

Collection of Cucurbit Crops (Cucurbitaceae) from Eastern Cambodia, 2015

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Summary

Less is known about cucurbit crops (Cucurbitaceae) in Southeast Asia than those in South and East Asia, which are recognized as useful breeding materials for disease resistance. A field survey was conducted in eastern Cambodia in order to collect genetic resources of cucurbit crops and to investigate the variation of seed and fruit traits in melon landraces. A total of 144 genetic resources were collected from markets, farmers' houses, and fields from the capital and eastern provinces of Cambodia, and the accessions were registered into the germplasm collections of both Cambodia and Japan. Among the 62 melon accessions, 45 and 17 were collected as seeds and fruits, respectively. The melon accessions seemed to share a gene pool *via* open pollination, which resulted in size variation in fruit and seed size both among and within the melon accessions and suggested that the accessions possess great variation in agricultural traits. The seed length of the Cambodian melon accessions was similar to that of *Cucumis melo* L. var. *momordica* (Roxburgh) Duthie & Fuller, which is indigenous to South Asia, but longer than that of melons from Laos, Vietnam, and East Asia, thus indicating the occurrence of genetic differentiation, even within Southeast Asian. Similarity in fruit character (e.g., flesh texture, occurrence of gelatinous sheaths around seeds, fruit size, and sugar concentration) were found in the melon landraces from Cambodia, South Asia and East Asia. We suggest that the Cambodian melon accessions should be evaluated for disease resistance so that they can be utilized as breeding material. The genetic resources of melon in Cambodia are thought to vary in both morphological and agricultural traits and may be useful for various breeding programs.

KEY WORDS: *Cucumis*, Field survey, Fruit, Genetic resource, Melon, Seed

Introduction

Cucurbit crops are one of the most important crops in the world, and their fruits are mainly utilized as vegetables and desserts (Robinson and Decker-Walters, 1997). As in other fruit crops, improved fruit quality and reduced yield loss during cultivation are demanded. Agricultural traits, such as resistance to insects, fungi, and viruses, have been improved by breeding, with the use of genetic resources (Staub *et al.*, 2008; Pitrat, 2008; Ferriol and Picó, 2008; Wehner, 2008), and such genetic resources are expected to facilitate various breeding programs both in the countries of their origin and in other countries. Therefore, genetic resources should be collected from various areas of the world and conserved in gene banks before they disappear.

Melon (*Cucumis melo* L.) is one such cucurbit crops, and many improved varieties and local landraces are cultivated around the world. Morphologically, physiologically, and genetically diverse melons can be found in centers of diversity, such as Africa, West Asia, Spain, India, and China (Pitrat, 2008; Robinson and Decker-Walters, 1997; Dhillon *et al.*, 2012). Based on traits, such as ovary hair, fruit shape, and flesh taste, melon is classified into 16 botanical groups (Burger *et al.*, 2010). Among these, *C. melo* vars. *makuwa* Thunberg and *conomon* (Thunberg) Makino are mainly cultivated in East Asia and are utilized in a various of ways. For example, the mature fruit of *C. melo* var. *makuwa* is eaten as a dessert, and the immature fruit of *C. melo* var. *conomon* is used as a vegetable (Kitamura, 1950; Pitrat, 2008). Meanwhile, *C. melo* vars. *momordica*, *flexuosus* (L.) Naudin and *acidulus* Naudin are grown in South and Southeast Asia, along with other types of melon that are not classified as proper botanical groups. Especially in Southeast Asia and the neighboring areas, such as the eastern part of Myanmar and the southwestern part of Yunnan Province in China, melon fruit is utilized similar to the way it is used in South Asia, in that immature and mature fruits primarily eaten as vegetables and desserts, respectively (Kato *et al.*, 2006, 2010; Nhi *et al.*, 2010; Tanaka *et al.*, 2014). Fully mature melon fruit often possesses a powdery flesh texture, which is a unique trait of *C. melo* var. *momordica* in India, and gelatinous sheaths around the seeds, which is often found in South Asian melons. The characters of Southeast Asian melons are similar of those of South Asian melons. Moreover, South and Southeast Asian melons have been classified as distinct from East Asian melons, according to the analysis of complementary genes that cause bitterness in the immature fruit of F₁ hybrids (Fujishita *et al.*, 1993). In addition, non-classified melons in Southeast Asia and the neighboring areas commonly possess seeds of <9.0 mm in length and, accordingly, are known as “small-seed type” melons, a group to which East Asian melons are also included. Southeast Asian melons are similar to both South and East Asian melons in regards to their fruit, seed, and genetic traits.

Indian melon landraces are known to possess resistance to diseases, including powdery mildew and downy mildew, and have been utilized as breeding material (Dhillon *et al.*, 2012). East Asian melons have also been introduced into breeding programs, owing to their resistance to various diseases, including Fusarium wilt, gummy stem blight, and cucumber mosaic virus (Takada, 1979, 1983). Thus, it is likely that valuable genetic resources for melon breeding could also be found in Southeast Asia. To collect such landraces, field surveys were previously conducted in Laos, Vietnam, and western Cambodia (Sakata *et al.*, 2008; Saito *et al.*, 2009; Kato *et al.*, 2010; Matsunaga *et al.*, 2015), which melon landraces are cultivated in wet conditions without agrochemicals and are, thus, expected to possess disease resistance. However, melon landraces from eastern Cambodia are difficult to access, since they are rarely conserved

in Cambodian gene bank, and currently, the melon genetic resources of the U.S. National Plant Germplasm System (NPGS), where the largest number of accessions is preserved, cannot be utilized, owing to a Japanese plant-protection policy that is aimed at preventing the introduction of cucumber green mottle mosaic virus.

Therefore, in the present field survey, cucurbit crops, including melon, were collected in eastern Cambodia. Morphological traits, such as fruit traits and seed size, were measured in order to characterize the cucurbit crops, particularly melon landraces, and were compared with those of melon landraces from other Southeast Asian countries, as well as those from and South- and East-Asian countries.

Materials and methods

A field survey was successfully conducted with a Letter of Agreement between the Cambodian Agricultural Research and Development Institute (CARDI; Cambodia), Genetic Resources Center in National Agriculture and Food Research Organization (NARO; Japan), and by PGRAsia project in the Ministry of Agriculture, Forestry and Fisheries (Japan). The 18-d field survey was conducted in the capital (Phnom Penh) of Cambodia and in six provinces in eastern Cambodia, including Kampong Cham, Tbong Khmum, Kratie, Mondolkiri, Ratanakiri, and Stung Treng (Fig. 1), starting on November 18th, during the dry season (Table 1).

Samples were collected from local markets, roadside vegetable stands, farmers' houses, and farmers' fields, and the precise positions of the sites were recorded using GPS. Other information, including local crop names and cultivation methods (e.g., cultivation place, sowing and harvest times, fertilizer application, and fruit usage), was also collected by interviews with locals. Seeds from each fruit and seed-storage-bag (in farmers' houses) were registered as single accessions. Mixed stored seeds were separated into seeds of each crop and the registered independently as individual corresponding accessions.

Table 1. Itinerary of the field survey in Cambodia, 2015

Date	Itinerary ¹	Stay
8 Nov.	Haneda -- Bangkok -- Phnom Penh	Phnom Penh
9 Nov.	Phnom Penh -- CARDI	Phnom Penh
10 Nov.	Phnom Penh -- Kampong Cham -- Tbong Khmum -- Snuol (Kratie)	Snuol
11 Nov.	Snuol -- Oam -- Sen Monorom (Mondolkiri)	Sen Monorom
12 Nov.	Sen Monorom -- Visit to eastern and northeastern area	Sen Monorom
13 Nov.	Sen Monorom -- Visit to southern and western area	Sen Monorom
14 Nov.	Sen Monorom -- Visit to northern area	Sen Monorom
15 Nov.	Sen Monorom -- Prouk -- Day Loo -- Banlung (Ratanakiri)	Banlung
16 Nov.	Sample preparation	Banlung
17 Nov.	Banlung -- Visit to northern area	Banlung
18 Nov.	Banlung -- Visit to eastern area	Banlung
19 Nov.	Banlung -- Visit to northern and western area	Banlung
20 Nov.	Banlung -- Stung Treng -- Siem Pang (Stung Treng)	Siem Pang
21 Nov.	Siem Pang -- Stung Treng	Stung Treng
22 Nov.	Stung Treng -- Visit to village around northwestern area	Stung Treng
23 Nov.	Stung Treng -- Phnom Penh	Phnom Penh
24 Nov.	Phnom Penh -- CARDI	Phnom Penh
25 Nov.	Phnom Penh -- Bangkok -- Haneda on 26 Nov.	On flight

