

## Collaborative Exploration of Cucurbitaceae Vegetable Genetic Resources in Western and Northwestern Cambodia in 2018

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Original Paper

## **Collaborative Exploration of Cucurbitaceae Vegetable Genetic Resources in Western and Northwestern Cambodia in 2018**

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### **Summary**

This report describes the second exploration of cucurbitaceous vegetable genetic resources in western and northwestern Cambodia, jointly conducted by the National Agriculture and Food Research Organization (NARO), Japan, and the Cambodian Agricultural Research and Development Institute (CARDI). A field survey was conducted from November 27 to December 6, 2018. The main objectives were to collect accessions of melon and other cucurbitaceous crops. During this mission, we surveyed the Kampong Chhnang, Pursat, Battambang, Pailin and Banteay Meanchey provinces of western and northwestern Cambodia. We collected a total of 38 accessions, 31 of *Cucumis melo* L., 3 of *Cucurbita moschata* Duchense, 2 of *Citrullus lanatus* (Thunb.) Matsum. & Nakai, 1 of *Cucumis sativus* L., 1 of *Mukia* sp. The seeds of all accessions were shared equally. All accessions were stored as seeds at CARDI Genebank, and subsets were transferred to the Genetic Resources Center, NARO using the standard material transfer agreement (SMTA).

KEY WORDS: Cambodia, genetic resources, *Cucumis melo*, field survey, melon

## Introduction

The Plant Genetic Resources in Asia (PGRAsia) project has been funded by the Ministry of Agriculture, Forestry and Fisheries, Japan, since 2014, to explore, collect, and evaluate the plant genetic resources of Asian countries. The exploration of cucurbitaceous vegetable genetic resources in the western and northwestern district of Cambodia was jointly conducted by the National Agriculture and Food Research Organization (NARO), Japan and the Cambodian Agricultural Research and Development Institute (CARDI), Cambodia.

Cambodia is a country located in the southern portion of the Indochina peninsula in Southeast Asia. It is 181,035 km<sup>2</sup> in area, and is bordered by Thailand to the northwest, Laos to the northeast, Vietnam to the east and the Gulf of Thailand to the southwest. Cambodia has a temperature range from 21 to 35 °C and is located in the tropical monsoon region, where the southwest monsoon blows inland bringing moisture-laden air from the Gulf of Thailand and Indian Ocean from May to October. The northeast monsoon ushers in the dry season, which lasts from November to April. The country experiences the heaviest rainfall precipitation from September to October, with the driest period occurring from January to February.

Melon (*Cucumis melo* L.) is a diversified crop cultivated in tropical, subtropical, and temperate zones. The wild ancestor of melon is suggested to have originated in Africa, and secondary center of genetic diversity are considered to be the Middle and Near East and India (Robinson and Decker-Walters 1997). Melon was domesticated at least twice, in Africa and in Asia (Serres-Giardi and Dogimont 2012; Endl *et al.* 2018). Recently Gonzalo *et al.* (2019) supported the hypothesis that India is the primary center of diversity of melon based on genotyping-by sequencing analysis. East and South Asian melon are known as important genetic resources, having resistance to powdery mildew, downy mildew, gummy stem blight, fusarium wilt, *Aphis gossypii*, and several viruses (Pryor *et al.* 1946; Whiteaker and Bohn 1954; Whiteaker and Davis 1962; Kishaba *et al.* 1971; Takada *et al.* 1979; Wako *et al.* 2000). However, access to melons from South Asia is difficult in Japan, unless a proper agreement for access and benefit-sharing is contracted between the provider and user, or the genetic resources are introduced from a third party, such as the U. S. National Plant Germplasm System (NPGS), where the largest numbers of accessions are preserved. Exotic melon genetic resources cannot ultimately be introduced in either case owing to a Japanese plant-protection policy aimed at preventing the introduction of bacterial fruit blotch (*Acidovorax avenae* subsp. *citrulli*) and melon fly (*Bactrocera cucurbitae*).

