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Original Paper

Collaborative Exploration and Collection of Plant Genetic Resources in Laos in February 2019

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Summary

Collaborative survey of plant genetic resources was performed in the southern part of Sayabouly Province, Lao People's Democratic Republic. Sorghum, maize, and beans were the main targets of the survey, which was conducted between February 16 and 19, 2019. Thirty accessions, including four *Sorghum bicolor*, 10 *Zea mays*, four *Vigna umbellata*, five *Vigna unguiculat*a, one *Glycine max*, three *Arachis hypogaea*, and three *Erianthus procerus*, were collected. All 10 maize accessions were waxy (glutinous) type.

KEY WORDS: Sayabouly Province, *Sorghum*, *Erianthus*, maize, *Vigna*, soybean, peanut

Introduction

The National Institute of Agrobiological Sciences (NIAS) of Japan and the National Agriculture and Forestry Research Institute (NAFRI) of Laos established a Joint Research Agreement (JRA) in 2014. The NIAS and NAFRI planned a collaborative survey in Laos for plant genetic resources. All obligations and rights of the NIAS under the JRA have been transferred to the National Agriculture and Food Research

Organization (NARO), owing to a merger between NARO and NIAS in April 2016.

Since 2006, the NIAS and NAFRI have conducted collaborative surveys and collection expeditions in Laos for plant genetic resources under the Memorandum of Agreement and Memorandum of Understanding (Sakata *et al.* 2008; Saito *et al.* 2009; Matsunaga *et al.* 2010).

Surveys of cereal crop genetic resources have also been conducted in the provinces of Xieng Khouang, Houa Phan, Bolikhamsay, Khammouane, Oudomsay, Luang Namtha, Bokeo, Phongsaly, and Luang Prabang and in the country's capital city Vientiane (Kawase *et al.* 2012; Okuizumi *et al.* 2011, 2013, 2015a, 2015b, 2016; Yamamoto *et al.* 2015a, 2015b).

In the present survey, we visited the southern part of Sayabouly Province, which was not surveyed in the past; this survey was mainly targeted at collecting sorghum, maize, and beans, which are the most important crops in Laos. The survey included both Japanese and Laotian researchers.

Methods

The survey was conducted from February 16 to 19, 2019 (Table 1). We visited seven sites during the present survey (Fig. 1). A rental car was used for transportation between the sites. The survey group consisted of a NARO researcher, NAFRI researcher, and Laotian driver. Samples were obtained from villagers or the field. We recorded the location information by using GPS (foretrex301, Garmin Ltd., Zurich, Switzerland), as well as data (e.g., plant height, panicle length, and local name) and photos of the collected plant samples. The alphabet spelling of locations in this report was refer to the map (World mapping project 2014).

Results

We visited five villages in the southern part of Sayabouly Province and collected 30 accessions of four *Sorghum bicolor*, 10 *Zea mays*, four *Vigna umbellata*, five *V. unguiculata*, one *Glycine max*, three *Arachis hypogaea*, and three *Erianthus procerus* (Table 2). Detailed results for each day are shown below.

(1) February 16, 2019 (Vientiane-Paklay dist., Sayabouly Prov.)

The survey started in Vientiane toward the west. We drove along the Mekong River and across it. We visited Paklay District Agriculture and Forestry Office (DAFO; Fig. 1). We visited farmers in Pangkho village (Photo 1); Ms Nivanh (*Lao tribe*) provided us with a *S. bicolor* sample with collection number 2019-02-L1 (hereafter L1, Photo 2), a *V. unguiculata sample* (L2, Photos 3 and 4), and three *Z. mays* samples (L4-6, Photos 6-8). Ms Ban and Mr Thun (both *Lao*) also provided *V. umbellata* (L3, Photo 5) and *V. unguiculata* (L7, Photo 9) samples, respectively.

