

Collaborative Exploration for Millets Genetic Resources in Laos, October, 2014

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Summary

Since 2006, the National Institute of Agrobiological Sciences (NIAS), Japan, has been collaborating on the surveying and exploring on the Plant Genetic Resources (PGR) under the Memorandum of Agreement (MOA) and Memorandum of Understanding (MOU) with the National Agriculture and Forestry Research Institute (NAFRI) of the Lao People's Democratic Republic (Lao P.D.R., Laos). The KAKEN mission was conducted from 16th Oct. to 1st Nov. 2014. In this mission, seeds of 19 samples of *Sorghum bicolor*, 5 samples of *Zea mays*, 4 samples of *Setaria italica* and one sample of *Eleusine coracana* were acquired. The collecting sites were Xiengkhuang and Houaphanh provinces. Topographically, those regions are located within the ranges of latitude: 19°-21°, longitude: 102°-105° and altitude: 269-1,393 m above the sea level.

These seed samples will be multiplied in the field of the Agriculture Research Center (ARC), Genebank, Laos to study their growth characteristics to share genetic resources between Laos and Japan.

KEY WORDS: *Sorghum bicolor*, *Zea mays*, *Setaria italica*, *Eleusine coracana*

Introduction

The world has to produce more and better foods for human beings within limited biological sources to meet its increasing population. To perform this obligation, plant breeders and agronomists have to work continually towards higher agricultural yields and improved quality of food crops. Genetic variation of the food crops and their wild relatives are the basic biological foundation for the breeding programs of the crop

breeders. This variation offers the genetic materials required for the development of new varieties equipped with higher yielding capacity, and resistances to pests and environmental stresses. On the other hand, nowadays, genetic diversity is decaying due to the erosion of genetic sources caused by deforestation, urbanization, industrial development, mining, and construction of roads and dams. The mentioned erosions are most emphasized in south-east Asian countries which are under development such as Laos. Therefore, the collection and conservation of the PGR is necessary for the future.

Sorghums and their relatives are important PGR having high biomass productivity due to their C₄ plant characteristic with higher photosynthetic capacity. It is believed that sorghum domestication was begun from the northeastern part of the African continent toward the Asian continent (House, 1995). In order to promote the research activity on PGR, Okuizumi *et al.* (2010) have developed an application of the restriction landmark genome scanning method for the analysis of genetic diversity between Asian and African sorghum.

Since 2006, NIAS of Japan and ARC of NAFRI of Laos have been working together in surveying the PGR under the MOA and MOU (Sakata *et al.* 2008, Saito *et al.* 2009, Matsunaga *et al.* 2010, Okuizumi *et al.* 2012, 2014).

This report describes the survey mission to investigate and collect sorghum, millets and maize in Laos with a grant support from KAKEN, Japan.

According to Simana and Preisig (2003), sorghum, foxtail millet, finger millet and maize are cultivated as staple-foods along with rice, and eaten in the forms of cakes. They are also used as animal feeds, mainly for pigs. Besides seeds, stems of certain kinds of sorghums are used for sweet instead of sugarcane. The green stems of these crops are used as fodders for buffaloes, cows, horses and elephants in the northern part of Laos.

According to Berg and Licht (2004), 61 % of the global bioethanol production in 2013 was from sugar crops (sugarcane and beets) and 39 % from cereals (wheat and maize), and they are mainly used as fuel. Therefore, there is a concern that such increase of bio-ethanol production would bring about a higher food pricing as a consequence of limited available land for producing conventional crops for human consumption and livestock feeds (Carus and Dammer, 2013). Under such concern, sorghum and other millet species are seen as better genetic resources to solve this fuel food conflict. However, the available accession number in Lao genebank should be increased. The survey in this country is still challenging.

Topographically, the exploring region, provinces of Xiengkhuang and Houaphan are located within narrow ranges of latitude between 19° - 21° and longitude between 102° - 105°, but with great variation of altitudes between 269 and 1,393 m above the sea level.