Southeast Asian melons such as *C. melo* L. var. *momordica* (Roxburgh) Duthie & Fuller, are distantly related to East Asian melons, such as var. *agrestis*, var. *makuwa*, and var. *conomon*, as shown by the analysis of complementary genes that cause bitterness in the immature fruit of F<sub>1</sub> hybrids (Fujishita *et al.* 1993). Melons from Southeast Asia are also thought to be useful genetic resources to widen the genetic base of cultivated melons, and should be used in exploring genetic variation in fruit and seed traits, both of which not only have valuable information to manage them as genetic resources efficiently, but may also contribute to downsizing the number of tested materials for the screening of agricultural traits, such as disease resistance.

Explorations of cucurbitaceous vegetable genetic resources in Cambodia were conducted in the western and northwestern areas in 2014 (Matsunaga *et al.* 2015), in the eastern area in 2015 (Tanaka *et al.* 2016), and in the northern area in 2016 (Tanaka *et al.* 2017). The first explorations in western and northwestern Cambodia were conducted mainly from markets and farmers around the city in 2014 (Matsunaga *et al.* 2015).

In this survey, the second exploration of the western and northwestern areas was extended to areas far from the city. With the creation of paved roads, we were able to explore previously unexplored areas. The western and northwestern areas of Cambodia are rapidly developing and there is a risk of losing local crops; thus, it is necessary to survey genetic resources as soon as possible.

## Method

From November 27 to December 6, 2018, we explored and collected cucurbitaceous vegetable genetic resources from the rural areas of Kampong Chhnang, Pursat, Battambang, Pailin, and Banteay Meanchey provinces located in western and northwestern Cambodia (Table 1, Fig. 1).

Table 1. Itinerary of the survey in western and northwestern Cambodia, 2018

Date	Day	Itinerary	Stay
26-Nov	Mon	Narita 10:50 (NH817) -- 15:40 Phnom Penh	Phnom Penh
27-Nov	Tue	Visit to Cambodian Agricultural Research and Development Institute (CARDI), Phnom Penh -- Kampong Chhnang (Kampong Chhnang Prov.)	Kampong Chhnang
28-Nov	Wed	Kampong Chhnang -- Southwest area, Romeas -- Pursat (Pursat Prov.)	Pursat
29-Nov	Thu	Pursat -- Southwest toward Pramaoy -- Pursat	Pursat
30-Nov	Fri	Pursat -- Pramaoy and its north and south area -- Pursat	Pursat
1-Dec	Sat	Pursat -- Moug Ruessei -- Prey Touch and its southwest area -- Battambang (Battambang Prov.)	Battambang
2-Dec	Sun	Battambang -- Pailin and its south area -- Battambang	Battambang
3-Dec	Mon	Battambang -- Bavel -- Malai -- Kamrieng -- Battambang	Battambang
4-Dec	Tue	Battambang -- Svay Chek -- Ta Phou -- Sisophon (Banteay Meanchey Prov.)	Sisophon
5-Dec	Wed	Sisophon -- Thma Puok and its west area -- Svay Chek and its east area -- Sisophon	Sisophon
6-Dec	Thu	Sisophon -- Pursat	Pursat
7-Dec	Fri	Pursat -- Phnom Penh	Phnom Penh
8-Dec	Sat	Sample preparation	Phnom Penh
9-Dec	Sun	Visit to Cambodian Agricultural Research and Development Institute (CARDI), Phnom Penh 22:50 (NH818) -- 6:30 Narita	