¹Name in parenthesis is Province

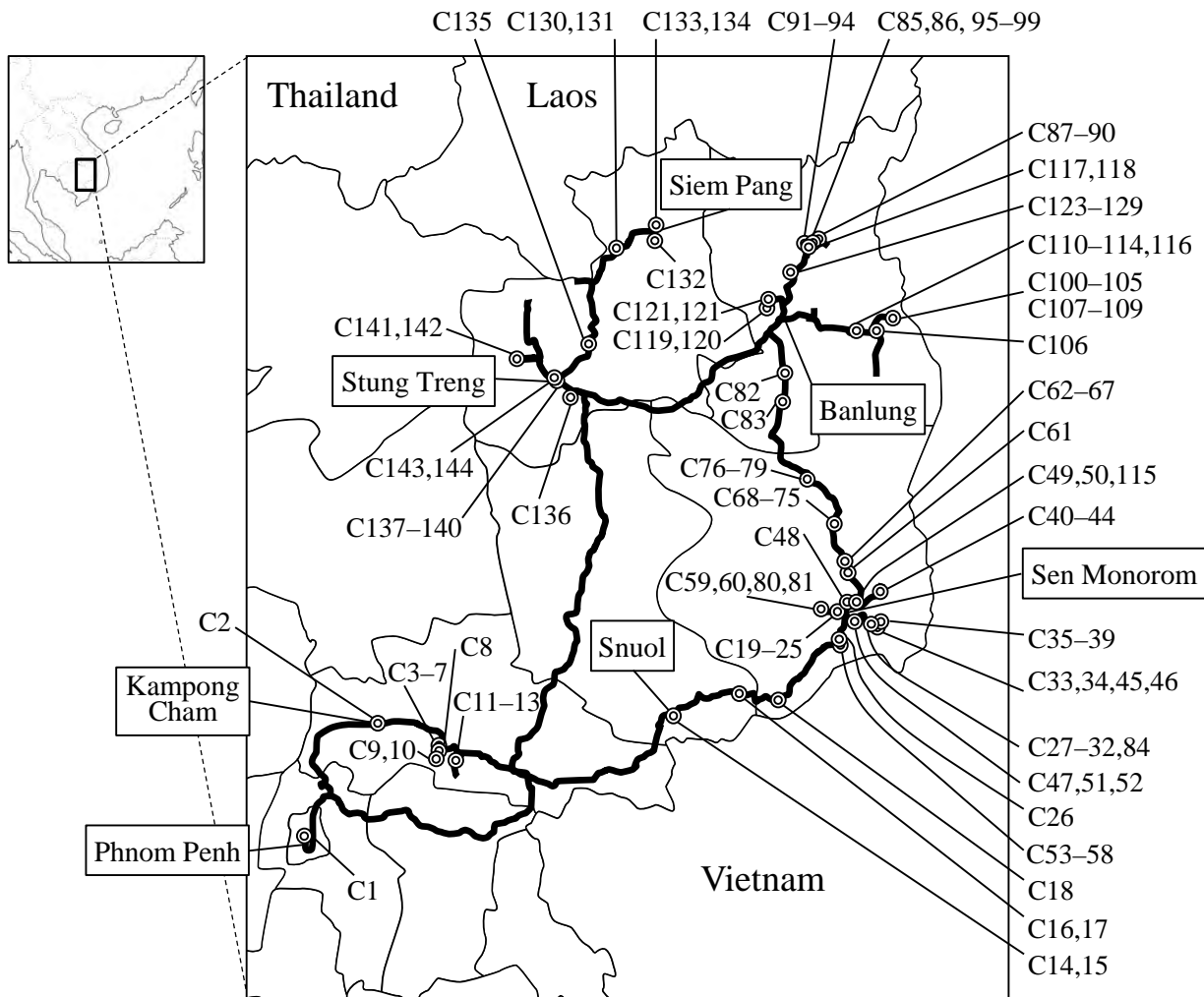


Fig. 1. Explored route and city in Cambodia. The explored route is shown by bold line. Collection site is indicated by double circle with accession number. The accession number “15CJV-” is abbreviated, and indicated just by the number, “C1”, “C2” and “C3” etc.

We also investigated 13 fruit characteristics, and recorded them for 17 melon fruit (Table 2). Seed length and width were measured for 10 seeds from each of 62 melon accessions, and the seed samples were classified as large- (≥ 9.0 mm length) or small-seed (< 9.0 mm length), according to Akashi *et al.* (2002). To document the variance of seed size within each melon accession, seed length and width were also measured for 100 seeds from each of 27 accessions of which 15 were harvested from a single fruit during the field survey and 12 were harvested from several fruits by farmers. These accessions were selected to cover a wide geographical area of eastern Cambodia, and the seeds were selected randomly.

Data analysis was conducted using 17 melon fruits and 620 melon seeds (10 seeds of 62 accessions) from eastern Cambodia, along previously reported data regarding the characteristics and sizes of 423 melon fruits and 936 seeds, respectively, which were derived from 336 melon accessions from East India, northern Laos, western Cambodia, northern Vietnam, and *C. melo* vars. *makuwa* and *conomon* from China, Korea, and Japan (Saito *et al.*, 2009; Kato *et al.* 2010; Nhi *et al.*, 2010; Tanaka *et al.*, 2015; Matsunaga *et al.*, 2015). For 35 accessions of *C. melo* vars. *makuwa* and *conomon*, of which seed size ($n = 10$) was measured for 25 accessions, the number of fruits measured ranged from one to 10. For 39 melon accessions

Table 2. Fruit characters of genetic resources of Cucurbitaceae from Eastern Cambodia, 2015

Sample Number	Plant name	Fruit size			Fruit epicarp			Fruit flesh					Plac-enta color	Sheath ^{2,3} around seed
		Weight (kg)	Length (cm)	Diameter (cm)	Color ¹	Stripes on rind	Sutures on rind	Outer color ¹	Inner color ¹	Thick-ness (cm)	Powder ² texture	Brix ² (%)		
15CJV-C2	Pumpkin	1.00	8.7	4.3	O	-	-	O	O	2.0	NC	NC	O	NC
15CJV-C3	Melon	0.80	15.1	10.6	G	-	-	W	W	2.7	+	5.0	W	+
15CJV-C4	Melon	1.00	24.2	8.7	G	+	-	G	G	2.2	+	4.0	W	+
15CJV-C5	Melon	0.90	20.6	8.2	O	+	-	W	W	1.9	+	3.0	W	+
15CJV-C8	Melon	0.50	8.7	9.8	G	-	-	G	G	1.9	-	12.2	W	+
15CJV-C9	Melon	2.10	27.4	11.7	O	+	-	LG	LG	3.2	-	5.0	Y	+
15CJV-C10	Melon	1.10	14.9	10.9	O	+	-	LG	LG	3.1	+	4.8	O	+
15CJV-C11	Melon	1.10	21.2	9.8	O	+	-	LG	LG	2.5	+	5.0	Y	+
15CJV-C12	Melon	1.50	24.4	10.4	G	-	-	G	G	3.1	+	5.0	Y	+
15CJV-C14	Pumpkin	0.60	11.5	12.9	O+G	-	-	Y	Y	2.9	NC	NC	Y	NC
15CJV-C15	Pumpkin	1.20	9.6	17.1	O	-	-	O	O	3.2	NC	NC	O	NC
15CJV-C16	Pumpkin	1.30	18.5	12.8	B	-	-	O	O	2.2	NC	NC	O	NC
15CJV-C17	Pumpkin	2.10	10.3	19.0	B	-	-	O	O	4.1	NC	NC	O	NC
15CJV-C18	Pumpkin	1.80	12.8	17.1	O	-	-	O	O	2.9	NC	NC	O	NC
15CJV-C23	Pumpkin	2.50	38.5	15.1	B	-	-	Y	Y	2.7	NC	NC	O	NC
15CJV-C26	Pumpkin	1.80	10.3	19.2	O	-	-	Y	Y	2.6	NC	NC	O	NC
15CJV-C30	Pumpkin	2.20	17.3	17.5	O	-	-	Y	Y	4.0	NC	NC	O	NC
15CJV-C48	Pumpkin	1.3	11.4	15.3	O	-	-	O	O	2.9	NC	NC	O	NC
15CJV-C50	Pumpkin	4.6	20.4	22.9	O	-	-	Y	Y	3.8	NC	NC	Y	NC
15CJV-C51	Watermelon	1.60	14.4	12.1	G	+	-	W	W	0.8	-	8.0	R	NC
15CJV-C52	Watermelon	2.90	25.3	13.6	G	+	-	W	W	0.7	-	12.0	R	NC
15CJV-C57	Pumpkin	1.50	11.5	15.7	O	-	-	O	O	2.0	NC	NC	O	NC
15CJV-C60	Pumpkin	2.90	13.2	20.4	O	-	-	Y	Y	3.9	NC	NC	Y	NC
15CJV-C68	Melon	0.90	12.9	7.4	G	+	-	G	W	2.8	+	2.0	Y	+
15CJV-C69	Melon	1.50	23.2	7.4	G	-	-	G	G	2.6	+	3.0	W	+
15CJV-C70	Melon	2.60	32.5	12.2	G	+	-	G	G	3.2	+	4.0	W	+
15CJV-C71	Melon	2.00	28.8	9.6	Y	-	-	G	G	2.7	+	3.0	LG	+
15CJV-C72	Melon	2.60	31.2	11.0	W	-	-	W	W	3.4	+	4.0	W	+
15CJV-C73	Cucumber	0.70	18.7	7.5	O	-	-	W	W	1.7	-	4.0	W	+
15CJV-C74	Watermelon	2.80	18.9	14.9	G	+	-	W	W	0.9	-	11.0	R	NC
15CJV-C75	Watermelon	3.20	26.2	13.2	G	+	-	W	W	1.3	-	11.0	R	NC
15CJV-C137	Melon	3.30	37.7	13.4	Y	-	+	W	W	3.0	+	6.0	W	+
15CJV-C138	Melon	3.30	36.2	11.7	G	-	+	G	Y	3.4	+	4.0	O	+
15CJV-C139	Melon	1.10	23.5	8.6	Y	-	-	W	LG	2.3	+	5.0	O	+
15CJV-C140	Melon	1.90	32.2	10.5	DG	-	-	LG	LG	2.1	+	5.0	W	+

¹O: Orange, W: White, G: Green, LG: Light green, Y: Yellow, R: Red

²NC: Not checked

³Gelatinous sheath surrounding seed in melon

from western Cambodia, a single fruit was measured for five accessions, and seed size (n = 10) was measured for 39 accessions. For the other reference accessions, a single fruit and single representative seed was measured. Thus, the total number of melon fruits and melon seeds included in the analysis were 440 and 1556, respectively. Using the Tukey-Kramer multiple comparison test, we compared the seed length of the accessions from eastern Cambodia and other countries.

