

ラオスにおける *Vigna* (ササゲ) 属マメ類遺伝資源の 調査 - 2003年11月15日~26日

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Field Survey of *Vigna* Genetic Resources in Laos, November 15 -26, 2003

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Summary

A field survey was conducted in Laos from November 15 to 26, 2003. During the survey, Vientiane, Luang Prabang, Champasak and Saravan provinces were explored. A total of 19 *Vigna* accessions consisting of 5 *Vigna umbellata*, 1 *V. unguiculata*, 3 *V. hirtella*, 1 *Vigna* sp. (cf. *V. reflexo-pilosa*), 5 *V. minima* and 4 *Vigna* sp. (cf. *V. hirtella*) were collected.

V. umbellata (rice bean) was found cultivated in a farmer's garden near Vientiane. Escaped *V. umbellata* was also found in Champasak and Saravan provinces. An accession of black seeded *V. unguiculata* (cowpea) was found growing as an escape around paddy field in Luang Prabang province. Three accessions of *V. hirtella* and 1 accession of *Vigna* sp. (cf. *V. reflexo-pilosa*) were found in Luang Prabang province. On the Bolovens plateau of Champasak province, an unidentified *Vigna* species (cf. *V. hirtella*) was found near an upland rice field at an elevation of around 1000 m. *V. minima* was found at a high elevation (the Bolovens plateau) and also a low elevation area (around lowland paddy rice field) in

Champasak and Saravan provinces.

Introduction

Leguminous crops belonging to the genus *Vigna* are agronomically and economically important in Laos. Among them, *V. radiata* (mungbean) and *V. unguiculata* (cowpea) are the most widely cultivated crops. *V. umbellata* (rice bean) is a traditional food crop of Laos. *V. umbellata* is thought to have been domesticated in Southeast Asia and therefore is expected to have high genetic variation in Laos. Beside these cultivated *Vigna* species, several wild *Vigna* species are distributed in Laos, which are thought to have high potential for future crop improvement programs. However, systematic survey and collection of these *Vigna* species have not been conducted in Laos. This report is a summary of a preliminary field survey of *Vigna* genetic resources in the vicinity of Vientiane, Luang Prabang, Champasak and Saravan provinces.

Methods

The itinerary of the survey is shown in Table 1. The survey route and collection sites are shown in Fig. 1.

Table 1. Itinerary of the survey in Laos

Day	yy/mm/dd	Day	Itinerary	Visit	Stay
1	03.11.14	Fri	Chiang Mai 13:30 – QV645 – Vientiane 15:40		Vientiane
2	03.11.15	Sat	Vientiane		Vientiane
3	03.11.16	Sun	Vientiane (survey around Nam Ngum reservoir by car)		Vientiane
4	03.11.17	Mon	Vientiane (visit NARC, seminar of legume genetic resources research activity in Japan)	NARC	Vientiane
5	03.11.18	Tue	Survey around Vientiane	NARC	Vientiane
6	03.11.19	Wed	Vientiane 10:30 – QV101 – Luang Prabang 11:10		Luang Prabang
7	03.11.20	Thu	Survey southwest and south of Luang Prabang		Luang Prabang
8	03.11.21	Fri	Survey north and northeast of Luang Prabang		Luang Prabang
9	03.11.22	Sat	Luang Parbang 11:30 – QV404 – Vientiane 12:00		Vientiane
10	03.11.23	Sun	Vientiane 06:30 – QV512 – Pakse 07:40 , survey around Pakxong		Pakxong
11	03.11.24	Mon	Pakxong – Saravan – Khongsedon -- Pakse		Pakse
12	03.11.25	Tue	Survey south of Pakse		Pakse
13	03.11.26	Wed	Pakse 11:20 – QV522 – Vientiane 12:30		Vientiane
14	03.11.27	Thu	Vientiane 13:00 – QV414 – Bangkok 14:00		Bangkok
15	03.11.28	Fri	Bangkok 11:20 – TG640 – Narita 19:00		Tsukuba

We have rented a car for the survey trip. At any place where wild *Vigna* seems to be growing, we stopped the car and surveyed the area. Seeds, herbarium specimens and root nodules were collected if available. Information on collection sites including a village name, altitude, latitude, longitude, habitat and other ecological aspects together with a detailed sketch map of the collection sites were recorded as the passport data.