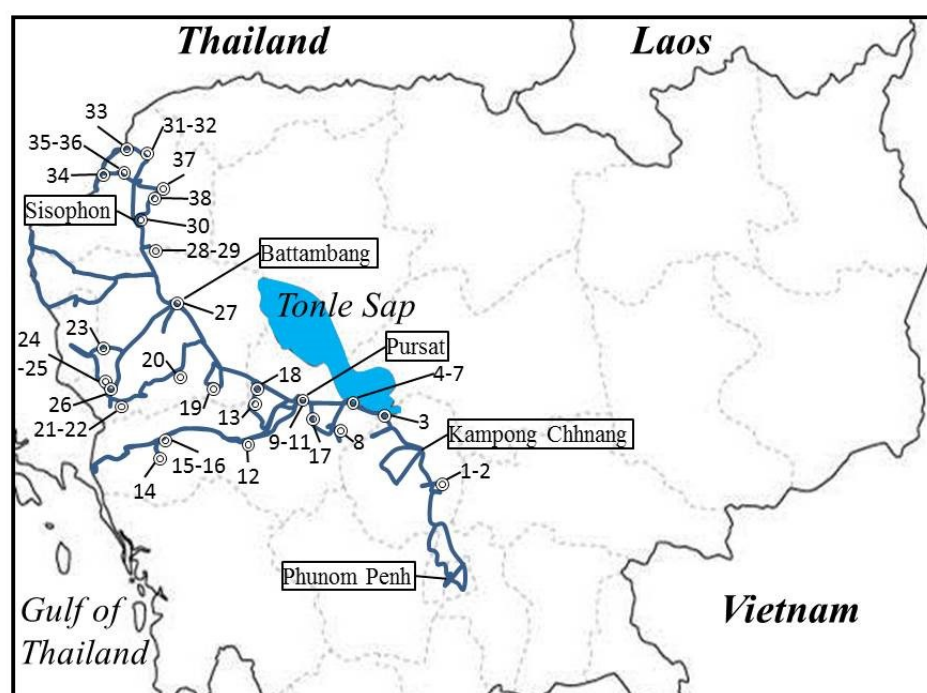


Fig. 1. Map of the explored route in Cambodia. The routes are shown by bold dotted lines. Each collection site is indicated by a double circle with a corresponding accession number(s). “18CJVC-1”, “18CJVC-2”, “18CJVC-3”, and so on, are abbreviated as “1”, “2”, “3” and so on.

Samples were collected from local markets, roadside vegetable stands, farmer's houses, cropping fields (Photos 1-4). The precise positions of the sites were recorded using GPS. The total mileage was about 3,200 km. The main road was paved, but most of the branching roads were dirt (Photo 5). Many farmers' houses were located along dirt roads. When we collected genetic resources, we interviewed farmers about the local names, cultivation methods (sowing and harvest season), harvesting methods, seed preservation methods, and other information on cultivation (Photo 6). Mixed stored seeds were separated into seeds of each crop and were registered independently as corresponding to individual seed samples.

We also investigated 12 characteristics for eight melon fruits. Melon accessions collected as fruits were harvested for seeds after the investigation of fruit characteristics in our hotels within same day, and the harvested seeds were dried by hanging them in individual plastic nets.

During the field survey, we visited the capitals of the five provinces and various villages along the route (Fig. 1). The field survey ranged from lowland areas surrounding Tonle Sap to northwestern hilly areas, at an altitude ranging from 6 to 275 m above sea level (Photos 7 and 8).

## Results and Discussion

We surveyed at local markets, roadside vegetable stands, farmers' houses and cropping fields, totally at 182 sites. A total of 38 samples were collected at 26 sites (Fig. 1, Table 2). In one of the fields visited, various cucurbitaceous crops, such as melon, cucumber, and pumpkin, had been loosely cultivated in the same field (Photos 3 and 4).

In this survey, we collected a total of 38 accessions, 31 of melon (*Cucumis melo*), three of pumpkin (*Cucurbita moschata*), two of watermelon (*Citrullus lanatus*), one of cucumber (*Cucumis sativus*), and one of *Mukia* sp. (Table 2). A total of 10 samples were collected as fruits from farmers, markets and fields (Table 3). All of the remaining samples were collected as seeds from farmers (Table 4). In the case of melon, eight accessions were collected as fruits and the remaining samples were collected as seeds. Of eight melon fruits, five were collected from farmers, one from traders, and two at markets. All of 23 melon seed samples were collected from farmers' stores. Local farmers stored their seeds in storage cases, such as plastic bottles and netted or plastic bags; further, some farmers stored all of their cucurbit crop seeds together. They obtained melon seeds by open pollination. Based on interviews with local people, we learned that many cultivated melon have been introduced from other provinces or regions.