Results

During the field survey in eastern Cambodia, we visited the capital, the provincial capitals of six provinces, and various other villages along the route (Fig.1). The survey was included both lowland areas and hill areas, with altitude ranging from 10 to 825 meters above sea level. During the survey, we observed lowland areas around the Mekong River in the provinces of Kampong Cham, Tbong Khmum, Kratie, and Stung Treng and in the border regions between the provinces of Mondolkiri and Ratanakiri, and we observed pastureland and gently undulating hilly areas in the provinces of Mondolkiri and Ratanakiri (Photos 1 and 2). The lowland areas were utilized for cultivating paddy rice, corn, beans, and vegetables (Photos 3-5), whereas the hilly areas were utilized for the cultivating upland rice, corn, beans, and vegetables (Photo 6). Both areas were also developed for the cultivation of cash crops, such as

rubber, cassava, pepper, and sugar cane (Photos 7 and 8). The local people utilize both wild and cultivated foodstuffs, including vegetables, fruits, animals and fish and sold both the raw and processed foods, such as pickled vegetables and dried or fermented fish, at city and local markets (Photos 9-16). We also observed that the immature and mature fruits of cucurbit crops, such as bottle gourd, cucumber, melon, pumpkin, sponge gourd, squash, watermelon, and wax gourd, being sold at the local markets (Photos 12, 13, 17, and 18). However, the cucurbit crops sold at the local markets were derived from both neighboring areas and other most distance provinces, owing to transportation over well-paved highways and dirt roads.

As a result of the present survey, 144 samples were collected from 45 sites (Tables 3 and 4; Photos 19-21) and comprised seven kinds of cucurbit crops, as well as one type of foxtail millet. Wild cucurbit (e.g., *Cucumis hystrix* Chakr.) were not collected during the survey because we were unable to determine how they were used from our interviews with local people (Photo 22). A total of 35 samples were collected as fruit (Table 2), and the remaining were collected as seeds from shops (sample number 15CJV-C6, 15CJV-C7, and 15CJV-C13) and farmers' houses (Photos 23 and 24). Local farmers stored their seeds in storage cases, such as plastic bottles, bamboo tubes, and bottle gourds, and some farmers stored all their cucurbit crop seeds together (Photos 24 and 25). Of the 144 samples, 138 represented landraces, and the remaining six (melon accession 15CJV-C1; cucumber accession 15CJV-C7; and watermelon accessions 15CJV-C51, 15CJV-C52, 15CJV-C74, and 15CJV-C75; Photo 26) represented improved varieties. All 144 samples were registered as accessions in CARDI and NIAS with NIAS registered-number numbers (JP; Table 4).

In regards to melons specifically, 62 accessions were collected during the field survey (Table 3). Of them, 17 were collected as fruit (Table 2; Photos 18 and 19), and the remaining 45 were collected as seeds that were either sold at market or stored by farmers (Photos 23-26). Based on the interview with local people, we determined that the cultivation of melon landraces starts at the beginning of the rainy season (i.e., May), either by mixed cropping with maize, upland rice, cucumber, wax gourd, and pumpkin or by single cropping in an open field on flat land or near a riverside (Photos 27 and 28). Fertilizers and pesticides are not applied during the cultivation, except for the improved variety of cucumber, which is cultivated using fertilizer, pesticides, mulch, and poles (Photo 29). Immature and mature melon fruits are harvested at two and three months after sowing, respectively (Photos 30 and 31). The immature fruits are prepared as a vegetable (e.g., being pickled or prepared in soups and salads), whereas the mature fruits are eaten as

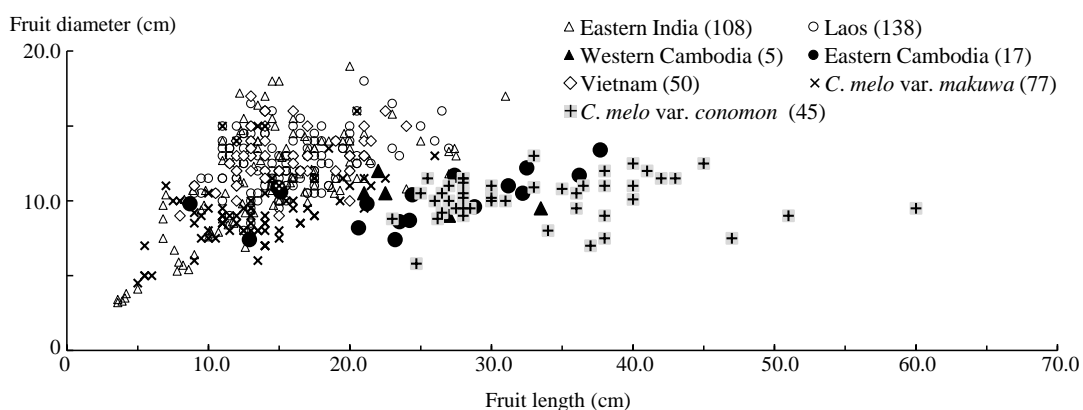


Fig. 2. Length and diameter variation in 440 melon fruits. Numerical character in parenthesis in legend is the number of fruits measured

Table 3. A total number of collection in Cambodia, 2015

Plant name	Total	Phnom Penh	Kampong Cham	Tbong Khmum	Kratie	Mondol-kiri	Ratana-kiri	Stung Treng
Melon	62	1	5	5	0	21	17	13
Cucumber	30	0	1	0	0	18	11	0
Pumpkin	32	0	1	0	4	20	5	2
Watermelon	15	0	0	0	0	5	10	0
Other crops ¹	5	0	0	0	0	2	3	0
Total	144	1	7	5	4	66	46	15

¹Waxgourd, bitter gourd, snake gourd and foxtail millet included to "other crops"

desserts, with sugar, condensed milk, coconut milk, or crushed ice (Photos 32-35). Seeds for the following year's cultivation are collected in-house from the first set fruit from each vine, and the number of the fruits for seed collection depends on the growing area, normally two or three fruits.

The 17 melon accessions exhibited variation in the measured fruit traits. For example, the observed epicarp colors included dark green, green, pale green, orange and yellow (Table 2, Photo 36), and in the village of De A (Mondolkiri Province), a farmer collected five fruits in which the epicarp exhibited four colors. Stures were recognized on the epicarp of fruits from accessions 15CJV-C137 and 15CJV-C138 (Photos 37 and 38). Fruit lengths varied widely and ranged from 8.7 to 37.7 cm, although most of the fruits were >20 cm (Fig. 2). Fruit length was also strongly correlated with fruit weight ($r = 0.858$, $p < 0.01$), and fruit weight was subsequently correlated with fruit diameter, which ranged from 7.4 to 13.4 cm ($r = 0.677$, $p < 0.01$). The fruit shape index (length/ diameter), which ranged from 1.8 to 3.1, indicated that the fruits were elongated (e.g., Photos 37 and 38), except for in the fruit from 15CJV-C8, which was globular (shape index = 0.9; Photo 39). The shape index values indicated that elongated melon fruits also occur in the landraces of western Cambodia and in *C. melo* var. *conomon* from East Asia. On the other hand, flesh traits exhibited less variation. Both the outer and inner flesh colors were green, white, or yellow (Photos 37 and 38), and the sugar concentration of the flesh was ≤ 6.0 °Bx, with the exception of 15CJV-C8, which yielded a Brix value of >12.0 °Bx (Fig. 3, Photo 39). The melon fruits from eastern Cambodia, except for those of accessions 15CJV-C8 and 15CJV-C9, also possessed a powdery texture and gelatinous sheaths around the seeds (Table 2). Therefore, the melons collected from eastern Cambodia were mainly either elongated with non-sweet flesh or globular with sweet flesh.

Out of 620 seeds (10 seeds from 62 melon accessions) collected from eastern Cambodia, seed length varied widely, ranging from 5.83 to 10.01 mm, and was weakly correlated with seed width ($r = 0.548$, $p < 0.01$; Fig. 4). Wide variation was also observed in the lengths of 100-seed samples (Fig. 5; Photo 40), and the lengths of stored seeds from 12 accessions (15CJV-C13 to 15CJV-C135; Fig. 5), exhibited wider variation than the seeds of the remaining accessions, including the reference accessions. the variance of 100- seed samples was >0.52 in 10 of the 12 accessions and <0.46 for the other two. Thus, the size of the stored seed varied greatly, probably reflecting seed harvest from several fruits.