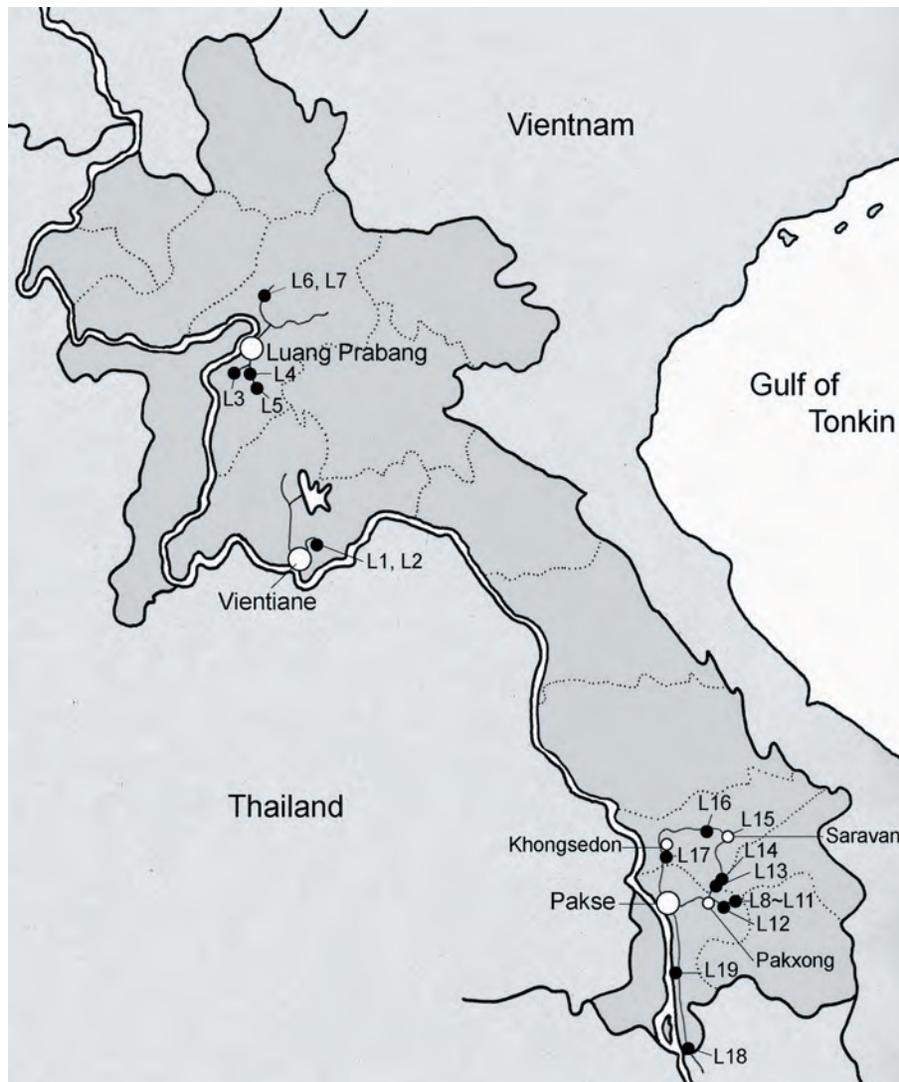


Fig.1. Surveyed areas and collection sites of *Vigna* species in Laos, 2003.

ラオスにおけるササゲ属植物の調査地域と収集地点.

Results

The passport data of collected materials are shown in Table 2.

Vientiane and surrounding area (15th Nov. -18th Nov., 2003)

Vicinity of the Nam Ngum dam located at the north of Vientiane was surveyed on 16th November. Although several places where wild *Vigna* seemed to grow were surveyed carefully, we could not find any species.

After a seminar on the legumes research in NIAS and discussion on the future collaborative project on legumes genetic resources between Laos and Japan were made at NARC on 17th November, the NARC campus was surveyed, but no wild *Vigna* could be found.