Melon, pumpkin, watermelon, and cucumber were called 'Tror Sork Srov', 'La Pov', 'Ov Lek', and 'Tror Sork Trerng', respectively, in the area of Cambodia we visited.

Fruit characters of genetic resources collected as fruits were shown in Table 3. All fruits, except for pumpkin and *Mukia* sp. of collection Nos. 18CJVC-9 and -14, respectively, were melon. The fruit weight ranged from 0.80 kg to 2.49 kg in melon. All melon fruits, except for 18CJVC-27, were vertically long. Epicarp colors of melon fruits were variable, such as white green, orange, yellow, green, or green yellow, with or without stripes. Outer and inner flesh colors were the same in five melon fruits, and differed in two. The former five melon fruits had green, yellow or white colored flesh, and the latter two had green outer flesh and yellow inner flesh. The flesh thickness ranged from 2.2 cm to 3.6 cm. Three melon samples (18CJVC-2, -10, and -30) had a powder textured fruit flesh. The soluble solids content (Brix) ranged from 2.6 to 6.2 °Bx in the seven melon fruits, which is lower than those of modern improved varieties; however, 18CJVJ-10, which had a soluble solid content of 6.2 °Bx, had a slight sweet taste. These melons had yellow orange, white, or white orange colored fruit placenta. Jelly was also observed around each seed in melon

Table 2. List of collected genetic resources

Plant name	Genus & Species	Number of Accessions
Melon	<i>Cucumis melo</i>	31
Pumpkin	<i>Cucurbita moschata</i>	3
Watermelon	<i>Citrullus lanatus</i>	2
Cucumber	<i>Cucumis sativus</i>	1
<i>Mukia</i> sp.	<i>Mukia</i> sp.	1
Total		38

Table 3 Fruit characters of cucurbitaceous genetic resources from western and northwestern Cambodia, 2018

Collection number	Fruit size			Fruit epicarp		Fruit flesh						
	Weight (kg)	Length (cm)	Diameter (cm)	Color <sup>1)</sup>	Stripe	Outer color <sup>1)</sup>	Inner color <sup>1)</sup>	Thickness (cm)	Powder texture	Brix ( ° Bx )	Placenta color <sup>1)</sup>	Jelly around seed
18CJVC-2	0.80	23.5	9.0	WG	-	G	G	2.2	+	3.0	YO	+
18CJVC-9	0.99	8.5	14.0	O	Rind	Y	Y	3.5	-		Y	
18CJVC-10	2.15	30.4	11.3	G	+	Y	Y	3.6	+	6.2	YO	+
18CJVC-11	1.75	22.8	13.2	Y	+	G	Y	3.0	-	5.0	YO	-
18CJVC-14	0.0006	0.6	0.5	R	-	-	-	-	-	-	-	-
18CJVC-15	2.49	33.0	14.0	G	+	Y	Y	3.4	-	4.8	YO	+
18CJVC-16	1.34	22.3	10.6	O	+	G	Y	3.0	-	5.0	W	+
18CJVC-25	1.17	19.5	12.0	G	+				-			
18CJVC-27	0.98	13.5	12.8	Y	-	W	W	3.0	-	2.6	WO	+
18CJVC-30	1.09	25.2	9.0	GY	+	W	W	2.5	+	3.2	W	+

<sup>1)</sup> Symbol character of color is follow as WG: white green, O: orange, G: green, Y: yellow, R: red, GY: green yellow, W: white, YO: yellow orange and WO: white orange.

fruits. 18CJVC-15 and -16 were collected as fruits that were being sold on roadside vegetable stands and cultivated at fields behind its stands. Thus, melon fruits collected had powdery textured fruit flesh and jelly around the seeds, and were likely of *C. melo* var. *momordica* from South Asia (Robinson and Decker-Walters 1997; Dhillon *et al.* 2012).