The lengths of 620 seeds were normally distributed (Fig. 4), and 586 (94.5 %) seeds were classified as small (<9.0 mm length), which is typical of melon landraces from eastern Cambodia, as well as of those from eastern India, Laos, Vietnam, western Cambodia, and East Asia. In addition, there was no noticeable difference in the length of seeds from the four provincial groups (Fig. 4). For accession 15CJV-C8, which

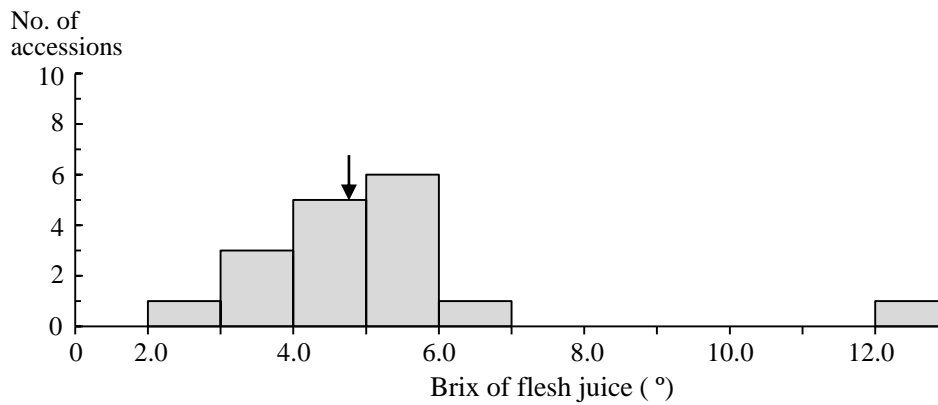


Fig. 3. Brix of flesh juice in 17 melon accessions from Eastern Cambodia. Allow indicates average of flesh brix

was collected from Kampong Cham Province and was the sweetest melon collected in this survey, the maximum length of the 10-seed sample was <6.83 mm, which was shorter than the average length of the 620 seeds from eastern Cambodia (7.82 mm). The same result was obtained for the 100-seed sample, for which seed length was consistently <7.56 mm (Fig. 5); however, the average length of the 100-seed sample was longer than seeds from eastern India, Laos, Vietnam, and *C. melo* vars. *makuwa* and *conomon* ($p < 0.01$) and a little shorter than those from western Cambodia. Therefore, it was a clear indication that the melon accession from eastern Cambodia, except for 15CJV-C8, had relatively larger seed than those from neighboring country.

Discussion

While interviewing local farmers during our field survey, we tried to collect information regarding the utilization of cultivars, as well as wild *Cucumis* species, especially *C. hystrix*, which is an important genetic resource for cucumber breeding and has been recently introduced into Japan from China and Laos (Chen *et al.*, 2004; Kato *et al.*, 2010; Tanaka *et al.*, 2014). Local people in eastern Cambodia utilize the local flora and fauna, including vegetables, mushrooms, and fish, and sell them at market (Photos 10 and 14). However, local people were not familiar with wild *Cucumis* species, even in the forested areas near Mondolkiri Province, where the altitude ranged from ~200 to ~300 m above sea level (Photo 2). In East India, Myanmar, Laos, Vietnam, and the southwestern part of Yunnan Province (China), *C. hystrix* was found in mountainous areas with an altitude of ~200 to ~1300 m above sea level, an area where local people were familiar with wild fruits and wildlife and collected *C. hystrix* fruit from open patches in the deep forest (Tanaka *et al.*, 2014). In contrast, *C. hystrix* was not utilized by local people living in the mountainous areas of southern Vietnam near Mondolkiri Province (Duong T.T., personal communication). Therefore, wild *Cucumis* species probably do not grow in eastern Cambodia, where we visited.

Among the seeds collected by farmers from two or three melon fruits, wide variation was observed in seed size among and within accessions (Figs. 3 and 4; Photo 40). We also expected to find variation in phenotypic traits, such as fruit and agricultural traits, within each accession. In the village of De A (Mondolkiri Province), where five fruits were harvested from an open field (Photos 21 and 36; 15CJV-C68 to 15CJV-C72), variation was observed in fruit characteristics, especially in the epicarp color (Table 2). According to the owner of the field, seeds for cultivating melon in the following year are annually harvested from five or six fruits, which are green in color with stripes on the epicarp, like 15CJV-C70,

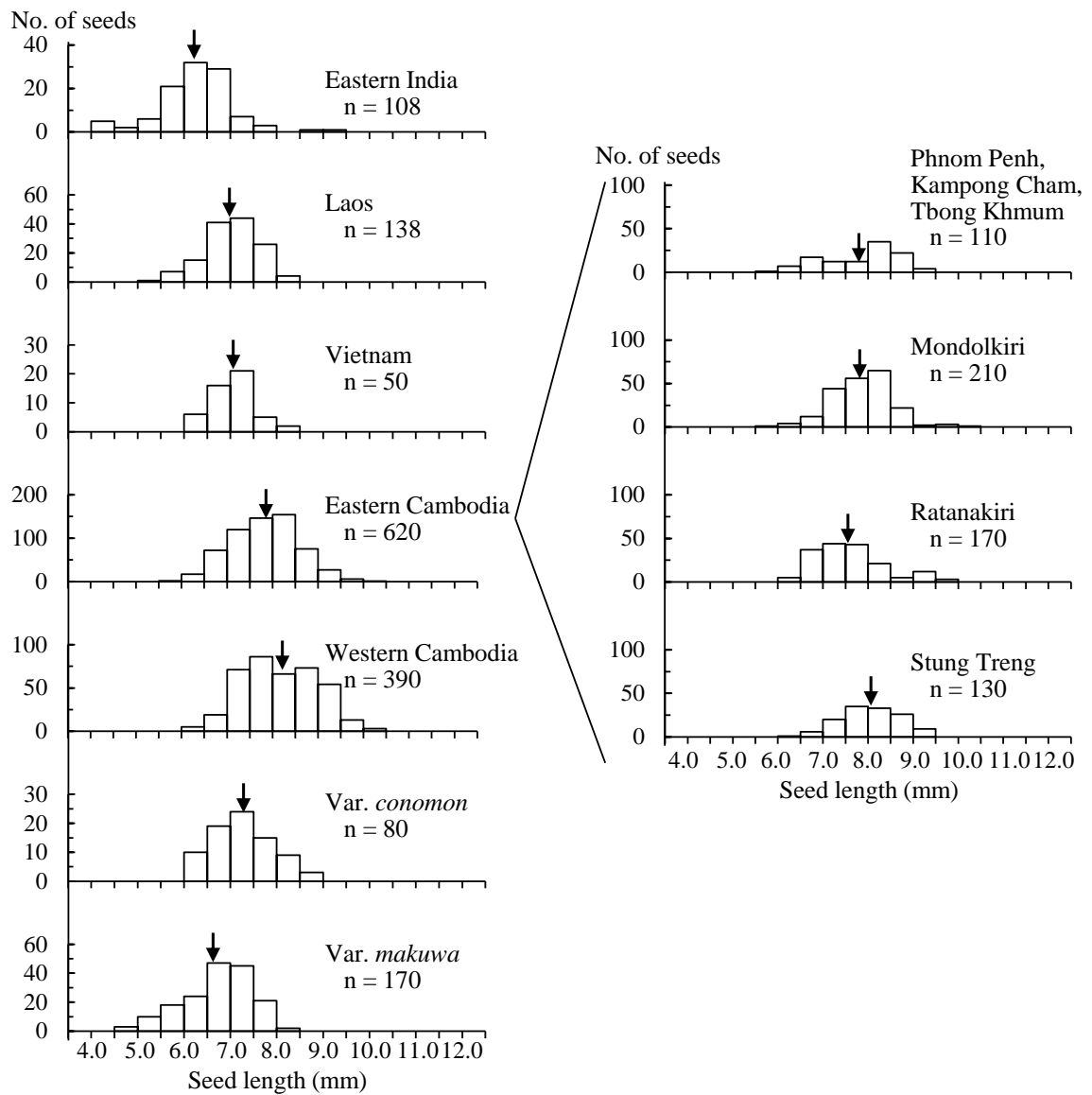


Fig. 4. Length variation in 1556 melon seeds from Southeast Asian countries and of two varieties of East Asia. Allow indicates average seed length in each area and variety

and variation in fruit characteristics are recognized in the field every year. Melon plants/landraces grown in open fields appeared to share the same gene pool through open pollination, thereby conserving genetic variation in fruit characteristics. Our interviews indicated that, in eastern Cambodia, melon landraces are generally cultivated in open fields. Thus, wide variation in fruit and agricultural traits can even be preserved in populations derived from seeds of single fruits. In the melon landraces of Laos, where local people cultivated melons in open fields on mountain slopes (Saito *et al.*, 2009), variation in fruit characteristics, even disease resistance, was observed in a single accession of seeds that was harvested from a single fruit (Kato K., personal communication). Therefore, it should be considered that each melon genetic resource also contains genetic variation in fruit and agricultural traits.

Despite the continuous variation of seed and fruit size in eastern Cambodia, the seeds and fruits of melons from eastern and western Cambodia were longer than those from Laos and Vietnam (Figs. 2 and 4). The Cambodian melons seemed to possess intrinsic seed characteristics that were different from those of other Southeast Asian melons. Ten quantitative trait loci (QTLs) have been associated with fruit length, diameter, and shape (Díaz *et al.*, 2014), and the length, width, shape, and weight of seeds also seem to be

controlled by QTLs (Wang *et al.*, 2011). This suggests that Cambodian melons are genetically distinct from the other Southeast Asian melons.