Table 1. Itinerary of the survey in Laos

Date	Day	Itinerary	Collection
16-Feb	Sat	Vientiane - Paklay Dist., Sayabouly Prov.	L1 - 7
17-Feb	Sun	Paklay Dist., Sayabouly Prov.	L8 - 17
18-Feb	Mon	Kenthao Dist., Sayabouly Prov.	L18 - 29
19-Feb	Tue	Xanakham Dist., Sayabouly Prov. - Vientiane	L30

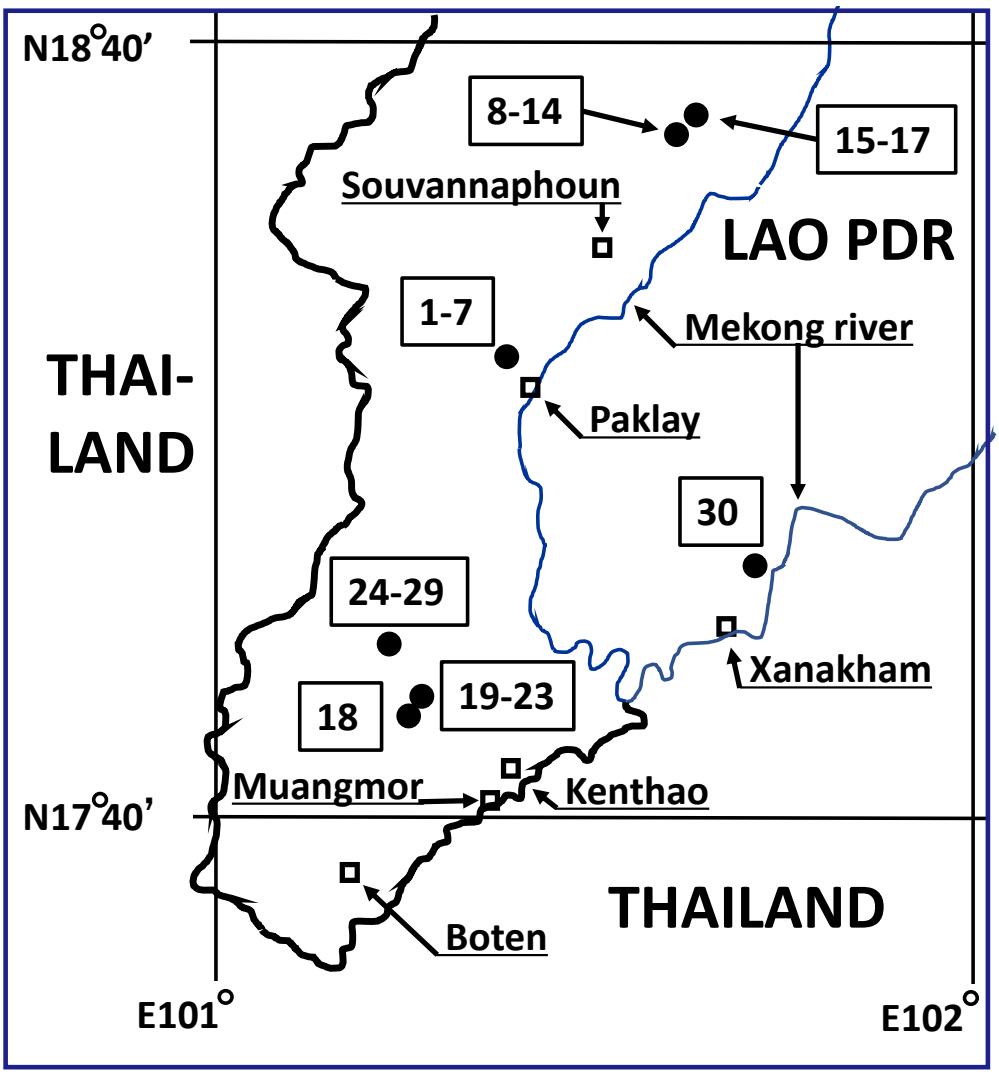

Fig. 1. Map of collection sites.