Based on information from farmers, six melon samples appeared to be introduced from another province distant from the collection site, such as 18CJVC-1 from Battambang province, 18CJVC-17 from Pailin province, 18CJVC-33 from the border area between Battambang province and Thailand, 18CJVC-10 and -11 from the fruits cultivated at Pramaoy in Pursat province, and 18CJVC-13 from western area. Five melon samples were progenies of introduced melons from seed shops or markets, such as 18CJVC-8 from commercial melon seeds sold quite some time ago, and 18CJVC-18, -19, -20 and -37 from fruits sold at markets. Melon samples of 18CJVC-28 and -29 were donated from the farmer's sister two years ago in the same commune. Melons and melon seeds are transported from production areas to other areas through well-paved highways in western Cambodia and seeds collected from those fruits appeared to be utilized for the next cultivation; new products and technologies can be introduced everywhere. Local people can utilize those new products and technologies. Melon seeds were hardly collected from farmers in western Cambodia, because they bought melon seeds from market and did not keep seeds for the next cultivation; thus, melon collections in western Cambodia were lower than those in eastern, northern, and southern Cambodia, which were 62, 70, and 101, respectively (Tanaka *et al.* 2016, 2017). In case of cucumber, improved varieties and cultivation with vertical farming, chemical fertilizer, and pesticide and fungicide were observed (Photo 9), and no cucumber landraces were found during our survey. Those facts indicated that melon landraces may gradually be lost.



However, 13 melon samples 18CJVC-3, -4, -7, -12, -23, -24, -25, -27, -31, -32, -34, -35, and -36, have been cultivated for many years, and could be valuable genetic resources.

Cambodia is developing rapidly, with the construction of paved roads to transport many goods everywhere, as well as the railway from Phnom Penh to Bangkok in Thailand. New agricultural varieties and technologies are being introduced through this new traffic. Therefore, useful landraces may be lost as genetic resources owing to Cambodian development, and should be collected as much as possible.

### Genetic resources

All seeds of the 38 accessions collected have been stored as genetic resources in the CARDI gene bank, and a subset was placed in the NARO Genebank with JP numbers under the standard material transfer agreement (SMTA) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). We plan to multiply the genetic resources and to evaluate them in 2019.

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# 2018 年度カンボジア西部および北西部における ウリ科植物遺伝資源の共同探索

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## 和文摘要

この調査はウリ科植物遺伝資源を探索するために、国立研究開発法人農業・食品産業技術総合研究機構（農研機構）（NARO）とカンボジア農業開発研究所（CARDI）とで実施した。カンボジア西部および北西部におけるウリ科植物の遺伝資源の2回目の調査報告である。2018年11月27日から12月6日にカンボジア西部および北西部のコンポンチュナン州、プルサット州、バットアンバン州、パイリン州、バンテアイミンチェイ州において現地調査を実施した。合計38点収集し、メロンが31点、カボチャが3点、スイカが2点、キュウリが1点、*Mukia* sp. が1点であった。これらの種子すべてを登録し、カンボジア農業開発研究所に保存するとともに標準材料移転契約（SMTA）に基づいて農研機構遺伝資源センタージーンバンクにも移転・保存した。

