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ミャンマー北西部および南東部地域における野生イネの探索収集（2005 年）

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Exploration and Collection of Wild Rice in Northwestern and Southeastern Regions of Myanmar, 2005

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Summary

Myanmar has been known as a part of the center of genetic diversity of wild rice as well as cultivated rice. In 2005, northwestern and southeastern regions of Myanmar were investigated in collaboration between Myanmar and Japan under the NIAS Genebank Project, since few samples of wild rice have been reported in the regions based on the information collected in 2004, when we have explored wild rice in the northern and western regions of the country. A total of 54 wild rice samples consisting of 40 *O. rufipogon* and 14 *O. officinalis* were collected. Regarding features of *O. rufipogon*, many wild rice plants were growing in swamps and canals that were near paddy fields along roads and disturbed by people and livestock. Wild rice plants growing in deep water showed floating ability, while others growing in shallow water did not. These ecological and morphological variations of *O. rufipogon* were mostly included in the range of those in the northern and western regions. But, we discovered a new habitat of *O. rufipogon* in Magway city located in the central dry region in Myanmar. The plants showed typical features of wild rice growing in shallow swamp, namely, short grass-type, compact

panicle-type, and long awn there. In case of the *O. officinalis*, wild rice plants were found in various places, from sunny to shady, and from damp to swampy. Some habitats of *O. officinalis* were also disturbed by livestock such as water buffalo. We found that several *O. officinalis* habitats in swamps and rivers with brackish water in Taninthayi Division, which was in the southeastern region. This exploration suggests that *O. officinalis* in Myanmar adaptive to diverse environments.

KEYWORDS: rice, wild species, *Oryza rufipogon*, *O. officinalis*, *O. sativa*, Myanmar

Introduction

Wild rice species are morphologically and physiologically different from cultivated rice (*Oryza sativa* L.) and are considered as potential germplasm carrying wide genetic variation[1]. Recently, cultivated rice germplasm has begun to be used not as only breeding materials but also as bio-resources for different analyses. For example, a miniature core collection representing most genetic diversity was developed from cultivated rice germplasm based on whole-genome polymorphism survey using RFLP[2]. It is also thought that wild rice germplasm may offer a great advantage to a variety of scientists if some wild rice accessions are selected and provided like a core collection. However, the main habitats of wild rice in tropical regions are rapidly decreasing due to land development in recent years. Therefore, it is an urgent subject to investigate and comprehend genetic diversity of wild rice distributed in various environments to conserve its diversity appropriately.

Myanmar is located in westernmost of Southeast Asia and has been known as a part of genetic diversity center of rice for a long time. The diversity of wild rice as well as that of cultivated rice might has been well conserved in Myanmar compared to surrounding countries, because traditional agriculture is still practiced in a natural environment without drastic destruction there. Wild rice has been surveyed and collected by previous explorations in Myanmar[3), 4), 5), 6)]. These explorations, however, did not survey comprehensively wild rice distributed in the whole Myanmar. More information is needed to discuss in situ conservation of wild rice or to develop a core collection which represents the wide diversity. Therefore, we planned exploration and collection of wild rice in whole areas of Myanmar. In 2004, we organized a collaborative exploration mission between Myanmar and Japan in northern and western areas of Myanmar under the NIAS Genebank project and collected a total of 102 samples consisting of 93 *O. rufipogon*, 6 *O. officinalis*, and 3 *O. granulata*[7]. In 2005, we explored and collected wild rice in the northwestern and southeastern areas, which were few samples of wild rice previously reported.

Methods

We made a field survey on wild rice for 31 days from October 13 to November 12 in 2005. The survey routes and collection sites are shown in Fig.1. The surveyed areas included Yangon, Bago, Magway, Mandalay, Sagaing, and Taninthayi Divisions, and Chin, Mon, and Kayin States. We tried to find wild rice based on its plant form, in particular, shape of panicles from a car window while we were moving by car. We also guessed the habitats of wild rice from the

ecological information of the circumferences and stopped the car to survey around at possible habitats. For exploration of wild rice around Myeik in Taninthayi Division, we flied from Yangon to Myeik, because the road between Mon State and Taninthayi Division was not suggested to pass. It is difficult to collect seed samples of wild rice floating on ponds and swamps. Therefore, we used a long reach lopper to collect seed samples of wild rice in this exploration. Information on collection sites including habitat, latitude, longitude, altitude, and other ecological aspects were recorded as the passport data. Seed materials of cultivated rice and other crops were kindly provided by farmers or official stuff in local areas.

The collected seed materials were divided into two subsets: one for the Seed Bank of DAR and other for NIAS based on a material transfer agreement (MTA). The latter were introduced into Japan in accordance with quarantine rules of the both countries. They will be cultured in an isolated greenhouse of NIAS for quarantine and evaluation on primary traits. When their seeds are propagated sufficiently, they will be conserved in the Genebank of NIAS. Leaf samples collected at several sites as the materials for DNA polymorphism analysis were transferred into Japan in accordance with quarantine rules. We also collected plant voucher specimens in some sites and are stored at Seed Bank, DAR at Yezin.

Results and Discussion

Summary of collected accessions

A total of 54 wild rice samples consisting of 40 *O. rufipogon* and 14 *O. officinalis* were collected in this exploration (Table 1). Twenty four *O. sativa* samples were also collected. A total of 19 samples of other cultivated plants including 8 *Eleusine coracana*, 8 *Setaria italica*, 1 *Solanum* spp., 1 *Vigna umbellata*, and 1 *Cucumis melo* were collected during this survey. Nine materials of wild plants including 1 *Brachirea ramose*, 1 *Fagopyrum* spp., 1 *Sesamum schinzianum*, 1 *Setaria* spp., and 5 *Vigna* spp. were also collected.

Wild rice of *O. sativa* complex (AA genome) in Asia has often been treated as two different taxa, i.e. *O. rufipogon* and *O. nivara*. We use a single taxon, *O. rufipogon* in a broad sense for them in this report, since we observed a wide and continuous variation other than typical *O. rufipogon* and typical *O. nivara* in this field survey. More studies have to be done to clarify the intraspecific differentiation in this taxon.