(2) February 17, 2019 (Paklay dist., Sayabouly Prov.)

The survey continued in Paklay district. In Muangpa village, Ms Sirao (*Hmong tribe*) provided us with three *Z. mays* samples (L8, L13, and L14; Photos 10, 16, and 17, respectively). Next, Ms Yerao (*Hmong*) provided *Z. mays* (L9, Photo 11) and *G. max* (L10, Photo 12) samples. An *S. bicolor* sample (L11, Photo 13) was provided by Ms Daivue (*Hmong*). An *E. procerus* sample (L12, Photos 14 and 15) was also obtained in the village.

In Nachan village, Ms Buachan (*Lao*) provided us three samples of *S. bicolor* (L15, Photo 18), *Z. mays* (L16, Photo 19), and *V. unguiculata* (L17, Photo 20).

(3) February 18, 2019 (Paklay dist., Sayabouly Prov.)

Along the way from Kenthao City to Houaykha village, we found an *E. procerus* sample (L18, Photos 21 and 22). In Houaykha village, Ms Khoun (*Lao*; Photo 25) provided us *Z. mays* (L19, Photo 23), *V. umbellata* (L20, Photo 24), and *A. hypogaea* (L21, Photo 26) samples. Mr Bualien (*Lao*) also provided *S. bicolor* (L22, Photo 27) and *Z. mays* (L23, Photo 28) samples.

We also visited Houayleuk village and met Ms Phou (*Lao*). She provided us two samples each of *V. unguiculata* (L24 and L25, Photos 30 and 31, respectively), *V. umbellata* (L27 and L28, Photos 33 and 34, respectively), and *A. hypogaea* (L26 and L29, Photos 32 and 35, respectively).

Table 2. Number of collected genetic resources and their names

Species Name	Number of collection	Lao's basic name		Hmong's basic name	
Sorghum bicolor	4	Oilkhaofang, Khaofang	ອ້ອຍເຂົ້າຜາງ, ເຂົ້າຜ້າງ	Oilkhaofang	ອ້ອຍເຂົ້າຜ້າງ
Zea Mays	10	Saroy, Salynem, Khaophodkao, Salylair	ສາລອຍ, ສາລີແນມ, ເຂົ້າໂພດຂາວ, ສາລີແຫຼ້	Saroy, Salykhaonyo, Salydum	ສາລອຍ , ສາລີເຂົ້າ ໜຽວ, ສາລີດ່າ
Vigna umbellata	4	Thoadeng	ຖົ່ວແດງ	-	-
Vigna unguiculata	5	Thoasaiaon, Thoadum, Thoatingsua	ຖົ່ວໃສ້ອົ້ນ, ຖົ່ວດ່າ, ຖົ່ວ ຕົງເສືອ	-	-
Glycine max	1	Thoalueng	ຖົ່ວເຫຼືອງ	-	-
Arachis hypogaea	3	Thoadin	ຖົ່ວດິນ	-	-
Erianthus procerus	3	Khemxang, Doklao, noun or rao	ແຂມຊ້າງ, ດອກເລົາ, ນຸ້ນ ຫຼື ເລົາ	-	-
Total	30				

(4) February 19, 2019 (Xanakham dist., Sayabouly Prov., Vientiane)

Along the way from Xanakham City to Vientiane, we found an *E. procerus* sample (L30, Photo 36).

Discussion

In the present survey, a total of 30 accessions of genetic resources were collected from farmers and on the roadsides (*E. procerus*), as discussed below.

(1) *Sorghum bicolor*

Three farmers (two *Lao* and one *Hmong tribe*) provided four accessions. They are called as "Oilkhaofang" or "Khaofangdeng." The crop season is May/June to October/November. The ranges of plant height and panicle length were 2–4 m and 27–33 cm, respectively. They were all grown for tasting sweet juice.