Table 4. Details of genetic resources collected in Cambodia in 2018

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/landrace	Collection	Province	District	Commune	Village	Latitude/Longitude	Altitude (m)	Source (Market name)	Remarks
269372	18CJVC-1	27 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Kampong Chhnang	Kampong Tralach	Saeb	Taseu	12-3-48.3/ 104-44-40.66	15	Farmer	Farmer moved from Battambang Province and got seeds from her family
269373	18CJVC-2	27 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Kampong Chhnang	Kampong Tralach	Saeb	Taseu	12-3-48.3/ 104-44-40.66	15	Farmer	Farmer moved from Battambang Province and got seeds from her family
269374	18CJVC-3	28 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Kampong Chhnang	Boribour	Trapaeng Chan	Trapaeng Chan	12-28-32.3/ 104-25-21.4	7	Farmer	Farmer cultivates for long years
269375	18CJVC-4	28 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Kampong Chhnang	Krakor	Kbal Trach	Kampong leu	12-31-57.9/ 104-13-24.2	6	Farmer	Farmer cultivates for long years
269376	18CJVC-5	28 Nov. 2018	<i>Cucumis sativus</i>	Cucumber	Tror Sork Treig	Improved	Seeds	Kampong Chhnang	Krakor	Kbal Trach	Kampong leu	12-31-57.9/ 104-13-24.2	6	Farmer	
269377	18CJVC-6	28 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Kampong Chhnang	Krakor	Kbal Trach	Kampong leu	12-31-57.9/ 104-13-24.2	6	Farmer	
269378	18CJVC-7	28 Nov. 2018	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Improved	Seeds	Kampong Chhnang	Krakor	Kbal Trach	Kampong leu	12-31-57.9/ 104-13-24.2	6	Farmer	Farmer cultivates for long years
269379	18CJVC-8	28 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Pursat	Krakor	Svay Sor	Lang Trach	12-23-3.9/ 104-9-8.6	53	Farmer	
269380	18CJVC-9	29 Nov. 2018	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Pursat	Krong Pusal	SangKat Ptesh Prey	Peal Nhaek I	12-32-20.6/ 103-55-12.6	16	Farmer	
269381	18CJVC-10	29 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	—	Fruit	Pursat	Krong Pusal	SangKat Ptesh Prey	Peal Nhaek I	12-32-20.6/ 103-55-12.6	16	Treader (Pursat Market)	Fruit was carried from Pramaoy
269382	18CJVC-11	29 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	—	Fruit	Pursat	Krong Pusal	SangKat Ptesh Prey	Peal Nhaek I	12-32-20.6/ 103-55-12.6	16	Treader (Pursat Market)	Fruit was carried from Pramaoy
269383	18CJVC-12	29 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Pursat	Veal Veng	Steung Thmey	Tang Yor	12-23-1.6/ 103-17-20.4	206	Farmer	Farmer cultivates for long years
269384	18CJVC-13	30 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Pursat	Bakan	Talour	Toul Tor Teong	12-33-6.5/ 103-39-45.2	16	Farmer	Young fruits is bitter taste
269385	18CJVC-14	30 Nov. 2018	<i>Mukia sp.</i>	Mukia	Tror Sork Prey	Wild	Fruit	Pursat	Veal Veng	Pramouy	Pcheuk Chrom	12-4-34.4/ 103-6-32.8	275	Field	
269386	18CJVC-15	30 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Pursat	Veal Veng	Pramouy	Steung Thmey	12-19-43.2/ 103-8-13.6	231	Farmer	
269387	18CJVC-16	30 Nov. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Pursat	Veal Veng	Pramouy	Steung Thmey	12-19-43.2/ 103-8-13.6	231	Farmer	
269388	18CJVC-17	1 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Pursat	Krakor	Tnout Cheom	Chheur Teal	12-27-1.3/ 104-1-35.2	27	Farmer	Seeds is originated in Pailin
269389	18CJVC-18	1 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Pursat	Bakan	Ou Ta peung	Chamka Klouy	12-38-1.1/ 103-40-18.4	13	Farmer	Seeds are originated from fruit sold at market
269390	18CJVC-19	1 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Battambang	Rukhak Kiri	Prek Cik	Chke Kham Prues	12-38-20.2/ 103-24-57.9	31	Farmer	Seeds are originated from fruit sold at market
269391	18CJVC-20	1 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Battambang	Koas Kra La	Chhnal Moan	Krang Svat	12-42-15.5/ 103-12-9.9	35	Farmer	Seeds are originated from fruit sold at market two years ago
269392	18CJVC-21	1 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Battambang	Samlout	Kampong Lpou	Kampong Lpou	12-32-46.6/ 102-52-18.9	131	Farmer	Farmer cultivates for long years
269393	18CJVC-22	1 Dec. 2018	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Battambang	Samlout	Kampong Lpou	Kampong Lpou	12-32-46.6/ 102-52-18.9	131	Farmer	Farmer cultivates for long years