On 18th November, vicinity of Vientiane was surveyed. Rice bean (*V. umbellata*) (2003 L1 & L2) was found in a home garden of the village of Ban Sanbon near the town Ban Thangon. The local name is "tua lan tek", which means easily shattering bean. Red and yellow seeded varieties were grown and an old farmer told that she prefers the yellow seeded variety. In this village, several varieties of *V. unguiculata* were cultivated. *V. unguiculata* originated in Africa, but this crop was very common in Laos. Since the environment of Vientiane and vicinity seems to be similar to that of north east Thailand where *V. minima* was found frequently (Tomooka *et al.*, 2000), we expected occurrence of *Vigna* in several deciduous forest areas but failed to find any plants.

Luang Prabang and surrounding areas (19th Nov. - 22nd Nov., 2003)

On 19th November, we flew to Luang Prabang from Vientiane.

On 20th November, we surveyed along the way to Sainyabuli located to the southwest of Luang Prabang. The road is a dirt road and there are many teak plantations along the road. At one village we found several populations of *V. unguiculata* growing naturally in the grassland around paddy fields. Farmers threshing the paddy rice told us that *V. unguiculata* grew spontaneously. They collected and ate the seeds. Seed color is black and are considered to have escaped from cultivation. Seed size is much smaller than modern cultivars sold in the market and pods are very easily shattered. The altitude of this area is around 300m.

In the vicinity of Chiang Mai (Thailand), which seems to have a similar environment, wild *V. umbellata* populations are frequently found at low elevations. However, we could not find any *V. umbellata* populations around Luang Prabang. In the case of Chiang Mai area, *V. minima*, *V. tenuicaulis* and *V. hirtella* are found at altitudes above 600 m. Surveying mountainous areas of a higher elevation at a wet slope, 2 populations of *V. hirtella* were found (2003L4 & 5). The elevation of L4 and L5 are 955 m and 1115 m, respectively. The plants in L5 population have very long pods. Farmers living near the population told that they call this wild bean as "tua sa det" which means "open sunshine beans" .

On 21st November, we have surveyed north and northeastern parts of Luang Prabang.

The road heading from Ban Sieu to Ban Punghai is a dirt road and the environmental condition of surrounding areas seems to be similar to the low elevation areas surveyed on the previous day. We have tried to find wild *Vigna* at several locations but could not find along this road. So we went back to the junction (Ban Sieu) and surveyed along the main road northward. Roadside grassland was very dry and did not seem suited for *Vigna*. At the site about 50 km N of Luang Prabang, there is a large paddy producing village named Huay Heuang. There is a stream in the center of the village. Beside the stream, a single plant of *V. hirtella* was found (2003L6). This plant did not bear any mature pods, so only herbarium specimens and root nodules were collected. About 10m apart from this plant, a small population of *Vigna* sp. (2003L7, cf. *V. reflexo-pilosa*) was found climbing on a tree. Living materials of *V. reflexo-pilosa* have not been collected in mainland Southeast Asia and this may be the first collection.

Pakse and surrounding areas (23rd Nov. - 26th Nov., 2003)

On 23rd November, we moved to Pakse from Vientiane using the morning flight. After renting a car near the airport, we went to Pakxong located in the center of the Bolovens Plateau. The Bolovens Plateau at an elevation of about 1000 m is a famous coffee plantation area since French colonial time. Rice bean was sold in the market of Pakxong, and they said it was cultivated in Senam Noi village. Roadside vegetation of the newly constructed dirt road heading eastward to Senam Noi was surveyed. No wild *Vigna* could be found. In Senam Noi village located about 30km E of Pakxong, we have interviewed several farmers. They said rice bean was cultivated in a remote mountain field together with upland rice. They also mentioned that wild legumes which have similar shape to rice bean with yellow flower could be found there.

At a place several kilometers north along the small village path from the main road junction of Senam Noi village, we asked a farmer whether there is an upland paddy cultivation in the vicinity. She said there are upland paddy fields behind the coffee plantations. In front of her house, several rice bean plants were cultivated. They said there are many wild beans similar to rice bean growing near the upland paddy. So we asked her son (about 12 years old) to take us to the upland paddy field. The upland rice field was located about 5 km from his house. His family migrated from the village near Sekong to this place about 15 years ago, because of the dam construction there. The government supplied the land for them. Several rice varieties were cultivated in the upland field. Seedlings of coffee were also planted among rice plants. He said after clearing the forest, they grow upland rice for one or two years and the place will become coffee plantation afterward. Several other food crops such as cowpea, rice bean, yam bean and yam were planted mixed in the upland rice field.