O. rufipogon

Almost all the plants of *O. rufipogon* collected in the northwestern and southeastern region of Myanmar were found in swamps or canals near paddy fields or small ponds which were disturbed more or less by livestock or human activity. *O. rufipogon* plants growing in deep water environment such as a pond and a lake showed floating ability, while those growing in shallow water environment such as a swamp and a stream did not. The morphological and ecological variations of wild rice in these areas were mostly similar to those in the northern and western regions[7]. We collected seed samples of wild rice in Magway city in the central dry zone which was much arid compared to other areas especially in dry season. But, we could not find wild rice near Nyaung-U city where it was much drier than Magway city in dry season. We supposed that the area where wild rice could inhabit was lowland areas from Yangon to Magway

in Lower Myanmar. *O. rufipogon* was not found in mountainous region such as Chin State that was more than 1,000 m from the sea level. Detailed information of collected accessions was described below for each area:

1) Yangon and Bago Divisions

Three seed samples (hereinafter referred to as #1, #3 and #70) were collected in the swamps along the National Highway (Yangon - Pyi). The #1 and #70 showed relatively high fertility (around 70%). Three seed samples (#4, #5 and #68) were collected in the swamps along the National Highway (Yangon - Pyi - Magway). They were generally characterized by a relatively short grass with less than 1.0 m tall from the water surface and medium seed fertility. Samples #71 - #73, and #78 were collected in the swamps along the National Highway (Yangon - Bago - Mawlamyine). Most wild rice plants of these samples showed the plant height of more than 1.0 m and relatively low seed fertility. Samples #72 (open panicle-type) and #73 (compact panicle-type) were found at the same site. Samples #75 - #77 collected in the Moyingyi Lake had floating ability and low fertility. Their leaves were also obtained from ten plants in each plot for further analysis on DNA polymorphism.

2) Magway Division

Four seed samples (#6 - #8, and #67) were collected in swamps along the National Highway in and around the Magway city. These samples showed semi-dwarf or short plants having compact panicles. Most of wild rice plants were just flowering at that time. Therefore, we could neither get a large amount of seed samples nor estimate an accurate seed fertility of them. The wild rice plants of #7 exhibited a taller plant(more than 1.0 m) compared to other samples collected in the Magway Division and was most likely hybrids between wild rice and cultivated rice. We could collect seed sample (#67) in the north suburb of Magway city (Photo 1). It is semi-arid in Magway city and its suburbs in dry season, and wild rice has never been reported especially in the north from Magway city. The leaves were also obtained from ten plants in five plots (50 samples in total) for further analysis on DNA polymorphism.

3) Mon and Kayin States

Eleven (#79 - #82, #84 - #88, #96, and #98) and seven (#89 - #95) seed samples were collected in the Mon State and Kayin State, respectively. Several morphological types of wild rice were observed in both states. For example, nine out of 18 seed samples were found to have floating ability (#80, #81, #85, #86, #89, #91, #95, and #96). By contrast, sample #90 showing a plant height of around 50 cm and a compact panicle-type grew in shallow or drying-up swamps (Photo 2).

4) Tanintayi Division

Five seed samples (#99, #101 - #103, and #105) were collected in Tanintayi Division. Most of the samples showed a tall grass-type (more than 1.0 m) and an open panicle-type (Photo 3). Because exploration around Myeik city was only admitted in this time but still limited, further survey is necessary to understand the whole picture of wild rice in Tanintayi Division.

O. officinalis

One (#2), two (#69 and #74), nine (#12 - #20), and two (#100 and #104) seed samples of *Oryza officinalis* were collected in the Divisions of Yangon, Bago, Sagain, and Taninthayi,

respectively. *O. officinalis* collected in previous exploration (2004) grew in the habitats that were hard to dry excessively being somewhat shaded by a shrub or grasses[7]. However, *O. officinalis* collected in this exploration (2005) were found in various places from sunny to shady, and from damp to swampy. This exploration result demonstrates that *O. officinalis* is adaptive to diverse environments in Myanmar. Detailed information of collected accessions was described below for each area:

1) Yangon and Bago Divisions

Sample #69 was collected in shaded small stream banks near a wall surrounding a house. By contrast, Samples #2 and #74 were growing in relatively sunny places in private houses.

2) Sagaing Division

Samples #12 to #15, and #20 were collected in sunny swamps beside paddy fields. Sample #16 was also growing in a vicinity of paddy fields but showed a long culm, a large panicle, and very high sterility compared to others. They might be derived from a hybrid between *O. officinalis* and *O. sativa*. Leaves of this population (10 samples) and neighboring cultivated rice (one sample) were collected to clarify whether this population was hybrid or not by using DNA markers. Samples #17 and #19 were found in a semi-shaded habitat far from villages and paddy fields. The wild rice plants of #19 were eaten by many water buffalos showing that their habitat was disturbed by livestock (Photo 4). For the population #17, leaf samples were collected from 10 individuals at regular interval for further DNA analysis.

3) Tanintayi Division

Samples #100 and #104 were collected in the different villages. But they grew spontaneously in similar environment, namely, some grew in the vicinity of a private house and others grew in swamps with *Nypa fruticans* and mangroves beside roads (Photo 5). The altitude of this area was relatively low (less than 5.0 m). Therefore, these swamps and rivers of this area were lapped by brackish water and the wild rice seemed to have potentially salt tolerance there.

O. sativa

Twenty three and one seed samples were collected in Chin state and Mon state, respectively. There is a mountain area of over 1,000 m above sea level in Chin state. We could not find wild rice in this area but many different types of cultivated rice. Samples #24, #25, #27, #30, and #42 were provided from farmers' stocks. Sample #23 was provided by a citizen. Samples #58, and #60 - #66 were provided by a local officer. Samples #40, #41, #43, and #44 were collected in a burnt field. The cultivated rice grown in the burnt field showed the root system that expanded into the vicinity of topsoil in a radial pattern (upper right corner in Photo 6). Sato (1997) also reported similar root system of rice to our observation in a burnt field of Laos [8]. He described that nourishment was accumulated in soil surface of a burnt field, because the burnt fields have not been plowed in most cases. Therefore, rice set a great root system in topsoil to efficiently get the nutrition accumulated there. The root systems of these varieties were thought to adapt to the environment of a burnt field. In case of the burnt field of the #43 and #44, the farmer cut down a bush in December and burned it in February or March, and sowed seed in April. She also mentioned that the seed waited for rain to germinate in the soil. They were harvested in October and stock temporarily in a shanty nearby the burnt field (Photo

6). Samples #48, and #50 - #53 were collected in a terraced field (Photo 7).