Table 4. (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Province	District	Commune	Village	Latitude/ Longitude	Altitude (m)	Source (Market name)	Remarks
269394	18CJVC-23	2 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Battambang	Ratanak Mondol	Traeng	Takrork	12-50-48.1/ 102-45-48.6	98	Farmer	Farmer moved from Banteay Meanchey and cultivates for 30 years
269395	18CJVC-24	2 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Battambang	Samlout	Samlout	Boeung Run	12-38-53.0/ 102-46-2.0	184	Farmer	Farmer moved from Prey Veng Province and cultivates melon for long years
269396	18CJVC-25	2 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Battambang	Samlout	Samlout	Boeung Run	12-38-53.0/ 102-46-2.0	184	Farmer	Farmer moved from Prey Veng Province and cultivates melon for long years
269397	18CJVC-26	2 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Improved	Seeds	Battambang	Samlout	Ta Sanh	Anlong Pouk	12-36-33.1/ 102-48-45.2	149	Farmer	Farmer started to melon cultivation two years ago, which seeds originated from fruit sold at market
269398	18CJVC-27	4 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Battambang	Krong Battambang	SangKat Svay Pao	Preak Moha Tep	13-6-14.9/ 103-11-44.2	23	Market (Boeung Chouk)	Farmer lives in Ratanak Mondol Dist. Lhea Montrey Com.&Vil., and cultivates more than 10 years.
269399	18CJVC-28	4 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Mongkol Borei	Phnum Touch	Prey Totueng	12-25-50.8/ 103-2-1.2	12	Farmer	Farmers started to cultivate two years ago when they got seeds from her sister who lives in same commune
269400	18CJVC-29	4 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Mongkol Borei	Phnum Touch	Prey Totueng	12-25-50.8/ 103-2-1.2	12	Farmer	Farmers started to cultivate two years ago when they got seeds from her sister who lives in same commune
269401	18CJVC-30	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Improved	Fruit	Banteay Meanchey	Krong Sereyi Saophan	Sangkat Preah Ponlea	No.3	13-35-13.8/ 102-58-22.2	12	Market (Serey Sophorn)	Treader carried fruit from Southern Pailin City
269402	18CJVC-31	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Thma Pouk	Komrou	Tayeong	13-57-49.7/ 103-1-3.2	38	Farmer	Farmer cultivates for long years
269403	18CJVC-32	5 Dec. 2018	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Banteay Meanchey	Thma Pouk	Komrou	Tayeong	13-57-49.7/ 103-1-3.2	38	Farmer	Farmer cultivates for long years
269404	18CJVC-33	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Improved	Seeds	Banteay Meanchey	Thma Pouk	Kork Romeat	Thral Bam Beak	13-58-27.6/ 102-51-25.6	78	Farmer	Seeds were originated from fruit which was cultivated at the border area in Thailand, Battambang Prov.
269405	18CJVC-34	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Svay Chek	Svay Chek	Damnak Kokos	13-51-7.6/ 102-46-8.9	52	Farmer	Farmer cultivates for long years
269406	18CJVC-35	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Svay Chek	Svay Chek	Khvav Lech	13-51-22.0/ 102-52-1.34	27	Farmer	Farmer cultivates for long years
269407	18CJVC-36	5 Dec. 2018	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Landrace	Seeds	Banteay Meanchey	Svay Chek	Svay Chek	Khvav Lech	13-51-22.0/ 102-52-1.34	27	Farmer	Farmer cultivates for long years
269408	18CJVC-37	5 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Improved	Seeds	Banteay Meanchey	Svay Chek	Sarongk	Chrung	13-45-35.7/ 103-6-59.1	19	Farmer	Seeds were originated from fruit which was sold at near market three years ago.
269409	18CJVC-38	6 Dec. 2018	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Banteay Meanchey	Preh Netr Preah	Bos Sbov	Pring Kaong	13-43-40.7/ 103-4-40.7	19	Farmer	Farmer cultivates for long years