Around the upland rice field, we found several populations of wild *Vigna* growing (2003L8, 10). They seem to be *V. hirtella* but we need detailed morphological and molecular analyses for the accurate identification. On some plants, many ants gathered on

the extra floral nectars and they seem to protect flowers from pest attack. Escaped rice bean populations (2003L9: black seeds, L11: red seeds) were also found and farmers collect pods from these plants. On the way back from this village to Pakxong, one more population of *V. hirtella*-like plants were found near a stream (2003L12). They had completely matured and dried out.

On 24th of November, a population of *V. minima* (2003L13) was found at 36km N of Pakxong. The population was located in a grassland between main road and upland rice field on the slope of a mountain. The grassland is in an open place. *V. minima* seems to prefer wet soil habitats in grassland. The altitude was about 900 m. In Tha Teng town located about 45km N of Pakxong, we have surveyed around a paddy field. A population of *V. hirtella*-like plants (2003L14) was found between a farmer's hut and a paddy rice field. They are growing in a home garden and climbing in banana trees. Farmers were harvesting paddy rice. The altitude of this site is about 865m.

The altitude decreased rapidly to the north of Tha Teng. At Saravan city located about 35km N of Tha Teng, the altitude falls down to 180m. In Saravan city, we visited the house of Mr. Souvanh's relative. There, rice bean (2003L15) was found climbing on the fence of a backyard garden. The seed color was yellow and size of the seed was relatively large. They were said to have grown spontaneously. It seems escaped rice bean. At about 10 km W of Saravan, a population of *V. minima* (2003L16) was found in the wet soil area on a harvested dry paddy field after harvest.

A village named Bundsgang near Khongsedon town was surveyed. This place is a vast irrigated paddy rice producing area where two crops of rice are possible. According to a farmer, during the time of rice harvesting season, there are plenty of yellow flowered wild legumes growing on the bunds around the paddy fields. He used to collect flowers and young pods for eating when he was young. We visited his house and his elder brother brought us to the paddy fields. He also mentioned that there were many yellow flowered wild legumes growing during rice harvesting time. He also said that after rice harvest, they released water buffalo into paddy field and let them eat grasses around rice fields so that almost all wild legumes might have been eaten already. As he told, we could not recognize any wild legumes around rice fields. However, after very careful survey, we found a single plant of *V. minima* remained on the bunds of the rice field. They said there was a fishpond and a fence surrounded it so that wild legumes might still remain there. We went to the fishpond and found many *V. minima* there (2003L17). They had already reached post maturity stage and almost all the pods had shattered. The farmers told us that wild *Vigna* could be seen only during first rice crop season and could not grow during the irrigated second rice crop season. After collecting remaining pods, we left the village and stayed at Pakse.

On 25th of November, we have surveyed along the road between Pakse and Veunkham, a village located about 150km S of Pakse. Veunkham is located at the border between Laos and Cambodia. In Veunkham village, a ferry port to Cambodia and several shops are located

along the Mekong River. We asked a lady and she told that she saw yellow flowered wild legume in her home garden. We visited her home garden. In the garden, several legume crops such as cowpea, pigeon pea, yard long bean were cultivated among tamarind trees. In one place, we found *V. minima* (2003L18) climbing on the cut tree. This was already in the post maturity stage and almost all the pods have already been shattered. She called this bean as "tua pee". Her family migrated from an island of Cambodia in the Mekong River in 1991. She told us that many wild legumes of this type grew around paddy fields and along the bunds of paddy fields on the island.

In a Ho Khao village located at 72 km N of Veunkham, a lady farmer was cleaning harvested paddy rice. She told us that yellow flowered wild legumes were growing on the bunds of the paddy field during the time of paddy harvesting. She said those legumes are still growing in the forest near the paddy field and took us to the forest. In the forest, there were many yellow flowered wild legumes and they were still in the flowering and maturing stage. They were identified as *V. minima* (2003L19). Red ants gathered to the extra floral nectars. She told she ate young pods and flowers but she did not use mature seeds for eating. After Ho Khao village, we surveyed several paddy fields that seem to have similar ecological conditions but could not find any wild *Vigna*.

