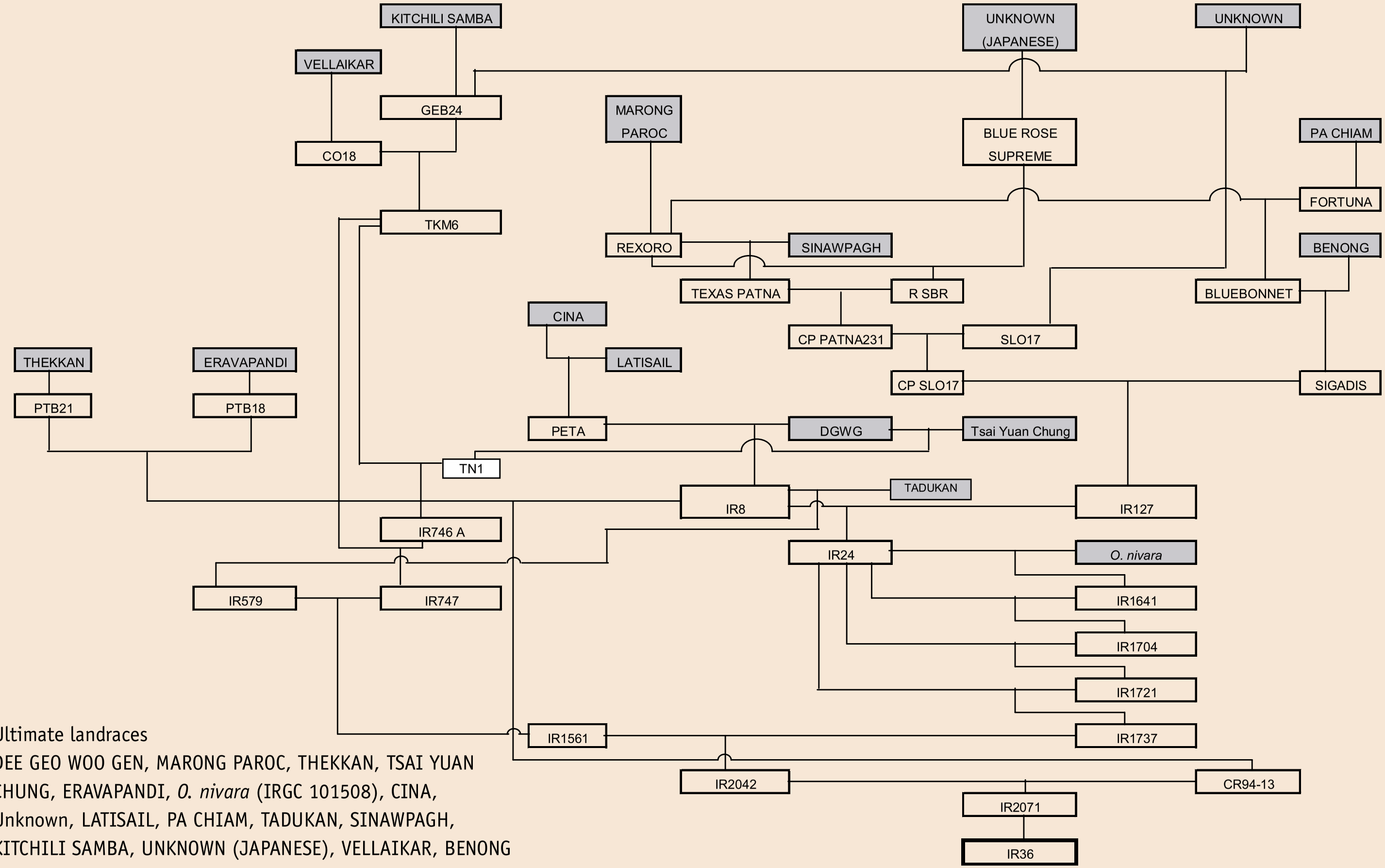
Tolerance of problem soils

IR36 is tolerant of salinity, alkalinity, iron and boron toxicity, and zinc deficiency.

Countries of release

Bhutan, Cambodia, Central Africa Republic, China, Gambia, India, Indonesia, Laos, Madagascar, Mozambique, Myanmar, Philippines, Vietnam

Pedigree of IR36.



Ultimate landraces

DEE GEO WOO GEN, MARONG PAROC, THEKKAN, TSAI YUAN CHUNG, ERAVAPANDI, *O. nivara* (IRGC 101508), CINA, Unknown, LATISAIL, PA CHIAM, TADUKAN, SINAWPAGH, KITCHILI SAMBA, UNKNOWN (JAPANESE), VELLAIKAR, BENONG

IR38

Parentage

IR20*2/*O. nivara*
CR94-13

Breeding history

The IR2070 cross was made in 1972 and the segregating F_2 and F_3 generations were also grown during 1972. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1973 and 1974. The most promising lines were evaluated in OYT and RYT during 1974-75.

Experimental line designation	IR2070-423-2-5-6	
Year of release in Philippines	1976	
Agronomic data	Days to maturity	120
	Plant height (cm)	104
	Tiller number hill^{-1}	15
	Grain yield (dry season) (kg ha^{-1})	5,467
	Grain yield (wet season) (kg ha^{-1})	4,004
	Seed germination at harvest (%)	3
	Seed germination after 6 wk (%)	88
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Resistant
Grain quality	% Amylose	26.2
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.8
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	70.4
	% Head rice	61.6
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Long (>2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	8.86
Rough rice width (mm)	2.36
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

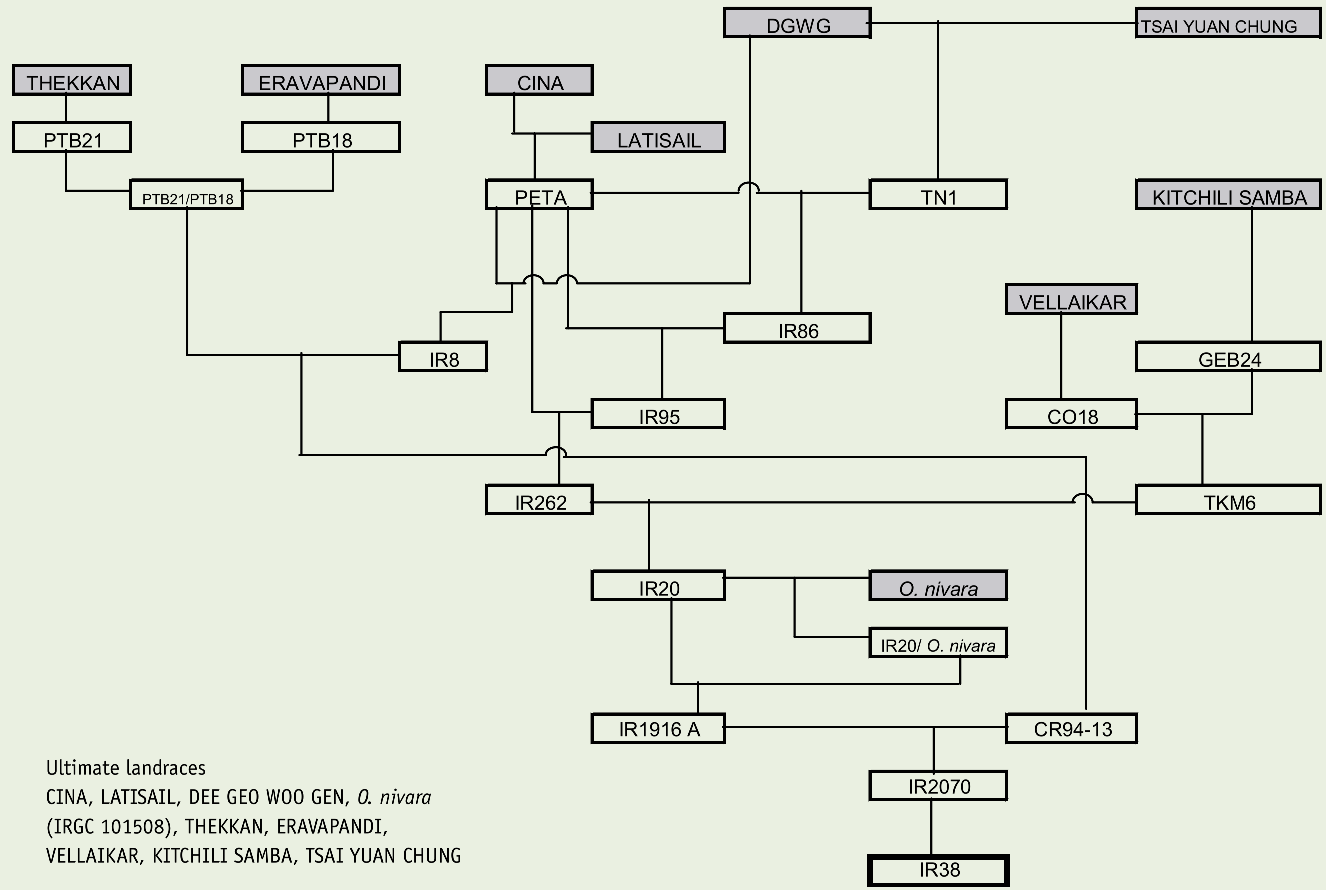
Tolerance of problem soils

IR38 is tolerant of boron toxicity and phosphorus and zinc deficiency.

Countries of release

Indonesia, Laos, Philippines, and Vietnam

Pedigree of IR38.



Ultimate landraces
CINA, LATISAIL, DEE GEO WOO GEN, *O. nivara* (IRGC 101508), THEKKAN, ERAVAPANDI, VELLAIKAR, KITCHILI SAMBA, TSAI YUAN CHUNG

IR40

Parentage

IR20*2/*O. nivara*
CR94-13

Breeding history

The IR2070 cross was made in 1972 and the segregating F_2 and F_3 generations were also grown during 1972. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries during 1973. The most promising lines were evaluated in RYT during 1974-75.

Experimental line designation	IR2070-414-3-9	
Year of release in Philippines	1977	
Agronomic data	Days to maturity	119
	Plant height (cm)	103
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,040
	Grain yield (wet season) (kg ha^{-1})	2,662
	Seed germination at harvest (%)	7
	Seed germination after 6 wk (%)	96
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Resistant
Grain quality	% Amylose	25.3
	Gelatinization temperature	Intermediate
	Gel consistency	Medium
	Grain length	Medium
	Grain shape	Slender
	1,000-grain weight (g)	21.9
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21.1
	% Total milled rice	71.3
	% Head rice	66.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.34
Rough rice width (mm)	2.40
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

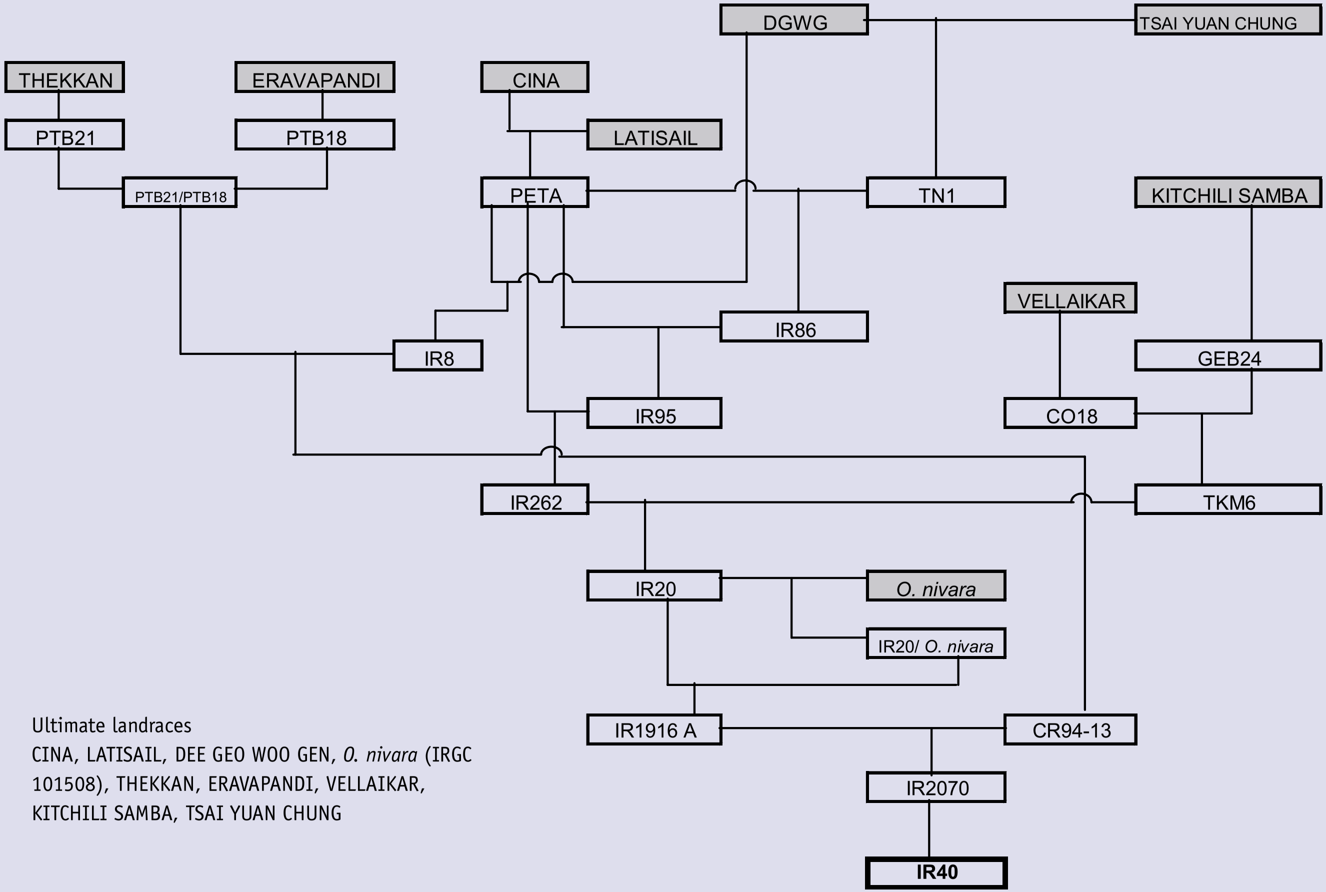
Tolerance of problem soils

IR40 is tolerant of iron and boron toxicity and phosphorus and zinc deficiency.

Countries of release

Mauritania, Philippines

Pedigree of IR40.



Ultimate landraces
CINA, LATISAIL, DEE GEO WOO GEN, *O. nivara* (IRGC 101508), THEKKAN, ERAVAPANDI, VELLAIKAR, KITCHILI SAMBA, TSAI YUAN CHUNG

IR42

Parentage

IR1561-228-1-2/IR1737
CR94-13

Breeding history

The IR2071 cross was made in 1972 and the segregating F_2 and F_3 generations were also grown during 1972. Progenies of the succeeding F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries during 1973 and 1974. The most promising lines were evaluated in OYT and RYT during 1975-76.