Photo 1. Typical vegetable market in Cambodia. This is a part of Pursat Market.



Photo 2. Roadside vegetable stand between Pursat and Pramaoy. Some types of melons were sold at this stand.



Photo 3. Cropping fields. Various cucurbitaceous crops are cultivated in the same field.



Photo 4. A melon fruit in the field.

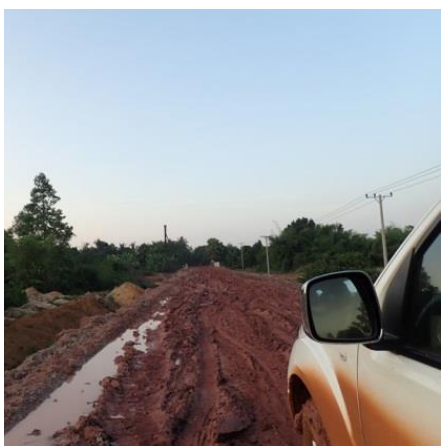


Photo 5. Dirt road after rain.



Photo 6. Interview survey with farmers.





Photo 7. Lowland areas surrounding Tonle Sap.



Photo 8. Northwestern hilly areas.



Photo 9. Vertically cultivated improved cucumber cultivar.

Photos of collected samples (Nos. correspond to CJV-Nos.)



No. 1 *Cucumis melo*



No. 2 *Cucumis melo*



No. 3 *Cucumis melo*



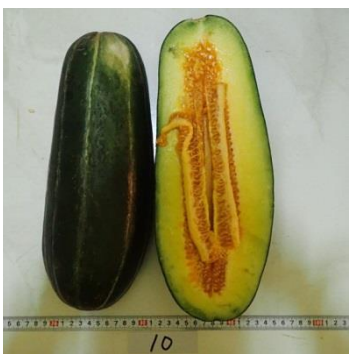
Nos. 4 and 5 *Cucumis melo* and *Cucumis sativus*



Nos. 6 and 7 *Cucumis melo* and *Citrullus lanatus*



No. 9 *Cucurbita moschata*



No. 10 *Cucumis melo*



No. 11 *Cucumis melo*



No. 12 *Cucumis melo*



No. 13 *Cucumis melo*



No. 14 *Mukia* sp.



No. 15 *Cucumis melo*



Photos of collected samples (No. correspond to CJV-Nos.)



No. 16 *Cucumis melo*



No.17 *Cucumis melo*



No. 18 *Cucumis melo*



No. 19 *Cucumis melo*



Nos. 21 and 22 *Cucumis melo*  
and *Cucurbita moschata*



No. 23 *Cucumis melo*



No. 24 *Cucumis melo*  
Seeds were inside this bottle



No. 25 *Cucumis melo*



No. 26 *Cucumis melo*



No. 27 *Cucumis melo*



Nos. 28 and 29 *Cucumis melo*



No. 30 *Cucumis melo*

Photos of collected samples (No. correspond to CJV-Nos.)



No. 31 *Cucumis melo*



No. 32 *Cucumis melo*



No. 33 *Cucumis melo*



No. 34 *Cucumis melo*



Nos. 35 and 36 *Cucumis melo*  
and *Citrullus lanatus*



No. 37 *Cucumis melo*



No. 38 *Cucumis melo*