Other plant species

Since remote areas of Myanmar have scarcely been surveyed from a point of view of plant genetic resources for food and agriculture, we paid attention to different species from *Oryza* species that were targeted in this field study. It is noteworthy that foxtail millet, *Setaria italica* spp. *italica*, and finger millet, *Eleusine coracana* spp. *coracana* were widely grown at mountainous areas of the altitude 1,000 m or more in Chin State. They were often grown in slash-and-burn (shifting) cultivation. For example, a finger millet (#45) grew nearby upland rice (#43 and #44) in the burnt field (Photo 8). Concerning *S. italica*, both non-glutinous and glutinous endosperm types, different panicle shapes, yellow and grayish pericarp colors were recognized by local farmers. Non-glutinous cultivars were mainly cocked like boiled rice or boiled with rice. Glutinous foxtail millet was milled into flour and used for making different kinds of cakes. They also fed foxtail millet to small birds kept at their house. Finger millet was often used for brewing. We think it necessary to make a systematic field survey for small millets in Myanmar for conservation and utilization.

Future subject

We explored primarily *O. rufipogon* in northwestern and southeastern regions of Myanmar where few samples of *O. rufipogon* were reported. Although *O. rufipogon* was not found in Chin State or the west part of Sagaing Division, we successfully collected seed samples of *O. rufipogon* in other regions. Both previous[7)] and the present explorations indicate that characteristics of *O. rufipogon* growing in Myanmar are classified by water environment of the habitat rather than geographical distribution. For example, many *O. rufipogon* growing in shallow swamps near paddy fields tends to show a short grass-type, a compact panicle-type, and red long awn, while many *O. rufipogon* growing in deep water shows floating ability. But, relationships between plant height and depth of water vary among sites. The reason why plant height of *O. rufipogon* growing in similar water environment of dry season was different from each other may be due to that water level was different in wet season. Therefore, it is important to survey behaviors of *O. rufipogon* even in wet season in detail for clarification of ecological features of *O. rufipogon* habitats in Myanmar.

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和文摘要

ミャンマーはイネの在来品種のみならず近縁野生種の遺伝的多様性中心地のひとつとして知られている. 我々は2004年にミャンマー北部および西部で野生イネの探索・収集を行った. 今回は, 野生イネの探索がほとんど行われていない北西部および南東部を中心に野生イネの調査・収集を生物研ジーンバンク事業として実施した. 今回の探索では, *O. rufipogon* を 40 点, *O. officinalis* を 14 点の合計 54 点を収集した. ミャンマー北西部および南東部で収集した *O. rufipogon* は, 多くの野生イネが水田脇の湿地や水路に自生しており, 人や家畜による撹乱を受けていた. 水深の深い湿地や湖に自生する野生イネは浮稲性を示したが, 比較的浅い湿地では浮稲性を示す野生イネはほとんど見られなかった. 野外での観察では, 今回収集した *O. rufipogon* は北部や西部で収集した *O. rufipogon* とほぼ同様の生態的, 形態的な変異を示した. ただし, 我々はミャンマー

でも乾燥が厳しい中央地域に位置する Magway 市周辺で *O. rufipogon* の自生地を新たに発見した．この野生イネは浅い沼地に自生する典型的な野生イネと同様の形態を示し，短稈，非開帳性の穂で長芒を持っていた．*O. officinalis* は日陰から日向，軽く湿った場所から沼地など多様な環境に自生しており，いくつかの集団が水牛などの家畜による強い撹乱を受けていることを観察した．南東部の Taninthayi 管区に見られた集団は汽水地域の沼地や小川に自生していた．本探索の結果はミャンマーの *O. officinalis* が多様な環境に適応していることを示している．