Experimental line designation	IR2071-586-5-6-3	
Year of release in Philippines	1977	
Agronomic data	Days to maturity	132
	Plant height (cm)	106
	Tiller number hill^{-1}	15
	Grain yield (dry season) (kg ha^{-1})	6,277
	Grain yield (wet season) (kg ha^{-1})	3,687
	Seed germination at harvest (%)	16
	Seed germination after 6 wk (%)	92
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Resistant
Grain quality	% Amylose	26.2
	Gelatinization temperature	Low
	Gel consistency	Medium hard
	Grain length	Medium
	Grain shape	Slender
	1,000-grain weight (g)	20.1
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	23.3
	% Total milled rice	68.6
	% Head rice	62.1
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.22
Rough rice width (mm)	2.56
Seed coat color	White

Adaptation

Suited to irrigated areas and well adapted to rainfed lowland areas.

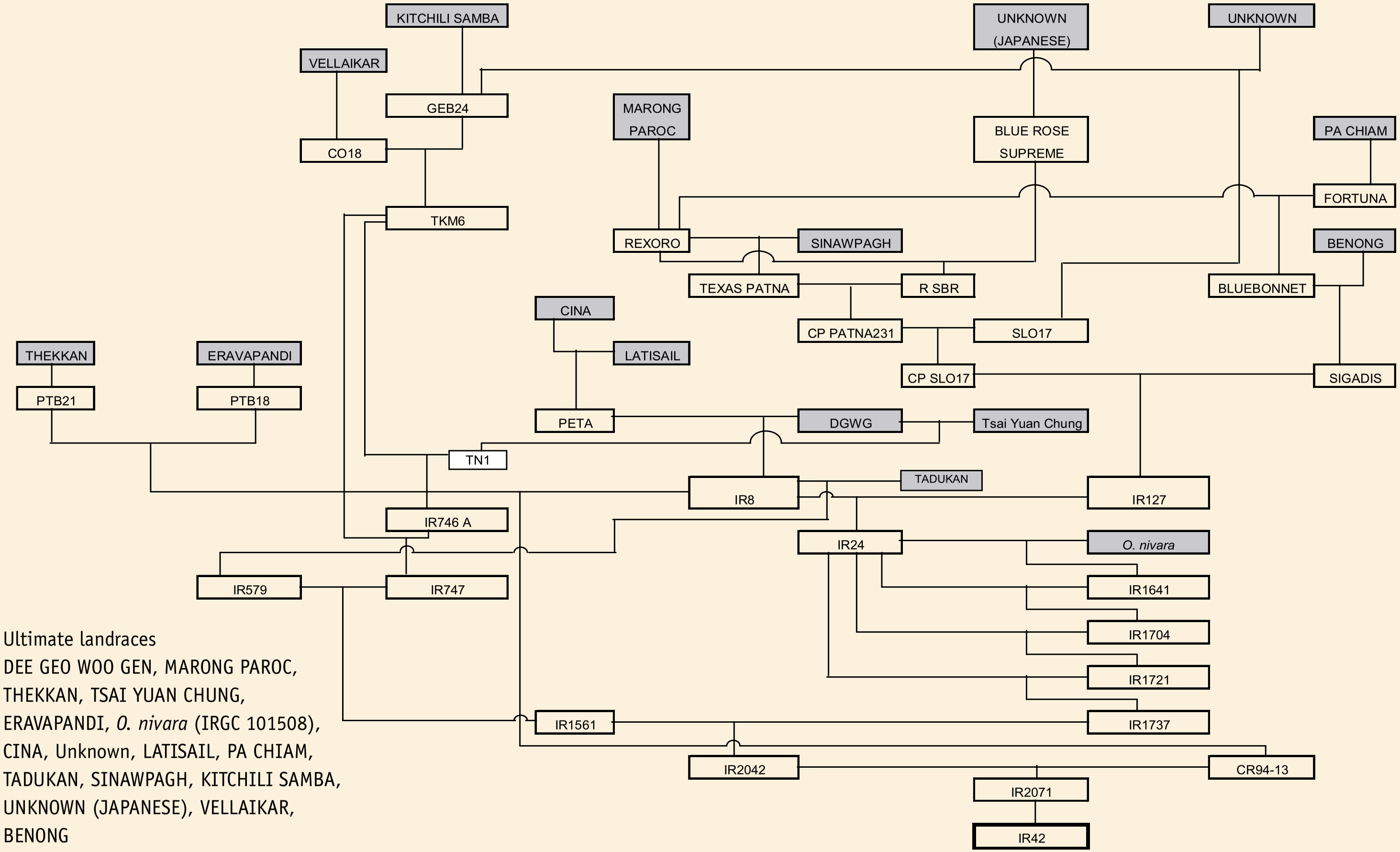
Tolerance of problem soils

IR42 is tolerant of salinity, alkalinity, iron and boron toxicity, and zinc and phosphorus deficiency.

Countries of release

Cambodia, Cameroon, Ghana, India, Indonesia, Malaysia, Mali, Mozambique, Myanmar, Niger, Nigeria, Philippines, Senegal, Tanzania, Vietnam

Pedigree of IR42.



Ultimate landraces
DEE GEO WOO GEN, MARONG PAROC, THEKKAN, TSAI YUAN CHUNG, ERAVAPANDI, *O. nivara* (IRGC 101508), CINA, Unknown, LATISAIL, PA CHIAM, TADUKAN, SINAWPAGH, KITCHILI SAMBA, UNKNOWN (JAPANESE), VELLAIKAR, BENONG

IR43

Parentage

IR305-3-17-1-3
IR661-1-140-3

Breeding history

The IR1529 cross was made in 1969 and the segregating F_2 and F_3 generations were grown during 1970. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries during 1971. The most promising lines were evaluated in OYT and RYT during 1971-72.

Experimental line designation	IR1529-430-3	
Year of release in Philippines	1978	
Agronomic data	Days to maturity	123
	Plant height (cm)	97
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,348
	Grain yield (wet season) (kg ha^{-1})	3,220
	Seed germination at harvest (%)	54
	Seed germination after 6 wk (%)	97
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Susceptible
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Susceptible
	BPH2	Susceptible
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	18
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	28.4
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	20.6
	% Total milled rice	72.0
	% Head rice	59.8
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Awnless
Rough rice length (mm)	9.00
Rough rice width (mm)	2.76
Seed coat (bran) color	White

Adaptation

Suited to upland areas.

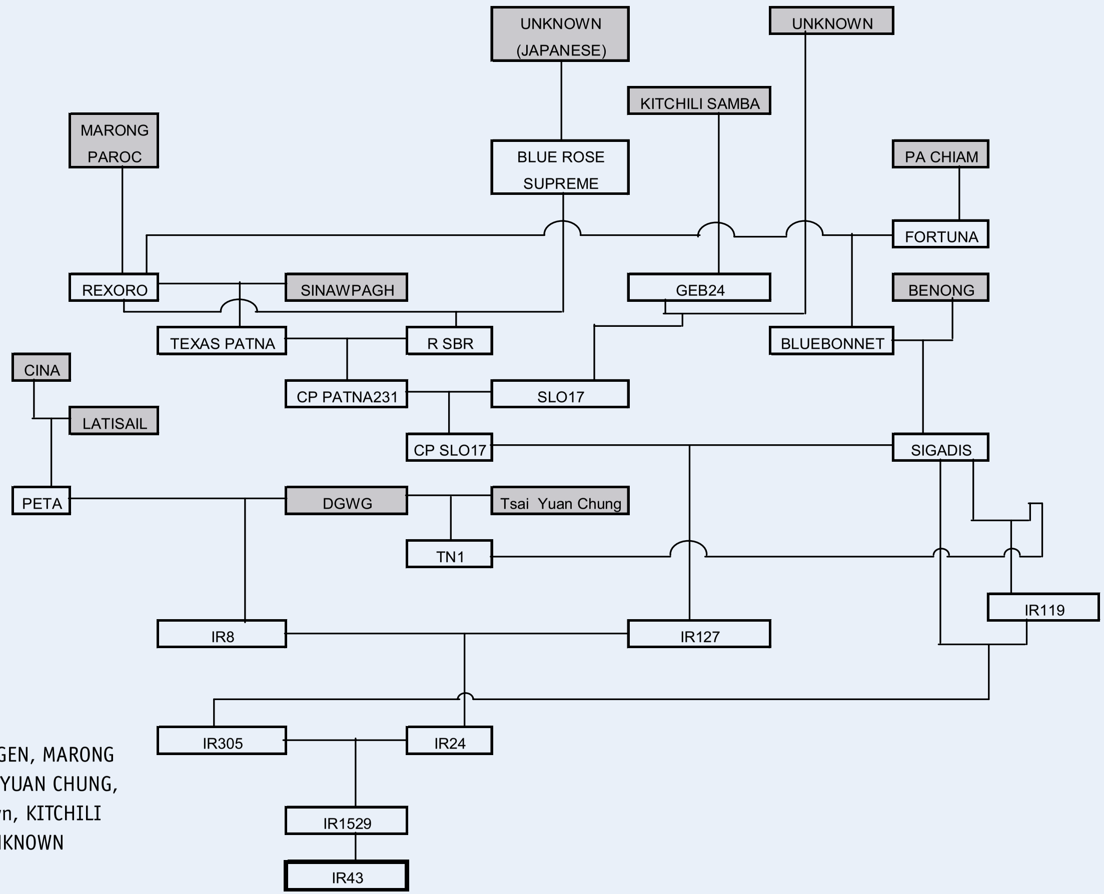
Tolerance of problem soils

IR43 is tolerant of salinity and zinc and phosphorus deficiency.

Countries of release

Argentina, Bolivia, Brazil, Cuba, Mexico, Peru, Philippines

Pedigree of IR43.



Ultimate landraces
BENONG, DEE GEO WOO GEN, MARONG PAROC, PA CHIAM, TSAI YUAN CHUNG, CINA, LATISAIL, Unknown, KITCHILI SAMBA, SINAWPAGH, UNKNOWN (JAPANESE)

IR44

Parentage

IR1529-680-3/CR94-13
IR480-5-9-3

Breeding history

The IR2863 cross was made in 1972 and the segregating F_2 generation was grown during 1973. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1974. The most promising lines were evaluated in RYT during 1975.

Experimental line designation	IR2863-38-1-2	
Year of release in Philippines	1978	
Agronomic data	Days to maturity	125
	Plant height (cm)	103
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,787
	Grain yield (wet season) (kg ha^{-1})	3,544
	Seed germination at harvest (%)	11
	Seed germination after 6 wk (%)	98
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	Susceptible
Grain quality	% Amylose	26.1
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	23
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21.9
	% Total milled rice	70.5
	% Head rice	62.3
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.30
Rough rice width (mm)	2.60
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

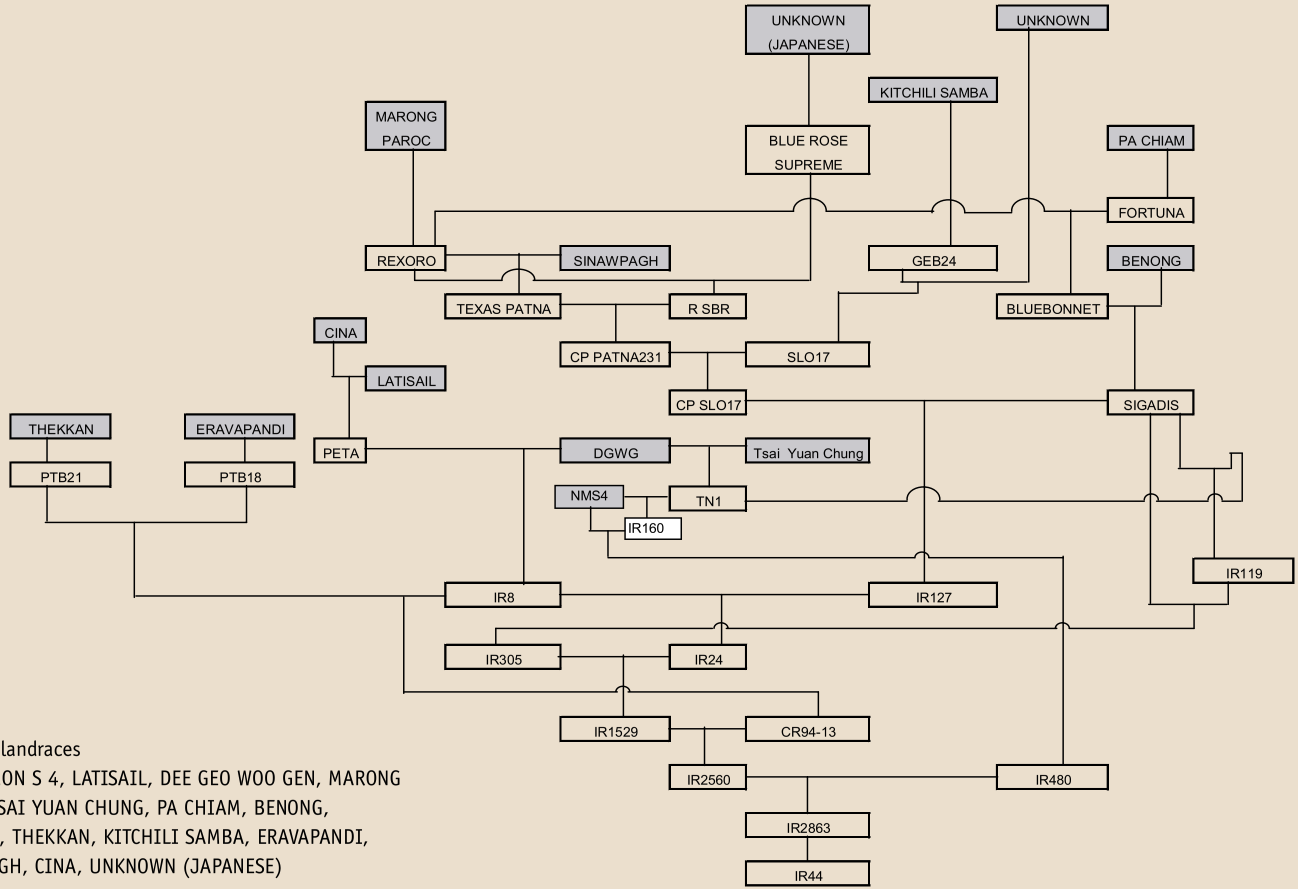
Tolerance of problem soils

IR44 is tolerant of salinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Philippines

Pedigree of IR44.



Ultimate landraces

NAHNG MON S 4, LATISAIL, DEE GEO WOO GEN, MARONG PAROC, TSAI YUAN CHUNG, PA CHIAM, BENONG, Unknown, THEKKAN, KITCHILI SAMBA, ERAVAPANDI, SINAWPAGH, CINA, UNKNOWN (JAPANESE)

IR45

Parentage

IR1416-128-5/IR1364-37-3-1
IR1824-1

Breeding history

The IR2035 cross was made in 1971 and the segregating F_2 generation was also grown during 1971. Progenies of the succeeding F_3, F_4, and F_5 generations were evaluated in pedigree nurseries during 1972 and 1973. The most promising lines were evaluated in OYT and RYT starting in 1973.