(2) *Zea mays* (maize)

Ten accessions of *Z. mays* were collected from four *Lao* and two *Hmong* tribes. Lao people called *Z. mays* "Saroy" (or "Saroynoy"), "Saly," ("Salylair" and "Salynem") and "Khaophod." The crop season is May/June to July/September. The ranges of plant height and ear length were 1–3 m and 6–15 cm, respectively. They were all grown for obtaining flesh ear/corn, and the grains were all waxy (glutinous) types.

(3) *Vigna umbellata* (rice bean)

Three farmers (*Lao tribe*) provided four accessions. All of them were called "Thaodeng." The crop season is July/August to October/January. The range of pod length was 15–30 cm. The grain of all the accessions was edible, and two of them had edible immature grains (like edamame in Japan).

(4) *V. unguiculata* (cowpea or yard long bean)

Four farmers (*Lao*) provided five accessions. They called the four cowpeas as "Thoasaiaon" or "Thoadum," and the yard long bean as "Thoatingsua." The crop season of cowpea was May to October and of yard long bean was May to July. The range of pod length was 14-30 cm. The grain of all accessions were edible. Two cowpeas had edible immature grains (like edamame in Japan), and the flesh pods of the other two cowpeas and yard long bean were edible as a vegetable.

(5) *Glycine max* (soybean)

One accession was collected from a *Hmong* farmer and called "Thoalueng." The crop season was August to November. The plant height was 60-80 cm, and pod length was 5 cm. It was grown for obtaining grain.

(6) *Arachis hypogaea* (peanut)

Two farmers (*Lao*) provided three accessions. All of them were called "Thoadin." The crop season was May to September. The range of plant height was 30-50 cm, and pod length was 1-4.5 cm. All accessions were grown for obtaining grain and flesh pod as vegetable.

(7) *Erianthus procerus*

Three accessions were collected on the roadside. They were called "Khemxang," "Doklao," or "Noun or rao." The range of plant height was 3.6-6.4 m, and panicle length was 0.8-1.2 m. The panicle has dense hair and was used to make pillows in two villages (Muangpa and Houaykha).

The detailed data of the 30 accessions mentioned above are shown in Table 3. Interestingly, all 10 maize accessions collected were waxy (glutinous) type. The glutinous varieties were chosen for maize in this region, as glutinous rice was preferred in Laos.

Conventional plant genetic resources were rapidly lost because of the shifting of large-scale cultivation of cash crops such as cassava (Photo 29). The survey and conservation of plant genetic resources other than cash crops need to be conducted at the earliest. The characteristics of plant genetic resources obtained in the present survey will be studied in Laos and Japan.

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ラオスにおける植物遺伝資源の探索・収集，2019 年 2 月

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和文摘要

本研究報告は，ジーンバンク事業の一環として，2019 年 2 月 16 日から 19 日にかけ行われたラオス (サニャブリ県) における海外植物遺伝資源の探索･収集に関するものである. 本探索では, ラオスのサニャブリ県南部の村で，ソルガム、トウモロコシ、マメを主な対象作物とする探索を行った．その結果, ソルガム 4 点 , トウモロコシ 10 点 , ツルアズキ 4 点, ササゲ 5 点, ダイズ 1 点, ラッカセイ 3 点 , エリアンサス 3 点 , 合計 30 点の植物遺伝資源を収集し , ラオスジーンバンクに保存した.