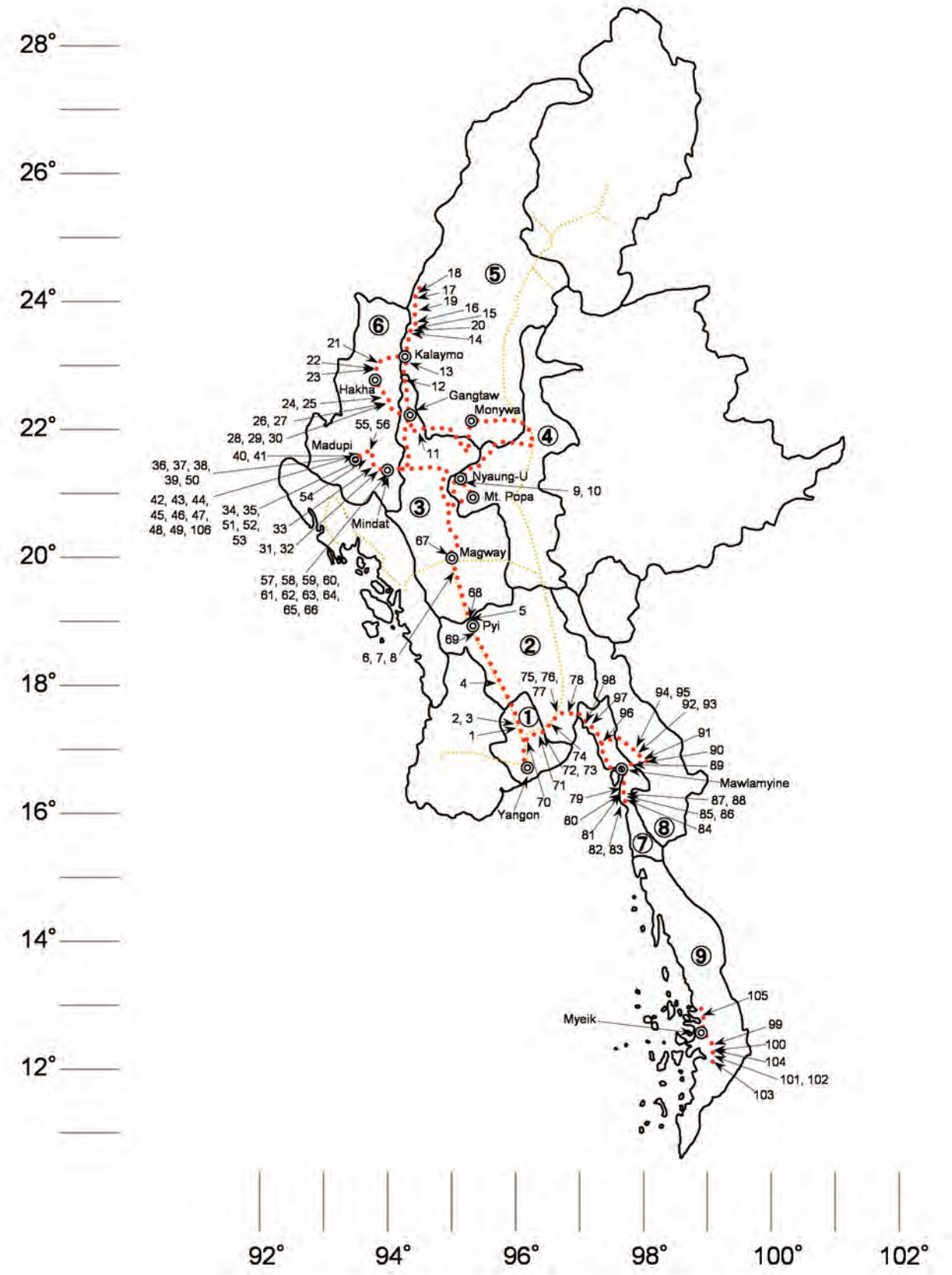

Fig.1. Route of field survey and collection sites in Myanmar. Number indicates the collection number. Bold dotted line (•••••)indicates the route of field survey. Dotted hairline (·····) indicates the route of the previous field survey reported by Uga et al. (2005). ◎：lodging place. States and Divisions are: ① Yangon Division, ② Bago Division, ③ Magway Division, ④ Mandalay Division, ⑤ Sagaing Division, ⑥ Chin State, ⑦ Mon State, ⑧ Kayin State, and ⑨ Taninthayi Division.

Table 1. Passport data of the collected materials in Manmar.