Experimental line designation	IR2035-242-1	
Year of release in Philippines	1978	
Agronomic data	Days to maturity	124
	Plant height (cm)	101
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,477
	Grain yield (wet season) (kg ha^{-1})	3,506
	Seed germination at harvest (%)	27
	Seed germination after 6 wk (%)	98
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	–
	Grassy stunt	–
Reaction to insect pests	GLH	Moderately resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	26.4
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	26.8
	Chalkiness (%)	>20
	Endosperm type	Nonwaxy
	% Hulls	20.6
	% Total milled rice	71.4
	% Head rice	59.1
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.56
Rough rice width (mm)	2.42
Seed coat color	White

Adaptation

Suited to dryland culture.

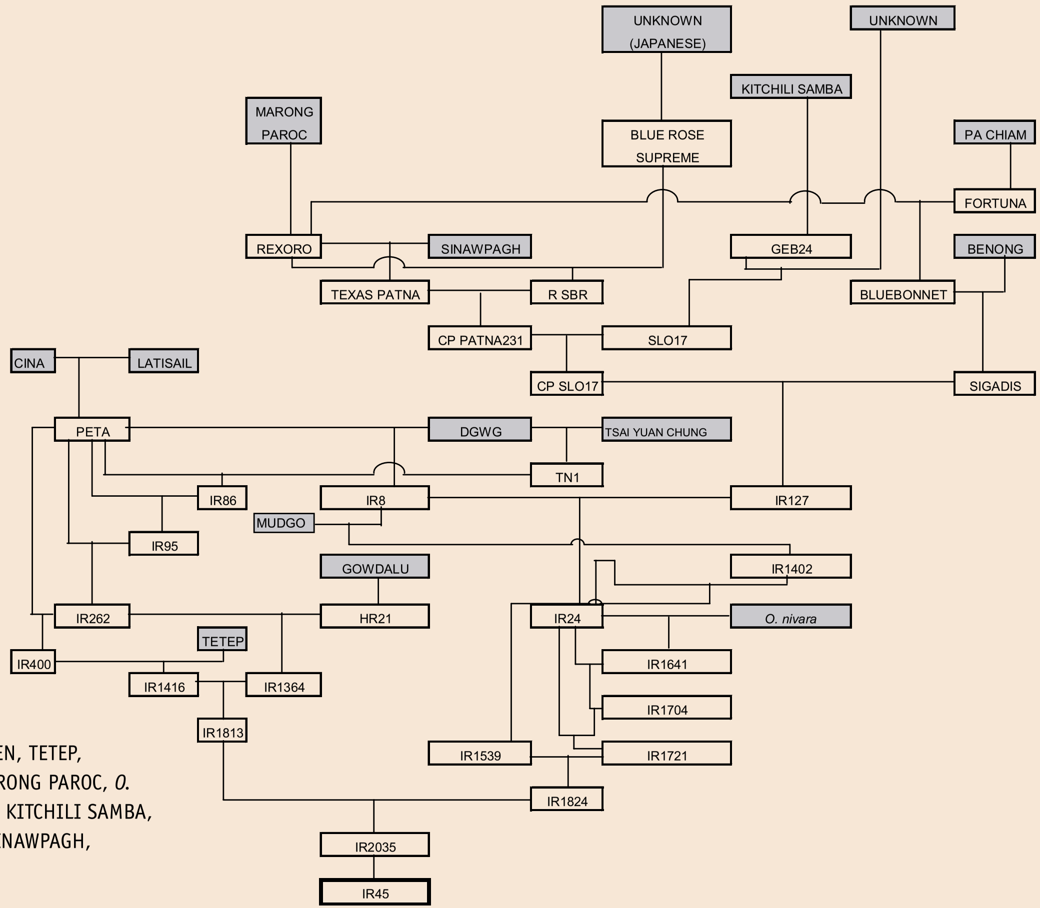
Tolerance of problem soils

IR45 is tolerant of salinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Philippines

Pedigree of IR45.



Ultimate landraces
CINA, LATISAIL, DEE GEO WOO GEN, TETEP, GOWDALU, MUDGO, BENONG, MARONG PAROC, *O. nivara* (IRGC 101508), Unknown, KITCHILI SAMBA, PA CHIAM, TSAI YUAN CHUNG, SINAWPAGH, UNKNOWN (JAPANESE)

IR46

Parentage

IR1416-131-5/IR1364-37-3-1
IR1366-120-3-1/IR1539-111

Breeding history

The IR2058 cross was made in 1971 and the segregating F_2 and F_3 generations were grown during 1972. Progenies of the succeeding F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries during 1973 and 1974. The most promising lines were evaluated in RYT during 1974.

Experimental line designation	IR2058-78-1-3-2	
Year of release in Philippines	1978	
Agronomic data	Days to maturity	122
	Plant height (cm)	104
	Tiller number $hill^{-1}$	17
	Grain yield (dry season) (kg ha^{-1})	6,001
	Grain yield (wet season) (kg ha^{-1})	3,502
	Seed germination at harvest (%)	8
	Seed germination after 6 wk (%)	50
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Moderately resistant
	Grassy stunt	Susceptible
Reaction to insect pests	GLH	Moderately resistant
	BPH1	Resistant
	BPH2	Susceptible
	BPH3	Resistant
	Stem borer	Moderately susceptible
	Gall midge	Susceptible
Grain quality	% Amylose	26.2
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	28.9
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21.1
	% Total milled rice	67.5
	% Head rice	59.4
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.38
Rough rice width (mm)	2.40
Seed coat (bran) color	White

Adaptation

Suited to rainfed lowland culture.

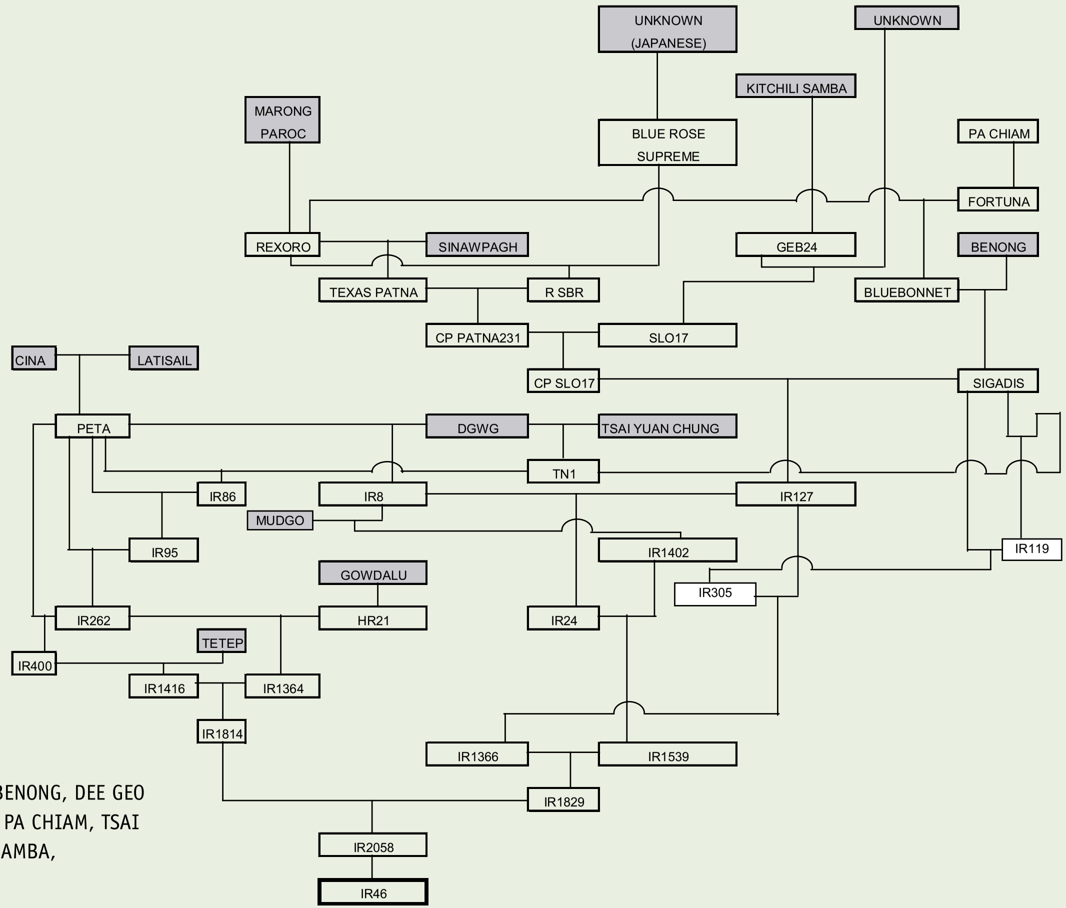
Tolerance of problem soils

IR46 is tolerant of salinity, alkalinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Brazil, Cameroon, Chad, Côte d'Ivoire, Indonesia, Mozambique, Nigeria, Philippines, Togo

Pedigree of IR46.



Ultimate landraces
CINA, LATISAIL, TETEP, GOWDALU, BENONG, DEE GEO WOO GEN, MARONG PAROC, MUDGO, PA CHIAM, TSAI YUAN CHUNG, Unknown, KITCHILI SAMBA, SINAWPAGH, UNKNOWN (JAPANESE)

IR48

Parentage

IR1702-74-3-2/IR1721-11-6-8-3
IR2055-481-2

Breeding history

The IR4570 cross was made in 1974 and the segregating F_2 generation was also grown during 1974. Progenies of the succeeding F_3, F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1975 and 1976. The most promising lines were evaluated in RYT during 1977-78.

Experimental line designation	IR4570-83-3-3	
Year of release in Philippines	1979	
Agronomic data	Days to maturity	135
	Plant height (cm)	119
	Tiller number hill^{-1}	13
	Grain yield (dry season) (kg ha^{-1})	6,068
	Grain yield (wet season) (kg ha^{-1})	3,222
	Seed germination at harvest (%)	16
	Seed germination after 6 wk (%)	87
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	23.5
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	29
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	71.4
	% Head rice	63.5
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.76
Rough rice width (mm)	2.73
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

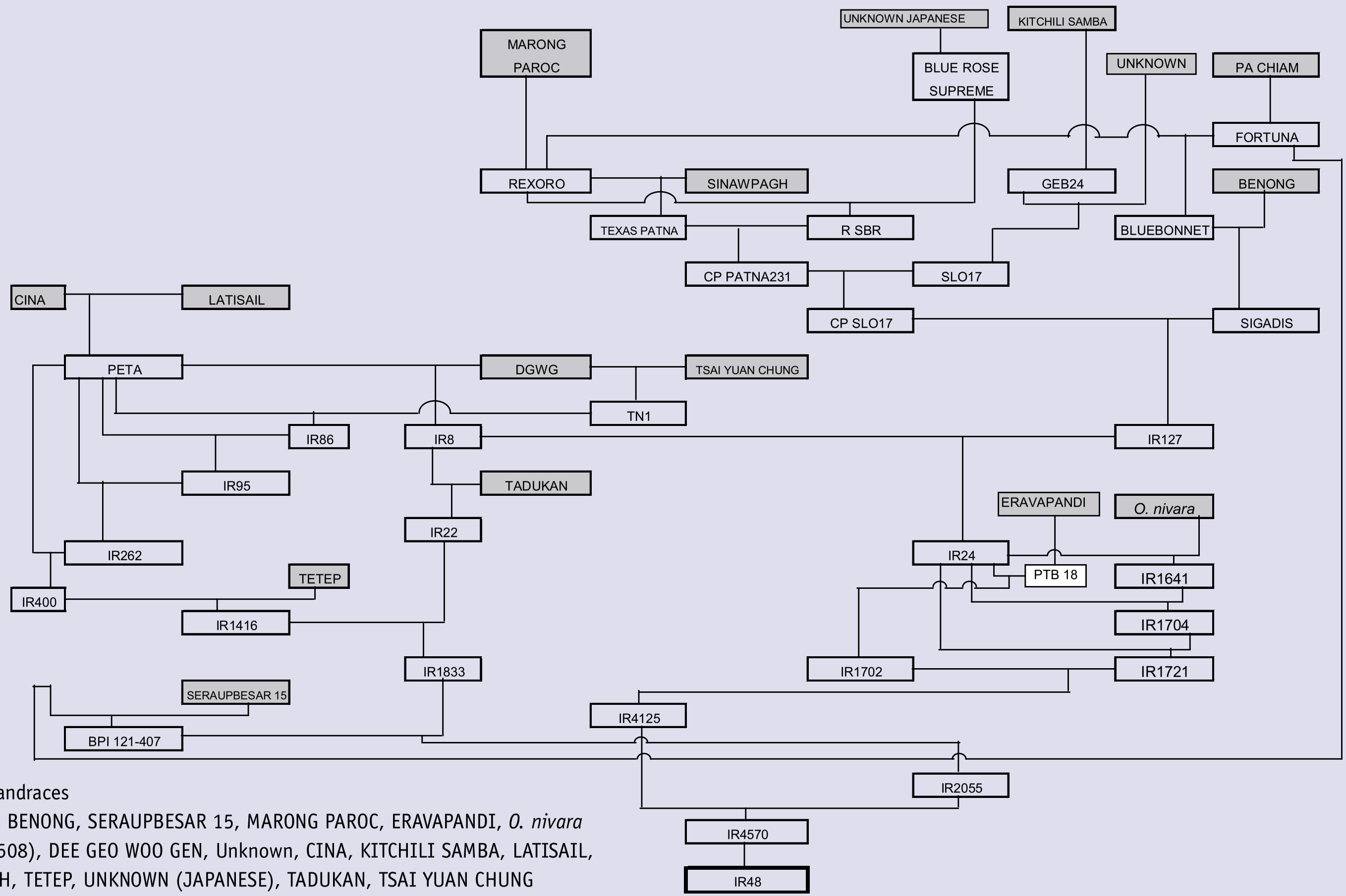
Tolerance of problem soils

IR48 is tolerant of salinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Indonesia, Mozambique, Peru, Philippines, Vietnam

Pedigree of IR48.



Ultimate landraces

PA CHIAM, BENONG, SERAUPBESAR 15, MARONG PAROC, ERAVAPANDI, *O. nivara* (IRGC 101508), DEE GEO WOO GEN, Unknown, CINA, KITCHILI SAMBA, LATISAIL, SINAWPAGH, TETEP, UNKNOWN (JAPANESE), TADUKAN, TSAI YUAN CHUNG

IR50

Parentage

IR2153-14-1-6-2/IR28
IR36

Breeding history

The IR9224 cross was made in 1975 and the segregating F_2 and F_3 generations were grown during 1976. Progenies of the succeeding F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries during 1977 and 1978. The most promising lines were evaluated in RYT during 1978.

