

Collection and Conservation of Leguminous Crops and Their Wild Relatives in Cambodia, 2013

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Summary

We have conducted a field survey on the leguminous plants in Cambodia from 18th to 27th November, 2013. A total of 74 accessions were collected, including *Vigna minima* (Roxb.) Ohwi & Ohashi, *Vigna umbellata* (Thunb.) Ohwi & Ohashi, *Vigna radiata* (L.) Wilczek, *Vigna reflexo-pilosa* Hayata, *Vigna unguiculata* (L.) Walp., *Phaseolus vulgaris* L. and *Glycine max* (L.) Merr.. The seeds had been conserved in the Cambodian Agricultural Research and Development Institute (CARDI) genebank, and the subset was transferred to the National Institute of Agrobiological Sciences (NIAS) genebank. We plan to multiply the seeds and evaluate their growth traits in NIAS, Japan.

KEY WORDS : Cambodia, Legume, *Vigna*, *Phaseolus vulgaris*, *Glycine max*

Introduction

Improving the yield of food crop production is one of the most important and urgent challenges for human being. This challenge requires the genetic diversity of crop for developing new crop varieties with both stress tolerance and high yield performance. However, the genetic diversity of crop has been decreased since the advent of modern agriculture. The genetic diversity of crop can also be improved by introducing genes from their wild relatives, but the habitats of wild relatives are also rapidly disappearing through environmental changes and urbanization. To secure the genetic diversity of crops and their wild relatives, the NIAS genebank was established to collect and conserve the wide range of germplasm.

The genus *Vigna* (the main target of the present survey) belongs to the legume family (Leguminosae), and includes several crop plants such as cowpea (*V. unguiculata* (L.) Walp.), mungbean (*V. radiata* (L.) Wilczek), rice bean (*V. umbellata* (Thunb.) Ohwi & Ohashi) and azuki bean (*Vigna angularis* (willd.) Ohwi & Ohashi). Their wild relatives grow in a diverse range of environments such as arid areas, coastlines and lime stone mountains. In addition, some of the wild *Vigna* species distributed in Cambodia such as *Vigna*

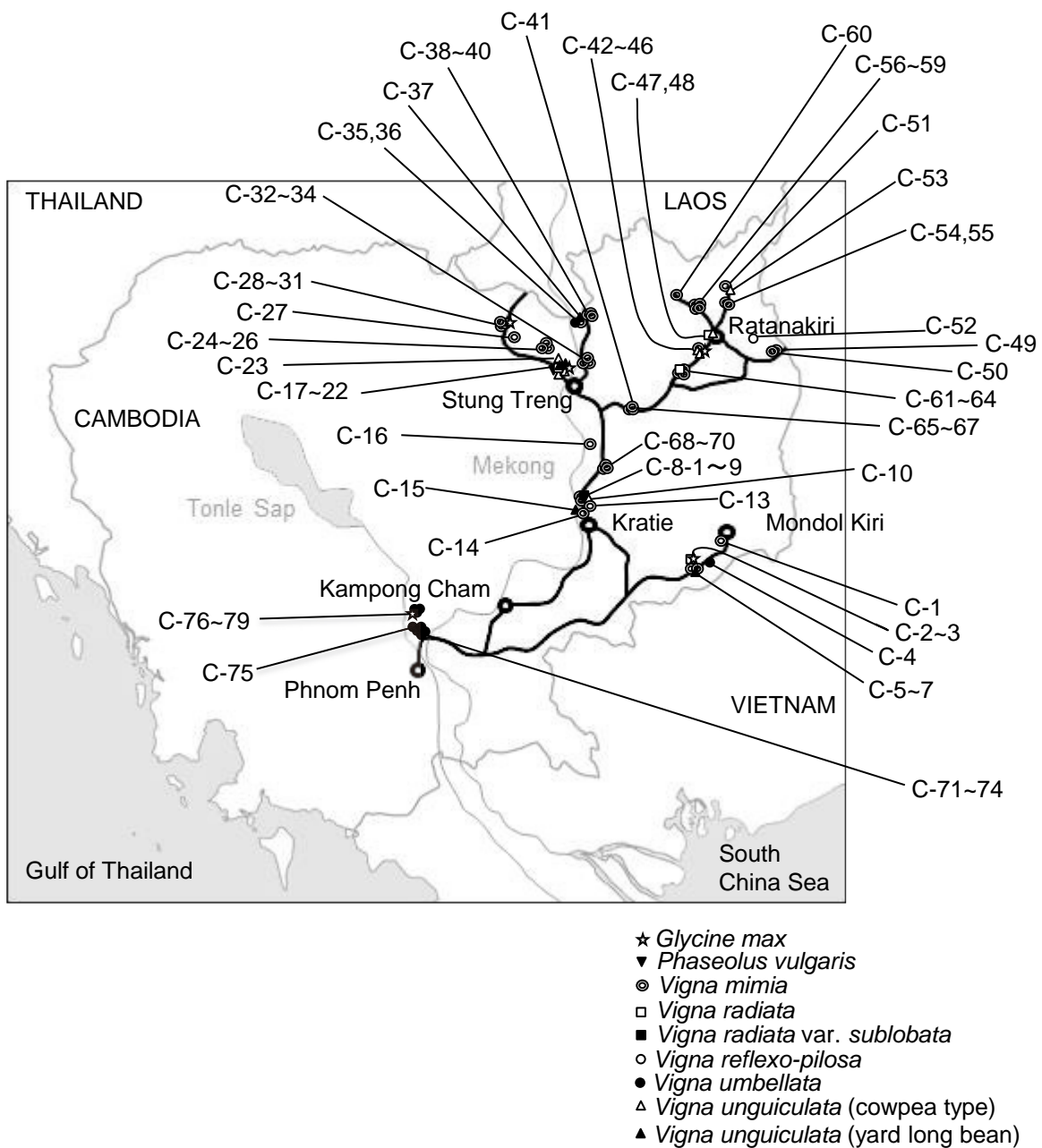


Fig. 1. Survey routes and collection sites in Cambodia, 2013

minima (Roxb.) Ohwi & Ohashi and *V. radiata* (L.) var. *sublobata* (Roxb.) Verd court can cross with *Vigna* crop. *Vigna minima* can cross with rice bean and azuki bean, while *V. radiata* var. *sublobata* can cross with mungbean. Therefore, it is expected that these wild relatives could be used directly as the breeding materials to develop stress tolerant crops. For this reason, the NIAS genebank has been concentrating on the collection and evaluation of wild *Vigna*. However, legume genetic resources (especially for wild *Vigna*) collection had not been conducted in Cambodia neither by CARDI nor by any other international research institutes including NIAS. This is a report of the third collaborative field survey on the collection of leguminous plants in Cambodia. The field survey was conducted by the researchers of the NIAS and CARDI, based on a Letter of Agreement (LOA) on Joint Research of Plant Genetic Resources between the NIAS and CARDI signed on November 2011.