Collection number*	JP No.	Local name	Scientific Name	Collection date	Status	Locality (Vill., T/S, Prov.)	Latitude	Longitude	Altitude	Source	Topography	Site	Soil texture	Drainage	Remarks
1	226003	-	*Oryza rufipogon* W.Griffith	2005/Oct/16	wild	TAIK-KYI, T/S TAIK-KYI, YANGON Division	N17-19-38.8	E95-57-15.8	12m	wild	swamp	level	loam	poor	Fertility: around 70 % , plant height: around 100 cm, awn color: red.
2	226004	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/16	wild	PHA-LON, T/S TAIK-KYI, YANGON Division	N17-26-7.9	E95-52-38.2	11m	wild	swamp	level	clay	moderate	In a garden of private house.
3	226005	-	*Oryza rufipogon* W.Griffith	2005/Oct/16	wild	PHA-LON, T/S TAIK-KYI, YANGON Division	N17-26-7.9	E95-52-38.2	11m	wild	swamp	level	clay	poor	At flowering time (unknown fertility), plant height: less than 100 cm, awn color: red.
4	226006	-	*Oryza rufipogon* W.Griffith	2005/Oct/16	wild	OK-CHIT-KONE, T/S OK-PHO, BAGO Division	N18-5-48.1	E95-42-14.3	19m	wild	swamp	level	clay	poor	Fertility: more than 50% , plant height: 50 - 70 cm, awn color: red.
5	226007	-	*Oryza rufipogon* W.Griffith	2005/Oct/17	wild	near an army camp, T/S PYI, BAGO Division	N18-57-0.6	E95-15-12.9	49m	wild	swamp	level	clay	poor	Medium fertility, plant height: less than 100 cm, awn color: red, open-type panicle.
6	226008	MYAT-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/17	wild	PAYAT-KYE, T/S TAUNGDWINGYI, MAGWAY Division	N19-49-43.9	E95-27-50.7	144m	wild	swamp	level	sand	poor	At flowering time (unknown fertility), plant height: around 60 cm, awn color: red, semi open-type panicle.
7	226009	MYAT-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/17	wild	PAYAT-KYE, T/S TAUNGDWINGYI , MAGWAY Division	N19-49-43.9	E95-27-50.7	144m	wild	swamp	level	sand	poor	Likely hybrid plants.
8	226010	MYAT-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/17	wild	PAYAT-KYE, T/S TAUNGDWINGYI , MAGWAY Division	N19-49-43.9	E95-27-50.7	144m	wild	swamp	level	sand	poor	Fertility: more than 50 % , plant height: around 60 cm, awn color: red.
9	226011	-	*Setaria* sp.	2005/Oct/18	wild	MIN-NAN-THU, T/S MYAUNG-U, MANDALAY Division	N21-10-5.5	E94-54-16.2	68m	wild	dried river	slope	sand	moderate	
10	226012	-	*Brachiaria*	2005/Oct/18	wild	MIN-NAN-THU, T/S MYAUNG-U, MANDALAY Division	N21-10-5.5	E94-54-16.2	68m	wild	dried river	slope	sand	moderate	
11	226013	-	*Vigna hirtella* Ridley	2005/Oct/20	wild	GYAW, T/S GANT-GAW, MAGWAY Division	N21-53-0.1	E94-24-28.5	769m	wild	mountainous	slope	clay	moderate	
12	226014	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/21	wild	KALAY, T/S KALAY, SAGAIN Division	N22-44-36.2	E94-4-29.4	132m	wild	swamp	level	clay	poor	A sunny habitat.
13	226015	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/21	wild	NUT-MYAUNG, T/S KALAY, SAGAIN Division	N23-1-13.9	E94-82-1.9	102m	wild	paddy field ridge	level	clay	moderate	A paddy fild ridge, wild Colacasia occurred in the neigborhood.
14	226016	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	KALA, T/S KALAY, SAGAIN Division	N23-27-1.1	E94-6-38	143m	wild	swamp	level	clay	poor	A sunny habitat with water.
15	226017	MYAT-SABA	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	56 MILES, T/S KALAY, SAGAIN Division	N23-29-13.7	E94-7-20.3	161m	wild	swamp	level	loam	poor	
16	226018	NAT-SABA	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	NAN-HAUK-HAUK, T/S TAMU, SAGAIN Division	N23-42-29.5	E94-9-3.2	175m	wild	paddy field ridge	level	clay	poor	Many tall plants with large panicles grown in paddy field edge, high sterility.
17	226019	NAT-SABA	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	YAN-LIN-PINE, T/S TAMU, SAGAIN Division	N24-3-3.9	E94-15-16.1	173m	wild	undulating	level	loam	poor	A semi-shaded habitat along a small stream with *Mimosa pudica*, *Eupatrium* sp., & *Paspalum* sp.
18	226020	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	KHIN-MON-LON, T/S TAMU, SAGAIN Division	N24-4-18.2	E94-16-18.4	155m	wild	swamp	level	loam	poor	A sunny swamp. Some water buffalos were grazing near by.
19	226021	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	KAN-MA-KYI, T/S TAMU, SAGAIN Division	N23-51-19.8	E94-9-39.4	159m	wild	swamp	level	clay	poor	A semi-shaded habitat with wild Colacasia.
20	226022	MYAT	*Oryza officinalis* Wall.ex Watt	2005/Oct/22	wild	KYAN-SAT-KONE, T/S KALAY, SAGAIN Division	N23-29-56.1	E94-7-13.2	153m	wild	swamp	level	loam	poor	"MYAT" means a weed or a grass.
21	226023	CHIN-KHAYAN-CHIN	*Solanum* sp.	2005/Oct/23	landrace	KHAW-LE, T/S FALAM, CHIN State	N23-1-45.9	E93-41-48.9	1706m	farmland	mountainous	slope	loam	good	"Thing Bok Khek" (Chin language).
22	226024	PE-ZIN	*Vigna umbellata* (Thunb.) Ohwi et Ohashi (=*Phaseolus calcaratus*)	2005/Oct/23	landrace	PAR-TE, T/S FALAM, CHIN State	N22-59-41.9	E93-41-15.4	1213m	farmland	mountainous	slope	loam	good	Cultivated plants are just flowering.
23	226025	MANG-BUH	*Oryza sativa* L.	2005/Oct/23	landrace	FALAM, T/S FALAM, CHIN State	N22-54-50.4	E93-40-41.1	1587m	from a citizen	mountainous	-	-	-	Cultivated in farmland of ZALAI village.
24	226026	SAN-BU	*Oryza sativa* L.	2005/Oct/24	landrace	THI-NAN, T/S HAKHA, CHIN State	N22-29-9.2	E93-46-11.3	1500m	farmstore	mountainous	slope	loam	good	Sowing by using a stick, three times of weeding.
25	226027	SAN-BWE	*Oryza sativa* L.	2005/Oct/24	landrace	THI-NAN, T/S HAKHA, CHIN State	N22-29-9.2	E93-46-11.3	1500m	farmstore	mountainous	slope	loam	good	Sowing by using a stick, three times of weeding.
26	226028	FANG	*Setaria italica* (L.) P.Beauv.	2005/Oct/24	landrace	LAM-TUK, T/S HAKHA, CHIN State	N22-28-50.2	E93-47-57.9	1272m	farmstore	mountainous	slope	loam	good	Cooked like boiled rice or with rice.
27	226029	SAN-BIAL	*Oryza sativa* L.	2005/Oct/24	landrace	LAM-TUK, T/S HAKHA, CHIN State	N22-28-50.2	E93-47-57.9	1272m	farmstore	mountainous	slope	loam	good	

Table 1(continued).