Discussion

This is the first systematic survey of cultivated and wild *Vigna* in Laos. It is found that cowpea (*V. unguiculata*) and rice bean (*V. umbellata*) are important legumes in the village and landraces of these species are still grown. Rice bean is considered an important gene source of bruchid resistance for breeding and therefore it is necessary to collect more genetic variation of this species (Kashiwaba *et al.*, 2003). It is now difficult to collect landraces of these species in Thailand (Tomooka, 1995), because Thai farmers prefer to grow improved varieties instead of landraces. Considering this situation, it is important to collect landraces and farmers knowledge before they disappear. As for wild legumes, we found 3 *Vigna* species, *V. hirtella*, cf. *V. reflexo-pilosa* and *V. minima*. The scientific importance and the potential as breeding materials of each wild species are discussed below.

V. hirtella

V. hirtella was first described by Ridley in 1920 based on a material collected on the Malay peninsula. After this, living materials had not been collected until recently, and the identity of the species has been unclear. We have collected several accessions considered to be *V. hirtella* from Malaysia, Thailand and Myanmar (Tomooka *et al.*, 1993, 1997, 2000, 2003). Based on the DNA analyses using Thai and Myanmar materials, a very high level of genetic variation has been recognized (Tomooka *et al.*, 2002a, Doi *et al.*, 2002, Worapa *et al.*, in prep). Further analysis including Laos materials similar to *V. hirtella* collected in Luang Prabang and on the Bolovens plateau will be important in clarifying the diversity in this important species (Tomooka *et al.*, 2002b). Accessions of *V. hirtella* collected in

Thailand are cross compatible with azuki bean and rice bean, further studies regarding to the potential use as breeding materials are important (Tomooka *et al.*, 2000, 2003).

V. reflexo-pilosa

This species is the only tetraploid species in the genus *Vigna*. Formerly another tetraploid species had been described using a material collected in Mauritius. This material was first described under the name *Phaseolus glaber* in 1832 by Roxburgh. Verdcourt (1970) considered this to be a glabrous variety of mungbean and gave a name *V. radiata* var. *glabra*. Swindell *et al.* (1973) revealed that this species has tetraploid nature using a material collected in the Philippines. Maréchal *et al.* (1978) treated this taxa as a distinct species under the name *V. glabrescens*, mentioned that several specimens conserved in Paris herbarium, which were collected in Vietnam, match this species. This tetraploid cultigen has vigorous growth and shows high levels of resistance to major diseases and pests as well as abiotic stresses, so that attempts have been made to use this species for the breeding of mungbean at the Asian Vegetable Research and Development Center (AVRDC) (Fernandez and Shanmugasundaram, 1998).

We have compared *V. glabrescens* conserved in AVRDC and *V. reflexo-pilosa* collected in Malaysia and Okinawa prefecture in Japan and revealed that morphology, protease inhibitors profiles and DNA sequences of rDNA ITS and *atpB-rbcL* intergenic regions of cpDNA between these two species showed very high levels of similarity (Konarev *et al.*, 2002, Doi *et al.*, 2002). Considering these similarity, their tetraploid nature, and high levels of cross compatibility, Tomooka *et al.* (2003) proposed that *V. reflexo-pilosa* is a wild ancestor of *V. glabrescens*, and renamed this cultigen as *V. reflexo-pilosa* var. *glabra*. This little known cultigen has a high potential as a food legume as well as forage crop. It has been reported to be cultivated in Mauritius, West Bengal, Vietnam and the Philippines, but its cultivation may nearly be extinct. Kobayashi *et al.* (1994) discovered this crop still be cultivated in Cao Bang and Lang Son provinces in northern Vietnam. This crop was grown mixed with corn and recognized as the same crop as mungbean called “Dao Xanh Vo” and “Dao Xanh Thua Cook” there.

This legume has a potential to become a “new” crop considering its robust nature. The number of available living materials of this species in the world genebanks is very limited. Therefore it is necessary to survey and collect this crop before it disappears. It seems probable that this crop is still cultivated in Laos. *V. reflexo-pilosa* var. *reflexo-pilosa* can be used for broadening the genetic base of var. *glabra*. For this reason, wild cf. *V. reflexo-pilosa* accession collected is considered to be a valuable genetic resource.