The first survey in 2011 was conducted in the southern part (Kampong Speu and Kep provinces) and in the eastern part of Cambodia (Kratie and Mondol Kiri provinces) (Tomooka *et al.*, 2012). A total of 18

Table 1. Itinerary of the field survey in Cambodia, 2013

Date	Itinerary	Stay
11/17	Bangkok -- Phnom Penh	Phnom Penh
11/18	Phnom Penh (visit CARDI)	Phnom Penh
11/19	Phnom Penh -- Mondol Kiri	Mondol Kiri
11/20	Mondol Kiri -- Kratie	Kratie
11/21	Kratie -- Stung Treng	Stung Treng
11/22	Stung Treng	Stung Treng
11/23	Stung Treng -- Rattanakiri	Rattanakiri
11/24	Rattanakiri	Rattanakiri
11/25	Rattanakiri	Rattanakiri
11/26	Rattanakiri -- Kratie -- Kampong Cham	Kampong Cham
11/27	Kampong Cham -- Phnom Penh	Phnom Penh
11/28	Phnom Penh (visit CARDI) -- Bangkok	Bangkok

Table 2. A summary of collected samples in Cambodia, 2013.

Species	Domesticated form (cultivated)	Naturally growing plants		Total
		Intermediate form	Wild form	
<i>Vigna minima</i>	-	-	41	41
<i>Vigna umbellata</i>	1	8	1	10
<i>Vigna radiata</i>	3	-	1	4
<i>Vigna reflexo-pilosa</i>	-	-	1	1
<i>Vigna unguiculata</i>	9	3	-	12
<i>Phaseolus vulgaris</i>	1	-	-	1
<i>Glycine max</i>	5	-	-	5
Total	19	11	44	74

accessions of leguminous plants consist of *Lablab purpureus* (L.) Sweet (1 accession), *Vigna minima* (7), *V. radiata* var. *sublobata* (1), *V. umbellata* (4) and *V. unguiculata* (5) were collected. The second survey in 2012 was conducted in the southwestern part (Sihanoukville and Koh Kong provinces) and northern part (Siem Reap, Anlong Veng, Tbaeng Meanchay and Kampong Thom provinces) of Cambodia (Tomooka *et al.*, 2013). As a result, 38 accessions of leguminous plants consist of *Lablab purpureus* (1 accession), *Vigna marina* (Burm.) Merr. (8), *V. minima* (10), *V. radiata* (3), *V. umbellata* (9), *V. unguiculata* (6) and *V. vexillata* (L.) A. Rich. (1) were collected. Therefore the target area in the present survey was planned to cover northwestern part of Cambodia where it was not visited in the former trips.

Methods

A field survey was conducted in Cambodia from 18th to 27th of November, 2013 (Table 1). We departed from Phnom Penh, and visited Mondol Kiri, Kratie, Stung Treng and reached Rattanakiri province by car, then returning to Phnom Penh via Kratie and Kampong Chan provinces (Fig. 1). When we saw wild *Vigna* plants from the car or saw the environment (vegetation) where wild *Vigna* plants seemed to grow, we stopped our car and search the area. In addition, when we came across farming villages, we sometimes stopped our car and conducted an interview to farmers on the cultivation of legume crops and also utilization of wild *Vigna* plants.

When we found wild *Vigna* population, bulk seeds were collected from naturally growing plants.

If a population contained plants with different traits, the seeds were separated according to these traits. Naturally growing plants (not cultivated by farmers) were classified visually either as wild form or intermediate form. Wild form shows typical wild characteristics, such as mottled black small seeds, shattering pods and twining slender stems. Intermediate form shows some of the characteristics of the domesticated form, generally having light-colored larger seeds, weak-shattering pods and non or less twinning stems. The domesticated form was collected from a seeds stock or a field of farmer, or from a local market. The collection was summarized in Table 2.

Identification of the *Vigna* species was based on a taxonomic key (Tomooka *et al.* 2002). As a passport data, the place name, latitude, longitude, altitude, characteristics of the collection site and plant population and information from local people were recorded (Table 3). The latitude, longitude and altitude were measured by Garmin GPSmap 60CSx using WGS84 world geodetic system. Dry weight of 100 seeds for each accession was recorded using collected seeds. Where there were less than 100 seeds available per an accession, this value was estimated by weighing all the seeds.

Results and discussion

A total of 74 accessions were collected from 6 species in 2 genera of legume (Table 2). These included 41 accessions of *V. minima*, 10 accessions of *V. umbellata*, 4 accessions of *V. radiata*, 1 accession of *V. reflexo-pilosa*, 12 accessions of *V. unguiculata*, 1 accession of *Phaseolus vulgaris* and 5 accessions of *G. max*.

Vigna minima (Roxb.) Ohwi & Ohashi

Vigna minima is a wild species and its cultivation has not been recorded. It could be used as breeding materials for azuki bean (*V. angularis*) and rice bean (*V. umbellata*), since these two cultivated species can be crossed with *V. minima*. Based on our 3 years field survey, it was revealed that *V. minima* grew in a diverse range of environments throughout Cambodia, and plants with different traits were frequently observed within a population.

In Mondol Kiri province, accession 'C1' was found on the floor of a pine forest at an altitude 505 m (Photos 1, 2). We visited the same site 2 years ago (Tomooka *et al.*, 2012). In 2011, we saw more plants crawling or sometimes climbing on large trees, but the population has now reduced in size. Accession 'C5' was found growing on the red gravel soil beside road (Photo 3, 4). 'C5' had a thick ovate leaflet that was not wilted, although this site was extremely dry. Seeds of 'C5' were small (100 seeds = 1.00 g) among collected *V. minima* accessions. 'C13' was found growing on the floor of a forest (Photo 5). This spot was an open gap space and had sunlight with many grasses flourishing. The pod of 'C13' was black, and the seeds were small (100 seeds = 1.18 g). 'C16' was found at an altitude of 57 m in the flood plains of the Mekong River (Photo 6). The plants of this population had extremely long linear leaflets, and had large seeds (100 seeds = 2.13 g). The local people told us that they boil the young pods of this naturally growing plant for food. In addition, Mrs. Heang Phola from Kok Nyay village told us that the flowers are eaten with rice noodles (Photo 7). Accessions 'C68' and 'C69' were found growing in a grassland area with a dense tree growth. The pods of 'C68' were pale brown, with lower pod shattering ability showing 2-3 twists of shattered pod (Photo 8). The pods of 'C69' were dark colored, with 5-6 twists of shattered pod indicating strong pod shattering ability. In the domestication genetics study, the number of twists of shattered dry pod was used as an indicator of pod shattering ability, one of the important domestication traits (Kaga *et al.* 2008).

In Stung Treng province, a population consists of 'C24', 'C25' and 'C26' were found growing between lowland forests and grasslands along the state highway on the west side of Mekong River (Photo 9, 10). The flower and pod sizes of 'C24' and 'C26' were conspicuously different. 'C24' had a large plant with linear leaves and produced large seeds (100 seeds = 2.86 g). 'C26' had a small plant with ovate leaves and produced small seeds (100 seeds = 1.34 g). We discovered another population with high diversity which consisted of 'C28', 'C29', 'C30' and 'C31' in a grassland near rice paddies at Chowang village. 'C28' had a small plant with small seeds (100 seeds = 0.93 g), but 'C29' had a larger plant with more than 3 times larger seeds (100 seeds = 2.89 g). 'C31' plants were growing vigorously, climbing on a tree (Photo 11). However, most of the seeds had been sucked by stinkbugs. A population consists of 'C32', 'C33' and 'C34' were discovered between the state highway and the rice paddies located north of Stung Treng (Photo 12). The pods and seeds were light brown, especially in 'C33'. Another interesting population consists of 'C38' and 'C39' was discovered in dark forest floor grassland located near the border with Laos (Photo 13, 14, 15). The site was covered by dense bamboo grasses under high canopy forest. 'C38' had ovate leaflets and pale whitish seed hila, while 'C39' had lanceolate to linear leaflets and blackish seed hila.