28	226030	FANG	*Setaria italica* (L.) P.Beauv.	2005/Oct/24	landrace	LAM-TUK, T/S HAKHA, CHIN State	N22-28-30.9	E93-48-26.6	1228m	farmstore	mountainous	slope	loam	good	Seed coat color: gray.
29	226031	FANG	*Setaria italica* (L.) P.Beauv.	2005/Oct/24	landrace	LAM-TUK, T/S HAKHA, CHIN State	N22-28-30.9	E93-48-26.6	1228m	farmstore	mountainous	slope	loam	good	Seed coat color: yellow.
30	226032	SAN-BUE	*Oryza sativa* L.	2005/Oct/24	landrace	LAM-TUK, T/S HAKHA, CHIN State	N22-28-30.9	E93-48-26.6	1228m	farmstore	mountainous	slope	loam	good	Highly shattering.
31	226033	TAR-SEAL	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/25	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-31	E93-57-13.2	1444m	backyard	mountainous	level	sand	good	Incurve-type panicle.
32	226034	TAR-SEAL	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/25	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-31	E93-57-13.2	1444m	backyard	mountainous	level	sand	good	Long finger-type panicle.
33	226035	-	*Fagopyrum*	2005/Oct/25	wild	12 miles from MINDAT, T/S MINDAT, CHIN State	N21-24-25	E93-51-5.9	2224m	wild	mountainous	slope	loam	good	Highly shattering, heterostyly.
34	226036	SUN-TUN	*Setaria italica* (L.) P.Beauv.	2005/Oct/25	landrace	56 MILES, T/S MADUPI, CHIN State	N21-35-6.2	E93-43-19.8	2430m	farmstore	mountainous	slope	loam	good	Cooked like boiled rice. Cake is rarely made from powder.
35	226037	MAT-SAH	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/25	landrace	56 MILES, T/S MADUPI, CHIN State	N21-35-6.2	E93-43-19.8	2430m	farmstore	mountainous	slope	loam	good	Used mainly for brewing.
36	226038	SAT-WAR	*Setaria italica* (L.) P.Beauv.	2005/Oct/25	landrace	LEISHIT, T/S MADUPI, CHIN State	N21-36-3.3	E93-37-29	1978m	farmstore	mountainous	slope	loam	good	Lemmata & paleae color: yellow. Cooked like boiled rice or mixed with rice. Panicles are harvested by hand.
37	226039	SAT-HNI	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/25	landrace	LEISHIT, T/S MADUPI, CHIN State	N21-36-3.3	E93-37-29	1978m	farmstore	mountainous	slope	loam	good	Panicles are harvested with a sickle. Used mainly for brewing.
38	226040	SAT-ME	*Setaria italica* (L.) P.Beauv.	2005/Oct/25	landrace	LEISHIT, T/S MADUPI, CHIN State	N21-36-3.3	E93-37-29	1978m	farmstore	mountainous	slope	loam	good	A cat-paw-shape panicle with black lemmata & paleae. Cakes are made from powder.
39	226041	SAT-WAR-GYI	*Setaria italica* (L.) P.Beauv.	2005/Oct/25	landrace	LEISHIT, T/S MADUPI, CHIN State	N21-36-3.3	E93-37-29	1978m	farmstore	mountainous	slope	loam	good	Lemmata & paleae color: yellow, a larger panicle.
40	226042	-	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-37-22.5	E93-26-13.7	1228m	farmland	mountainous	slope	loam	good	Highly shattering. Large kernels.
41	226043	-	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-37-13.5	E93-26-34.3	1238m	farmland	mountainous	slope	loam	good	In a tea plantation, medium shattering.
42	226044	LAI-SHAWNG	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-48.7	E93-26-26.7	1140m	farmstore	mountainous	slope	loam	good	
43	226045	SANG-HTAW	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-53.5	E93-26-31.1	1085m	farmland	mountainous	slope	loam	good	Aromatic rice, medium shattering.
44	226046	MADU	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-53.5	E93-26-31.1	1085m	farmland	mountainous	slope	loam	good	Medium shattering.
45	226047	MALKET	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-53.5	E93-26-31.1	1085m	farmland	mountainous	slope	loam	good	Incurve-type panicle. Used for brewing.
46	226048	MALKET	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-53.5	E93-26-31.1	1085m	farmland	mountainous	slope	loam	good	Long finger-type panicle. Used for brewing.
47	226049	MALKET	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-53.5	E93-26-31.1	1085m	farmland	mountainous	slope	loam	good	Fist-type panicle. Used for brewing.
48	226050	-	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-25.1	E93-26-42.5	1021m	farmland	mountainous	level	loam	good	Medium shattering.
49	226051	-	*Vigna angularis* var. *nipponensis* (Ohwi) Ohwi & Ohashi	2005/Oct/26	wild	MADUPI, T/S MADUPI, CHIN State	N21-36-25.1	E93-26-42.5	1021m	farmland	mountainous	slope	loam	good	Near a paddy field of sample No. 48.
50	226052	-	*Oryza sativa* L.	2005/Oct/26	landrace	MADUPI, T/S MADUPI, CHIN State	N21-35-51.5	E93-27-16.3	865m	farmland	mountainous	level	clay	poor	Medium shattering.
51	226053	SANG-HUM	*Oryza sativa* L.	2005/Oct/26	landrace	LEMYO-CHAUNG, T/S MADUPI, CHIN State	N21-35-6.3	E93-27-45.2	732m	farmland	hilly	level	loam	good	Long sterile lemmata.
52	226054	GA-NANG	*Oryza sativa* L.	2005/Oct/26	landrace	LEMYO-CHAUNG, T/S MADUPI, CHIN State	N21-35-6.3	E93-27-45.2	732m	farmland	hilly	level	loam	good	Purple-colored apiculus tip.

Table 1(continued).