Experimental line designation	IR9224-117-2-3-3-2	
Year of release in Philippines	1979	
Agronomic data	Days to maturity	108
	Plant height (cm)	92
	Tiller number hill^{-1}	15
	Grain yield (dry season) (kg ha^{-1})	5,334
	Grain yield (wet season) (kg ha^{-1})	3,676
	Seed germination at harvest (%)	35
	Seed germination after 6 wk (%)	99
Reaction to diseases	Blast	Moderately susceptible
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.2
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	19.4
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21.4
	% Total milled rice	70.0
	% Head rice	57.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.94
Rough rice width (mm)	2.24
Seed coat color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

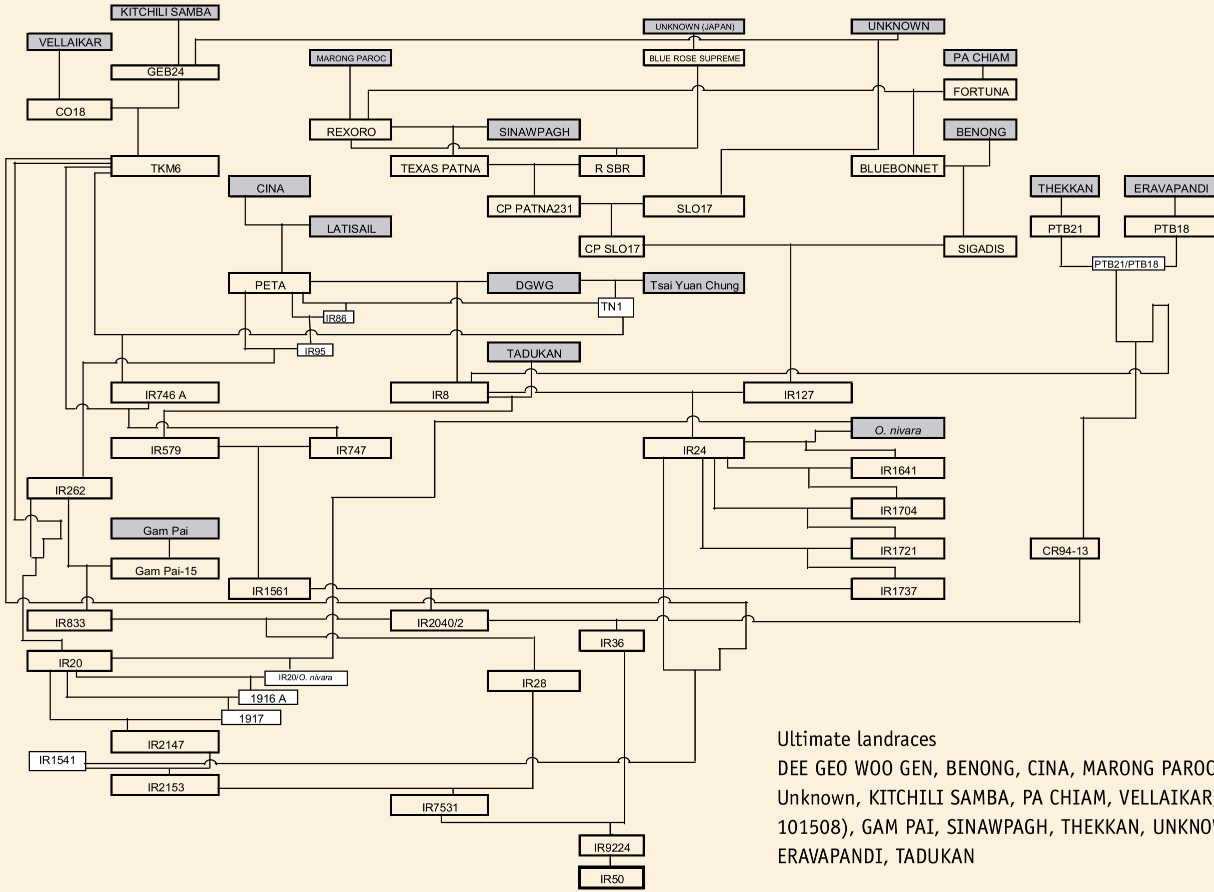
Tolerance of problem soils

IR50 is tolerant of salinity, alkalinity, boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Cambodia, India, Indonesia, Madagascar, Mauritania, Mozambique, Myanmar, Philippines

Pedigree of IR50.



Ultimate landraces

DEE GEO WOO GEN, BENONG, CINA, MARONG PAROC, LATISAIL, Unknown, KITCHILI SAMBA, PA CHIAM, VELLAIKAR, O. nivara (IRGC 101508), GAM PAI, SINAWPAGH, THEKKAN, UNKNOWN (JAPANESE), ERAVAPANDI, TADUKAN

IR52

Parentage

NAM SA-GUI 19/IR2071-88
IR2061-214-3-6-20

Breeding history

The IR5853 cross was made in 1974 and the segregating F_2 and F_3 generations were grown during 1975. Progenies of the succeeding F_4 generation were evaluated in pedigree nurseries during 1976. The most promising lines were evaluated in RYT during 1976-78.

Experimental line designation	IR5853-118-5	
Year of release in Philippines	1980	
Agronomic data	Days to maturity	116
	Plant height (cm)	104
	Tiller number hill^{-1}	14
	Grain yield (dry season) (kg ha^{-1})	5,804
	Grain yield (wet season) (kg ha^{-1})	3,514
	Seed germination at harvest (%)	7
	Seed germination after 6 wk (%)	40
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.3
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	25.6
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	21
	% Total milled rice	70.2
	% Head rice	53.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Short and partly awned
Rough rice length (mm)	10.08
Rough rice width (mm)	2.43
Seed coat (bran) color	White

Adaptation

Suited to rainfed lowland areas.

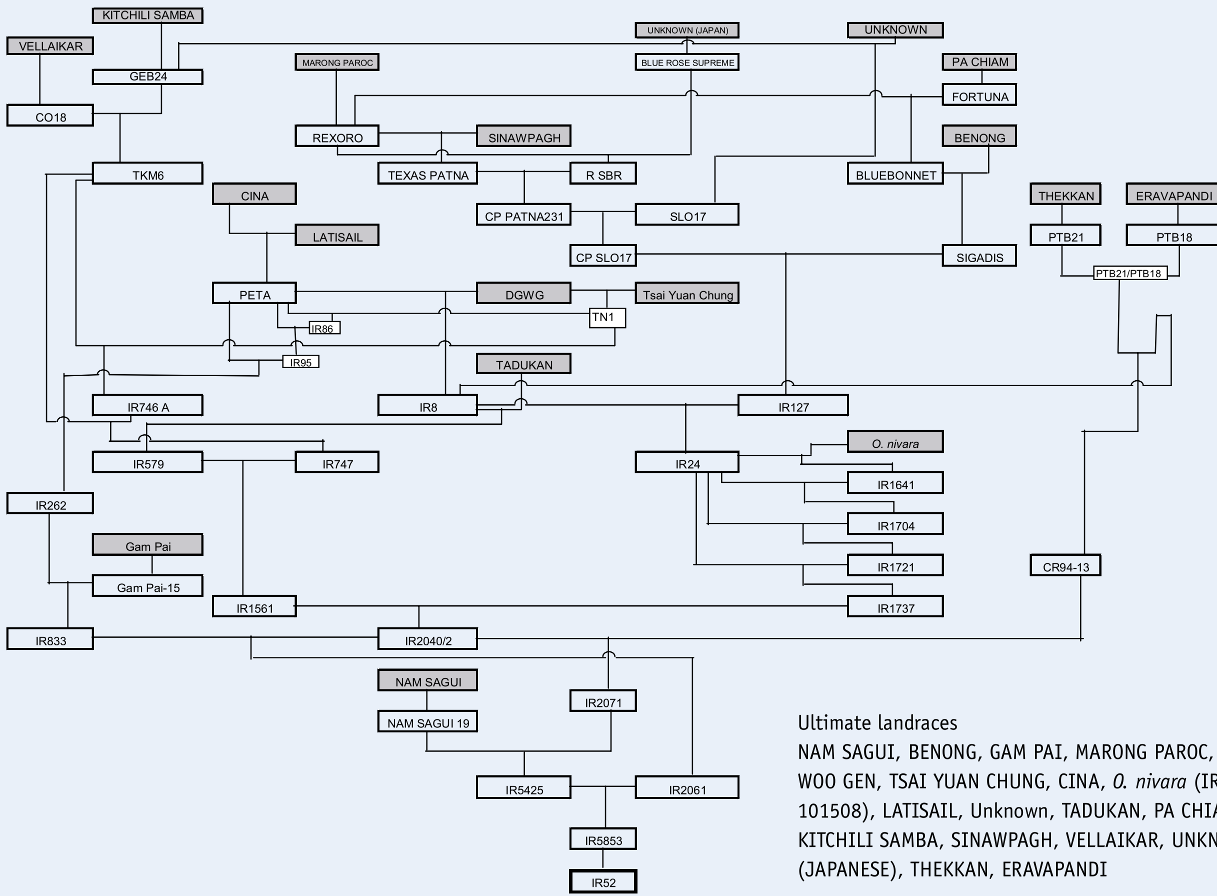
Tolerance of problem soils

IR52 is tolerant of salinity, alkalinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Bolivia, Indonesia, Mozambique, Philippines

Pedigree of IR52.



Ultimate landraces
NAM SAGUI, BENONG, GAM PAI, MARONG PAROC, DEE GEO WOO GEN, TSAI YUAN CHUNG, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, TADUKAN, PA CHIAM, KITCHILI SAMBA, SINAWPAGH, VELLAIKAR, UNKNOWN (JAPANESE), THEKKAN, ERAVAPANDI

IR54

Parentage

NAM SA-GUI 19/IR2071-88
IR2061-214-3-6-20

Breeding history

The IR5853 cross was made in 1974 and the segregating F_2 and F_3 generations were also grown during 1974 and 1975. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1976. The most promising lines were evaluated in RYT during 1977-78.

Experimental line designation	IR5853-162-1-2-3	
Year of release in Philippines	1980	
Agronomic data	Days to maturity	123
	Plant height (cm)	98
	Tiller number $hill^{-1}$	17
	Grain yield (dry season) (kg ha^{-1})	5,957
	Grain yield (wet season) (kg ha^{-1})	2,873
	Seed germination at harvest (%)	50
	Seed germination after 6 wk (%)	94
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.6
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	23.9
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	20.4
	% Total milled rice	71.1
	% Head rice	57.7
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Short and partly awned
Rough rice length (mm)	9.58
Rough rice width (mm)	2.40
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

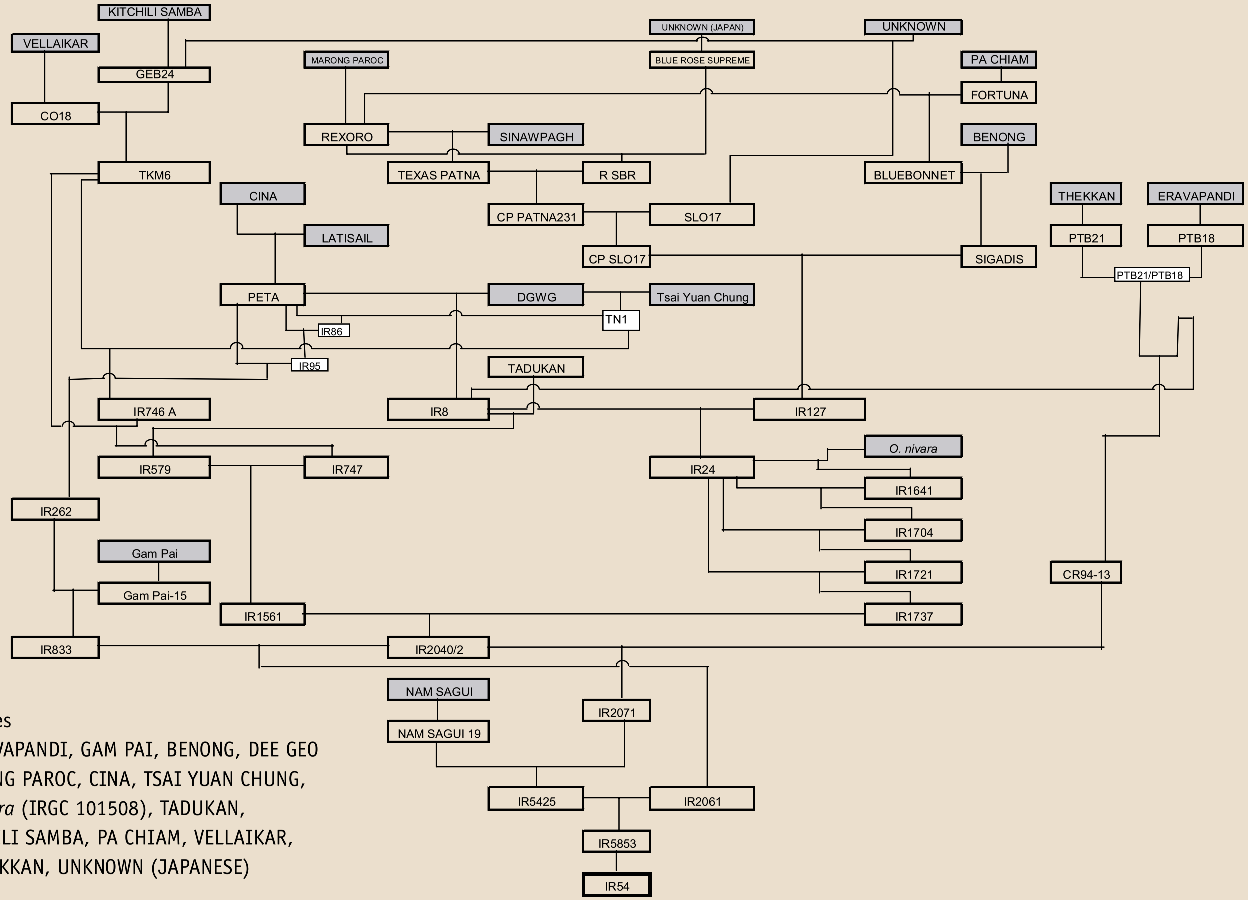
Tolerance of problem soils

IR54 is tolerant of boron toxicity and phosphorus and zinc deficiency.

Countries of release

China, Gambia, Indonesia, Kenya, Malaysia, Mozambique, Philippines, Tanzania

Pedigree of IR54.



Ultimate landraces
NAM SAGUI, ERAVAPANDI, GAM PAI, BENONG, DEE GEO WOO GEN, MARONG PAROC, CINA, TSAI YUAN CHUNG, LATISAIL, *O. nivara* (IRGC 101508), TADUKAN, Unknown, KITCHILI SAMBA, PA CHIAM, VELLAIKAR, SINAWPAGH, THEKKAN, UNKNOWN (JAPANESE)

IR56

Parentage

IR4432-53-33/PTB33
IR36

Breeding history

The IR13429 cross was made in 1976 and the segregating F_2 and F_3 generations were grown during 1977. Progenies of the succeeding F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries during 1978 and 1979. The most promising lines were evaluated in RYT during 1979.

