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Original Paper

Collaborative Exploration of Cucurbitaceae Genetic Resources in Eastern Cambodia, 2019

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Summary

The National Agriculture and Food Research Organization (NARO) and the Cambodian Agricultural Research and Development Institute (CARDI) conducted a collaborative exploration of plant genetic resources in Eastern Cambodia in 2019. The exploration was conducted within the framework of the Plant Genetic Resources Asia (PGRAsia) project funded by the Ministry of Agriculture, Forestry and Fisheries, Japan. We surveyed four provinces of Eastern Cambodia (Kandal, Kratie, Mondul Kiri, and Kampon Cham Province) and collected 72 samples: 29 pumpkins (*Cucurbita moschata*), 27 melons (*Cucumis melo*), 7 cucumbers (*Cucumis sativus*), 1 watermelon (*Citrullus lanatus*), 7 chili peppers (*Capsicum frutescens*), and 1 eggplant (*Solanum melongena*). The seeds of each accession were divided into two, with one half being conserved in CARDI and the other being transferred to the Genetic Resource Center, NARO, using the standard material transfer agreement.

KEY WORDS: pumpkin, cucumber, melon, genetic resource, Cambodia, PGRAsia

Introduction

It is important to collect new plant genetic resources for developing new varieties of crops that have desirable traits such as resistance to pests or diseases, high quality, or high yield. To promote the collection of plant genetic resources, a new research project, Plant Genetic Resources Asia (PGRAsia) project, was started in 2014 and funded by the Ministry of Agriculture, Forestry and Fisheries, Japan. The objective of the project was to characterize, evaluate, and utilize plant genetic resources for food and agriculture (PGRFA) in collaboration between Asian countries and Japan as well as to develop open databases related to PGRFA for effective use of PGRFA. One of the research topics of the project is to survey and collect plant genetic resources in Asian countries. Here, we report the results of our survey in Eastern Cambodia to collect mainly cucurbitaceous vegetables such as pumpkin, melon, cucumber, and watermelon. Cucurbitaceous vegetables were collected in western and northwestern Cambodia in 2014 (Matsunaga *et al*. 2015) and 2018 (Yashiro *et al*. 2019) and in northern Cambodia in 2016 (Tanaka *et al.* 2017) and

2018 (Kondo *et al.* 2019). Surveys for cucurbitaceous vegetables in Eastern Cambodia were conducted in 2015 (Tanaka *et al.* 2016) and 2017 (Matsushima *et al.* 2018). The collection sites in the study by Tanaka *et al.* (2017) also included Eastern Cambodia (the survey year was 2016). Therefore, we surveyed cucurbitaceous vegetables in places different from those surveyed by Tanaka *et al*. (2016, 2017) and Matsushima *et al.* (2018).

Methods

A car (TOYOTA LAND CRUISER) was used for the survey and collection. We discussed the survey and collection before and after the trip (October 28 and November 8, 2019) (Photo 1). From October 29 to November 7, 2019, we visited Kandal, Kratie (Photo 2), Mondul Kiri (Photo 3), and Kampon Cham Province (Table 1, Fig. 1). We collected fruit or seed samples of vegetable crops from farmers, their backyards, and roadsides. During the trip, seeds were removed from the collected fruits, washed with tap water, put into nets, and air-dried. We collected information on each sample from farmers, including local plant name, sowing date, harvest date, usage, and cultivation methods (Photo 4). We also recorded the place name, latitude and longitude, and altitude of each collection site, which were measured using Garmin eTrex20J GPS (Garmin International Inc., Olathe, KS, USA).

Results and Discussion

We collected 72 samples, comprising 29 pumpkins (*Cucurbita moschata*), 27 melons (*Cucumis melo*), 7 cucumbers (*Cucumis sativus*), 1 watermelon (*Citrullus*

Table 1. Itinerary of the exploration of plant genetic resources in Eastern Cambodia, 2019

Date (month/day)	Day	Itinerary	Stay
10/27	Sun	Narita - Phnom Penh	Phnom Penh
10/28	Mon	Phnom Penh (CARDI)	Phnom Penh
10/29	Tue	Phnom Penh - Snuol	Snuol
10/30	Wed	Snuol - Sen Monorom	Sen Monorom
10/31	Thu	Sen Monorom	Sen Monorom
11/1	Fri	Sen Monorom	Sen Monorom
11/2	Sat	Sen Monorom	Sen Monorom
11/3	Sun	Sen Monorom - Kratie	Kratie
11/4	Mon	Kratie	Kratie
11/5	Tue	Kratie	Kratie
11/6	Wed	Kratie - Kampong Cham	Kampong Cham
11/7	Thu	Kampong Cham - Phnom Penh	Phnom Penh
11/8	Fri	Phnom Penh (CARDI)	Airplane
11/9	Sat	Narita	