V. minima

V. minima can cross with azuki bean and rice bean and is considered to be a useful gene source for these crops (Yoon *et al.*, 2000, Tomooka *et al.*, 2002a). Up to now, we have collected accessions of *V. minima* in Thailand and Myanmar. They grow in shady wet habitats located between 600 and 1000 m alt. in northern Thailand. In northeast Thailand, they were found in dry deciduous forest and they are sometimes crawling on the shady

floor or sometimes climbing in trees. Consequently *V. minima* has been considered a species of shady habitats.

However, based on the information from the farmers of Khongsedon and Ho Khao villages in southern Laos, *V. minima* grows profusely in a sunny place such as on the paddy bunds. It is interesting to note that *V. minima* can be seen only in rainy season. According to the information from farmers in Khongsedon village, two crops of rice cultivation are prevailed in Khongsedon village, first crop is in the rainy season and the second crop is in the dry season using irrigation water from the Mekong River. They told that there were plenty of *Vigna* growing on the bunds in rainy season crop. However, they told that they did not see any *Vigna* in the dry season. Since there is irrigation water in the paddy field, it is strange that there is no *Vigna* in dry season.

Judging from the growth pattern of *V. minima* in Khongsedon village, this species seems to have a high potential as a cover crop to protect paddy bunds. After rice harvest they can be used as forage. In central dry zone of Myanmar, Tomooka *et al.* (2003) observed *V. stipulacea* showed a similar growth pattern. They grow exclusively on the bunds of the heavy clay soil paddy field. Further study regarding to symbiotic nitrogen fixation ability, allelopathic effects, water logging resistance are important research approaches for studying wild *Vigna* genetic resources.

Acknowledgements

This research is supported by the Research project of the Research Institute for Humanity and Nature (No.4-2) "A Transdisciplinary Study on the Regional Eco-History in Tropical Monsoon Asia: 1945-2005"

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和文摘要

ラオスは東南アジア大陸部に位置し、北部山岳地帯から南部平地地帯まで多様な生態環境を有する国であるが、これまで植物遺伝資源の組織的調査収集は行われてこなかった。今回ラオスのヴィエンチャン (Vientiane) 周辺、ルアンプラバン (Luang Prabang) 県周辺およびチャンパサック (Champasak)、サラヴァン (Saravan) 県周辺において *Vigna* (ササゲ) 属マメ類遺伝資源の分布調査を行い、ツルアズキ (*Vigna umbellata*) 5 点、エスケープと思われるササゲ (*V. unguiculata*) 1 点、*V. hirtella* 3 点、*Vigna* sp. (cf. *V. reflexo-pilosa*) 1 点、*V. minima* 5 点、*Vigna* sp. (cf. *V. hirtella*) 1 点を収集できたので報告する。

ツルアズキはヴィエンチャン郊外の農家の庭先で栽培されていた。南部のチャンパサックやサラヴァン県においても、ボロヴェン高原パクソン (Pakxong) の市場で売られていた他、パクソン東部の陸稲畑でも自家消費用に作られていた。この陸稲畑の周辺にはおそらく *V. hirtella* と思われる植物が多数生育していた。また、低地部サラヴァンの町では民家の垣根にエスケープと思われる黄色種子のツルアズキが自生していた。

ササゲは、広く一般に栽培されていた。ルアンプラバンの南東部水田地帯で水田の周辺に自生していた逸脱と思われるササゲを収集した。このササゲは黒種子で現在一般に栽培されている品種に比べて小粒で莢の裂莢性が高かった。農民はこの自生しているササゲを収集して食べるという。ルアンプラバンの南部標高約 1000m の山岳道路脇で *V. hirtella* を 2 点収集した。また、ルアンプラバンの北部水田地帯の小河川沿いで *V. hirtella* と思われる個体を発見したが未熟で種子は収集できなかった。また、そこから約 15m の地点で河川沿いの樹木に絡み付いている *V. reflexo-pilosa* と思われる植物を発見した。

V. minima は、南部においていくつかの自生地を見出すことができた。まず、ボロヴェン高原の焼畑跡地と思われる道路脇の草原に自生しているのを発見した。さらに、サラヴァンやチャンパサック県の平地部では水田地帯の畦や周辺の林に生育していた。サラヴァン県 Khongsedon 村の農民によれば、水稻の収穫期には畦は *V. minima* の黄色い花で覆われるそうで、昔からその花や若莢を集めて食べていたという。水稻の収穫後には、水田に水牛を放牧し畦や周辺の *V. minima* やその他の雑草を食べさせるそうである。