Experimental line designation	IR13429-109-2-2-1	
Year of release in Philippines	1982	
Agronomic data	Days to maturity	111
	Plant height (cm)	92
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,237
	Grain yield (wet season) (kg ha^{-1})	3,538
	Seed germination at harvest (%)	17
	Seed germination after 6 wk (%)	65
Reaction to diseases	Blast	Resistant
	Bacterial blight	Susceptible
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26
	Gelatinization temperature	Low
	Gel consistency	Medium
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.5
	Chalkiness (%)	<10
	Endosperm type	Nonwaxy
	% Hulls	21.2
	% Total milled rice	70.9
	% Head rice	58.8
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Short and partly awned
Rough rice length (mm)	10.04
Rough rice width (mm)	2.36
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

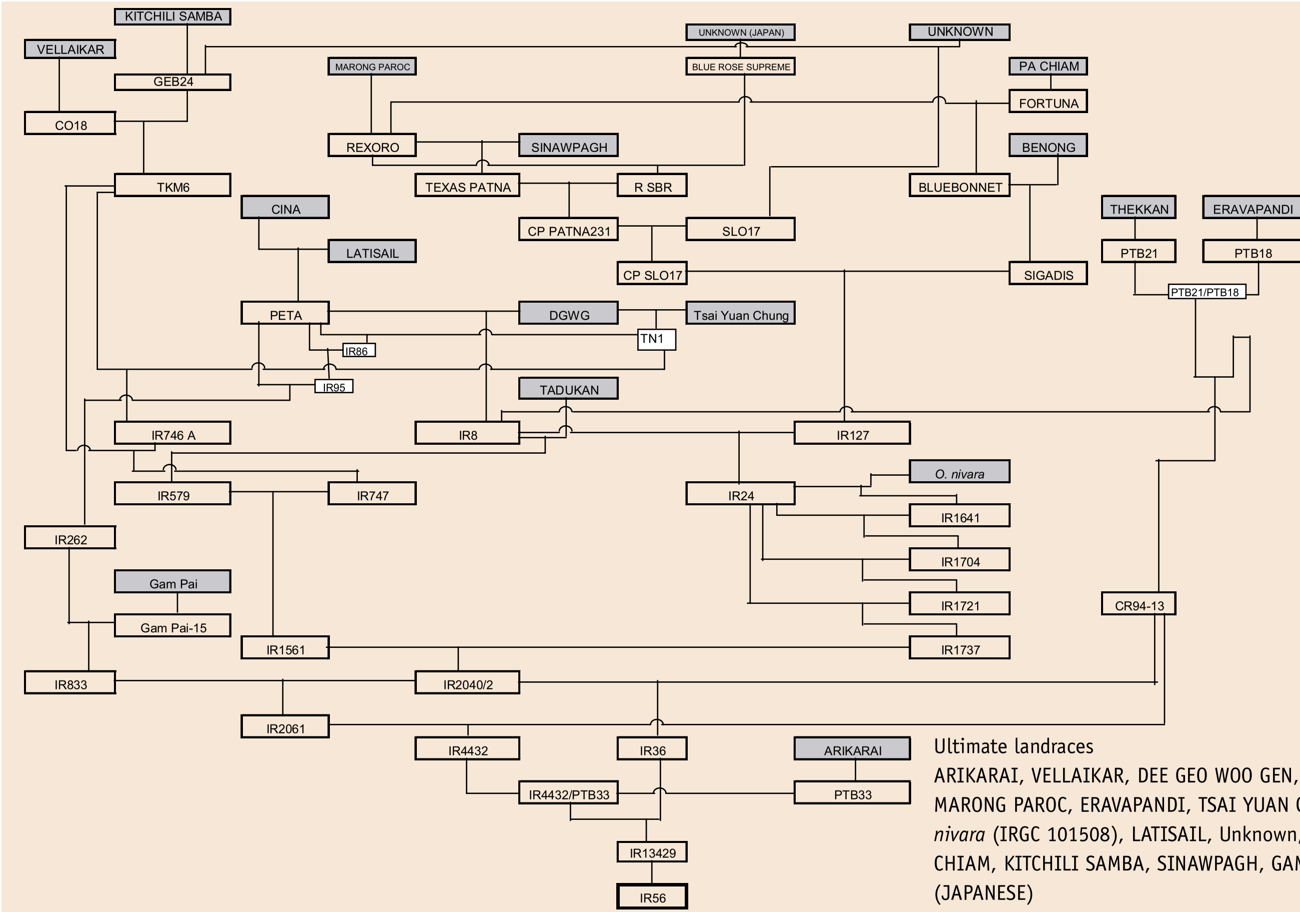
Tolerance of problem soils

IR56 is tolerant of salinity, alkalinity, boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Indonesia, Philippines

Pedigree of IR56.



Ultimate landraces

ARIKARAI, VELLAIKAR, DEE GEO WOO GEN, BENONG, THEKKAN, MARONG PAROC, ERAVAPANDI, TSAI YUAN CHUNG, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, TADUKAN, PA CHIAM, KITCHILI SAMBA, SINAWPAGH, GAM PAI, UNKNOWN (JAPANESE)

IR58

Parentage

IR28/KWANG-CHANG-AI
IR36

Breeding history

The IR9752 cross was made in 1976 and the segregating F_2 and F_3 generations were planted during 1976. Progenies of the succeeding F_4 and F_5 generations were evaluated in pedigree nurseries during 1977-78. The most promising lines were evaluated in OYT and RYT during 1978-79.

Experimental line designation	IR9752-71-3-2	
Year of release in Philippines	1983	
Agronomic data	Days to maturity	106
	Plant height (cm)	86
	Tiller number hill^{-1}	15
	Grain yield (dry season) (kg ha^{-1})	5,550
	Grain yield (wet season) (kg ha^{-1})	3,857
	Seed germination at harvest (%)	42
	Seed germination after 6 wk (%)	94
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Susceptible
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.2
	Gelatinization temperature	Low
	Gel consistency	Hard
	Grain length	Medium
	Grain shape	Medium
	1,000-grain weight (g)	21.4
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	22.2
	% Total milled rice	70.3
	% Head rice	65
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.90
Rough rice width (mm)	2.52
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

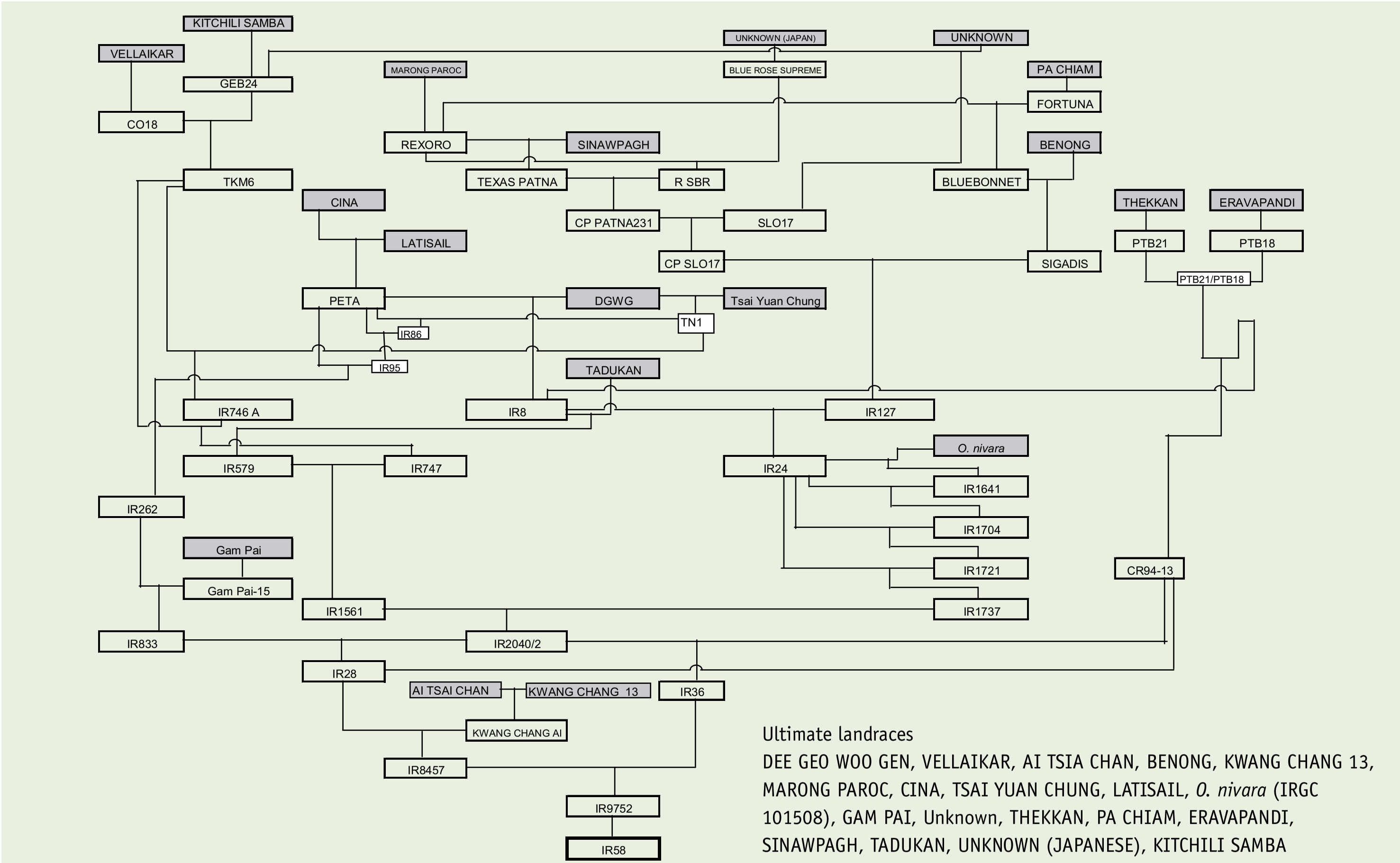
Tolerance of problem soils

IR58 is tolerant of salinity, alkalinity, iron and boron toxicity, and phosphorus and zinc deficiency.

Countries of release

Philippines, Sierra Leone, Tanzania

Pedigree of IR58.



IR60

Parentage

IR4432-53-33/PTB33
IR36

Breeding history

The IR13429 cross was made in 1976 and the segregating F_2, F_3, and F_4 generations were grown during 1977. Progenies of the succeeding F_5 and F_6 generations were evaluated in pedigree nurseries during 1978. The most promising lines were evaluated in RYT during 1979-81.

Experimental line designation	IR13429-299-2-1-3	
Year of release in Philippines	1983	
Agronomic data	Days to maturity	110
	Plant height (cm)	92
	Tiller number $hill^{-1}$	15
	Grain yield (dry season) (kg ha^{-1})	5,709
	Grain yield (wet season) (kg ha^{-1})	3,935
	Seed germination at harvest (%)	6
	Seed germination after 6 wk (%)	45
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.4
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	20.8
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	20.3
	% Total milled rice	72.6
	% Head rice	66.3
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.06
Rough rice width (mm)	2.44
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

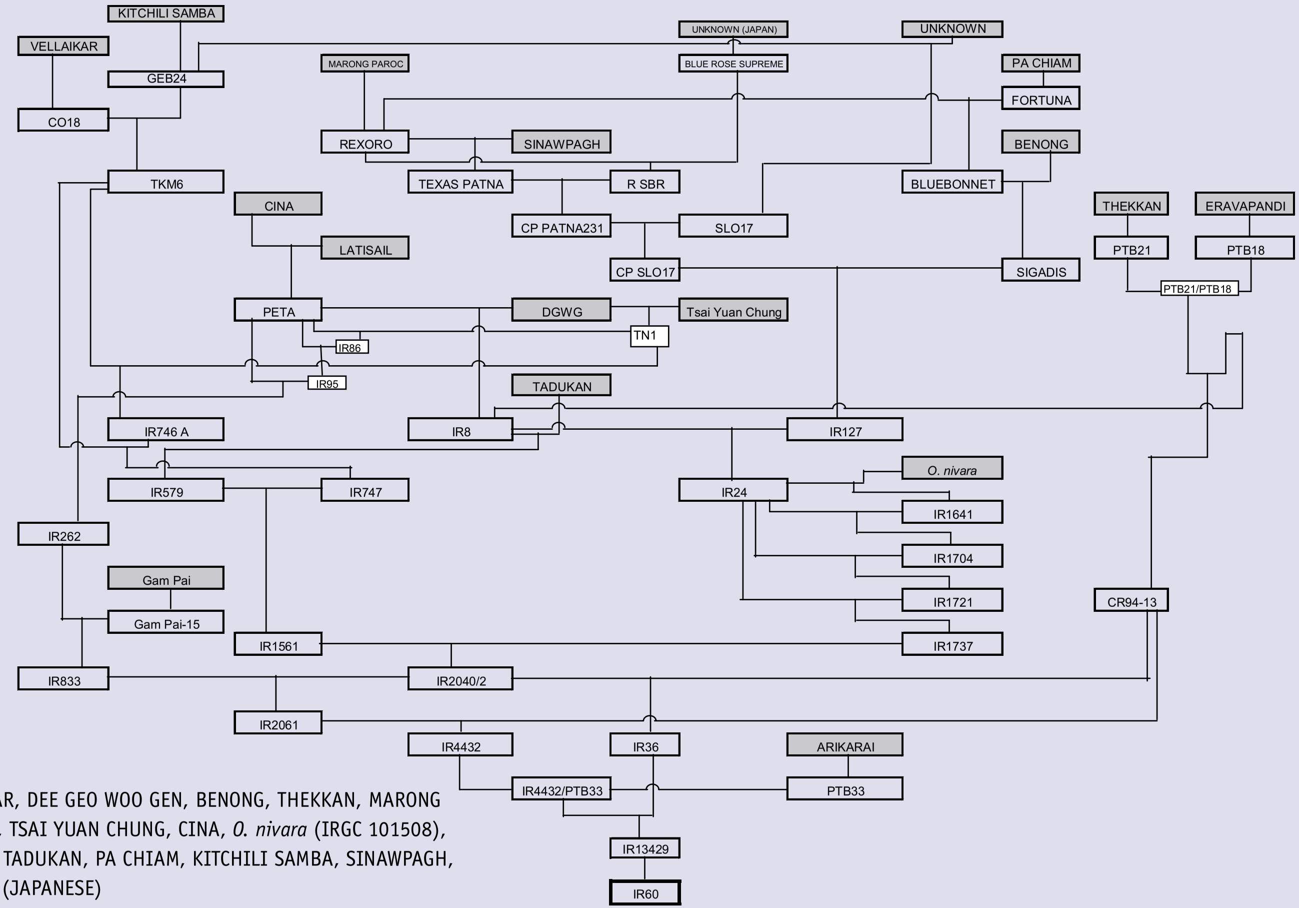
Tolerance of problem soils

IR60 is tolerant of salinity, alkalinity, boron toxicity, and phosphorus deficiency.

Countries of release

China, Philippines, Vietnam

Pedigree of IR60.



Ultimate landraces

ARIKARAI, VELLAIKAR, DEE GEO WOO GEN, BENONG, THEKKAN, MARONG PAROC, ERAVAPANDI, TSAI YUAN CHUNG, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, TADUKAN, PA CHIAM, KITCHILI SAMBA, SINAWPAGH, GAM PAI, UNKNOWN (JAPANESE)

IR62

Parentage	PTB33/IR30 IR36
Breeding history	The IR13525 cross was made in 1976 and the segregating F_2 and F_3 generations were grown during 1977. Progenies of the succeeding F_4, F_5, F_6, F_7, and F_8 generations were evaluated in pedigree nurseries during 1978 and 1979. The most promising lines were evaluated in OYT and RYT during 1979-80.