Methods

In this mission, collecting activity was done on sorghums, millets and maize. The surveying itinerary is shown in Table 1 and the seed collecting sites in Fig. 1. A car was hired at Vientiane and used to travel to the surveying destinations. Landscape of the surveying sites, information on the investigated and collected samples, such as plant height, season of seeding and harvesting, local name of the crop, cultivation practice, and diseases and pests were recorded. Sample collections were done when favorable landraces in the collecting sites were found, and then photographic records were made.

Table 1. Activity schedule for the surveying and collecting mission in December, 2014

Day	Month	Date		Daily activities
1	Oct	16	Thu	Move from Vientiane to Xiengkhouang by car
2	Oct	17	Fri	Survey in Xiengkhouang
3	Oct	18	Sat	Survey in Xiengkhouang and move to Houaphanh
4	Oct	19	Sun	Survey in Houaphanh
5	Oct	20	Mon	Survey in Houaphanh
6	Oct	21	Tue	Survey in Houaphanh
7	Oct	22	Wed	Survey in Houaphanh
8	Oct	23	Thu	Survey in Houaphanh
9	Oct	24	Fri	Survey in Houaphanh
10	Oct	25	Sat	Survey in Houaphanh
11	Oct	26	Sun	Move to Xiengkhouang
12	Oct	27	Mon	Survey in Xiengkhouang
13	Oct	28	Tue	Survey in Xiengkhouang
14	Oct	29	Wed	Survey in Xiengkhouang
15	Oct	30	Thu	Survey in Xiengkhouang
16	Oct	31	Fri	Survey in Xiengkhouang
17	Nov	1	Sat	Move from Xiengkhouang to Vientiane by car

Results

As shown in Table 1, the survey mission started from Vientiane to Xiengkhouang and Houaphanh provinces on 16th October using a car. Those regions are mountainous, and still rich in biological resources.

As shown in Fig. 1 and Table 2, we indicated the collected sites of *Sorghum bicolor* as “S,” *Setaria italica* as “F,” *Eleusine coracana* as “E” and *Zea mays* as “Z.”

Houaphanh Province (18th -25th October, 2014)

We surveyed from 18th to 25th October in Houaphanh province. On 20th, in Na Hid village, Muang Et district, Mr. Viengkham provided 3 plant genetic resources (PGRs) (L13S, L14S and L15S). On 21st, in Phieng Yang village, Muang Et district, Mr. Kai Yeng provided 1 PGR (L18S). In Phou Jaeng village, Sam Neua district, Mr. Lao provided 6 PGRs (L20S, L21S, L22Z, L23Z, L24Z and L25F), and Mr. Poye provided 1 PGR (L26F). In Nong Khang village, Sam Neua district, Mr. Khan provided 2 PGRs (L30Z and L31Z). On 22nd, in Nala village, Sam Tai district, Mr. Thong Loun provided 2 PGRs (L38S and L39F). In Soay village, Viengxai district, Mr. Lianphone provided 1 PGR (L41S). On 24th, in Napoung village, Mrs. Nam provided 1 PRG (L42S). On 25th, in Phiengdi village, Houameuang district, Mr. Phanvilay provided 1 PGR (L46S). In Thaenhing village, Viengthong district, Mrs. Jaeng provided 1 PGR (L48S). In Kor Kieng village, Viengthong district, Mr. On provided 1 PGR (L52S).

L13S, L14S, L15S, L18S, L20S, L21S, L38S, L41S, L42S, L46S, L48S and L52S were *Sorghum bicolor*. Their local names were “Oi Na Man” for L13S, “Oi Nium” for L14S, L15S, L38S, L41S and L48S, “Khao Fang” for L18S, “Kon Jour” for L20S and L21S, “Oi Deuy Nium” for L42S and “Krame” for L46S. “Oi” and “Krame” mean *sugarcane* and “Khao” means *cereal*. Their stems were used as sweet juice. For L13S, its plant height was 2 m, panicle type was cylinder, panicle length was 30.5 cm and grain color was reddish brown. For L14S, panicle type was corn, panicle length was 28 cm and grain color was reddish brown. For L15S, panicle type was corn, panicle length was 23.5 cm and grain color was reddish brown. For L18S, panicle type was corn and panicle length was 40cm. For L20S, its plant height was 5 m,