Table 3. Passport data of the collection materials

No.	JP No.	Coll. No.	Coll. Date (Feb)	Species name	Local name in Lao	Local name in alphabet	Sample P/In *1)	Status *2)	Locatilty (Vill., District, Province)	Latitude	Longitude	Altitude (m)	Crop season	Cultural practice	Usage	Diseases & Pest	Topography *3)	Site *4)	Drainage *5)	Note *6)	Photo No.	Name and tribe
L1	270478	2019-02-L1	16	*Sorghum bicolor*	ອ້ອຍເຂົ້າຜ້ຽ	Oilkhaofang	In	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Oct	Seed sowing	Stem as sugacane	No	6	2	3	Height (H) = 3 - 4 m, panicle length (PaL) = 28 cm	P2 (#54)	Ms Nivanh; Lao
L2	270479	2019-02-L2	16	*Vigna unguiculata*	ຖົ່ວໃສອົ້ນ	Thoasaiaon	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Oct	Seed sowing	edamame, grain	No	6	2	3	Cowpea, pod length (PoL) = 14 - 24 cm	P3 (#57), P4 (#58)	Ms Nivanh; Lao
L3	270480	2019-02-L3	16	*Vigna umbellata*	ຖົ່ວແດງ	Thoadeng	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	July to Oct	Seed sowing	edamame, grain	No	6	2	3	PoL = 15 - 20 cm	P5 (#59)	Ms Ban Lao
L4	270481	2019-02-L4	16	*Zea mays*	ສາວອຍ	Saroy	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1 - 1.5 m, ear H = 0.5 - 1 m, ear length (EL) = 6 cm, waxy	P6 (#62)	Ms Nivanh; Lao
L5	270482	2019-02-L5	16	*Zea mays*	ສາວອຍ	Saroy	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1 - 1.5 m, ear H = 0.5 - 1 m, (EL) = 6 cm, waxy	P7 (#64)	Ms Nivanh; Lao
L6	270483	2019-02-L6	16	*Zea mays*	ສາວອຍນ້ອຍ	Saroynoy	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1 - 1.5 m, ear H = 0.7 - 1,2 m, (EL) = 9 cm, waxy	P8 (#65)	Ms Nivan;h Lao
L7	270484	2019-02-L7	16	*Vigna unguiculata*	ຖົ່ວດຳ	Thoadum	p	3	Ban Pangkho, Paklay, Sayabouly	N18-15-05.9	E101-22-56.1	234	May to Oct	Seed sowing	edamame, grain	No	6	2	3	Cowpea, H = 60 cm, (EL) = 20 - 30 cm	P9 (#66)	Mr Thun; Lao
L8	270485	2019-02-L8	17	*Zea mays*	ສາລີເຂົ້າຫນຽວນ້ອຍ	Salykhaonyonoy	p	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	June to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1.5 - 1.6 m, ear H = 0.8 - 1 m, EL = 12 cm, waxy	P10 (#72)	Ms Sirao; Hmong
L9	270486	2019-02-L9	17	*Zea mays*	ສາລີເຂົ້າຫນຽວ	Salykhaonyo	p	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	June to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1.5 - 1.6 m, ear H = 0.8 - 1 m, EL = 12 cm, waxy	P11 (#73)	Ms Yerao; Hmong
L10	270487	2019-02-L10	17	*Glycine max*	ຖົ່ວເຫຼືອງ	Thoalueng	p	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	Aug to Nov	Seed sowing	grain	No	6	2	3	H = 60 - 80 cm, PoL = 5 cm	P12 (#74)	Ms Yerao; Hmong