The average length of seeds from the eastern Cambodian melon accessions was 7.82 mm (Fig. 4), which is similar to that of *C. melo* var. *momordica*, as indicated by Fujishita (1983) and Tanaka *et al.* (2015). Similarities between the South Asian and the Cambodian melon were observed for several characteristics. Powdery fruit flesh texture, which is a typical trait of *C. melo* var. *momordica* from South Asia (Kato *et al.*, 2006; Dhillon *et al.*, 2012), was observed in the collected melon fruits (Table 2). Moreover, the occurrence of gelatinous sheaths around the seeds was also noticed in the melon fruits from South Asia (Kato K., personal communication). Such similarities may indicate that Cambodian and South Asian melons share a similar genetic composition, as suggested in the study of bitterness of immature fruit from interspecific hybrids (Fujishita *et al.*, 1993). South Asian melons, including *C. melo* var. *momordica* have been utilized in breeding programs for disease resistance (Dhillon *et al.*, 2012). Thus, Cambodian melons likely possess disease resistance, as well.

Similarities were also found in the fruit shape and sugar concentration of the melon accessions from Cambodia and other countries. The melon landraces from eastern Cambodia were categorized as either elongated with non-sweet flesh or globular with sweet flesh (Figs. 2 and 3), which seems similar to the pattern observed in the East Asian *C. melo* vars. *conomon* and var. *makua*, respectively (Kitamura, 1950). Both *C. melo* vars. *conomon* and *makua* possess genes that confer resistance to Fusarium wilt, gummy stem blight, and cucumber mosaic virus (Takada, 1979, 1983). The similarity of the Cambodian melon accessions and East Asian melons suggests the Cambodian melon germplasm represents an important source of disease resistance genes and can be utilized as breeding material.

In the present study, we found that local people utilize the mature melon fruit as a dessert and immature fruit as a vegetable, as in other cucurbit crops (Photos 17, 30, and 32). These uses were also found in western Cambodia (Matsunaga *et al.*, 2015) and seem to be common throughout the country. In the case of cucumber, immature fruit is utilized as a vegetable in both eastern and western Cambodia, and an improved variety was commonly found at vegetable markets (Photo 17; Matsunaga *et al.*, 2015). The improved variety was produced using pesticides and fertilizers (Photo 29). The demand for high-yielding, high-quality fruit production is increasing in Cambodia, and local people are shifting to the cultivation of improved varieties. In melon, seeds of an improved variety were found at seed shops in city and local markets in eastern and western Cambodia (Photo 26; Matsunaga *et al.*, 2015). These findings suggest that melon landraces will be lost in Cambodia, as melon farmers stop cultivating landraces and being cultivating improved varieties.

In conclusion, melon accessions from eastern Cambodia were maintained through open pollination, which resulted in variable fruit and seed size, both among and within accessions, and suggested that the accession also possessed wide variation in agricultural traits. Seed length indicated genetic differences in the melon accessions from eastern Cambodia, other Southeast Asian countries, such as Laos and Vietnam, and East Asia. Similarities were also found in the fruit characteristics (e.g., flesh texture, the occurrence of gelatinous sheaths around the seeds, fruit size, and sugar concentration) of the eastern Cambodian melons and the melons of western Cambodia, South Asia, and East Asian, which have already been utilized for the breeding of disease resistance. These findings indicate that the Cambodian melon accessions collected during the present study should be evaluated for disease resistance. These genetic resources may also possess variation in agricultural traits and may be useful for various breeding programs. Therefore, we

should collect genetic resources for melon in Cambodia, as well as for other cucurbit crops, before they are lost.

Genetic resources

Seeds of the 144 accessions that were collected in the present study have been stored as genetic resources in the CARDI gene bank, and the subsets were introduced to the NARO gene bank using 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 2016.

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2015年度カンボジアにおけるウリ科作物遺伝資源の探索

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和文摘要

ウリ科作物遺伝資源を収集するためカンボジア東部において調査を実施した。調査で収集した遺伝資源は144点で、市場、畑や農家にて収集した。これらのうち、メロン遺伝資源は62点であり、17系統を果実として、残り45点を種子として収集した。これら遺伝資源は、それぞれ、カンボジア農業調査開発研究所ならびに農業生物資源研究所において系統として登録した。農家からの聞き取りに基づくと、メロンは屋外の圃場にて栽培されており、他家受精により遺伝子プールを共有できる状況であった。このため、17系統のメロン果実では果高と果径は幅広い変異を示し、62系統の種子長においても、系統間や系統内において幅広いサイズ変異が認められた。これらのことから、収集したメロン系統が農業形質においても多様な変異を含んでいることが予想された。また、カンボジアメロン遺伝資源の種子長は、隣国のラオスやベトナム、ならびに東アジアの在来メロンよりも長く、南アジアに固有のモルディカメロンと近かった。さらに、カンボジアメロン遺伝資源は果肉の粉質や種子周辺のゼリー質では南アジアの在来メロンと類似性があるだけでなく、果実のサイズや果肉のBrixでは東アジアの在来メロンと類似性が認められた。南アジアや東アジアの在来メロンが病害抵抗性の育種素材として利用されていることから、これらの類似性はカンボジアメロン遺伝資源が病害抵抗性を有している可能性を示唆していた。収集したカンボジアメロン系統から病害抵抗性を含むさまざまな有用農業形質を選択できることが考えられることから、今後の特性評価が待たれる。

Table 4. Details of collected materials in Cambodia, 2015

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site					Remarks	
								Province	District	Village	Latitude & Longitude	Altitude (m)		Source (Market name)
255548	15CJV-C1	9 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Cultivar	Seeds	Phnom Penh	Phnom Penh		N11-32-25.41 & E104-54-51.56	10	Market (Toul Tom Poug)	Yellow color with strip on epicarp
255549	15CJV-C2	10 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Kampong Cham	Phnom Han Chey	Kokor	N12-3-31.56 & E105-15-27.88	27	Market (Prey Toteung Toeh)	Cultivated near Kampong Cham city
255550	15CJV-C3	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov Keav	Landrace	Fruit	Kampong Cham		Kampong Cham	N11-59-27.67 & E105-27-55.33	14	Market (Kampong Cham Taom)	
255551	15CJV-C4	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Kampong Cham		Kampong Cham	N11-59-27.67 & E105-27-55.33	14	Market (Kampong Cham Taom)	
255552	15CJV-C5	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Kampong Cham		Kampong Cham	N11-59-27.67 & E105-27-55.33	14	Market (Kampong Cham Taom)	
255553	15CJV-C6	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Kampong Cham		Kampong Cham	N11-59-27.67 & E105-27-55.33	14	Market (Kampong Cham Taom)	Collected at seed shop in the market
255554	15CJV-C7	10 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Tror Sork Treig	Cultivar	Seeds	Kampong Cham		Kampong Cham	N11-59-27.67 & E105-27-55.33	14	Market (Kampong Cham Taom)	Collected at seed shop in the market
255555	15CJV-C8	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Prait	Landrace	Fruit	Kampong Cham		Kampong Cham	N11-58-43.73 & E105-27-40.69	23	Road stand shop	Cultivated at Kah Pain island on the Mekong River in front of the road stand shop
255556	15CJV-C9	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Tbong Khmum	Tbong Khmum	Toul Ksach	N11-56-1.61 & E105-28-23.51	24	Market (Tonle bet)	
255557	15CJV-C10	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Tbong Khmum	Tbong Khmum	Toul Ksach	N11-56-1.61 & E105-28-23.51	24	Market (Tonle bet)	
255558	15CJV-C11	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Tbong Khmum	Tbong Khmum	Toul Trea	N11-54-34.16 & E105-33-58.29	42	Road stand shop	
255559	15CJV-C12	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Tbong Khmum	Tbong Khmum	Toul Trea	N11-54-34.16 & E105-33-58.29	42	Road stand shop	
255560	15CJV-C13	10 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Tbong Khmum	Tbong Khmum	Toul Trea	N11-54-34.16 & E105-33-58.29	42	Road stand shop	Bulked seeds
255561	15CJV-C14	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Kratie	Snuol	Snuol	N12-4-34.55 & E106-25-18.42	152	Market (Snuol)	Cultivated near Snuol market
255562	15CJV-C15	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Kratie	Snuol	Snuol	N12-4-34.55 & E106-25-18.42	152	Market (Snuol)	Cultivated near market on the way to Mondolkiri
255563	15CJV-C16	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Kratie	Snuol	K3	N12-8-20.45 & E106-43-15.30	119	Market (K3)	
255564	15CJV-C17	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Kratie	Snuol	K3	N12-8-20.45 & E106-43-15.30	119	Market (K3)	Cultivated near the market
255565	15CJV-C18	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Mondolkiri	Kae Sema	O' am	N12-5-32.69 & E106-53-36.41	136	Farmer's house	The seed is bought from other farmer
255566	15CJV-C19	11 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 1	Stored together with other Cucurbitaceae crops seeds
255567	15CJV-C20	11 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Tror Sork Treig	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 1	Stored together with other Cucurbitaceae crops seeds
255568	15CJV-C21	11 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 1	Stored together with other Cucurbitaceae crops seeds
255569	15CJV-C22	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 1	Stored together with other Cucurbitaceae crops seeds
255570	15CJV-C23	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 1	