panicle type was spindle, panicle length was 32 cm and grain color was red. For L21S, panicle type was lax corn, panicle length was 45 cm and grain color was reddish brown. For L38S, its plant height was 3 m, panicle type was lax corn, panicle length was 31 cm, and grain color was red. For L41S, its plant height was 3 m, panicle type was bloom, panicle length was 40 cm and grain color was reddish brown. For L42S, its plant height was 3 m, panicle type was corn, panicle length was 26 cm and grain color was red. For L46S, its plant height was 3.5 m, panicle type was bloom, panicle length was 34 cm and grain color was brown. For L48S, its plant height was 3 m, panicle type was corn and grain color was reddish brown. For L52S, its plant height was 2.5 m, panicle type was spindle, panicle length was 25 cm and grain color was brown. The growing period of L14S and L15S was from June to November, of L18S, L20S, L21S, L42S, L48S and L52S was from May to October, of L38S was from June to September / November, and of L41S was from June to September.

L22Z, L23Z, L24Z, L30Z and L31Z were *Zea mays*. L22Z is called “Mark Sali” as a common name, and “Pak Kue Du” as a local name. L23Z and L24Z were called “Nor Dark,” L30Z was called “Sali Khao,” and L31Z was called “Sali Leuang” as a local name. “Mark Sali” indicates “*Zea mays*.” For L22Z, its panicle length was 12 cm and grain color was black. For L23Z, its panicle length was 15 cm and grain color was yellow. For L24Z, its panicle length was 17 cm and grain color was yellow. For L30Z, its panicle length was 13 cm and grain color was white with some black grains. For L31Z, its panicle length was 10 cm and grain color was yellow with some black grains. The sowing time of L22Z, L23Z and L24Z was May, and of L30Z and L31Z was March. The harvesting time of L22Z, L23Z and L24Z was October, and of L30Z and L31Z was June.

L25F, L26F and L39F were *Setaria italica*. L25F was called “Su Da” as a local name. For L25F, its panicle length was 27 cm, L26F was 38 cm and L39F was 28 cm. L25F and L26F were sown in May to harvest in October. F30 was sown in June to harvest in September.

Xiengkhouang Province

(26th -31th October, 2014)

We surveyed from 26th to 31st October in Xiengkhouang province. On 26th, in Phavaen village, Nonghet district, Mr. Norjaya provided 1 PGR (L55S). On 27th, in Na O village, Phonsavan district, Mr. Bounpan provided 1 PGR (L60S). On 29th, in Xiengnga village, Phoukoud district, Mr. Bounkhong provided 1 PGR (L66S). In Namsai village, Kham district, Mr. Phorpao provided 2 PGRs (L69S and L70F). In Naphan village, Kham district, Mr. Guxong provided 1 PGR (L73E). On 30th, in Na Khae village, Mok district, Mr. Daovang provided 1 PGR (L81S). In Bong village, Phou Koud district, Mr. Ya provided 2 PGRs (L85S and L86S).

L55S, L60S, L66S, L69S, L81S, L85S and L86S were *Sorghum bicolor*. Their local names were “Kon Jour,” “Oi Lium,” “Oi Lium,” “Oi Nium,” “Gon Jour Pa,” “Khao Fang” and “Khao Fai,” respectively. L55S, L66S and L69S stems were used as sweet juice. L60S, L85S and L86S were harvested as food. L81S was used as food and feed. For L55S, its panicle length was 29 cm, panicle type was lax corn and grain color was red. For L60S, its plant height was 2.5 m, panicle length was 16 cm, panicle type was lax corn and grain color was white. For L66S, its plant height was 2.5 m, panicle length was 35 cm, panicle type was lax corn and grain color was black. For L69S, panicle length was 39 cm, panicle type was bloom and grain color was reddish brown. For L81S, its panicle length was 25 cm, panicle type was spindle and grain