L11	270488	2019-02-L11	17	*Sorghum bicolor*	ອ້ອຍເຂົ້າຜ້ຽ	Oilkhaofang	In	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	June to Nov	Seed sowing	Stem as sugacane	No	6	2	3	H = 2.5 m, PaL = 27 cm	P13 (#75)	Ms Daivue; Hmong
L12	270489	2019-02-L12	17	*Erianthus procerus*	ແຂມຊ້ຽ	Khemxang	p	1	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289			Pillow	No	6	2	3	H = 6.4 m, PaL = 1.2 m, total = 7.6 m	P14 (#83), P15 (#86)	
L13	270490	2019-02-L13	17	*Zea mays*	ສາລີດຳ	Salydum	p	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	June to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1.5 - 1.6 m, EH = 0.7 - 1 m, EL = 11 cm, waxy	P16 (#77)	Ms Sirao; Hmong
L14	270491	2019-02-L14	17	*Zea mays*	ສາວອຍຂີ້ໝູ	Saroykimoo	p	3	Ban Muangpa, Paklay, Sayabouly	N18-32-31.4	E101-36-04.8	289	June to Sep	Seed sowing	Fresh ear	No	6	2	3	H = 1.7 - 1.8 m, ear H = 1 - 1.2 m, EL = 10 cm, waxy	P17 (#79)	Ms Sirao; Hmong
L15	270492	2019-02-L15	17	*Sorghum bicolor*	ເຂົ້າຜາງແດງ	Khaofangdeng	In	3	Ban Nachan, Paklay, Sayabouly	N18-34-30.8	E101-37-51.8	301	May to Oct	Seed sowing	Stem as sugacane	warm	6	2	3	H = 3 m, PaL = 27 cm	P18 (#87)	Ms Buachan; Lao
L16	270493	2019-02-L16	17	*Zea mays*	ສາລີແນມ	Salynem	p	3	Ban Nachan, Paklay, Sayabouly	N18-34-30.8	E101-37-51.8	301	May to July	Seed sowing	Fresh ear	No	6	2	3	H = 2 - 3 m, ear H = 1.5 - 1.7 m, EL = 10 cm, waxy	P19 (#89)	Ms Buachan; Lao
L17	270494	2019-02-L17	17	*Vigna unguiculata*	ຖົ່ວຕົ້ງເສືອ	Thoatingsua	p	3	Ban Nachan, Paklay Sayabouly	N18-34-30.8	E101-37-51.8	301	May to July	Seed sowing	Fresh pod, grain	sting bug, hopper	6	2	3	Yard long bean?, pole climbing, PoL = 42 cm	P20 (#92)	Ms Buachan; Lao
L18	270495	2019-02-L18	18	*Erianthus procerus*	ດອກເວົ້າ	Doklao	In	1	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462			Pillow		6	2	3	H = 5 m, PaL = 0.8 m, total = 5.8 m	P21 (#102), P22 (#104)	
L19	270496	2019-02-L19	18	*Zea mays*	ເຂົ້າໂພດຂາວ	Khaophodkao	p	3	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462	May to July	Seed sowing	Fresh ear	No	6	2	3	H = 1.5 m, ear H = 0.5 - 0.7 m, EL = 15 cm, waxy	P23 (#105)	Ms Khoun; Lao
L20	270497	2019-02-L20	18	*Vigna umbellata*	ຖົ່ວແດງ	Thoadeng	p	3	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462	Aug to Jan	Seed sowing	edamame, grain	sting bug, hopper	6	2	3	Pole climbing, PoL = 15 - 20 cm	P24 (#106)	Ms Khoun; Lao