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site					Remarks	
								Province	District	Village	Latitude & Longitude	Altitude (m)		Source (Market name)
255571	15CJV-C24	11 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Tror Sork Treig	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 2	Collected at different farmer from C20 and C25
255572	15CJV-C25	11 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Tror Sork Treig	Landrace	Seeds	Mondolkiri	Sen Monorom	Trem Tmei	N12-27-34.30 & E107-9-32.00	681	Farmer's house 3	Collected at different farmer from C20 and C24
255573	15CJV-C26	11 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Mondolkiri	Sen Monorom	Pu Tang	N12-24-43.24 & E107-11-11.22	690	Shop (Oromis)	Cultivated around the shop at hill
255574	15CJV-C27	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 1	Cultivated with upland rice
255575	15CJV-C28	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Rachik	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 2	Stripe on epicarp, cultivated with upland rice
255576	15CJV-C29	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 2	Cultivated with upland rice
255577	15CJV-C30	12 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Fruit	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 2	Cultivated with upland rice
255578	15CJV-C31	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 3	Larger fruit size than C32 Cultivated with upland rice
255579	15CJV-C32	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chob	N12-25-12.21 & E107-17-54.57	825	Farmer's house 3	Smaller fruit size than C31, Cultivated with upland rice
255580	15CJV-C33	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Leass	N12-25-6.62 & E107-18-44.12	830	Farmer's house	Cultivated with upland rice
255581	15CJV-C34	12 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	O' Raing	Pu Leass	N12-25-6.62 & E107-18-44.12	830	Farmer's house	Cultivated with upland rice
255582	15CJV-C35	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Ropung clan	Landrace	Seeds	Mondolkiri	O' Raing	Pu Traing	N12-25-30.27 & E107-18-51.76	825	Farmer's house 1	Stripe on epicarp, cultivated with upland rice
255583	15CJV-C36	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Traing	N12-25-30.27 & E107-18-51.76	825	Farmer's house 1	Cultivated with upland rice
255584	15CJV-C37	12 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	O' Raing	Pu Traing	N12-25-30.27 & E107-18-51.76	825	Farmer's house 1	Cultivated with upland rice
255585	15CJV-C38	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Ropung clan	Landrace	Seeds	Mondolkiri	O' Raing	Pu Traing	N12-25-30.27 & E107-18-51.76	825	Farmer's house2	Stripe on epicarp, cultivated with upland rice
255586	15CJV-C39	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Traing	N12-25-30.27 & E107-18-51.76	825	Farmer's house2	Cultivated with upland rice
255587	15CJV-C40	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Srok Sorv	Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 1	Cultivated with upland rice, larger seed
255588	15CJV-C40	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Srok Sorv	Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 1	Cultivated with upland rice, smaller seed
255589	15CJV-C41	12 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 1	Cultivated with upland rice
255590	15CJV-C42	12 Nov., 2015	<i>Trichosanthes anguina</i>	Snake gourd		Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 1	Cultivated with upland rice
255591	15CJV-C43	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Srok Sorv	Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 2	Cultivated with upland rice
255592	15CJV-C44	12 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Pech Chhey Da	Pu Krang	N12-34-49.18 & E107-21-7.38	483	Farmer's house 2	Cultivated with upland rice
255593	15CJV-C45	12 Nov., 2015	<i>Cucumis melo</i>	Melon	Ropung clan	Landrace	Seeds	Mondolkiri	O' Raing	Pu Leass	N12-25-6.62 & E107-18-44.12	830	Farmer's house	Stripe on epicarp, cultivated with upland rice
255594	15CJV-C46	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung Pa	Landrace	Seeds	Mondolkiri	O' Raing	Pu Leass	N12-25-6.62 & E107-18-44.12	830	Farmer's house	Cultivated with upland rice
255595	15CJV-C47	13 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Oak	Landrace	Seeds	Mondolkiri	Sen Monorom	Sen Monorom	N12-27-29.94 & E107-11-0.80	699	Road market (Mondolkiri)	Collected from farmer lived in Dos Kromon village, Sok Dom district, Mondolkiri

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site					Remarks	
								Province	District	Village	Latitude & Longitude	Altitude (m)		Source (Market name)
255596	15CJV-C48	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds & Fruit	Mondolkiri	Sen Monorom	Pu Long	N12-29-25.42 & E107-14-2.38	723	Farmer's house	
255597	15CJV-C49	13 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung Tak	Landrace	Seeds	Mondolkiri	Sen Monorom	Pu Long	N12-29-32.05 & E107-14-45.99	751	Farmer's house	
255598	15CJV-C50	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Pol	Landrace	Fruit	Mondolkiri	Sen Monorom	Pu Long	N12-29-32.05 & E107-14-45.99	751	Farmer's house	
255599	15CJV-C51	13 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Cultivar	Fruit	Mondolkiri	Sen Monorom	Sen Monorom	N12-27-29.94 & E107-11-0.80	699	Road market (Mondolkiri)	Seed were collected by farmer
255600	15CJV-C52	13 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Cultivar	Fruit	Mondolkiri	Sen Monorom	Sen Monorom	N12-27-29.94 & E107-11-0.80	699	Road market (Mondolkiri)	Seed were collected by farmer
255601	15CJV-C53	13 Nov., 2015	<i>Cucumis melo</i>	Melon	Rochik	Landrace	Seeds	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house1	Stripe on epicarp, cultivated with upland rice
255602	15CJV-C54	13 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung Pa	Landrace	Seeds	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house1	Cultivated with upland rice
255603	15CJV-C55	13 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house2	Fruit size is 30cm length by 10cm width, cultivated with upland rice
255604	15CJV-C56	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Ra Porl	Landrace	Seeds	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house2	Cultivated with upland rice
255605	15CJV-C57	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Ra Porl	Landrace	Fruit	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house3	Cultivated with upland rice
255606	15CJV-C58	13 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Trou	N12-22-52.10 & E107-13-47.96	703	Farmer's house3	Cultivated with upland rice
255607	15CJV-C59	13 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung Pa	Landrace	Seeds	Mondolkiri	Sen Monorom	Pa Trom II	N12-28-2.07 & E107-6-13.48	621	Farmer's house	Fruit size is 30cm length by 15cm width, cultivated with upland rice
255608	15CJV-C60	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Ra Porl	Landrace	Fruit	Mondolkiri	Sen Monorom	Pa Trom II	N12-28-2.07 & E107-6-13.48	621	Farmer's house	Cultivated with upland rice
255609	15CJV-C61	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Pok Mon	Landrace	Seeds	Mondolkiri	Me Pai	Pu Chey	N12-39-9.67 & E107-12-41.05	369	Farmer's house	Stripe on epicarp, cultivated separately from upland rice in a field, larger seed
255610	15CJV-C61	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Pok Mon	Landrace	Seeds	Mondolkiri	Me Pai	Pu Chey	N12-39-9.67 & E107-12-41.05	369	Farmer's house	Stripe on epicarp, cultivated separately from upland rice in a field, smaller seed
255611	15CJV-C62	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house1	Stripe on epicarp, cultivated with pumpkin and mung bean
255612	15CJV-C63	14 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house1	Cultivated with melon and mung bean
255613	15CJV-C64	14 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house2	Cultivated with melon
255614	15CJV-C65	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house2	Stripe on epicarp, cultivated with pumpkin
255615	15CJV-C66	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house3	Stripe on epicarp, cultivated with pumpkin by rotation cropping
255616	15CJV-C67	14 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Pach Cear Da	Pu Tang	N12-41-33.77 & E107-12-49.13	359	Farmer's house3	Cultivated with melon by rotation cropping
255617	15CJV-C68	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Mondolkiri	Pach Cear Da	De A	N12-47-56.67 & E107-9-27.94	368	Road stand shop	Cultivated with corn
255618	15CJV-C69	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Mondolkiri	Pach Cear Da	De A	N12-47-56.67 & E107-9-27.94	368	Road stand shop	Cultivated with corn
255619	15CJV-C70	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Mondolkiri	Pach Cear Da	De A	N12-47-56.67 & E107-9-27.94	368	Road stand shop	Cultivated with corn
255620	15CJV-C71	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Mondolkiri	Pach Cear Da	De A	N12-47-56.67 & E107-9-27.94	368	Field	Cultivated with corn