53	226055	-	*Oryza sativa* L.	2005/Oct/26	landrace	LEMYO-CHAUNG, T/S MADUPI, CHIN State	N21-35-12.7	E93-27-53.3	743m	farmland	hilly	level	clay	poor	Few tillers.
54	226056	-	*Vigna angularis* var. *nipponensis* (Ohwi) Ohwi & Ohashi	2005/Oct/27	wild	CHINN-PYANN, T/S MADUPI, CHIN State	N21-34-8.4	E93-29-21.6	780m	wild	mountainous	slope	sand	good	Roadside.
55	226057	-	*Vigna angularis* var. *nipponensis* (Ohwi) Ohwi & Ohashi	2005/Oct/27	wild	LEI-SHIT, T/S MINDAT, CHIN State	N21-36-49.7	E93-37-46.8	1768m	wild	mountainous	slope	loam	good	Roadside.
56	226058	-	*Vigna umbellata* (Thunb.) Ohwi et Ohashi (=*Phaseolus calcaratus*)	2005/Oct/27	wild	MINDAT, T/S MINDAT, CHIN State	N21-36-22	E93-38-53.3	2063m	wild	mountainous	slope	loam	good	Roadside.
57	226059	HTANG-SEN	*Eleusine coracana* (L.) Gaertn. ssp. *coracana* Hilu et de Wet	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
58	226060	PYEEN-HTA	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
59	226061	HTANG-TUN	*Setaria italica* (L.) P.Beauv.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
60	226062	HTAK-KAPA	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
61	226063	HKAK-PALAP	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
62	226064	MALEK-KAWM	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
63	226065	PYIT-HTA	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
64	226066	TAUNG-O-NU	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
65	226067	HTANG-LE	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
66	226068	HTANG-PYEEK	*Oryza sativa* L.	2005/Oct/28	landrace	MINDAT, T/S MINDAT, CHIN State	N21-22-15.6	E93-58-4.7	1428m	from MAS	-	-	-	-	provided by MAS Mindat T/S Manager.
67	226069	-	*Oryza rufipogon* W.Griffith	2005/Oct/29	wild	MAGWAY, T/S MAGWAY, MAGWAY Division	N20-9-54.7	E94-56-56.1	83m	wild	swamp	level	sand	poor	Plant type: dwarf, open-type panicle.
68	226070	DAUNG-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/29	wild	KYAW-SWA-LANPAUK, T/S AUNG-LAN, BAGO Division	N18-59-50	E95-13-11.6	66m	wild	swamp	level	loam	poor	Fertility: less than 50 % , plant height: around 50 cm.
69	226071	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/29	wild	PYAY, T/S PYAY, BAGO Division	N18-49-38.5	E95-15-54.5	35m	wild	swamp	level	loam	poor	Shaded small stream banks near a wall surrounding a house.
70	226072	-	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	EAK-RISK, T/S HLEGU, YANGON Division	N17-4-16.1	E96-10-28.5	2m	wild	swamp	level	clay	poor	Fertility: 60 - 70 % , plant height: less than 100 cm.
71	226073	DIKE-CHO	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	INTA-GAW, T/S INTA-GAW, BAGO Division	N17-11-20.6	E96-23-35.6	8m	wild	swamp	level	clay	poor	Fertility: 30 to 40 % , plant height: more than 100 cm, plants having red and white awns.
72	226074	DIKE-CHO	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	INTA-GAW, T/S INTA-GAW, BAGO Division	N17-11-19.4	E96-23-36.5	7m	wild	swamp	level	clay	poor	Fertility: around 20 % , open-type panicle.
73	226075	DIKE-CHO	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	INTA-GAW, T/S INTA-GAW, BAGO Division	N17-11-19.4	E96-23-36.5	7m	wild	swamp	level	clay	poor	Fertility: around 50 % , compact-type panicle.
74	226076	-	*Oryza officinalis* Wall.ex Watt	2005/Oct/30	wild	KALE, T/S BAGO, BAGO Division	N17-21-55	E96-30-35.9	7m	wild	plain level	level	loam	good	In a swampy garden of a private farmers house.
75	226077	-	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	MOYINGYI lake, T/S BAGO, BAGO Division	N17-35-24.5	E96-34-46.3	0m	wild	lake	level	clay	poor	
76	226078	-	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	MOYINGYI lake, T/S BAGO, BAGO Division	N17-35-22.5	E96-34-43.5	0m	wild	lake	level	clay	poor	
77	226079	-	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	MOYINGYI lake, T/S BAGO, BAGO Division	N17-35-23.6	E96-34-42.9	2m	wild	lake	level	clay	poor	
78	226080	-	*Oryza rufipogon* W.Griffith	2005/Oct/30	wild	THEIN-ZA-YAT, T/S WAW, BAGO Division	N17-31-0.9	E96-46-7.4	1m	wild	swamp	level	clay	poor	Plant height, around 100 cm. In a swamp between paddy fields and a road.
79	226081	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	CHAUK-MINE, T/S MAWLAMYINE, MON State	N16-27-36.4	E97-40-14.7	10m	wild	swamp	level	loam	poor	Plant height, around 50 cm, plants having open- and compact-type panicles.

Table 1(continued).