Table 3. (Continued).

No.	JP No.	Coll. No.	Coll. Date (Feb)	Species name	Local name in Lao	Local name in alphabet	Sample P/In *1)	Status *2)	Locatilty (Vill., District, Province)	Latitude	Longitude	Altitude (m)	Crop season	Cultural practice	Usage	Diseases & Pest	Topography *3)	Site *4)	Drainage *5)	Note *6)	Photo No.	Name and tribe
L21	270498	2019-02-L21	18	*Arachis hypogaea*	ຖົ່ວດິນ	Thoadin	p	3	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462	May to Sep	Seed sowing	Fresh pod, grain	termite	6	2	3	H = 30 - 50 cm, PoL = 2 - 2.5 cm	P26 (#109)	Ms Khoun; Lao
L22	270499	2019-02-L22	18	*Sorghum bicolor*	ອ້ອຍຂົ້ວຜ້າງ	Oilkhaofang	p	3	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462	June to Nov	Seed sowing	Stem as sugacane	No	6	2	3	H = 2 - 2.5 m, PaL = 33 cm,	P27 (#110)	Mr Bualien; Lao
L23	270500	2019-02-L23	18	*Zea mays*	ສາລີແຫ້	Salylair	p	3	Ban Houaykha, Kenthao, Sayabouly	N17-48-58.7	E101-16-37.2	462	May to Aug	Seed sowing	Fresh ear	No	6	2	3	H = 1.5 m, ear H = 0.8 - 1 m, EL = 10 - 12 cm, waxy	P28 (#111)	Mr Bualien; Lao
L24	270501	2019-02-L24	18	*Vigna unguiculata*	ຖົ່ວໃສອົ້ນ	Thoasaiaon	p	3	Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	May to Oct	Seed sowing	Fresh pod, grain	No	6	2	3	Cowpea, pole climbing, EL = 30 cm	P30 (#119)	Ms Pho;u Lao
L25	270502	2019-02-L25	18	*Vigna unguiculata*	ຖົ່ວໃສອົ້ນ	Thoasaiaon	p	3	Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	May to Oct	Seed sowing	Fresh pod, grain	No	6	2	3	Cowpea, pole climbing, EL = 30 cm	P31 (#121)	Ms Phou; Lao
L26	270503	2019-02-L26	18	*Arachis hypogaea*	ຖົ່ວດິນ	Thoadin	p	3	Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	May to Sep	Seed sowing	Fresh pod, grain	No	6	2	3	H = 40 cm, PoL = 1 - 3 cm	P32 (#122)	Ms Phou; Lao
L27	270504	2019-02-L27	18	*Vigna umbellata*	ຖົ່ວແດງ	Thoadeng	p	3	Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	Aug to Nov	Seed sowing	grain	No	6	2	3	Pole climbing, PoL = 20 - 30 cm	P33 (#124)	Ms Phou; Lao
L28	270505	2019-02-L28	18	*Vigna umbellata*	ຖົ່ວແດງ	Thoadeng	p	3	Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	Aug to Nov	Seed sowing	grain	No	6	2	3	Pole climbing, PoL = 20 - 30 cm	P34 (#126)	Ms Phou; Lao
L29	270506	2019-02-L29	18	*Arachis hypogaea*	ຖົ່ວດິນ	thaodin	p		Ban Houayleuk, Kenthao, Sayabouly	N17-52-46.2	E101-13-05.9	460	May to Sep	Seed sowing	Fresh pod, grain	No	6	2	3	H = 30 - 40 cm, PoL = 3.5 - 4.5 cm	P35 (#127)	Ms Phou; Lao
L30	270507	2019-02-L30	19	*Erianthus procerus*	ນ້ານ ຫຼື ເວົ້າ	noun or rao	In	1	Ban Pakxao, Xanakham, Sayabouly	N17-59-44.8	E101-43-03.9	250					3	1	2	H = 3.6 m, PaL = 1.1 m, total = 4.7 m	P36 (#141)	

*1) Sample In; Individual, P; Population (seeds)

*2) Status 1; wild, 2; farmland, 3; farmstore, 4; backyard, 5; village market, 6; commercial market, 7; institute, 8; others

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

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

*5) Drainage 1; poor, 2; moderate, 3; good, 4; excessive

*6) Note (abbreviations) Height (H), panicle length (PaL), pod length (PoL), ear length (EL)

Photo 1. Interviewing farmers in Pongkho village

Photo 2. *S. bicolor,* L1 (#54)

Photo 3. *V. unguiculata*, L2 (#57)

Photo 4. *V. unguiculata*, L2 (#58)

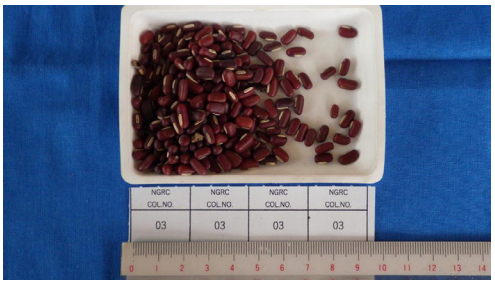

Photo 5. *V. umbellata,* L3 (#59)

Photo 6. *Z. mays*, L4 (#62)

Photo 7. *Z. mays*, L5 (#64)

Photo 8. *Z. mays,* L6 (#65)

Photo 9. *V. unguiculata*, L7 (#66)