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site						Remarks
								Province	District	Village	Latitude & Longitude	Altitude (m)	Source (Market name)	
255621	15CJV-C72	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Mondolkiri	Pach Chear Da	De A	N12-47-56.67 & E107-9-27.94	368	Field	Cultivated with corn
255622	15CJV-C73	14 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Tror Sork Or	Landrace	Fruit	Mondolkiri	Pach Chear Da	De A	N12-47-56.67 & E107-9-27.94	368	Field	Cultivated with corn
255623	15CJV-C74	14 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Cultivar	Fruit	Mondolkiri	Pach Chear Da	De A	N12-47-56.67 & E107-9-27.94	368	Road stand shop	Cultivated with corn
255624	15CJV-C75	14 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ov Lek	Cultivar	Fruit	Mondolkiri	Pach Chear Da	De A	N12-47-56.67 & E107-9-27.94	368	Road stand shop	Cultivated with corn
255625	15CJV-C76	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Ropung Pa	Landrace	Seeds	Mondolkiri	Koh Ngek	Srea Huy	N13-4-11.25 & E107-3-11.08	175	Farmer's house 1	Stripe on epicarp, cultivated corn
255626	15CJV-C77	14 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Ra Porl	Landrace	Seeds	Mondolkiri	Koh Ngek	Srea Huy	N13-4-11.25 & E107-3-11.08	175	Farmer's house 1	Cultivated with corn
255627	15CJV-C78	14 Nov., 2015	<i>Benincasa hispida</i>	Wax gourd	Tror Lack	Landrace	Seeds	Mondolkiri	Koh Ngek	Srea Huy	N13-4-11.25 & E107-3-11.08	175	Farmer's house 1	Cultivated with corn
255628	15CJV-C79	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Koh Ngek	Srea Huy	N13-4-11.25 & E107-3-11.08	175	Farmer's house 2	Stripe on epicarp
255629	15CJV-C80	14 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Mondolkiri	Sen Monorom	Pu Trom II	N12-28-2.07 & E107-6-13.48	621	Farmer's house 2	Cultivated with melon
255630	15CJV-C81	14 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Mondolkiri	Sen Monorom	Pu Trom II	N12-28-2.07 & E107-6-13.48	621	Farmer's house 2	Stripe on epicarp, cultivated separately from upland rice in a field
255631	15CJV-C82	15 Nov., 2015	<i>Cucumis melo</i>	Melon	Paeya Pung	Landrace	Seeds	Ratanakiri	Lom Pat	Prouk	N13-34-2.98 & E106-57-38.17	126	Farmer's house	Pale green color on epicarp, cultivated by swidden cultivation
255632	15CJV-C83	15 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Ratanakiri	Lom Pat	Day Loo	N13-28-35.47 & E106-59-3.37	110	Farmer's house	Pale green color or stripe on epicarp, Cultivated by swidden cultivation, larger seed
255633	15CJV-C83	15 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Ratanakiri	Lom Pat	Day Loo	N13-28-35.47 & E106-59-3.37	110	Farmer's house	Pale green color or stripe on epicarp, Cultivated by swidden cultivation, smaller seed
255634	15CJV-C84	12 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ropung	Landrace	Seeds	Mondolkiri	O' Raing	Pu Chab	N12-25-12.21 & E107-17-54.57	825	Farmer's house	Stripe on epicarp, cultivated with upland rice
255635	15CJV-C85	17 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung Kan Reng	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer 1	Cultivated with upland rice
255636	15CJV-C86	17 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer 1	Stripe on epicarp, cultivated with upland rice
255637	15CJV-C87	17 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Barue	N14-4-12.50 & E107-9-21.39	121	Farmer's house	Pale yellow color with and without strip on epicarp
255638	15CJV-C88	17 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung Kayek	Landrace	Seeds	Ratanakiri	Ta Vang	Barue	N14-4-12.50 & E107-9-21.39	121	Farmer's house	Separately cultivated from other crops in a field
255639	15CJV-C89	17 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ta Vang	Barue	N14-4-12.50 & E107-9-21.39	121	Farmer's house	Separately cultivated from other crops in a field
255640	15CJV-C90	17 Nov., 2015	<i>Momordica charantia</i>	Bitter gourd	Tang On rass	Landrace	Seeds	Ratanakiri	Ta Vang	Barue	N14-4-12.50 & E107-9-21.39	121	Farmer's house	Separately cultivated from other crops in a field
255641	15CJV-C91	17 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ta Vang	Tom Pon Rourng Thom	N14-4-26.46 & E107-4-36.88	113	Farmer's house	Cultivated with cucumber and melon
255642	15CJV-C92	17 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Ka dav	Landrace	Seeds	Ratanakiri	Ta Vang	Tom Pon Rourng Thom	N14-4-26.46 & E107-4-36.88	113	Farmer's house	Cultivated with sugar cane
255643	15CJV-C93	17 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung	Landrace	Seeds	Ratanakiri	Ta Vang	Tom Pon Rourng Thom	N14-4-26.46 & E107-4-36.88	113	Farmer's house	Cultivated with watermelon and melon
255644	15CJV-C94	17 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Tom Pon Rourng Thom	N14-4-26.46 & E107-4-36.88	113	Farmer's house	Cultivated with cucumber and watermelon, larger seed
255645	15CJV-C94	17 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Tom Pon Rourng Thom	N14-4-26.46 & E107-4-36.88	113	Farmer's house	Cultivated with cucumber and watermelon, smaller seed

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site					Remarks	
								Province	District	Village	Latitude & Longitude	Altitude (m)		Source (Market name)
255646	15CJV-C95	17 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer2	Pale yellow color on epicarp, cultivated with upland rice
255647	15CJV-C96	17 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer2	Cultivated with upland rice, the fruit originated from C98 seeds
255648	15CJV-C97	17 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer 3	Cultivated with upland rice, the fruit originated from C99 seeds
255649	15CJV-C98	17 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer 3	Original seeds for C96
255650	15CJV-C99	17 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ta Vang	Soren	N14-3-49.28 & E107-7-15.50	112	Farmer 3	Original seeds for C97
255651	15CJV-C100	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Meen Tok	Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Village leader (Farmer)	Cultivated with upland rice near field growing modern variety
255652	15CJV-C101	18 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Poss Koi	Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Village leader (Farmer)	Cultivated with upland rice
255653	15CJV-C102	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Meen Tok	Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Farmer	Cultivated with upland rice
255654	15CJV-C103	18 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Poss Koi	Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Farmer	Cultivated with upland rice
255655	15CJV-C104	18 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Poss Tol	Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Farmer	Cultivated with upland rice
255656	15CJV-C105	18 Nov., 2015	<i>Benincasa hispida</i>	Wax gourd		Landrace	Seeds	Ratanakiri	Oya dav	Pok Toch	N13-43-46.67 & E107-26-48.15	224	Farmer	Cultivated with upland rice
255657	15CJV-C106	18 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Mon Ya	Landrace	Seeds	Ratanakiri	Oya dav	Som Kol	N13-43-59.14 & E107-22-43.05	245	Village leader (Farmer)	Cultivated by swidden cultivation
255658	15CJV-C107	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Mon Tok	Landrace	Seeds	Ratanakiri	Oya dav	Som Kol	N13-43-46.67 & E107-26-48.15	245	Village leader (Farmer)	Cultivated by swidden cultivation
255659	15CJV-C108	18 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Poss Tol	Landrace	Seeds	Ratanakiri	Oya dav	Som Kol	N13-43-46.67 & E107-26-48.15	245	Village leader (Farmer)	Cultivated by swidden cultivation
255660	15CJV-C109	18 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Poss Kai	Landrace	Seeds	Ratanakiri	Oya dav	Som Kol	N13-43-46.67 & E107-26-48.15	245	Village leader (Farmer)	Cultivated by swidden cultivation
255661	15CJV-C110	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Mon Tok	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Yellow color with strip or pale green color on epicarp
255662	15CJV-C111	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Mon Tok	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Yellow color with strip or pale green color on epicarp
255663	15CJV-C112	18 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Pa Kai	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Cultivated with upland rice
255664	15CJV-C113	18 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	Pos tol	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Cultivated with upland rice
255665	15CJV-C114	18 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Mon Ya	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Cultivated with upland rice
255666	15CJV-C115	13 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Pol	Landrace	Fruit	Mondolkiri	Sen Monorom	Pa Trom II	N12-29-32.05 & E107-14-45.99	751	Farmer's house	
255667	15CJV-C116	18 Nov., 2015	<i>Cucumis melo</i>	Melon	Mon Tok	Landrace	Seeds	Ratanakiri	Oya dav	Pa Or	N13-40-36.56 & E107-19-23.04	261	Farmer's house	Yellow color with strip or pale green color on epicarp
255668	15CJV-C117	19 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Ta Vang	N14-3-14.41 & E107-6-46.74	102	Farmer's house	Yellow color with stripe, white color, and pale yellow color on epicarp, larger seed
255669	15CJV-C117	19 Nov., 2015	<i>Cucumis melo</i>	Melon	Ta Voung Chess	Landrace	Seeds	Ratanakiri	Ta Vang	Ta Vang	N14-3-14.41 & E107-6-46.74	102	Farmer's house	Yellow color with stripe, white color, and pale yellow color on epicarp, smaller seed