Table 2. Passport data of the collected materials in Laos 2003

No.	Coll. Date	Coll. No.	Species	Status	Collection Site	Latitude/ Longitude	Altitude (m)	Habitat	Shading	Disturbance	Population size	Growth stage	Soil	Seed	Herbarium	Rhizobium	Remarks
1	2003/11/18	2003L-1	<i>Vigna umbellata</i> (Thunb.) Ohwi et Ohashi 5420610012	cultivated	Ban Sanbor, Ban Thangor, Vientiane	N18-13-26 E102-44-65	187m	kitchen garden	light	medium	several plants	mature	fine silt	yes	no	no	Yellow seed
2	2003/11/18	2003L-2	<i>Vigna umbellata</i> (Thunb.) Ohwi et Ohashi 5420610012	cultivated	Ban Sanbor, Ban Thangor, Vientiane	N18-13-26 E102-44-65	187m	kitchen garden	light	medium	several plants	mature	fine silt	yes	no	no	Red seed
3	2004/11/20	2003L-3	<i>Vigna unguiculata</i> (L.) Walpers cv-gr. Unguiculata E. Westphal 5420610051	escape	30km SW of Luang Prabang	N19-39 E102-04	300m	beside paddy field	light	high	many	mature	clay	yes	no	no	seed size small, easy shattering
4	2004/11/20	2003L-4	<i>Vigna hirtella</i> Ridley 5420610031	wild	Kew Gnau (Phabang Region), Xieng Ngeun District, Luang Prabang	N19-41-93 E102-11-92	955m	road side, slope 5°	medium	high	a few plants	past maturity	red soil clay	yes	yes	yes	no flower seen, very small stipule
5	2004/11/20	2003L-5	<i>Vigna hirtella</i> Ridley 5420610031	wild	33.4km S of Luang Prabang	N19-35-46 E102-13-37	1115m	beside road	heavy	high	several plants	flowering ←→ mature	wet clay	yes	yes	yes	long pods Local name: Tua Sa(=open) det(d)=(sun shine)
6	2004/11/21	2003L-6	<i>Vigna hirtella</i> Ridley 5420610031	wild	about 45km landmark, Hovay Leuang, Pakou, Luang Prabang	N20-13-65 E102-20-19	270m	near the stream	medium	high	maybe single plant	mature	clay	no	yes	yes	very wet riverside
7	2004/11/21	2003L-7	<i>Vigna</i> sp. 5420610019	wild	about 45km landmark, Hovay Leuang, Pakou, Luang Prabang	N20-13-65 E102-20-19	270m	near the stream	heavy	medium	a few plants	mature	clay	yes	yes	no	cf. <i>V. reflexo-pilosa</i> . Flowers dark yellow, outside standard purple. Some pods shattered or shirvelled, others still young, no good mature pods found. Very large leaflet.
8	2004/11/23	2003L-8	<i>Vigna</i> sp. 5420610019	wild	Som Nuk, Senam Noi, Pakxong, Cham Pasak	N15-09-94 E106-29-24	890m	beside upland rice	light	medium	several population sporadically	past maturity	red silt	yes	yes	no	cf. <i>V. hirtella</i> . No. open flowers seen. Leaf: dense hairy. Pods: black & pale brown.
9	2004/11/23	2003L-9	<i>Vigna umbellata</i> (Thunb.) Ohwi et Ohashi 5420610012	escape	Som Nuk, Senam Noi, Pakxong, Cham Pasak	N15-09-94 E106-29-24	890m	beside upland rice	light	medium	several population sporadically	past maturity	red silt	no	yes	no	seed color: black No. open flowers seen.
10	2004/11/23	2003L-10	<i>Vigna</i> sp. 5420610019	wild	Som Nuk, Senam Noi, Pakxong, Cham Pasak	N15-09-94 E106-29-24	890m	beside upland rice	light	medium	several population sporadically	past maturity	red silt	yes	yes	no	cf. <i>V. hirtella</i> No. open flowers seen. Leaf: dense hairy.
11	2004/11/23	2003L-11	<i>Vigna umbellata</i> (Thunb.) Ohwi et Ohashi 5420610012	escape	Som Nuk, Senam Noi, Pakxong, Cham Pasak	N15-09-94 E106-29-24	890m	beside upland rice	light	medium	several population sporadically	past maturity	red silt	no	no	no	seed color: red No. open flowers seen.
12	2004/11/24	2003L-12	<i>Vigna</i> sp. 5420610019	wild	ca. 20km E of Pakxong, Cham Pasak	N15-24-36 E106-23-19	1000m	beside river	medium	high	several plants	past maturity	silt	yes	no	no	cf. <i>V. hirtella</i> Plants already dry out.
13	2004/11/24	2003L-13	<i>Vigna minima</i> (Roxb.) Ohwi & Ohashi 5420610033	wild	30.1km N of Pakxong (GPS), Tha Teng, Sekong	N15-24-36 E106-23-19	900m	maybe after upland paddy Slope: 3°	open	low	many	mature	clay	yes	yes	yes	Flower color: clean yellow with purple outside Flower: small. Leaf: dark green.
14	2004/11/24	2003L-14	<i>Vigna</i> sp. 5420610019	wild	Tha Teng, Sekong	N15-25-25 E106-22-86	865m	between farmers hut and paddy	medium	medium	several plants	mature	silt	yes	yes	no	cf. <i>V. hirtella</i> small flower