color was white. For L85S, its plant height was 1.6 m, panicle length was 34 cm, panicle type was lax corn and grain color was orange. For L86S, panicle length was 39 cm, panicle type was spindle and grain color was yellowish white. The sowing time of L55S, L66S, L69S and L69S was June, and harvesting time was October. The sowing time of L85S and L86S was May, and harvesting time was October. L60S was sowing in June, transplanted in July and harvested from October to November.

L70F was *Setaria italica*. Its local name was “Khao Fang.” “Khao” means *cereal*. Its plant height was 1.6 m and panicle length was 38 cm. Seeds were sown in July to harvest in October.

L73E was *Eleusine coracana*. Its local name was “Pia.” Crops were used to make cakes. Its plant height was 1.2 m and panicle length was 11 cm. Seeds were sown in July to harvest in October.

Discussions

In this mission, the collecting activity was concentrated in the north-eastern part of Laos. Okuizumi *et al.* (2012) had collected *Sorghum bicolor*, *Zea mays*, *Saccharum spontaneum* and *Erianthus* from Phongsaly province which is situated in the north-east, Luang Prabang and Luang Namtha provinces which are situated westward, and Vientiane province situated southward of the exploring sites.

We visited 16 villages in total. Five Hmong tribe villages located at 269 - 1,393 m and Khmu tribe village located at 560 m, where 8 Lao loun tribe villages located at 271 - 1,130 m in altitude.

The local names of sorghum were “Oi Na Man” (L13S), “Oi Nium” (L14S, L15S, L38S, L41S and L69S), “Oi Deuy Nium” (L42S), “Oi Lium” (L66S) and “Khao Fang” (L85S and L86S) in the village of Lau loun tribe. In the village of Hmong tribe, sorghum names were “Kon Jour” (L20S, L21S and L55S) and “Kon Jour Pa” (L81S). And in the village of Khmu tribe, sorghum was called “Krame” as a local name.

In this mission, 19 samples of *Sorghum* species, 4 samples of millet species (*Setaria italica* and *Eleusine coracana*) and 5 samples of *Zea mays* were acquired. It shows that further exploration in this country which occupies a long span of mountainous landscape from Yunnan, China to Cambodia in the south, may offer more access to new collections of such PGR. Along with routine exploration, collection, characteristic evaluation and conservation of the sample and DNA analysis will be applied for the genetic diversity study.

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Fig 1. Map of the Collection Sites

ラオスにおける雑穀遺伝資源の共同探索 2014 年 10 月

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摘要

独立行政法人農業生物資源研究所遺伝資源センター (NIAS) (現国立研究開発法人農業生物資源研究所) とラオス農林省 (MAF) の国立農林業研究所 (NAFRI) との間で締結した共同研究協定 (MOA, MOU) に基づいて 2006 年からラオスで遺伝資源調査・収集が行われてきた。

本報告は 2014 年の文部科学省科学研究費助成事業 基盤研究 (A)25257416 辺境少数民族地帯での植物利用及び伝統知の遺存と地域発展活動や国際経済の影響評価 (研究代表：渡邊和男・筑波大学) の一環として実施した。

今回の調査・収集は 10 月 16 日から 11 月 1 日の期間、ラオス北東部のシエンクアン県とフアパン県で行った。これらの地域は緯度 19° から 21°、経度 102° から 105° にあり、標高は 269 から 1393 m であった。

収集したのはソルガム (19 点)、アワ (4 点) シコクビエ (1 点) およびトウモロコシ (5 点) であった。これらのサンプルはラオスの農業研究センター (ARC) で栽培して種子増殖を行ったうえ、日本とラオスとの共同研究による特性調査に供試される予定である。