In Rattanakiri province, 'C41' was found growing in a thick bamboo grass bush under lowland open forest along the state highway 'route 78' (Photo 16). Almost all leaves of 'C41' were totally hidden by bamboo grass bush, but flowers and pods could be seen on the twining elongated stem protruding out of the bush. In addition, 'C65' with two trifoliate leaves developed from one stem node was discovered at this site (Photo 17). Three independent plants having this 'C65' type leaves were discovered in close proximity, leading us to believe that this trait was genetic. 'C42' was discovered in grassland near rice paddies along the same state highway (Photo 18). The seed coat of this accession was shiny black. This was the first experience that we found *V. minima* plants having seed coat of shiny black. However, only one individual in the population had a seed coat of this color. 'C50' was then discovered in a swampy water site (Photo 19, 20). Surprisingly, this accession was growing together with aquatic plants such as sedges (Family Cyperaceae) and arums (Family Araceae). After the collection of 'C50', we discovered a *V. minima* population 'C51' consists of plants with slender stems and plenty of small, soft leaflets in a wet stream side area close to the border with Vietnam (Photo 21). None of the plants had any pod. Accessions 'C61', 'C61B' and 'C63' were collected from the plants growing on the ridge of rice paddy beside a sunny open forest (Photo 22). Many *V. minima* plants were also growing on the open forest floor but they did not bear the pods. Bulk samples of accession 'C61' contained some black colored seeds, so they were separated after harvesting and named as 'C61B'. The flowers of *V. minima* are usually golden yellow in color, but some plants in this population had pale yellow flowers (Photo 23).

A relationship between the altitude of collection site and the weight of 100 seeds in *V. minima* was shown (Fig. 2). The seed weights of plants growing in a site above 200 m altitude are below 1.8 g (the average weight of 100 seeds). In contrast, wide seed size variation (from ca. 1.5 g to 3.0 g of 100 seed weight) was observed for plants growing in lowland (a site below 200 m altitude). The seeds produced from plants with long linear leaflets growing in an open forest floor of the lowland flood plains and rice paddies are large. Plants with small seeds tend to have ovate leaves or small lanceolate to ovate leaflets.

Based on the interviews, people living in the lowland flood plains sometimes use flowers and young pods of naturally growing *V. minima* as food. Most of the *V. minima* plants grown in lowland flood plains have large flowers, pods and seeds and sometimes have variation including light-colored and weakly-shattering pods (Photo 24). So far, neither cultivation of wild *V. minima* nor the domesticated form of

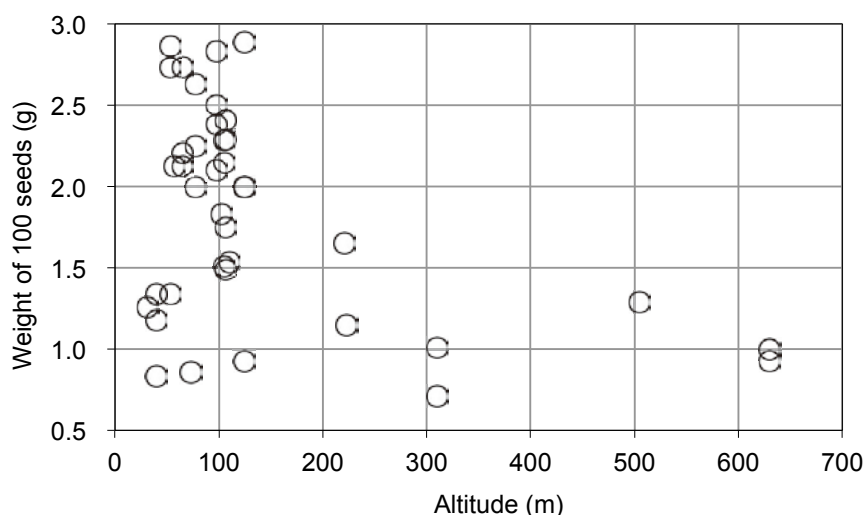


Fig. 2. A relationship between the altitude and the seed weight of 39 accessions of *V. minima* collected in Cambodia

V. minima have not been recorded. Considering the exceptionally high levels of morphological diversity including existence of plants with large seeds, large pods with lower shattering ability, large flowers and shiny black seed coat, there could be a possibility of human selection to *V. minima* which could be called semi-domestication. Although it is not known that the domestication of *V. minima* had been proceeded or not, potential value of domesticating this species as a new food crop named gneo-domesticationh (Tomooka *et al.*, 2014) needs to be investigated since there seems to be a high adaptability of this edible species against various stressful environments. gNeo-domesticationh is a newly proposed concept to develop new stress tolerant crops from wild edible species which is adapted to highly stressful environments by artificial mutation breeding by irradiation or chemical mutagens. In this concept, selection should be accelerated based on the detection of sequence variation of already identified domestication genes such as seed size increase gene, pod shattering gene and seed dormancy gene (TILLING). By the gneo-domesticationh, it is expected to develop new stress adapted crops with higher level of tolerance compared with the existing domesticated crops.

***Vigna umbellata* (Thunb.) Ohwi & Ohashi**

Vigna umbellata includes the wild form and the domesticated form (rice bean). It is cross compatible with *V. minima*.

In Mondol Kiri province, accession 'C4' was found in a farmerfs home garden located on an isolated area close to the border with Vietnam (Photo 25). Local resident Mr. Seab Son Aoon said that he started cultivating this plant using seeds collected from naturally growing plants near the pond in his home garden. It was thought that this plant was an escape from cultivation, because the plant had large red colored seeds and weak-shattering pods.

In Stung Treng province, an accession 'C35' was growing naturally at roadside near the border with Laos (Photo 26, 27). *V. minima* 'C36' was also discovered at the same site, on the opposite side of the road. This is the only place where both species were discovered together. The plants of two species were in different growth stages. 'C35' (*V. umbellata*) was in full bloom, whereas 'C36' (*V. minima*) was at the maturity stage. So, in addition to the fact that these two species have different habitat, the different

phenology (flowering time) is thought to be another mechanism of reducing natural hybridization event even in sympatric populations.

In Kampong Chan, 8 naturally growing *V. umbellata* populations were discovered in the paddy field areas (Photo 28). Since these had relatively large seeds and weak-shattering pod (Photo 29), they were classified as 'weedy form' probably escaped populations from old cultivation or naturally growing populations derived from natural hybridization between cultivated and wild *V. umbellata*. However, since an accession 'C75' had small black mottled seeds and strongly shattered pods, it was classified as 'wild form' in this report.

***Vigna radiata* (L.) Wilczek**

Vigna radiata includes the wild form (var. *sublobata*) and the domesticated form, mungbean (var. *radiata*). In Kratie province, an accession 'C9' was discovered at the boundary between the houses and the rural road in Koh San village (Photo 30, 31). Only one population of wild *V. radiata* was discovered in this survey. Although we could not confirm the distribution of wild *V. radiata* from Cambodia based on the herbarium survey in Europe (Tomooka *et al.* 2002), wild *V. radiata* was revealed to be distributed sporadically in Cambodia (Tomooka *et al.* 2013).