Photo 10. *Z. mays*, L8 (#72)

Photo 11. *Z. mays,* L9 (#73)

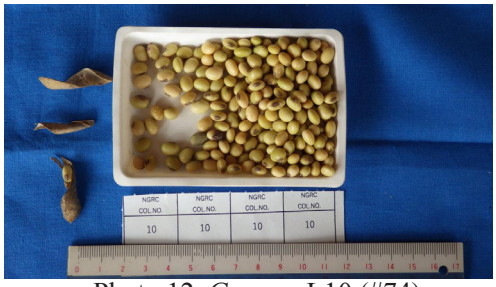

Photo 12. *G. max*, L10 (#74)

Photo 13. *S. bicolor*, L11 (#75)

Photo 14. *E. procerus,* L12 (#83)

Photo 15. *E. procerus*, L12 (#86)

Photo 16. *Z. mays*, L13 (#77)

Photo 17. *Z. mays,* L14 (#79)

Photo 18. *S. bicolor*, L15 (#87)

Photo 19. *Z. mays*, L16 (#89)

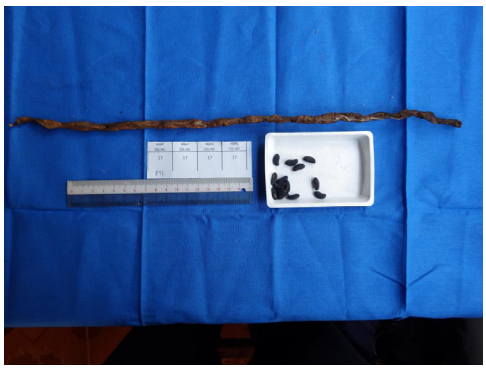
Photo 20. *V. unguiculata* cv-gr. sesquipedalis, L17 (#92)

Photo 21. *E. procerus*, L18 (#102)

Photo 22. *E. procerus*, L18 (#104)

Photo 23. *Z. mays*, L19 (#105)

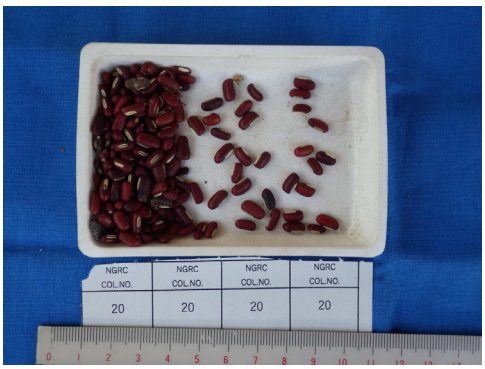

Photo 24. *V. umbellata*, L20 (#106)

Photo 25. Interviewing farmers in Houaykha village

Photo 26. *A. hypogaea*, L21 (#109)

Photo 27. *S. bicolor*, L22 (#110)

Photo 28. *Z. mays*, L23 (#111)

Photo 29. Drying cassava

Photo 30. *V. unguiculata*, L24 (#119)

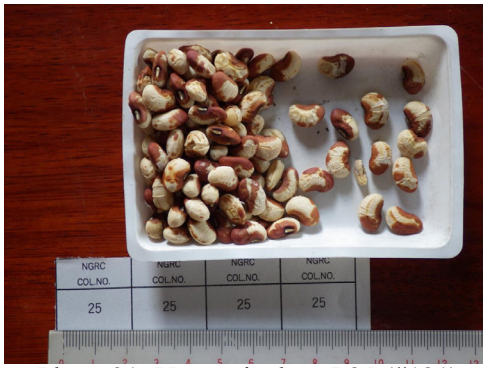

Photo 31. *V. unguiculata*, L25 (#121)

Photo 32. *A. hypogaea*, L26 (#122)

Photo 33. *V. umbellata*, L27 (#124)

Photo 34. *V. umbellata*, L28 (#126)

Photo 35. *A. hypogaea*, L29 (#127)

Photo 36. *E. procerus*, L30 (#141)