Table 2. Collection list

No.	Coll. No.	JP No.	Coll. Date	Species name	Status ^{*1)}	Local name	Sample ^{*2)}	Locality (Province, District, Village)	Latitude	Longitude	Altitude (m)	Condition ^{*3)}	Collection	Remarks [Tribe]	Photo no. / Original photo ID
L13S	2014-10-L13	254189	20 Oct	<i>Sorghum bicolor</i>	4	Oi Na Man	In	Houaphanh, Muang Et, Na Hid Village	N20-44-06.3	E104-02-23.3	271	6-2-1-2-4	Seed	Mr. Viengkham [Lao loup] Plant hight 2m Panicle length 30.5cm	1/1133
L14S	2014-10-L14	254190	20 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Houaphanh, Muang Et, Na Hid Village	N20-44-06.3	E104-02-23.3	271	6-2-1-2-4	Seed	Mr. Viengkham [Lao loup] Panicle length 28cm	2/1134
L15S	2014-10-L15	254191	20 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Houaphanh, Muang Et, Na Hid Village	N20-44-06.3	E104-02-23.3	271	6-2-1-2-4	Seed	Mr. Viengkham [Lao loup] Panicle length 23.5cm	3/1135
L18S	2014-10-L18	254192	21 Oct	<i>Sorghum bicolor</i>	4	Khao Fang	In	Houaphanh, Muang Et, Phieng Yang Village	N20-48-06.6	E104-00-22.5	269	6-2-1- -4	Seed	Mr. Kai Yeng [Hmong] Panicle length 40cm	4/1231
L20S	2014-10-L20	254193	21 Oct	<i>Sorghum bicolor</i>	4	Kon Jour	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Plant hight 5m Panicle length 32cm	5/1242
L21S	2014-10-L21	254194	21 Oct	<i>Sorghum bicolor</i>	4	Kon Jour	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Panicle length 45cm	6/1243
L22Z	2014-10-L22	254195	21 Oct	<i>Zea mays</i>	4	Mark Sali, Pak Kue Du	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Panicle length 12cm	7/1244
L23Z	2014-10-L23	254196	21 Oct	<i>Zea mays</i>	4	Nor Dark	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Panicle length 15cm	8/1247
L24Z	2014-10-L24	254197	21 Oct	<i>Zea mays</i>	4	Nor Dark	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Panicle length 17cm	9/1248
L25F	2014-10-L25	254198	21 Oct	<i>Setaria italica</i>	4	Su Da	In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Lao [Hmong] Panicle length 27cm	10/1249
L26F	2014-10-L26	254199	21 Oct	<i>Setaria italica</i>	4		In	Houaphanh, Sam Neua, Phou Jaeng Village	N20-41-11.3	E104-02-57.6	1006	6-2-1-2-4	Seed	Mr. Poye [Hmong] Panicle length 38cm	11/1250
L30Z	2014-10-L30	254200	21 Oct	<i>Zea mays</i>	4	Sali Khao	In	Houaphanh, Sam Neua, Nong Khang Village	N20-37-07.7	E104-04-36.6	1022	6-2-1-2-4	Seed	Mr. Khan [Lao loup] Plant hight 1.8m Panicle length 13cm	12/1283
L31Z	2014-10-L31	254201	21 Oct	<i>Zea mays</i>	4	Sali Leuang	In	Houaphanh, Sam Neua, Nong Khang Village	N20-37-07.7	E104-04-36.6	1022	6-2-1-2-4	Seed	Mr. Khan [Lao loup] Panicle length 10cm	13/1284
L38S	2014-10-L38	254202	22 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Houaphanh, Sam Tai, Nala Village	N19-56-22.4	E104-37-24.8	678	6-2-1-2-4	Seed	Mr. Thong Loun [Lao loup] Plant hight 3m Panicle length 31cm	14/1404
L39F	2014-10-L39	254203	22 Oct	<i>Setaria italica</i>	4	Khao Fang	In	Houaphanh, Sam Tai, Nala Village	N19-56-22.4	E104-37-24.8	678	6-2-1-2-4	Seed	Mr. Thong Loun [Lao loup] Panicle length 28cm	15/1405
L41S	2014-10-L41	254204	22 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Houaphanh, Vieng Xai, Soay Village	N20-16-07.7	E104-31-49.7	404	6-2-1-2-4	Seed	Mr. Lianphone [Lao loup] Plant hight 3m Panicle length 40cm	16/1441
L42S	2014-10-L42	254205	24 Oct	<i>Sorghum bicolor</i>	4	Oi Deuy Nium	In	Houaphanh, Viengxai, Napoung Village	N20-28-16.0	E104-09-20.3	832	6-2-1-2-4	Seed	Mrs. Nam [Lao loup] Plant hight 3m Panicle length 26cm	17/1472
L46S	2014-10-L46	254206	25 Oct	<i>Sorghum bicolor</i>	4	Krame	In	Houaphanh, Houameuang, Phiengdi Village	N20-03-20.9	E103-38-41.7	560	6-2-1-2-4	Seed	Mr. Phanvilay [Khum] Plant hight 3.5m Panicle length 34cm	18/1545
L48S	2014-10-L48	254207	25 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Houaphanh, Viengthong, Thaenhing Village	N20-03-41.1	E103-22-08.8	670	6-2-1-2-4	Seed	Mrs. Jaeng Plant hight 3m	19/1583
L52S	2014-10-L52	254208	25 Oct	<i>Sorghum bicolor</i>	4		In	Houaphanh, Viengthong, Kor Kieng Village	N20-01-14.4	E103-20-52.6	648	6-2-1-2-4	Seed	Mr. On [Lao loup] Plant hight 2.5m Panicle length 25cm	20/1595