***Vigna reflexo-pilosa* Hayata**

All the members of the genus *Vigna* are diploid ($2n=22$) except *Vigna reflexo-pilosa*, which is amphidiploid ($2n=4x=44$). *Vigna reflexo-pilosa* includes the wild form (var. *reflexo-pilosa*) and the cultivated form, creole bean (var. *glabra*). An accession 'C52' is a wild form, found growing naturally on the edge of swamp in Ratanakiri province (Photo 32, 33, 34). The distribution of wild form is concentrated in Southeast Asia and Oceania (Tomooka *et al.* 2002). This is the first record of this species from Cambodia.

***Vigna unguiculata* (L.) Walp.**

It is believed that *Vigna unguiculata* was domesticated in Africa (Ng and Marechal 1985). It is cultivated in Cambodia as grain legume (cowpea, cultivar group *Unguiculata*), and as vegetable legume (yard long bean, cultivar group *Sesquipedalis*). Populations with small seeds were found growing naturally in Kratie, Stung Treng and Rattanakiri provinces ('C10', 'C23', 'C45') (Photos 35, 36). They were classified as weedy form, because these accessions have shiny black seed coats (see seed photo) and weak-shattering pods.

The young pods of yard long bean are frequently sold in the market, and are eaten as a side dish with noodles or in a salad (Photos 37, 38). Yard long beans are commonly cultivated in local farmer's gardens (Photo 39). Generally, the seed coat color was black, brown or speckled white. However, a variety sold in Stung Treng had plain white seed coats ('C21').

***Phaseolus vulgaris* L.**

An accession of kidney bean (*Phaseolus vulgaris*) was collected at a market of Stung Treng. It was called "Sandaek Ankouy (=sit down) Kmao (=black)".

***Glycine max* (L.) Merr.**

Processed soybean products are sold in the form of tofu and fermented bean seasoning in local

markets (Photos 40, 41). Accessions 'C3' and 'C27' were also sold in local markets as food in Stung Treng and Ratanakiri provinces. The soybean seeds in Cambodia were generally small and light yellow.

In Chowang village, Stung Treng province, soybean cultivation seemed to be common, and harvested seeds were dried on roadside when we visited. According to Mrs. Kawd Wa, who was drying 'C27' on her garden, soybean is not a traditional crop in this area, but is a new crop cultivated as a cash crop (Photo 42).

In Kampong Chan province, an accession 'C78' was grown in a field next to the weedy forms of *V. umbellata* ('C76', 'C77', 'C79'). An owner of the field, Mr. Song Sok Kaing, told us that "the seeds were sown in July, which is the best time. If there is no damage from pests and diseases, the yield is 1.5-2 tons per hectare, and the price is 50 cents per kilogram." (Photo 43)

Genetic resources

In this survey, we collected 74 accessions of leguminous plants. All the seeds had been stored in CARDI genebank, and the subsets were transferred to the NIAS genebank using Standard Material Transfer Agreement (SMTA) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). We plan to multiply from the seeds and evaluate their traits in 2014.

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カンボジアにおけるマメ科遺伝資源多様性の保全， 2013年

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和文摘要

本報告は独立行政法人農業生物資源研究所ジーンバンクとカンボジア農業研究機構の間で2011年11月に締結した共同研究協定（LOA）に基づいて行ったカンボジアにおける第三回目のマメ科植物遺伝資源の調査報告である。調査は2013年11月18日から27日にかけて行った。その結果、ホソバツルアズキ（*Vigna minima*）、ツルアズキ（*Vigna umbellata*）、リョクトウ（*Vigna radiata*）、オオヤブツルアズキ（*Vigna reflexo-pilosa*）、ササゲ（*Vigna unguiculata*）、インゲンマメ（*Phaseolus vulgaris*）、ダイズ（*Glycine max*）、を含む計74点の種子を収集した。これらの遺伝資源は、カンボジア農業研究機構ジーンバンクにおいて保存すると共に、半量をSMTA（標準材料移転契約）に基づいて農業生物資源研究所ジーンバンクに移転し保存した。これらは2014年度に種子増殖と特性評価を実施する計画である。

Table 3. A passport data of collected materials 収集品のパスポートデータ

JP No.	Coll. No.	Map ID	Coll. Date	Species name	Status	Coll. Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
251262	2013C-1	C-1	19 Nov., 2013	<i>Vigna minima</i>	wild	car parking area, open forest, Bonsla Water Fall, Mondol Kiri, Cambodia	N12-34-01.6	E107-25-02.7	505	organic soil	bulk	no	yes	slope 0°, Bonsla Water Fall, crawling on the open forest floor, and climbing to the trees.
-	2013C-2	C-2	20 Nov., 2013	<i>Vigna radiata</i>	cultivated	market, Sen Manorom, Mondol Kiri, Cambodia	N12-27-30.6	E107-11-09.79	696	-	no	no	no	market sample, no seed collected
251263	2013C-3	C-3	20 Nov., 2013	<i>Glycine max</i>	cultivated	market, Sen Manorom, Mondol Kiri, Cambodia	N12-27-30.6	E107-11-09.79	696	-	bulk	no	no	market sample
251264	2013C-4	C-4	20 Nov., 2013	<i>Vigna umbellata</i>	cultivated	Pou Chorb, near Vietnam border, Dok Dam, Olean District, Mondol Kiri, Cambodia	N12-20-45.6	E107-18-59.8	805	red clay soil	bulk	no	no	slope 5°, red clay soil, beside farmer's house, local name: Sandaek Prey (wild bean), red seeds, most of the seeds were shriveled by stink bug damage, eat mixed with rice, He (Mr. Seab Son Aoon) found this bean naturally growing near a pond in his home garden. He said rice bean was grown between rubber trees in Kampong Tom, to reduce weed.
251265	2013C-5	C-5	20 Nov., 2013	<i>Vigna minima</i>	wild	Oh Te, Mondol Kiri, Cambodia	N 12-23-04.5	E107-10-43.9	630	red clay soil	bulk	no	no	slope 0°, red clay soil, beside pepper farm, crawling on the floor and have very slender leaflet, pod length shorter than those (2013C-1) found in Bonsura Water Fall.
251266	2013C-6	C-6	20 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	red clay soil	bulk	no	no	slope 0°, red clay soil, beside pepper farm, crawling on the floor and have very slender leaflet, pod length shorter than them (2013C-1) found in Bonsura Water Fall, small seeds.
251267	2013C-7	C-7	20 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	home garden below pepper farm	"	"	620	organic soil	individual	no	no	yard long bean, black seeds, only 6 seeds (1/6 not matured)
251268	2013C-8-1	C-8-1	21 Nov., 2013	<i>Vigna minima</i>	wild	Koh San, Jon Krong, Kratie, Cambodia	N12-40-48.8	E106-07-40.3	40	sandy soil	bulk	no	no	growing in a wood land in a paddy field. Government gave this land to farmer 2 years ago. Before that, this area was covered by forest.
251269	2013C-8-2	C-8-2	21 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing beside road side ditch. Government gave this land to farmer 2 years ago. Before that, this area was covered by forest. Another place of 2013C8-1, found by driver.
251270	2013C-9	C-9	21 Nov., 2013	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing beside road side ditch. Government gave this land to farmer 2 years ago. Before that, this area was covered by forest.
251271	2013C-10	C-10	21 Nov., 2013	<i>Vigna unguiculata</i>	intermediate	Kor San, Jon Krong commune, Kratie, Cambodia	N12-40-37.0	E106-08-28.6	40	sandy soil	bulk	no	no	maybe an escaped population, growing in a grassland beside farmer's house (Mr. Jim Mony), black small seeds, less pod shattering.
251272	2013C-13	C-13	21 Nov., 2013	<i>Vigna minima</i>	wild	Kor San, Jon Krong commune, Kratie, Cambodia	N12-40-35.1	E106-08-33.6	40	fine sand	bulk	no	no	slope 0°, growing in a forest behind a farmer's house
251273	2013C-14	C-14	21 Nov., 2013	<i>Vigna minima</i>	wild	in Five temple (ruin), Kor San, Jon Krong commune, Kratie, Cambodia	N12-38-11.9	E106-05-43.1	32	fine sand	bulk	no	no	growing in an open forest, dark black pods
251274	2013C-15	C-15	21 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	Phoum Thom, Sandan, Sombo District, Kratie, Cambodia	N12-40-36.6	E106-01-05.6	23	fine sand	bulk	no	no	local name: Sandaek Kur, farmer's field (Mr. Roi Soi), yard long bean, white seeds. This year, this place was flooded up to 50cm in September. Water from Mekong River.
251275	2013C-16	C-16	21 Nov., 2013	<i>Vigna minima</i>	wild	Kok Nyay (Mekong River side village), Kom Oh Krean, Sambo District, Kratie, Cambodia	N13-07-04.3	E106-05-09.6	57	sandy soil	bulk	no	no	growing in a grassland beside road, very slender long leaflets, flowers eaten with a dish called "Kanom Chin" (with Nam Prick). Old ladies collect flowers and come to sell. Many plants growing but still young. Mr. Man Supee, Mrs. Ee Tuuy, Mrs. Heang Phola (flower eaten)