Experimental line designation	IR13525-43-2-3-1-3-2	
Year of release in Philippines	1984	
Agronomic data	Days to maturity	118
	Plant height (cm)	98
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) ($kg\ ha^{-1}$)	5,782
	Grain yield (wet season) ($kg\ ha^{-1}$)	4,062
	Seed germination at harvest (%)	7
	Seed germination after 6 wk (%)	88
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately susceptible
	Gall midge	–
Grain quality	% Amylose	26.7
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Medium
	Grain shape	Medium slender
	1,000-grain weight (g)	22.4
	Chalkiness (%)	<10
	Endosperm type	Nonwaxy
	% Hulls	19.7
	% Total milled rice	72.1
	% Head rice	60.5
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.30
Rough rice width (mm)	2.64
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

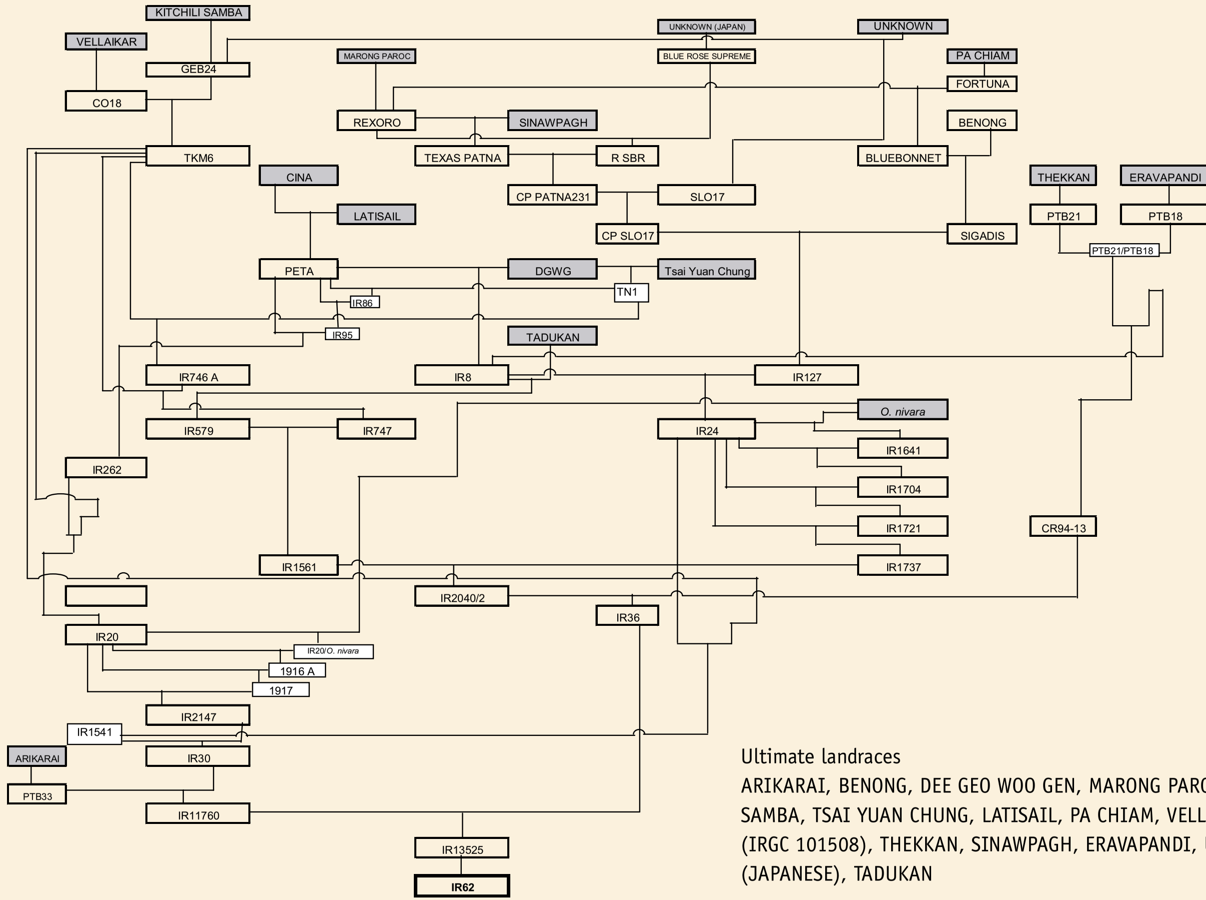
Tolerance of problem soils

IR62 is tolerant of salinity, iron toxicity, and phosphorus deficiency.

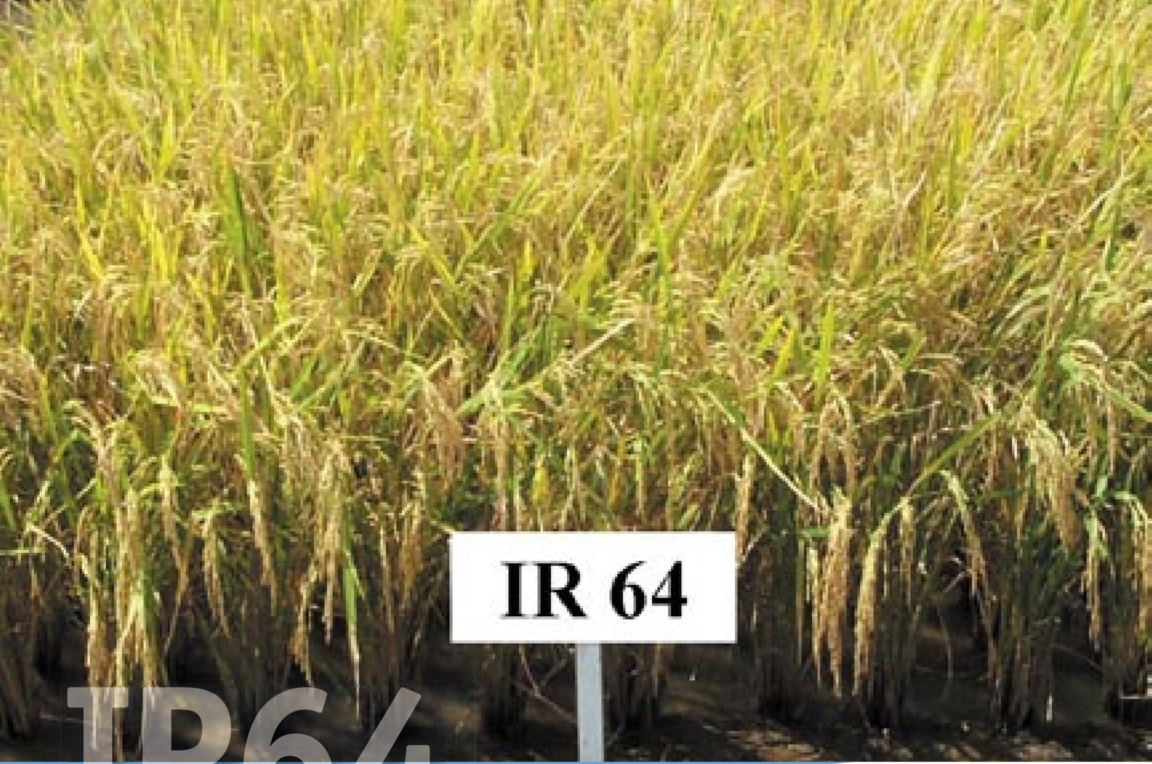
Countries of release

India, Indonesia, Philippines

Pedigree of IR62.



Ultimate landraces
ARIKARAI, BENONG, DEE GEO WOO GEN, MARONG PAROC, KITCHILI SAMBA, TSAI YUAN CHUNG, LATISAIL, PA CHIAM, VELLAIKAR, *O. nivara* (IRGC 101508), THEKKAN, SINAWPAGH, ERAVAPANDI, UNKNOWN (JAPANESE), TADUKAN



IR64

Parentage

IR5657-33-2-1/
IR2061-465-1-5-5

Breeding history

The parents of a cross that led to the development of IR64 were crossed in early 1977. The F_1 hybrid plants were planted in the field in June 1977. The first segregating generation, F_2, was evaluated during 1978, whereas F_3 and F_4 progenies were grown during 1979 in a pedigree nursery. The F_5 generation was evaluated during 1980 and one of them was bulk harvested and evaluated in yield trials during 1981-83.

Experimental line designation	IR18348-36-3-3	
Year of release in Philippines	1985	
Agronomic data	Days to maturity	117
	Plant height (cm)	103
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,965
	Grain yield (wet season) (kg ha^{-1})	3,852
	Seed germination at harvest (%)	10
	Seed germination after 6 wk (%)	74
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Moderately resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	23.2
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	26.3
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	22.2
	% Total milled rice	69.8
	% Head rice	59.4
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Dark green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Short and partly awned
Rough rice length (mm)	9.72
Rough rice width (mm)	2.48
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

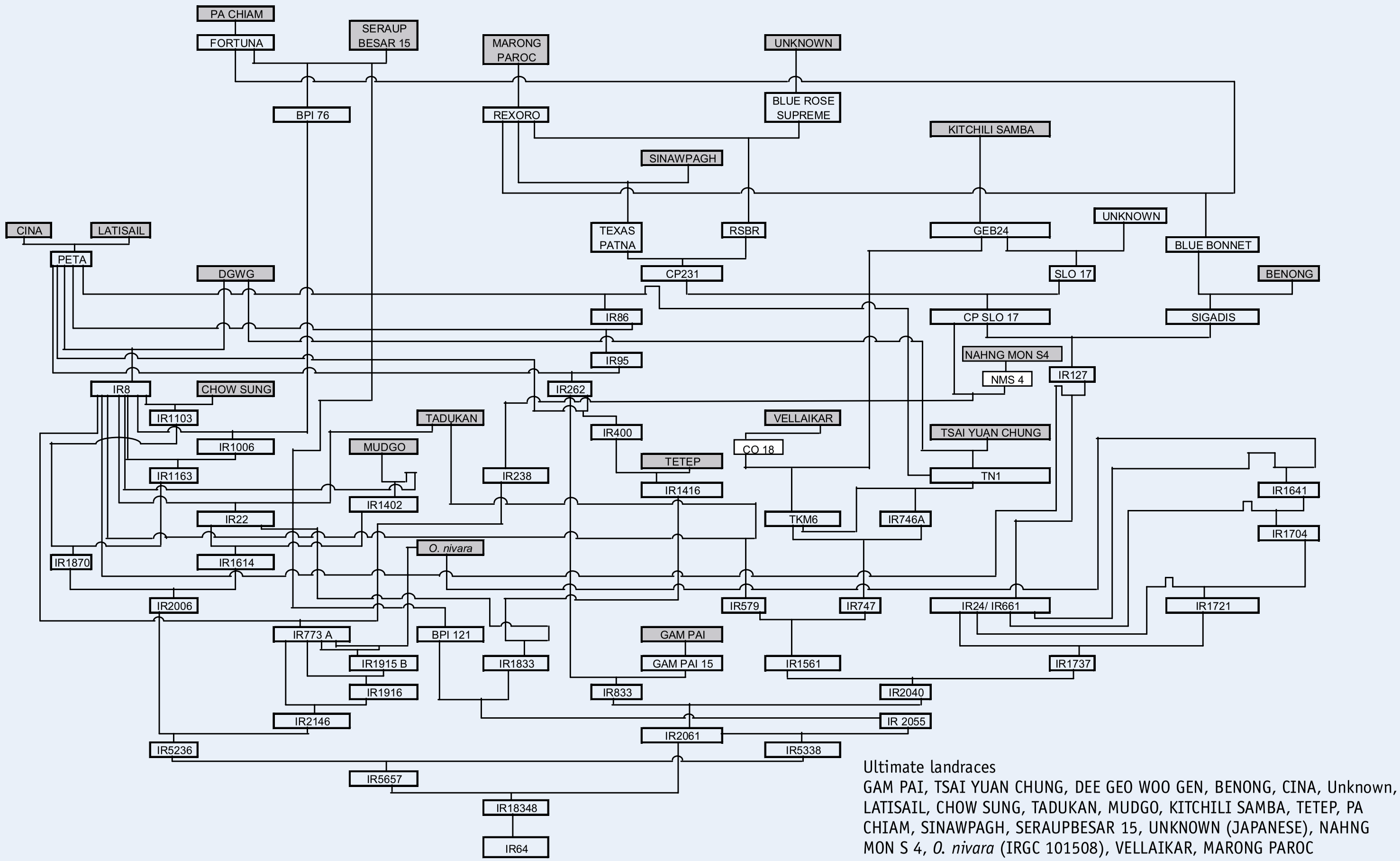
Tolerance of problem soils

Tolerant of moderate levels of salinity, alkalinity, acid sulfate and acid upland soils, boron toxicity, and zinc and phosphorus deficiency.

Countries of release

Bhutan, Burkina Faso, Cambodia, China, Ecuador, Gambia, India, Indonesia, Mauritania, Mozambique, Philippines, Vietnam

Pedigree of IR64.



Ultimate landraces
GAM PAI, TSAI YUAN CHUNG, DEE GEO WOO GEN, BENONG, CINA, Unknown, LATISAIL, CHOW SUNG, TADUKAN, MUDGO, KITCHILI SAMBA, TETEP, PA CHIAM, SINAWPAGH, SERAUPBESAR 15, UNKNOWN (JAPANESE), NAHNG MON S 4, *O. nivara* (IRGC 101508), VELLAIKAR, MARONG PAROC

IR65

Parentage

Batatais/IR36
IR52

Breeding history

The IR21015 cross was made in 1978 and the segregating F_2 generation was also grown during 1978. Progenies of the succeeding F_3, F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1979 and 1980. The most promising lines were evaluated in RYT during 1981.