80	226082	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	KEA-TWIN-GONE, T/S KYAUK-MA-YAW, MON State	N16-23-41.9	E97-42-14.5	7m	wild	swamp	level	loam	poor	Fertility: around 20% , plant height: 50 to 60 cm, a floating type in a swamp. Water depth: 20 cm when collected.
81	226083	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	KYAUK-TA-LONE, T/S MAWLAMYINE, MON State	N16-19-19.3	E97-42-14.9	15m	wild	swamp	level	loam	poor	Fertility: 30 to 50% , plant height: around 50% .
82	226084	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	PALAUK-NYAUNG-WINE, T/S MUDON, MON State	N16-11-39.9	E97-38-6.5	-4m	wild	pond	level	loam	poor	Water depth: around 100 cm, plant height: around 100 cm, an open-type panicle.
83	226085	EKALE	*Oryza sativa* L.	2005/Oct/31	landrace	PALAUK-NYAUNG-WINE, T/S MUDON, MON State	N16-11-39.9	E97-38-6.5	-4m	farmland	plain level	level	clay	poor	Deep water rice.
84	226086	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	KOK-PA-YAN, T/S MUDON, MON State	N16-13-51.8	E97-41-27.7	-1m	wild	pond	level	loam	poor	Plant height: 50 to 100 cm. Water depth: around 100 cm.
85	226087	MYIN-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	SHWE-NYAUNG-BIN, T/S MUDON, MON State	N16-15-3.8	E97-42-32.2	5m	wild	pond	level	loam	poor	Long culm, an open-type panicle.
86	226088	MYIN-SABA	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	SHWE-NYAUNG-BIN, T/S MUDON, MON State	N16-15-3.8	E97-42-32.2	5m	wild	pond	level	loam	poor	Short culm, a compact-type panicle.
87	226089	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	BEYANG, T/S MUDON, MON State	N16-16-0.5	E97-42-55.5	1m	wild	swamp	level	loam	poor	Plant height: less than 100 cm, white awn. Water depth: 10 cm.
88	226090	-	*Oryza rufipogon* W.Griffith	2005/Oct/31	wild	MUDON farm, T/S MUDON, MON State	N16-16-0.6	E97-43-10.8	6m	wild	swamp	level	loam	poor	Plant height: less than 100 cm.
89	226091	NAT-SABA	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	KYAIK-KOK, T/S HPA-AN, KAYIN State	N16-34-34.2	E97-44-4.8	9m	wild	pond	level	loam	poor	A floating type having open-type panicles.
90	226092	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	SHWE-PYI-AYE, T/S HPA-AN, KAYIN State	N16-35-41.6	E97-43-54.1	10m	wild	swamp	level	loam	moderate	Plant heigth: less than 50 cm, a compact-type panicle.
91	226093	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	PHA-YA-GONE, T/S HPA-AN, KAYIN State	N16-39-26.5	E97-44-33.3	8m	wild	swamp	level	loam	poor	Plant heigth: less than 100 cm.
92	226094	NAT-SABA	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	INDU, T/S HPA-AN, KAYIN State	N16-46-30.5	E97-45-5.3	5m	wild	swamp	level	loam	modelate	A possible hybrid swarm, fertility: around 50% , plant heigth: around 50 cm, plants having compact- and semi open-type panicles.
93	226095	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	INDU, T/S HPA-AN, KAYIN State	N16-46-30.5	E97-45-5.3	5m	wild	swamp	level	loam	modelate	A hybrid-like plant.
94	226096	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	HPA-AN, T/S HPA-AN, KAYIN State	N16-50-42.2	E97-37-19	12m	wild	swamp	level	loam	poor	Fertility: less than 10% , plant heigth around 150 cm.
95	226097	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	GYINE, T/S HPA-AN, KAYIN State	N16-50-0.4	E97-37-33.4	15m	wild	pond	level	loam	poor	Fertility: around 80% , plant height: around 100 cm, a floating type.
96	226098	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	KYAT-KAW, T/S THA-HTON, MON State	N17-2-21.9	E97-16-0.7	3m	wild	canal	level	loam	poor	A possible hybrid swarm, fertility: less than 50% , plant height: around 100 cm.
97	226099	-	*Sesamum* sp.	2005/Nov/1	wild	KYWUN-TAW, T/S KYAIK-HTO, MON State	N17-17-46.5	E97-4-43.5	27m	wild	undulating	slope	loam	good	Roadside. Plant height: 70 to 80 cm.
98	226100	-	*Oryza rufipogon* W.Griffith	2005/Nov/1	wild	KYAIK-HTO, T/S KYAIK-HTO, MON State	N17-19-23.5	E96-59-57.2	7m	wild	swamp	level	loam	poor	A swampy stream bank.
99	226101	MYAT-SABA	*Oryza rufipogon* W.Griffith	2005/Nov/2	wild	KAN-THAYA, T/S MYEIK, TANINTHAYI Division	N12-23-47.8	E98-45-6.6	6m	wild	swamp	level	loam	poor	At flowering time (unknown fertility), plant height: more than 100 cm, awn color: red, population including some hybrid-like plants.
100	226102	-	*Oryza officinalis* Wall.ex Watt	2005/Nov/2	wild	KHONE-MAW, T/S MYEIK, TANINTHAYI Division	N12-18-3.4	E98-51-33.8	6m	wild	swamp	level	clay	poor	Plant height: 250 - 300 cm, long panicles (about 40 cm). In a sunny swamp near a road. Nypa fruticans is grown in the vicinity.
101	226103	-	*Oryza rufipogon* W.Griffith	2005/Nov/2	wild	LATHA, T/S MYEIK, TANINTHAYI Division	N12-15-47.2	E98-52-41.9	7m	wild	swamp	level	loam	poor	Low fertility, plant height: 120 - 130 cm, population including some hybrid-like plants.
102	226104	-	*Oryza rufipogon* W.Griffith	2005/Nov/2	wild	LATHA, T/S MYEIK, TANINTHAYI Division	N12-14-25.6	E98-52-50	5m	wild	swamp	level	loam	poor	Plant height: around 100 cm, wild rice found in a paddy field.
103	226105	-	*Oryza rufipogon* W.Griffith	2005/Nov/2	wild	MAW-TOME, T/S TANINTHAYI, TANINTHAYI Division	N12-8-31.6	E98-57-39.2	5m	wild	swamp	level	loam	poor	
104	226106	-	*Oryza officinalis* Wall.ex Watt	2005/Nov/2	wild	TONE-BYAW, T/S MYEIK, TANINTHAYI Division	N12-17-23.5	E98-52-92.4	4m	wild	plain level	slope	loam	good	
105	226107	DIKE-SABA	*Oryza rufipogon* W.Griffith	2005/Nov/3	wild	PALA , T/S PALAW, TANINTHAYI Division	N12-50-48.6	E98-40-10.3	9m	wild	swamp	level	loam	poor	Plant height: around 150 - 170 cm. In a canal that was just a swamp when collected.
106	226108	T H A K H W A - HMWE	*Cucumis melo* L.	2005/Oct/27	landrace	MADUPI, T/S MADUPI, CHIN State	N21-36-6.2	E93-26-30.4	1212m	local market	-	-	-	-	Obtained at the MADUPI morning market. A little fragrance. Fruit Length: 40 cm, Diameter 15 cm.

*Each collected material is named COL/MYANMAR/2005/NIAS/(Collection number).

Photo 1. Short grass-type *O. rufipogon* occurred in a swamp near *Agave americana* (arrow) beside a road (#67, Magway Division).

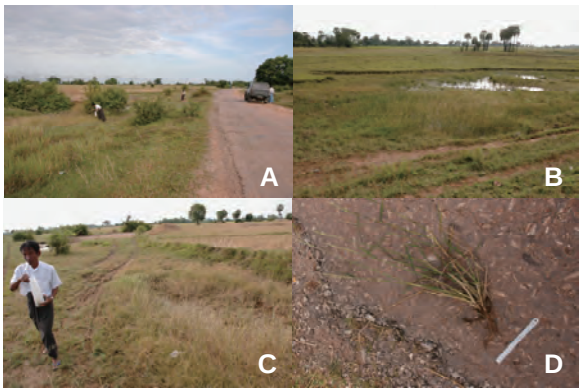

Photo 2. *O. rufipogon* (arrow) grew in a shallow swamp. A specimen (D) was collected from a dry habitat (C) (#90, Kayin State).

Photo 3. *O. rufipogon* grew in a swamp in front of a private house. (#101, Tanintayi Division)

Photo 4. *O. officinalis* (arrow) grew in a swamp and water buffalo were eating this population (#19, Sagain Division)

Photo 5. *O. officinalis* (arrow) grew near a private house (A & C) and beside a road (B & D) (#100, Tanintayi Division).

Photo 6. *O. sativa* was grown in sloped burnt fields (#40, #43, and #44, Chin State).

Photo 7. *O. sativa* was grown on terraced field without an irrigation system (#53, Chin State).

Photo 8. Finger millet was grown in a burnt field (#45, Chin State).