Table 3 (Continued).

JP No.	Coll. No.	Map ID	Coll. Date	Species name	Status	Coll. Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
251276	2013C-17	C-17	22 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	Stung Treng Market	N13-31-48.5	E105-58-20.0	62		bulk	no	no	Stung Treng Market. Lodal name: Sandaek Ankouy. cowpea, white seeds with black eye
251277	2013C-18	C-18	22 Nov., 2013	<i>Glycine max</i>	cultivated	"	"	"	"		"	"	"	Stung Treng Market. Lodal name: Sandaek Seang
251278	2013C-19	C-19	22 Nov., 2013	<i>Vigna radiata</i>	cultivated	"	"	"	"		"	"	"	Stung Treng Market. Lodal name: Sandaek Bay
251279	2013C-20	C-20	22 Nov., 2013	<i>Phaseolus vulgaris</i>	cultivated	"	"	"	"		"	"	"	Stung Treng Market. Lodal name: Sandaek Ankouy (=sit down) Kmao (=black). black kidney bean.
251280	2013C-21	C-21	22 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	"	"	"	"		"	"	"	Stung Treng Market. white seeded yard long bean, commercial variety, seeds from Vietnam
251281	2013C-22	C-22	22 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	"	"	"	"		"	"	"	Stung Treng Market. Lodal name: Sandaek Kou. brown seeded yard long bean (Cambodian vriety)
251282	2013C-23	C-23	22 Nov., 2013	<i>Vigna unguiculata</i>	intermediate	Kang Tachao, Tha La Borivat, Stung Treng, Cambodia	N13-32-24.7	E105-56-43.9	57	sandy soil	bulk	no	no	local name: Sandaek Somlang Kmoch (=ghost). slope 0°, in a farmer's garden (grow naturally), eat only young pod and flower, small black seeds, black pods, less shattering, probably escaped from cultivation
251283	2013C-24	C-24	22 Nov., 2013	<i>Vigna minima</i>	wild	Srey Rousy, Stung Treng, Cambodia	N13-34-28.7	E105-56-13.9	53	sandy soil	bulk	no	no	growing on a cutted forest floor, large seeds, pale brown pods, large flower, purple pigments
251284	2013C-25	C-25	22 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing on a cutted forest floor,
251285	2013C-26	C-26	22 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing on a cutted forest floor, short pods, small seeds, small flower
251286	2013C-27	C-27	22 Nov., 2013	<i>Glycine max</i>	cultivated	Chowang, Som Arn commune, Tara Boriwat District, Cambodia	N13-43-43.6	E105-46-15.3	116	sandy soil	bulk	no	no	local name: Sandaek Sieng. Drying in front of a farmer's house (Mrs. Kawd Wa). cultivated in a field at 30km apart. She cultivates only soybean. Middle man comes to buy harvested seeds.
251287	2013C-28	C-28	22 Nov., 2013	<i>Vigna minima</i>	wild	Chowang, Som Arn commune, Stung Treng, Cambodia	N13-45-55.2	E105-40-41.2	124	sandy soil	bulk	no	no	small seeds, small ovate leaflet, growing on a open forest floor, in this place, there are 3 types (2013C-28, 2013C-29, 2013C-30) based on seeds size and leaflet shape.
251288	2013C-29	C-29	22 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	large seeds, long linear leaflet, growing on a open forest floor, in this place, there are 3 types (2013C-28, 2013C-29, 2013C-30) based on seeds size and leaflet shape.
251289	2013C-30	C-30	22 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	intermediate seed size, growing on a open forest floor, in this place, there are 3 types (2013C-28, 2013C-29, 2013C-30) based on seeds size and leaflet shape.
251290	2013C-31	C-31	22 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	climbing on a tree, growing in a open forest.
251291	2013C-32	C-32	23 Nov., 2013	<i>Vigna minima</i>	wild	Ka Pan, Samaky, Stung Treng, Cambodia	N13-36-46.0	E106-03-52.8	65	clay	bulk	no	no	slope 0°, between road and paddy field, large seeds. Ants gathered around flower stem.
251292	2013C-33	C-33	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	clay	bulk	no	no	slope 0°, growing on a ridge in a paddy field, large seeds, especially pale pod color with pale brown seeds. Ants gathered around flower stem.
251293	2013C-34	C-34	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	clay	bulk	no	no	slope 0°, growing on a ridge in a paddy field, large seeds, especially pale pod color with pale brown seeds. Ants gathered around flower stem.

Table 3 (Continued).