Table 2 Continued).

No.	Coll. No.	JP No.	Coll. Date	Species name	Status* ¹⁾	Local name	Sample* ²⁾	Locality (Province, District, Village)	Latitude	Longitude	Altitude (m)	Condition* ³⁾	Collection	Remarks [Tribe]	Photo no. / Original photo ID
L55S	2014-10-L55	254209	26 Oct	<i>Sorghum bicolor</i>	4	Kon Jour	In	Xiengkhouang, Nonghet, Phavaen Village	N19-27-50.2	E104-01-04.0	1393	6-2-1-2-4	Seed	Mr. Norjaya [Hmong] Panicle length 29cm	21/1684
L60S	2014-10-L60	254210	27 Oct	<i>Sorghum bicolor</i>	4	Oi Lium	In	Xiengkhouang, Phonsavan, Na O Village	N19-25-16.4	E103-10-56.1	1105	5-2-1-2-4	Seed	Mr. Bounpan Plant hight 2.5m Panicle length 16cm	22/1746
L66S	2014-10-L66	254211	29 Oct	<i>Sorghum bicolor</i>	4	Oi Lium	In	Xiengkhouang, Phoukoud, Xiengnga Village	N19-29-04.7	E102-51-45.2	1130	5-2-1-2-4	Seed	Mr. Bounkhong [Lao loum] Plant hight 2.5m Panicle length 35cm	23/1906
L69S	2014-10-L69	254212	29 Oct	<i>Sorghum bicolor</i>	4	Oi Nium	In	Xiengkhouang, Kham, Namsai Village	N19-45-41.5	E103-23-19.4	1029	6-2-1-2-4	Seed	Mr. Phorpao [Lao loum] Panicle length 39cm	24/1929
L70F	2014-10-L70	254213	29 Oct	<i>Setaria italica</i>	4	Khao Fang	In	Xiengkhouang, Kham, Namsai Village	N19-45-41.5	E103-23-19.4	1029	6-2-1-2-4	Seed	Mr. Phorpao [Lao loum] Plant hight 1.6m Panicle length 38cm	25/1931
L73E	2014-10-L73	254214	29 Oct	<i>Eleusine coracana</i>	4	Pia	In	Xiengkhouang, Kham, Naphan Village	N19-43-29.1	E103-27-42.4	887	6-2-1-2-4	Seed	Mr. Guxong [Hmong] Plant hight 1.2m Panicle length 11cm	26/1950
L81S	2014-10-L81	254215	30 Oct	<i>Sorghum bicolor</i>	4	Gon Jour Pa	In	Xiengkhouang, Mok, Na Khae Village	N19-04-47.4	E103-57-04.9	484	6-1-1-2-	Seed	Mr. Daovang [Hmong] Panicle length 25cm	27/2043
L85S	2014-10-L85	254216	30 Oct	<i>Sorghum bicolor</i>	4	Khao Fang	In	Xiengkhouang, Phou Koud, Bong Village				6-2-1-2-4	Seed	Mr. Ya [Lao loum] Plant hight 1.6m Panicle length 34cm	28/2081
L86S	2014-10-L86	254217	30 Oct	<i>Sorghum bicolor</i>	4	Khao Fai	In	Xiengkhouang, Phou Koud, Bong Village				6-2-1-2-4	Seed	Mr. Ya [Lao loum] Panicle length 39cm	29/2082