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site						Remarks
								Province	District	Village	Latitude & Longitude	Altitude (m)	Source (Market name)	
255670	15CJV-C118	19 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta Voung Ka yek	Landrace	Seeds	Ratanakiri	Ta Vang	Ta Vang	N 14-3-14.41 & E107-6-46.74	102	Farmer's house	Cultivated with upland rice and maize
255671	15CJV-C119	19 Nov., 2015	<i>Cucumis melo</i>	Melon	Ó dom	Landrace	Seeds	Ratanakiri	Ó Chum	La Lay	N13-48-36.73 & E106-56-0.86	149	Farmer's house	Yellow color with stripe on epicarp, cultivated with upland rice
255672	15CJV-C120	19 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta bom	Landrace	Seeds	Ratanakiri	Ó Chum	La Lay	N13-48-36.73 & E106-56-0.86	149	Farmer's house	Cultivated with upland rice
255673	15CJV-C121	19 Nov., 2015	<i>Cucumis melo</i>	Melon	Ó dom	Landrace	Seeds	Ratanakiri	Ka Lay	Ka Lay	N13-50-7.31 & E106-57-3.20	238	Farmer's house	Yellow color with stripe on epicarp, cultivated with upland rice
255674	15CJV-C122	19 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ka Lay	Ka Lay	N13-50-7.31 & E106-57-3.20	238	Farmer's house	Cultivated with upland rice
255675	15CJV-C123	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Ó dom	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 1	Yellow color with stripe on epicarp, cultivated with upland rice, larger seed
255676	15CJV-C123	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Ó dom	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 1	Yellow color with stripe on epicarp, cultivated with upland rice, smaller seed
255677	15CJV-C124	20 Nov., 2015	<i>Setaria italica</i>	Fox tail millet	Ta Vou	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 2	Cultivated by swidden cultivation, 2.0 m of plant height
255678	15CJV-C125	20 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta bom	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 2	Cultivated with upland rice
255679	15CJV-C126	20 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 2	Cultivated with upland rice
255680	15CJV-C127	20 Nov., 2015	<i>Citrullus lanatus</i>	Watermelon	Ka ai	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 3	Mixed with large and small seeds which are oblong and globular fruit shape, respectively; cultivated with upland rice
255681	15CJV-C128	20 Nov., 2015	<i>Cucumis sativus</i>	Cucumber	Ta bom	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 3	Cultivated with upland rice
255682	15CJV-C129	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Ó dom	Landrace	Seeds	Ratanakiri	Ta Vang	Torn	N13-57-46.58 & E107-3-12.73	178	Farmer's house 3	Yellow color with or without stripe on epicarp, cultivated with upland rice
255683	15CJV-C130	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Siem Pang	Som Rong	N14-00-46.99 & E106-12-50.22	94	Farmer's house	Yellow color with stripe on epicarp; cultivated with corn, cassava, banana, sweet potato and pumpkin
255684	15CJV-C131	20 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Stung Treng	Siem Pang	Som Rong	N14-00-46.99 & E106-12-50.22	94	Farmer's house	Cultivated with corn, cassava, banana, sweet potato and melon
255685	15CJV-C132	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Siem Pang	Ban Moung	N14-05-13.71 & E106-23-7.60	65	Farmer's house	Yellow color with stripe on epicarp, cultivated near a tributary of the Mekong River, larger seed
255686	15CJV-C132	20 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Siem Pang	Ban Moung	N14-05-13.71 & E106-23-7.60	65	Farmer's house	Yellow color with stripe on epicarp, cultivated near a tributary of the Mekong River, smaller seed
255687	15CJV-C133	21 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Siem Pang	Yang Som	N14-08-14.81 & E106-24-55.18	68	Farmer's house	Yellow color with stripe on epicarp, cultivated by two times per one year
255688	15CJV-C134	21 Nov., 2015	<i>Cucurbita moschata</i>	Pumpkin	La Poa	Landrace	Seeds	Stung Treng	Siem Pang	Yang Som	N14-08-14.81 & E106-24-55.18	68	Farmer's house	Cultivated twice a year
255689	15CJV-C135	21 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Song Kat Sam Ki Krong	Kom Pann	N13-38-26.27 & E106-3-19.26	80	Farmer's house	Yellow and green color with stripe on epicarp, Cultivated twice a year
255690	15CJV-C136	21 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Stung Treng	Reachea Nok Kol	N13-27-16.83 & E106-2-19.00	115	Farmer's house	Yellow or green color with stripe on epicarp
255691	15CJV-C137	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Stung Treng	Stung Treng	Stung Treng	N13-31-49.89 & E105-58-21.34	46	Market (Strung Treng)	Cultivated at island on the Mekong River
255692	15CJV-C138	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Stung Treng	Stung Treng	Stung Treng	N13-31-49.89 & E105-58-21.34	46	Market (Strung Treng)	Cultivated at island on the Mekong River

Table 4 (Continued).

JP No.	Sample No.	Collected date	Species	Plant name	Local name	Cultivar/ landrace	Collection	Collected site					Remarks	
								Province	District	Village	Latitude & Longitude	Altitude (m)		Source (Market name)
255693	15CJV-C139	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Stung Treng	Stung Treng	Stung Treng	N13-31-49.89 & E105-58-21.34	46	Market (Strung Treng)	Cultivated at island on the Mekong River
255694	15CJV-C140	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Fruit	Stung Treng	Stung Treng	Stung Treng	N13-31-49.89 & E105-58-21.34	46	Market (Strung Treng)	Cultivated at island on the Mekong River
255695	15CJV-C141	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Thalaborivat	On Lung Kromorn	N13-36-58.29 & E105-50-35.99	65	Farmer's house	Yellow color with stripe on epicarp, oblong fruit shape
255696	15CJV-C142	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Thalaborivat	On Lung Kromorn	N13-36-58.29 & E105-50-35.99	65	Farmer's house	Pale green or yellow color on epicarp, globular fruit shape, sweet taste
255697	15CJV-C143	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Thalaborivat	O' Treng	N13-32-18.43 & E105-56-32.36	53	Farmer's house	Pale green color on epicarp
255698	15CJV-C144	22 Nov., 2015	<i>Cucumis melo</i>	Melon	Tror Sork Srov	Landrace	Seeds	Stung Treng	Thalaborivat	O' Treng	N13-32-18.43 & E105-56-32.36	53	Farmer's house	Yellow color with stripe on epicarp



Photo 1. Lowland, Stung Treng Province.



Photo 2. Hill area in Mondolkiri Province. Grassland is found at the top of hill, as well as photo-taking point.



Photo 3. Paddy field of CARDI rice at lowland area in Stung Treng Province.



Photo 4. Corn cultivation near the side of river, Stung Treng Province.



Photo 5. Mung bean cultivation near the side of river, Stung Treng Province.



Photo 6. Upland rice field at hill area in Ratanakiri Province.



Photo 7. Rubber plantation at flatland, Mondolkiri Province.



Photo 8. Cassava plantation at flatland, Mondolkiri Province.



Photo 9. Market at Ban Lung city, Ratanakiri Province.



Photo 10. Wild vegetable at market, Ratanakiri Province.



Photo 11. Vegetable seller at outdoor market of airport, Mondolkiri Province.



Photo 12. Vegetable shop at market, Ratanakiri Province. Cucurbitaceae fruits and flowers were sold.



Photo 13. Fruit shop at market, Kampong Cham Province. Watermelon was also sold in the shop.



Photo 14. River fish shop at market near the Mekong River, Stung Treng Province.



Photo 15. Three kinds of pickled vegetable, Ratanakiri Province.



Photo 16. Fermented fish and some pickled vegetables, Ratanakiri Province.



Photo 17. Immature luffa, angled luffa and cucumber at vegetable shop, Kratie Province.



Photo 18. Melon seller at roadside stand, Tbong Khmum Province.



Photo 19. Elongated-melon fruit of “15CJV-C137” at market, Stung Treng Province.



Photo 20. Farmer's house at Pu Trou village, Mondolkiri. “15CJV-C53” and “15CJV-C54” were stored near the fireplace.



Photo 21. Open-field of melon cultivation at village “De A”.



Photo 22. Interview with local people by using photo of wild species of *Cucumis*.



Photo 23. Seed shop at market “Kampong Cham Taom”, Kampong Cham Province.



Photo 24. Stored-seeds of “15CJV-C19” to “15CJV-C22” in bamboo tube, Mondolkiri Province.

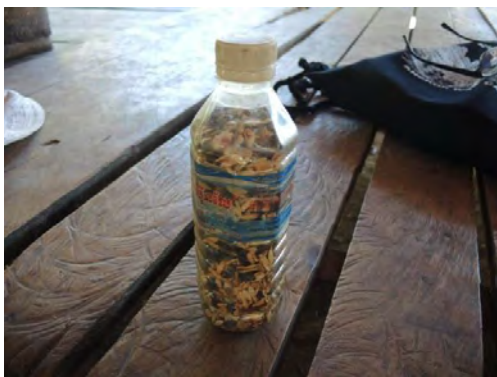


Photo 25. Stored-seeds of “15CJV-C87” to “15CJV-C90” in plastic bottle, Ratanakiri Province.



Photo 26. Improved varieties of melon sold at market, Phnom Penh.



Photo 27. A field of mixed cropping with maize and Cucurbitaceae crops, Mondolkiri Province.



Photo 28. A field of Cucurbitaceae crops at the side of river, Stung Treng Province. Each the crop was separately planted in the field.



Photo 29. Cultivation of cucumber improved variety, Mondolkiri Province.



Photo 30. Immature melon fruits, market, Mondolkiri Province.



Photo 31. Mature melon fruits at roadside stand, Tbong Khmum Province.



Photo 32. Pickled vegetable of immature melon fruit at market, Ratanakiri Province.



Photo 33. A cuisine of immature melon fruit at market, Kampong Cham Province.



Photo 34. Dried-immature-fruits of melon for pickles, Tbong Khmum Province.



Photo 35. Melon dessert by cooking with condensed milk (right side can).

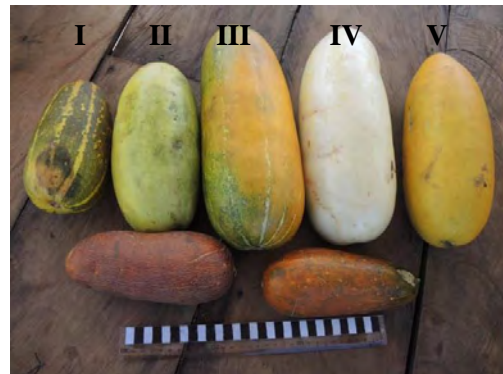


Photo 36. Variation of melon fruit at a open-field. I: 15CJV-C68, II: 15CJV-C69, III: 15CJV-C70, IV: 15CJV-C72, V: 15CJV-C71.



Photo 37. Melon fruit of “15CJV-C137”.



Photo 38. Melon fruit of “15CJV-C138”.



Photo 39. Melon fruit of “15CJV-C8” at collection site, Kampong Cham Province.



Photo 40. Ten-melon-seeds of “15CJV-C13” measured.