JP No.	Coll. No.	Map ID	Coll. Date	Species name	Status	Coll. Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
251294	2013C-35	C-35	23 Nov., 2013	<i>Vigna umbellata</i>	intermediate	near Lao border gate near Mekong River, Omlong Morakort, O'Svay, Thala Borivat, Stung Treng, Cambodia	N13-55-16.5	E106-00-15.2	73	sandy soil	bulk	no	no	beside road, severely attacked by spider mites.
251295	2013C-36	C-36	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	organic soil	bulk	no	no	beside road, growing on mountain side.
251296	2013C-37	C-37	23 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	Omlong Morakart, O'Svay, Thala Borivat, Stung Treng, Cambodia	N13-55-14.3	E106-00-19.7	60	organic soil	bulk	no	no	yard long bean grown in a home garden of a farmer (Mrs. Hourm Malay), white seeds, pale green pod color
251297	2013C-38	C-38	23 Nov., 2013	<i>Vigna minima</i>	wild	Domkrolor, Samaky, Stung Treng, Cambodia	N13-55-05.0	E106-03-44.8	105	organic soil	bulk	no	no	growing in a shady tall natural rofest with thick bamboo grass floor, white hilum seeds, round leaf, leaflet not slender even upper node.
251298	2013C-39	C-39	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	organic soil	bulk	no	no	growing ina shady tall natural rofest with thick bamboo grass floor, rather slender leaf.
251299	2013C-40	C-40	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	organic soil	bulk	no	no	outside forest edge, bulk,
251300	2013C-41	C-41	23 Nov., 2013	<i>Vigna minima</i>	wild	ca. 40km E from Stung Treng town, Stung Treng, Cambodia	N13-24-33.3	E106-20-25.0	110	organic soil	bulk	no	no	bamboo grass floor in a forest, black pods, black seeds with white hilum, a mutant with more branching was found and collected as 2013C-65 (JP251322) on the way back
251301	2013C-42	C-42	23 Nov., 2013	<i>Vigna minima</i>	wild	Phom 4, Trapang Srech, Kon mom, Rattanakiri, Cambodia	N13-35-58.7	E106-49-28.7	125	clay soil	bulk	no	no	Complete black seeds with yellowish hilum. Growing around trees with grassland in a paddy area.
-	2013C-43	C-43	23 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	clay soil	no	no	no	no seed collected. mottled seeds type growing at the same site with 2013C-42 (JP251301).
251302	2013C-44	C-44	23 Nov., 2013	<i>Glycine max</i>	cultivated	"	"	"	"	organic soil	bulk	no	no	non shattering soybean from a farmer (Mr. Seang Som).
251303	2013C-45	C-45	23 Nov., 2013	<i>Vigna unguiculata</i>	intermediate	"	"	"	"	organic soil	bulk	no	no	escaped cowpea, black pod, local name: Sandaek Kmaoy (=ghost), never eat. (Mr. Seang Som)
251304	2013C-46	C-46	23 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	"	"	"	"	organic soil	bulk	no	no	cultivated cowpea, white pod, local name Dak Sary, mature seeds boiled. (Mr. Seang Som)
251305	2013C-47	C-47	24 Nov., 2013	<i>Vigna radiata</i>	cultivated	Rattanakiri market	N13-44-09.32	E106-59-15.16	315	organic soil	bulk	no	no	bought at Ratanakiri market. Produced in Oundong Mas village (= 50km from Rattanakiri town, Cambodia)
251306	2013C-48	C-48	24 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	"	"	"	"	organic soil	bulk	no	no	bought at Ratanakiri market. Produced near the market.
251307	2013C-49	C-49	24 Nov., 2013	<i>Vigna minima</i>	wild	near Vietnam border, Rattanakiri, Cambodia	N13-40-35.1	E107-28-11.3	223	organic soil	bulk	no	no	mountain road side wet place, mature pods found on this side (a bit dryer), climbing on the tree.
251308	2013C-50	C-50	24 Nov., 2013	<i>Vigna minima</i>	wild	Yatong commune, Oyadau district, Rattanakiri, Cambodia	N13-40-27.2	E107-26-21.5	221	clay, wet soil	bulk	no	no	very wet habitat like samp, <i>V. minima</i> plants growing together with plants of genus Cyperus and wild Taro.
	2013C-51	C-51	24 Nov., 2013	<i>Vigna minima</i>	wild	ca. 33km NE from Rattanakiri town, Rattanakiri, Cambodia	N13-54-16.1	E107-16-36.9	124	sandy soil	no	no	no	near the river, growing in a stream, no mature pods, many slender and tender stems grow together so that look like very leafy plants.
251309	2013C-52	C-52	24 Nov., 2013	<i>Vigna reflexo-pilosa</i>	wild	Malich commune, Andongmeas District, Rattanakiri, Cambodia	N13-48-28.9	E107-15-58.1	216	sandy soil	bulk	no	no	beside road, growing beside paddy along a stream, wet habitat, wild Taro also growing.
251310	2013C-53	C-53	24 Nov., 2013	<i>Vigna unguiculata</i>	cultivated	Tom Poun Rong, Rattanakiri, Cambodia	N13-59-36.7	E107-05-02.3	112	sandy soil	individual	no	no	local name: Sandaek Kadox (= windy and cold season). Backyard home garden of a farmer, young pods eaten with some seasoning, mature seeds boiled and eaten . one pod only collected.

Table 3 (Continued).

JP No.	Coll. No.	Map ID	Coll. Date	Species name	Status	Coll. Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
251311	2013C-54	C-54	24 Nov., 2013	<i>Vigna minima</i>	wild	Laork, Laork commune, Ochum, Rattanakiri, Cambodia	N13-50-01.5	E107-00-14.0	310	sandy soil	bulk	no	no	growing in a wet land beside road.
251312	2013C-55	C-55	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing in a wet land beside road.
251313	2013C-56	C-56	24 Nov., 2013	<i>Vigna minima</i>	wild	Bunsai District, Rattanakiri, Cambodia	N13-55-05.8	E106-51-51.8	107	sandy soil	bulk	no	no	growing in a wet, open forest floor, pale brown pod, larger seeds with white hilum
251314	2013C-57	C-57	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing in a wet, open forest floor, black pod, smaller seeds with brown hilum
251315	2013C-58	C-58	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing in a wet, open forest floor, slender stem
251316	2013C-59	C-59	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	growing in a wet, open forest floor, red slender stem and virose at flower stem.
251317	2013C-60	C-60	24 Nov., 2013	<i>Vigna minima</i>	wild	Rattanakiri, Cambodia	N13-57-16.1	E106-49-53.2	98	fine gray sand	bulk	no	no	growing in a wet open Dipterocarpus forest, slender stem, twining many times, distribution of <i>V. minima</i> plants seems to be limited to the area near the road.
251318	2013C-61 (BULK)	C-61	24 Nov., 2013	<i>Vigna minima</i>	wild	Ang Krong, Srey Ang Krong, Ratanakiri, Kon Mom diesh, Cambodia	N13-31-18.5	E106-40-01.7	98	sandy soil	bulk	no	no	slope 0°, growing in a open forest grass floor and also in a paddy area. Plants growing in a forest do not set pods, plants growing in a paddy area set many good pods, flower eaten with nam prik or kanom chin. Very slender leaflet, large pale mottled seeds. Young pod eaten after boiled or fresh, mature seeds never eaten.
251319	2013C-61 (BLACK SEEDS)	C-61B	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	black seeds type
	2013C-62	C-62	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	no	no	no	small flower type, no seed collected
251320	2013C-63	C-63	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	big seed, pale brown pod type
251321	2013C-64	C-64	24 Nov., 2013	<i>Vigna radiata</i>	cultivated	"	"	"	"	sandy soil	bulk	no	no	mungbean seeds obtained from a farmer
251322	2013C-65	C-65	24 Nov., 2013	<i>Vigna minima</i>	wild	Chrorb, Kbal Romas, Sam San, Cambodia (same site as 2013C-41)	N13-24-33.2	E106-20-24.9	103	organic soil	bulk	no	yes	a mutant with more branching, shallow lateral roots. Mrs. Som Ngow, "Whole plant boiled and extract solution drunk to decrease blood pressure. flower eaten."
251323	2013C-66	C-66	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	organic soil	bulk	no	no	narrow leaflet type.
-	2013C-67	C-67	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	organic soil	no	no	no	mutant (dig with soil), no seed collected
251324	2013C-68	C-68	24 Nov., 2013	<i>Vigna minima</i>	wild	ca. 30km NE from Kratie town, Kratie, Cambodia	N12-54-30.8	E106-11-29.1	78	sandy soil	bulk	no	no	slender leaflet, pale brown pod with slightly weak shattering
251325	2013C-69	C-69	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	slender leaflet, black pod with highly shattering
251326	2013C-70	C-70	24 Nov., 2013	<i>Vigna minima</i>	wild	"	"	"	"	sandy soil	bulk	no	no	slender leaflet
251327	2013C-71	C-71	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	Kong Moha, Kampong Siem, Kampong Cham Cambodia	N12-02-04.2	E105-22-02.6	20	clay	bulk	no	no	growing in a home garden, edge of paddy field, black seeds, Mrs. Long Savat said young pod boiled, mature seeds cooked with glutinous rice, flower not eaten. Seed size and seed color variable.