Experimental line designation	IR21015-196-3-1-3	
Year of release in Philippines	1985	
Agronomic data	Days to maturity	118
	Plant height (cm)	101
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,548
	Grain yield (wet season) (kg ha^{-1})	3,668
	Seed germination at harvest (%)	18
	Seed germination after 6 wk (%)	82
Reaction to diseases	Blast	Resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately susceptible
	Gall midge	–
Grain quality	% Amylose	1.0
	Gelatinization temperature	Low
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.3
	Chalkiness	Opaque
	Endosperm type	Waxy
	% Hulls	21.8
	% Total milled rice	68.6
	% Head rice	50.9
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	White
Awn presence	Short and partly awned
Rough rice length (mm)	9.88
Rough rice width (mm)	2.32
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

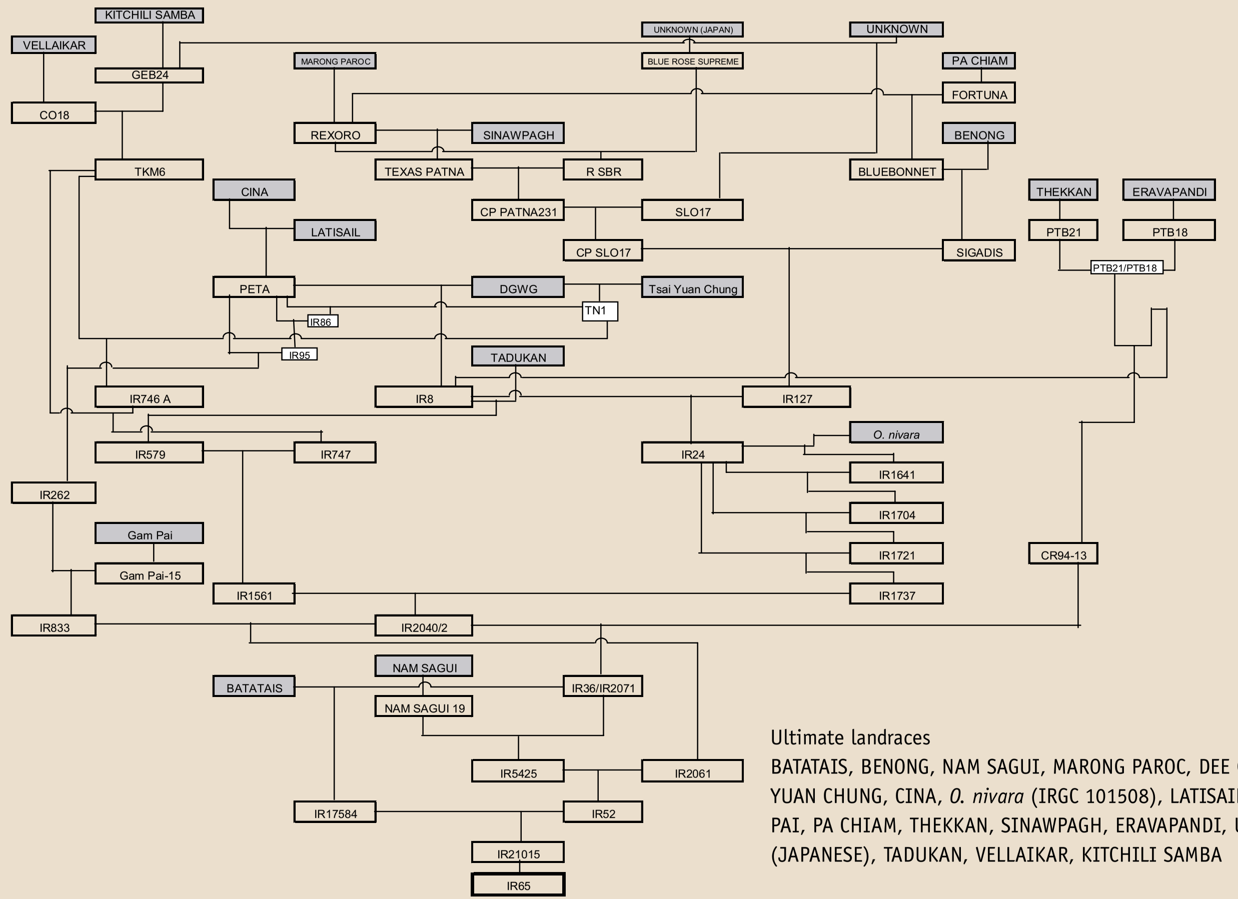
Tolerance of problem soils

Tolerant of iron toxicity.

Countries of release

Indonesia, Philippines

Pedigree of IR65.



Ultimate landraces

BATATAIS, BENONG, NAM SAGUI, MARONG PAROC, DEE GEO WOO GEN, TSAI YUAN CHUNG, CINA, *O. nivara* (IRGC 101508), LATISAIL, Unknown, GAM PAI, PA CHIAM, THEKKAN, SINAWPAGH, ERAVAPANDI, UNKNOWN (JAPANESE), TADUKAN, VELLAIKAR, KITCHILI SAMBA

IR66

Parentage	IR13240-108-2-2-3 IR9129-209-2-2-2-1
Breeding history	The IR32307 cross was made in 1980 and the segregating F_2, F_3, and F_4 generations were planted during 1981. Progenies of the succeeding F_5 and F_6 generations were evaluated in pedigree nurseries during 1982. The most promising lines were evaluated in RYT starting in 1983.

Experimental line designation	IR32307-107-3-2-2	
Year of release in Philippines	1987	
Agronomic data	Days to maturity	115
	Plant height (cm)	97
	Tiller number $hill^{-1}$	15
	Grain yield (dry season) (kg ha^{-1})	5,883
	Grain yield (wet season) (kg ha^{-1})	4,053
	Seed germination at harvest (%)	13
	Seed germination after 6 wk (%)	87
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	25.8
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	21.7
	Chalkiness	None
	Endosperm type	Nonwaxy
	% Hulls	22.2
	% Total milled rice	70.9
	% Head rice	58.4
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.48
Rough rice width (mm)	2.52
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

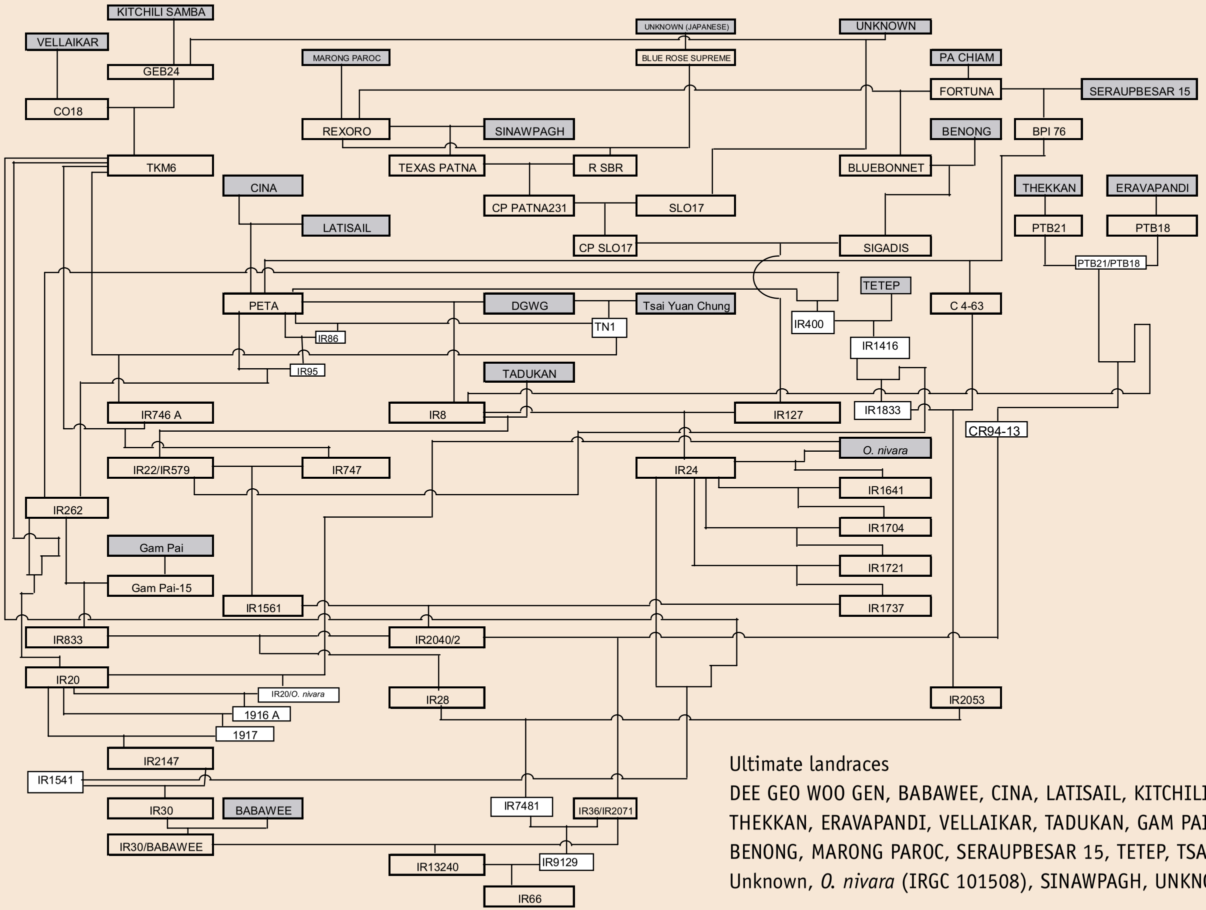
Tolerance of problem soils

IR66 is tolerant of zinc deficiency.

Countries of release

Cambodia, India, Indonesia, Laos, Philippines, Vietnam

Pedigree of IR66.



Ultimate landraces

DEE GEO WOO GEN, BABAWEE, CINA, LATISAIL, KITCHILI SAMBA, THEKKAN, ERAVAPANDI, VELLAIKAR, TADUKAN, GAM PAI, PA CHIAM, BENONG, MARONG PAROC, SERAUPBESAR 15, TETEP, TSAI YUAN CHUNG, Unknown, *O. nivara* (IRGC 101508), SINAWPAGH, UNKNOWN (JAPANESE)

IR68

Parentage

IR19660-73-4/IR2415-90-4-3-2
IR54

Breeding history

The IR28224 cross was made in 1979 and the segregating F_2 and F_3 generations were grown during 1980. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1981and 1982. The most promising lines were evaluated in OYT and RYT during 1983-85.

Experimental line designation	IR28224-3-2-3-2	
Year of release in Philippines	1988	
Agronomic data	Days to maturity	125
	Plant height (cm)	117
	Tiller number hill^{-1}	13
	Grain yield (dry season) (kg ha^{-1})	5,554
	Grain yield (wet season) (kg ha^{-1})	3,149
	Seed germination at harvest (%)	60
	Seed germination after 6 wk (%)	96
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.9
	Gelatinization temperature	Low
	Gel consistency	Medium hard
	Grain length	Extra long
	Grain shape	Slender
	1,000-grain weight (g)	32.6
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	21
	% Total milled rice	69.6
	% Head rice	51.5
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	10.92
Rough rice width (mm)	2.48
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

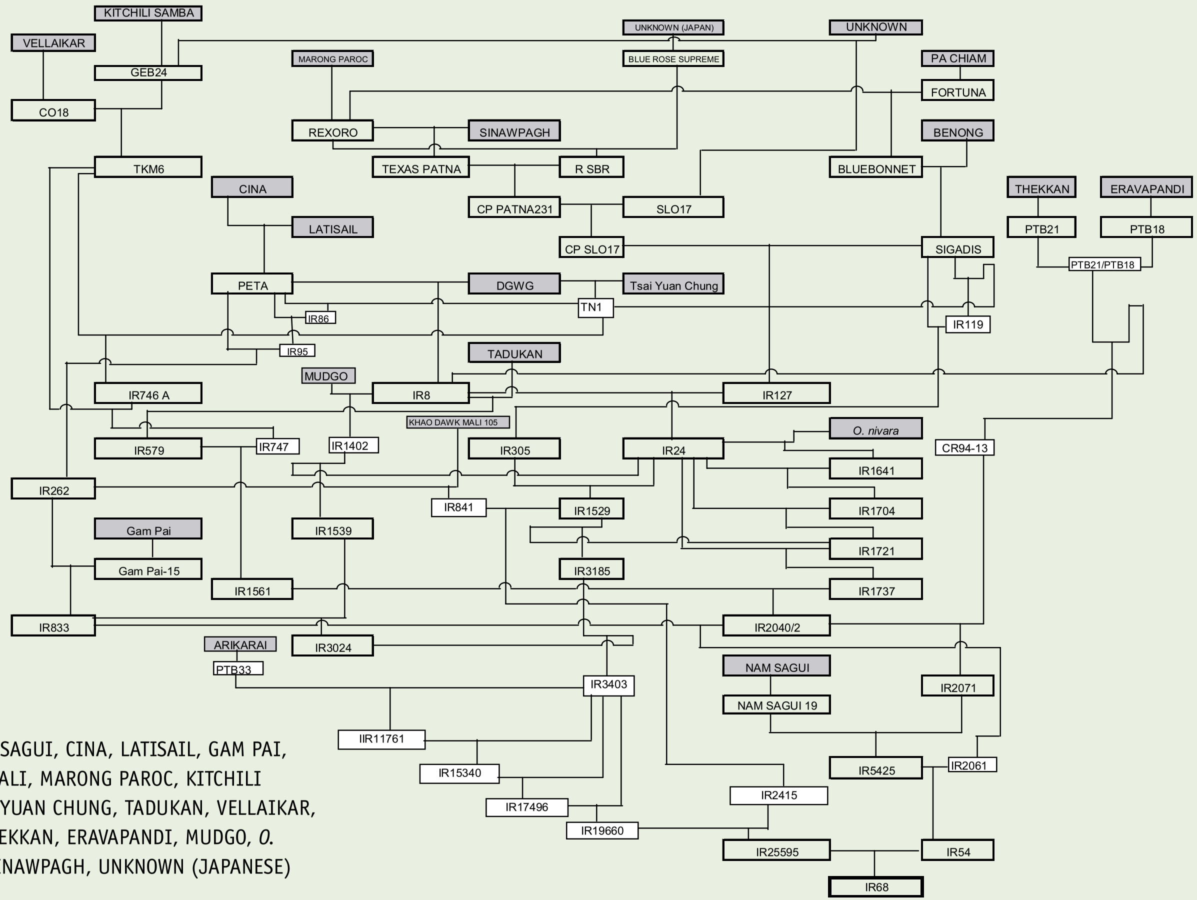
Tolerance of problem soils

IR68 is tolerant of iron toxicity and phosphorus and zinc deficiency.

Countries of release

Indonesia, Philippines, Vietnam

Pedigree of IR68.



Ultimate landraces

DEE GEO WOO GEN, NAM SAGUI, CINA, LATISAIL, GAM PAI, BENONG, KHAO DAWK, MALI, MARONG PAROC, KITCHILI SAMBA, PA CHIAM, TSAI YUAN CHUNG, TADUKAN, VELLAIKAR, Unknown, ARIKARAI, THEKKAN, ERAVAPANDI, MUDGO, *O. nivara* (IRGC 101508), SINAWPAGH, UNKNOWN (JAPANESE)

IR70

Parentage

IR19660-73-4/IR54
IR9828-36-3

Breeding history

The IR28228 cross was made in 1979 and the segregating F_2 and F_3 generations were grown during 1980. Progenies of the succeeding F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries during 1981and 1982. The most promising lines were evaluated in RYT during 1983-85.