*1) : 4; landrace

*2) : In; Individual

*3)

Topography 1; swamp, 2; flood plain, 3; plain level, 4; undulation, 5; hilly, 6; mountainous, 7; other (specify)

Site 1; level, 2; slope, 3; summit, 4; depression

Stoniness 1; none, 2; low, 3; medium, 4; rocky

Soil texture 1; sand, 2; loam, 3; clay, 4; silt, 5; highly organic

Drainage 1; poor, 2; moderate, 3; good, 4; excessive



Photo 1. *Sorghum bicolor* (1133/L13)



Photo 2. *Sorghum bicolor* (1134/L14)



Photo 3. *Sorghum bicolor* (1135/L15)



Photo 4. *Sorghum bicolor* (1231/L18)



Photo 5. *Sorghum bicolor* (1242/L20)



Photo 6. *Sorghum bicolor* (1243/L21)



Photo 7. *Zea mays* (1244/L22)



Photo 8. *Zea mays* (1247/L23)



Photo 9. *Zea mays* (1248/L24)



Photo 10. *Setaria italica* (1249/L25)



Photo 11. *Setaria italica* (1250/L26)



Photo 12. *Zea mays* (1283/L30)



Photo 13. *Zea mays* (1284/L31)



Photo 14. *Sorghum bicolor* (1404/L38)



Photo 15. *Setaria italica* (1405/L39)



Photo 16. *Sorghum bicolor* (1441/L41)



Photo 17. *Sorghum bicolor* (1472/L42)



Photo 18. *Sorghum bicolor* (1545/L46)



Photo 19. *Sorghum bicolor* (1583/L48)



Photo 20. *Sorghum bicolor* (1595/L52)



Photo 21. *Sorghum bicolor* (1684/L55)



Photo 22. *Sorghum bicolor* (1746/L60)



Photo 23. *Sorghum bicolor* (1906/L66)



Photo 24. *Sorghum bicolor* (1929/L69)



Photo 25. *Setaria italica* (1931/L70)



Photo 26. *Eleusine coracana* (1950/L73)

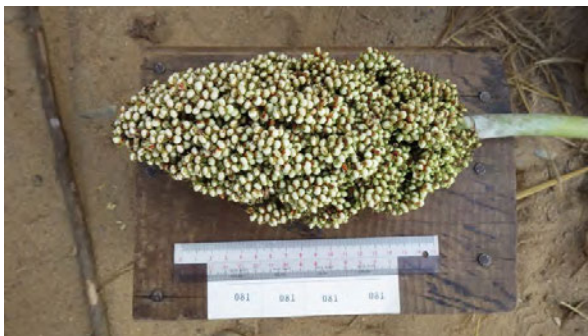


Photo 27. *Sorghum bicolor* (2043/L81)



Photo 28. *Sorghum bicolor* (2081/L85)



Photo 29. *Sorghum bicolor* (2082/L86)