Table 3 (Continued).

JP No.	Coll. No.	Map ID	Coll. Date	Species name	Status	Coll. Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
251328	2013C-72	C-72	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	Kong Moha, Kampong Siem, Kampong Cham Cambodia	N12-02-04.2	E105-22-02.6	20	clay	bulk	no	no	local name: Sandaek (=bean) Meas (=gold). growing in a home garden, edge of paddy field, yellow seeds, Mrs. Long Savat saie young pod boiled, mature seeds coocked with glutinous rice, flower not eaten. Seed size and seed color variable.
251329	2013C-73	C-73	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	"	"	"	"	clay	bulk	no	no	growing in a home garden, edge of paddy field, large black seeds, Mrs. Long Savat saie young pod boiled, mature seeds coocked with glutinous rice, flower not eaten. Seed size and seed color variable.
251330	2013C-74	C-74	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	"	"	"	"	clay	bulk	no	no	local name: Sandaek (=bean) Meas (=gold). growing in a home garden, edge of paddy field, large yellow seeds, Mrs. Long Savat saie young pod boiled, mature seeds coocked with glutinous rice, flower not eaten. Seed size and seed color variable.
251331	2013C-75	C-75	27 Nov., 2013	<i>Vigna umbellata</i>	wild	Kong Moha, Kampong Siem, Kampong Cham, Cambodia	N12-02-20.4	E105-22-02.6	33	clay	bulk	no	no	grassland beside rainfed paddy field, small black seeds
251332	2013C-76	C-76	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	Velrylach, Sweytep commune, Chomkaley District, Kampong Cham Province, Cambodia	N12-16-59.7	E105-16-04.2	60	clay	bulk	no	no	brown pod, Mr. Song Sok Kaing said mature seeds eaten with glutinous rice, young pods and flowers never eaten. Pod color variable.
251333	2013C-77	C-77	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	"	"	"	"	clay	bulk	no	no	black pod, Mr. Song Sok Kaing, mature seeds eaten with glutinous rice, young pods and flowers never eaten. Pod color variable.
251334	2013C-78	C-78	27 Nov., 2013	<i>Glycine max</i>	cultivated	"	"	"	"	clay	bulk	no	no	Mr. Song Sok Kaing said optimum time for soybean planting is July, if not planted in July, problem with insects and diseases, yeild=1.5~2.0 t/ha, price=0.5 US\$/kg
251335	2013C-79	C-79	27 Nov., 2013	<i>Vigna umbellata</i>	intermediate	"	"	"	"	clay	bulk	no	no	Mr. Song Sok Kaing said mature seeds eaten with glutinous rice, young pods and flowers never eaten.



Photo 1. *Vigna minima*, C-1, JP251262, Mondol Kiri, Cambodia



Photo 2. *Vigna minima*, C-1, JP251262, Mondol Kiri, Cambodia



Photo 3. *Vigna minima*, C-5, JP251265, Mondol Kiri, Cambodia



Photo 4. *Vigna minima*, C-5, JP251265, Mondol Kiri, Cambodia



Photo 5. *Vigna minima*, C-13, JP251272, Kratie, Cambodia



Photo 6. Linear leaflet of *Vigna minima*, C-16, JP251275, Kratie, Cambodia



Photo 7. A local person, Mrs. Heang Phola, showing us to eat flower of *Vigna minima*, Kratie, Cambodia



Photo 8. Pale brown pods of *Vigna minima*, C-68, JP251324, Kratie, Cambodia



Photo 9. *Vigna minima*, C-24 (large flower), JP251283, C-26 (small flower), JP251285, Stung Treng, Cambodia



Photo 10. *Vigna minima*, C-24 (long pod), JP251283, C-26 (short pod), JP251285, Stung Treng, Cambodia



Photo 11. *Vigna minima*, C-31, JP251290, Stung Treng, Cambodia



Photo 12. *Vigna minima*, C-33, JP251292, Stung Treng, Cambodia



Photo 13. Habitat of *Vigna minima*, C-38, JP251297, C-39, JP251298, Stung Treng, Cambodia



Photo 14. *Vigna minima*, C-38, JP251297, Stung Treng, Cambodia



Photo 15. *Vigna minima*, C-39, JP251298, Stung Treng, Cambodia



Photo 16. Habitat of *Vigna minima*, C-41, JP251300, Rattanakiri, Cambodia



Photo 17. *Vigna minima*, C-65, JP251322, two trifoliate leaves type, Rattanakiri, Cambodia

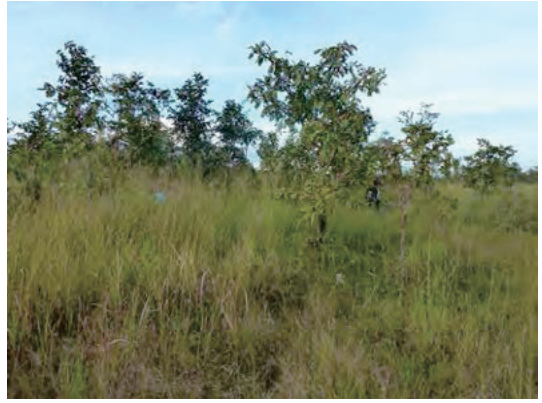


Photo 18. Habitat of *Vigna minima*, C-42, JP251301, shiny black seed type, Rattanakiri, Cambodia



Photo 19. Swampy habitat of *Vigna minima*, C-50, JP251308, Rattanakiri, Cambodia



Photo 20. *Vigna minima*, C-50, JP251308, with wild Taro and *Cyperus*, Rattanakiri, Cambodia



Photo 21. *Vigna minima*, C-51, leafy type, Rattanakiri, Cambodia



Photo 22. Habitat of *Vigna minima*, C-61, C-61B, C-62, Rattanakiri, Cambodia



Photo 23. Golden yellow and pale yellow flowers of *Vigna minima* at C-61, C-62 site, Rattanakiri, Cambodia



Photo 24. Variation of pods in *Vigna minima* collected in Cambodia



Photo 25. *Vigna umbellata*, C-4, JP251264, Mondol Kiri, Cambodia



Photo 26. *Vigna umbellata*, C-35, JP251294, Stung Treng, Cambodia



Photo 27. Habitat of *Vigna umbellata*, C-35, JP251294, Stung Treng, Cambodia



Photo 28. Naturally growing *Vigna umbellata* in paddy field area, Kampong Chan, Cambodia



Photo 29. Weakly shattered pod of *Vigna umbellata*, Kampong Chan, Cambodia



Photo 30. *Vigna radiata* var. *sublobata*, C-9, JP251270, Kratie, Cambodia



Photo 31. Habitat of *Vigna radiata* var. *sublobata*, C-9, JP251270, Kratie, Cambodia



Photo 32. Habitat of *Vigna reflexo-pilosa*, C-52, JP251309, Rattanakiri, Cambodia



Photo 33. Habitat of *Vigna reflexo-pilosa*, C-52, JP251309, Rattanakiri, Cambodia