Experimental line designation	IR28228-12-3-1-1-2	
Year of release in Philippines	1988	
Agronomic data	Days to maturity	127
	Plant height (cm)	102
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,652
	Grain yield (wet season) (kg ha^{-1})	3,926
	Seed germination at harvest (%)	9
	Seed germination after 6 wk (%)	97
Reaction to diseases	Blast	Resistant
	Bacterial blight	Susceptible
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately susceptible
	Gall midge	–
Grain quality	% Amylose	25.3
	Gelatinization temperature	Intermediate
	Gel consistency	Medium
	Grain length	Medium
	Grain shape	Medium slender
	1,000-grain weight (g)	22.6
	Chalkiness (%)	>20
	Endosperm type	Nonwaxy
	% Hulls	22.1
	% Total milled rice	69.8
	% Head rice	44.8
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Gold and gold furrows
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	8.60
Rough rice width (mm)	2.51
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

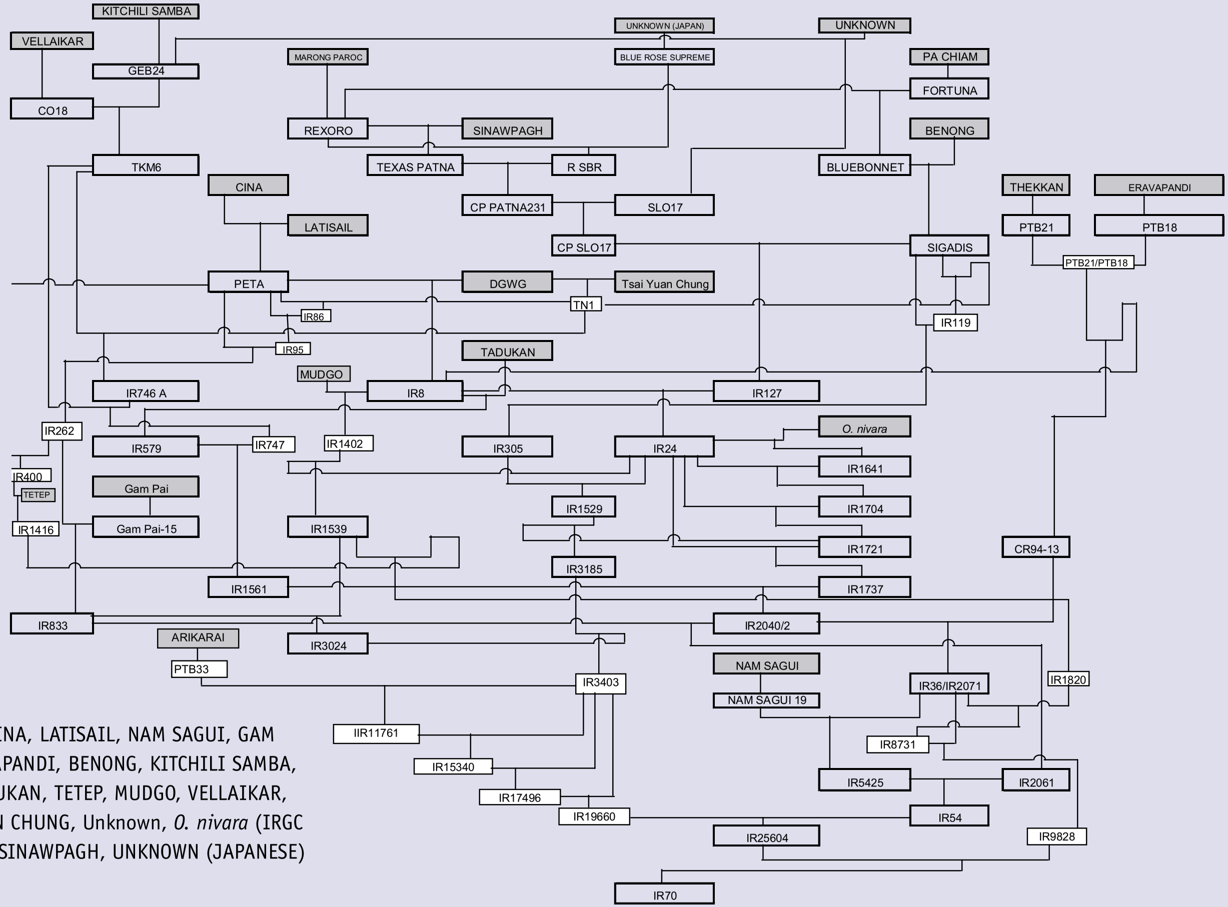
Tolerance of problem soils

IR70 is tolerant of salinity and iron toxicity.

Countries of release

Indonesia, Philippines

Pedigree of IR70.



Ultimate landraces

DEE GEO WOO GEN, CINA, LATISAIL, NAM SAGUI, GAM PAI, THEKKAN, ERAVAPANDI, BENONG, KITCHILI SAMBA, MARONG PAROC, TADUKAN, TETEP, MUDGO, VELLAIKAR, PA CHIAM, TSAI YUAN CHUNG, Unknown, *O. nivara* (IRGC 101508), ARIKARAI, SINAWPAGH, UNKNOWN (JAPANESE)

IR72

Parentage

IR19661-9-2-3/IR15795-199-3-3
IR9129-209-2-2-2-1

Breeding history

The IR35366 cross was made in 1981 and the segregating F_2 generation was also grown during 1981. Progenies of the succeeding F_3, F_4, F_5, F_6, and F_7 generations were evaluated in pedigree nurseries between 1982 and 1984. The most promising lines were evaluated in RYT during 1985-86.

Experimental line designation	IR35366-90-3-2-1-2	
Year of release in Philippines	1988	
Agronomic data	Days to maturity	119
	Plant height (cm)	92
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,901
	Grain yield (wet season) (kg ha^{-1})	4,332
	Seed germination at harvest (%)	2
	Seed germination after 6 wk (%)	36
Reaction to diseases	Blast	Moderately resistant
	Bacterial blight	Resistant
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.6
	Gelatinization temperature	Intermediate
	Gel consistency	Soft
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	24.4
	Chalkiness (%)	<10
	Endosperm type	Nonwaxy
	% Hulls	21.2
	% Total milled rice	71.1
	% Head rice	44.1
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Medium (1.6–2.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.24
Rough rice width (mm)	2.48
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

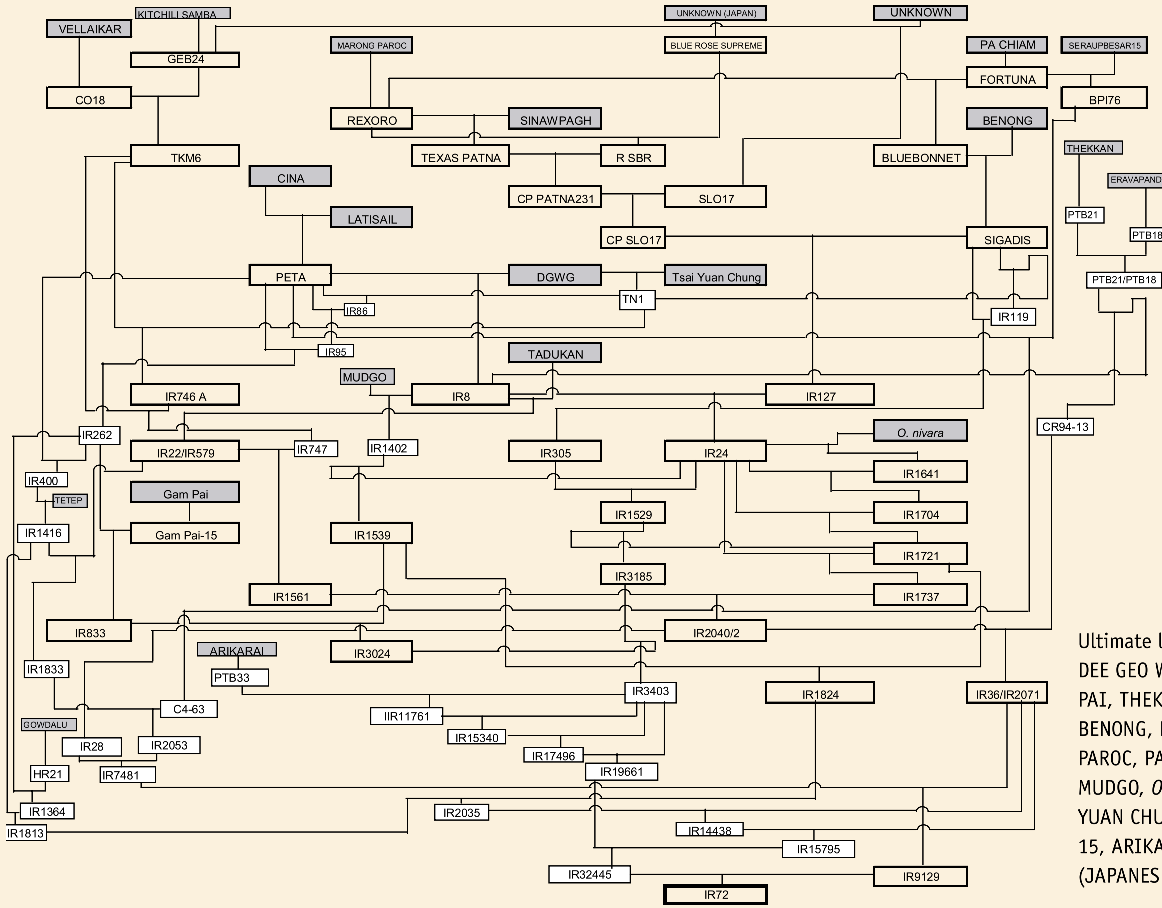
Tolerance of problem soils

IR72 is tolerant of iron toxicity and zinc deficiency.

Countries of release

Cambodia, China, Indonesia, Laos, Myanmar, Vietnam, Philippines

Pedigree of IR72.



Ultimate landraces
DEE GEO WOO GEN, CINA, LATISAIL, GAM PAI, THEKKAN, ERAVAPANDI, TADUKAN, BENONG, KITCHILI SAMBA, MARONG PAROC, PA CHIAM, VELLAIKAR, TETEP, MUDGO, *O. nivara* (IRGC 101508), TSAI YUAN CHUNG, Unknown, SERAUPBESAR 15, ARIKARAI, SINAWPAGH, UNKNOWN (JAPANESE), GOWDALU

IR74

Parentage

IR19661-131-1-2
IR15795-199-3-3

Breeding history

The IR32453 cross was made in 1980 and the segregating F_2 and F_3 generations were grown during 1981. Progenies of the succeeding F_4, F_5, and F_6 generations were evaluated in pedigree nurseries during 1982 and 1983. The most promising lines were evaluated in RYT during 1984-85.

Experimental line designation	IR32453-20-3-2-2	
Year of release in Philippines	1988	
Agronomic data	Days to maturity	130
	Plant height (cm)	92
	Tiller number $hill^{-1}$	14
	Grain yield (dry season) (kg ha^{-1})	5,493
	Grain yield (wet season) (kg ha^{-1})	3,618
	Seed germination at harvest (%)	5
	Seed germination after 6 wk (%)	56
Reaction to diseases	Blast	Resistant
	Bacterial blight	Susceptible
	Tungro	Resistant
	Grassy stunt	Resistant
Reaction to insect pests	GLH	Resistant
	BPH1	Resistant
	BPH2	Resistant
	BPH3	Resistant
	Stem borer	Moderately resistant
	Gall midge	–
Grain quality	% Amylose	26.8
	Gelatinization temperature	Low
	Gel consistency	Medium hard
	Grain length	Long
	Grain shape	Slender
	1,000-grain weight (g)	23.3
	Chalkiness (%)	10–20
	Endosperm type	Nonwaxy
	% Hulls	22.2
	% Total milled rice	69.3
	% Head rice	60.2
Some morphological traits that can be used as a basis for identifying the variety	Leaf blade color	Green
	Leaf blade pubescence	Pubescent
	Leaf sheath color	Green
	Auricle color	Light green
	Stigma color	White
	Ligule color	Whitish
	Lemma and palea color	Straw
	Sterile lemma color	Straw

Sterile lemma length	Short (<1.5 mm)
Apiculus color	Straw
Awn presence	Awnless
Rough rice length (mm)	9.99
Rough rice width (mm)	2.36
Seed coat (bran) color	White

Adaptation

Suited to irrigated and rainfed lowland areas.

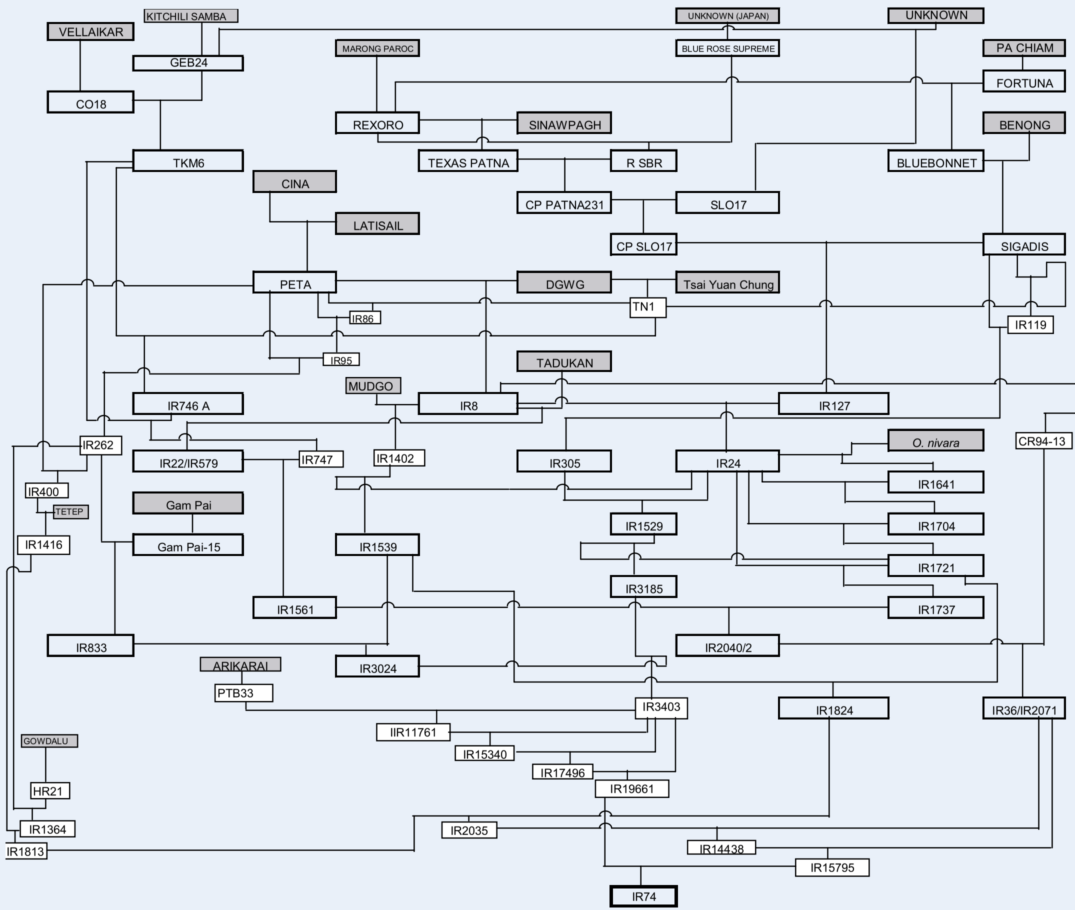
Tolerance of problem soils

IR74 is tolerant of salinity and iron toxicity.

Countries of release

Indonesia, Philippines

Pedigree of IR74.



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