Table 2 (continued).

No.	Coll. Date	Coll. No.	Species	Status	Collection Site	Latitude/Longitude	Altitude (m)	Habitat	Shading	Distur-bance	Population size	Growth stage	Soil	Seed	Herba-rium	Rhizo-bium	Remarks
15	2004/11/24	2003L-15	<i>Vigna umbellata</i> (Thunb.) Ohwi et Ohashi 5420610012	escape	Saravan, Saravan	N15-42 E106-24	180m	backyard garden fence	open	medium	several plants	flowering → mature	silt	yes	yes	no	Escape yellow seed. They said grow naturally.
16	2004/11/24	2003L-16	<i>Vigna minima</i> (Roxb.) Ohwi & Ohashi 5420610033	wild	W of Saravan, Saravan	N15-41-67 E106-15-66	191m	beside paddy (wet place)	medium	medium	several plants	mature	clay	yes	yes	yes	only in wet place
17	2004/11/24	2003L-17	<i>Vigna minima</i> (Roxb.) Ohwi & Ohashi 5420610033	wild	Bungang, Khongsedon, Saravan	N15-33 E105-47	135m	ridge of paddy field	open	medium	farmers said all along paddy ridge	past maturity	clay	yes	yes	no	Local name: Tua pee
18	2004/11/25	2003L-18	<i>Vigna minima</i> (Roxb.) Ohwi & Ohashi 5420610033	wild	134km S from Pakse, Mr. Keo, Veun Khan Village, Cham Pasak	N13-55-52 E105-59-33	71m	backyard garden	open	medium	several plants	past maturity	silt	yes	yes	no	Local name: Tua pee. Flower color: clean yellow, outside standard purple. Narrow leaflet.
19	2004/11/25	2003L-19	<i>Vigna minima</i> (Roxb.) Ohwi & Ohashi 5420610033	wild	Ho Khao, ca. 70km S of Pakse, Cham Pasak	N14-22-48 E105-53-36	100m	forest beside paddy	medium	medium	many plants in the forest	flowering → mature	clay	yes	yes	no	Local name: Tua sian Many red soldier ants gather to flower (extra floral nectars)



Photo 1. 2003L5 *V.hirtella* site (1115m). South of Luang Prabang.



Photo 2. 2003L8(cf. *V. hirtella*) site (890m). Southern Laos. Beside upland paddy field near Pakxong on the Bolovens plateau.



Photo 3. 2003L6,7 sites (270m). Paddy field area, north of Luang Prabang where *V.hirtella* and *Vigna* sp. (cf.*V.reflexo-pilosa*) were found.



Photo 4. 2003L7 site (270m). North of Luang Prabang. *Vigna* sp.(cf. *V.reflexo-pilosa*) climbing on a tall tree near the stream.



Photo 5. 2003L17 site(135m). Southern Laos. A farmer told that plenty of *V.minima* plants grew on the paddy bunds at Khongsedon village, Saravan province.



Photo 6. 2003L19 site(100m).Southern Laos, south of Pakse. Red ants gathered to the extra-floral nectars of *V.minima* flower.They may protect flowers and pods from insect pests.