Photo 34. Young seedling of *Vigna reflexo-pilosa*, C-52, JP251309, Rattanakiri, Cambodia



Photo 35. Flower of *Vigna unguiculata*



Photo 36. Naturally growing plants of *Vigna unguiculata*



Photo 37. Pods of yard long bean, *Vigna unguiculata* cultivar group *Sesquipedalis*, in a local market



Photo 38. Young pod of yard long bean served with noodle



Photo 39. Cultivation of yard long bean, C-7, JP251267, Mondol Kiri, Cambodia



Photo 40. Soybean curd, "tofu", sold in a local market



Photo 41. Fermented soybean seasoning sold in a local market



Photo 42. Drying soybean seeds, C-27, JP251286, Rattanakiri, Cambodia



Photo 43. An interview from a soybean growing farmer, Kampong Chan, Cambodia



C-1, JP251262, *Vigna marina*



C-3, JP251263, *Glycine max*



C-4, JP251264, *Vigna umbellata*



C-5, JP251265, *Vigna minima*



C-6, JP251266, *Vigna minima*



C-7, JP251267, *Vigna unguiculata*



C-8-1, JP251268, *Vigna minima*



C-8-2, JP251269, *Vigna minima*



C-9, JP251270, *Vigna radiata*



C-10, JP251271, *Vigna unguiculata*



C-13, JP251272, *Vigna minima*



C-14, JP251273, *Vigna minima*



C-15, JP251274, *Vigna unguiculata*



C-16, JP251275, *Vigna minima*



C-17, JP251276, *Vigna unguiculata*



C-18, JP251277, *Glycine max*



C-19, JP251278, *Vigna radiata*



C-20, JP251279, *Phaseolus vulgaris*



C-21, JP251280, *Vigna unguiculata*



C-22, JP251281, *Vigna unguiculata*



C-23, JP251282, *Vigna unguiculata*



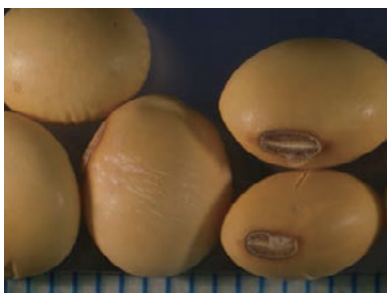
C-24, JP251283, *Vigna minima*



C-25, JP251284, *Vigna minima*



C-26, JP251285, *Vigna minima*



C-27, JP251286, *Glycine max*



C-28, JP251287, *Vigna minima*



C-29, JP251288, *Vigna minima*



C-30, JP251289, *Vigna minima*



C-31, JP251290, *Vigna minima*



C-32, JP251291, *Vigna minima*



C-33, JP251292, *Vigna minima*



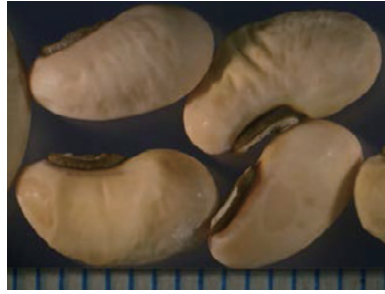
C-34, JP251293, *Vigna minima*



C-35, JP251294, *Vigna umbellata*



C-36, JP251295, *Vigna minima*



C-37, JP251296, *Vigna unguiculata*



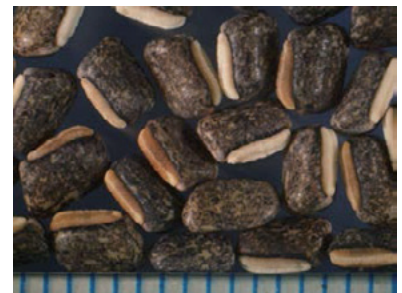
C-38, JP251297, *Vigna minima*



C-39, JP251298, *Vigna minima*



C-40, JP251299, *Vigna minima*



C-41, JP251300, *Vigna minima*



C-42, JP251301, *Vigna minima*



C-44, JP251302, *Glycine max*



C-45, JP251303, *Vigna unguiculata*



C-46, JP251304, *Vigna unguiculata*



C-47, JP251305, *Vigna radiata*



C-48, JP251306, *Vigna unguiculata*



C-49, JP251307, *Vigna minima*



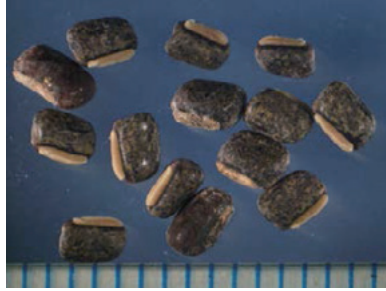
C-50, JP251308, *Vigna minima*



C-52, JP251309, *Vigna minima*



C-53, JP251310, *Vigna unguiculata*



C-54, JP251311, *Vigna minima*



C-55, JP251312, *Vigna minima*



C-56, JP251313, *Vigna minima*



C-57, JP251314, *Vigna minima*



C-58, JP251315, *Vigna minima*



C-59, JP251316, *Vigna minima*



C-60, JP251317, *Vigna minima*



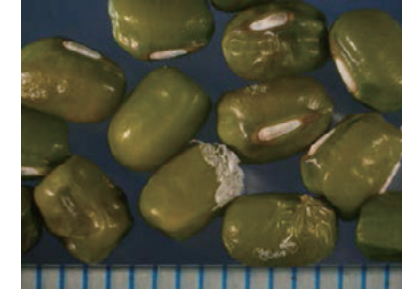
C-61 black seeds, JP251318, *Vigna minima*



C-61 bulk, JP251319, *Vigna minima*



C-63, JP251320, *Vigna minima*



C-64, JP251321, *Vigna radiata*



C-65, JP251322, *Vigna minima*



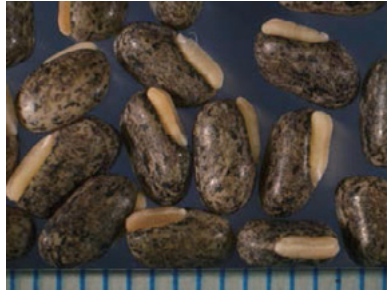
C-66, JP251323, *Vigna minima*



C-68, JP251324, *Vigna minima*



C-69, JP251325, *Vigna minima*



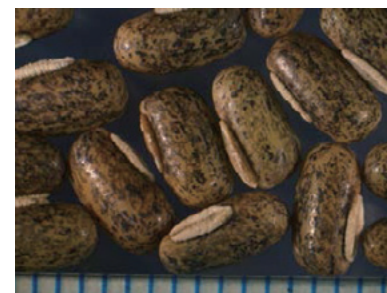
C-70, JP251326, *Vigna minima*



C-71, JP251327, *Vigna umbellata*



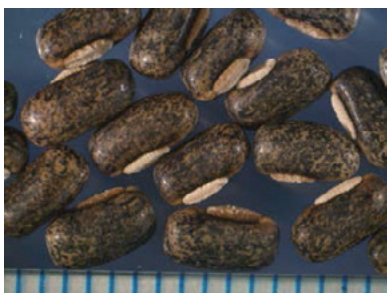
C-72, JP251328, *Vigna umbellata*



C-73, JP251329, *Vigna umbellata*



C-74, JP251330, *Vigna umbellata*



C-75, JP251331, *Vigna umbellata*



C-76, JP251332, *Vigna umbellata*



C-77, JP251333, *Vigna umbellata*



C-78, JP251334, *Glycine max*



C-79, JP251335, *Vigna umbellata*