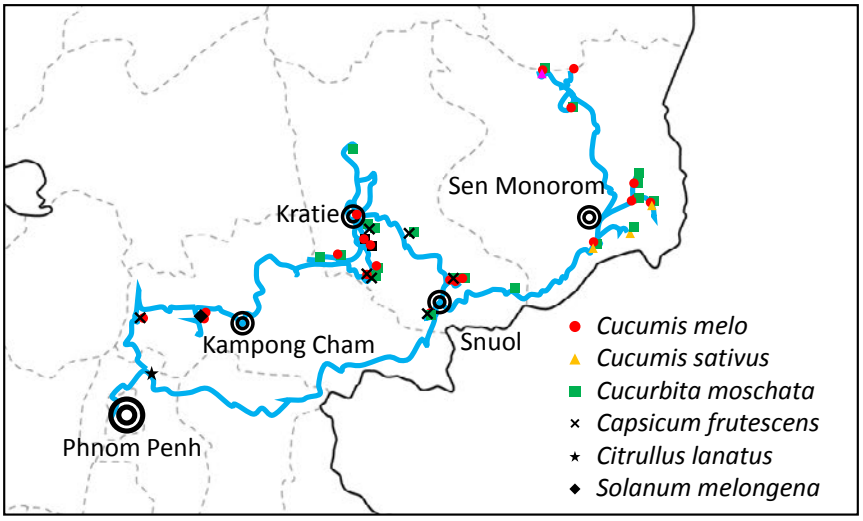

Fig. 1. Sites in Eastern Cambodia where plant genetic resources were collected. The routes are shown by blue lines.

Photo 1. Members of the exploration. A driver, Sreynech, Kawazu, and Kuzuya (from left to right).

Photo 3. Rubber plantation in Mondul Kiri Province.

Photo 2. We loaded our car onto a ship and crossed the Mekong River in Kratie Province.

Photo 4. Interviewing local people in Kratie Province.

lanatus), 7 chili peppers (*Capsicum frutescens*), and 1 eggplant (*Solanum melongena*) (Tables 2 and 3, Photos of collected samples). The collection sites are shown in Fig. 1. All samples of melon and cucumber were seeds, and all samples of watermelon, chili pepper and eggplant were fruits when they were collected (Table 3). Fifteen and fourteen samples of pumpkin were seeds and fruits, respectively. Five samples of cucumber were mixed with melon seeds, and one sample of cucumber was mixed with melon and pumpkin seeds after collection. Therefore, we separated them into each species (Photo 5). The seeds of each accession were divided into two, with one half being conserved in CARDI while the other half being transferred to the Genetic Resource Center, NARO, under the standard material transfer agreement.

Pumpkin

We collected 15 samples of pumpkin fruits and 14 of pumpkin seeds from farmers (Table 3). They were all *C. moschata*. The collected fruits weighed between 0.5 kg and 5.05 kg. The heaviest fruit was from No. A49, and the lightest one was from No. A06. Fruit shapes were flat for Nos. A04, A05, A14, A36, A49, and A64; slightly flat for Nos. A13 and A15; globular for Nos.

Table 2. A summary of collected genetic resources in Eastern Cambodia, 2019

Data	Province	District	Mean altitude (m)	*Cucurbita moschata*	*Cucumis melo*	*Cucumis sativus*	*Citrullus lanatus*	*Capsicum frutescens*	*Solanum melongena*	Total
10/29	Kandal	Ksarch Kandal	17				1			1
10/29	Kratie	Snuol	70	3	1			1		5
10/30	Kratie	Snuol	83	5	3			1		9
10/31	Mondul Kiri	Pechrea Da	519	4	5	4				13
11/1	Mondul Kiri	O'Rang	648	2	2	2				6
11/1	Mondul Kiri	Pechrea Da	456	2	1					3
11/2	Mondul Kiri	Koh Nheak	136	3	5	1				9
11/4	Kratie	Prek Pro Sorb	23	3	3					6
11/5	Kratie	Sambo	26	1						1
11/5	Kratie	Chet Borey	30	3				2		5
11/6	Kratie	Chhloung	46	3	4			2		9
11/7	Kampong Cham	Korng Meas	16		2				1	3
11/7	Kampong Cham	Ba Teay	15		1			1		2
		Total		29	27	7	1	7	1	72

Photo 5. Separating mixed seeds of melon and cucumber.

A17, A37, and A56; elongated for No. A53; pyriform for Nos. A06 and A29; or triangular for No. A16. Most farmers do not use any fertilizers or chemicals, but one farmer said that both fertilizers and insecticides were used for pumpkin cultivation (No. A04, A05, and A06). The farmers cultivated pumpkins for selling. Many farmers sow pumpkin seeds in May and harvest fruits from July to October (Remarks in Table 3).

Melon

We collected 27 samples of melon seeds from farmers. According to the information from farmers, the skin color of the fruit of collected melon was yellow (for example, No. A08, A23, A31, and A33), green (for example, No. A41, A67, and A69), white (for example, No. A43), or brown (for example, No. A50). Most farmers did not use any fertilizers or chemicals, but some farmers said that they use both fertilizers and insecticides for melon cultivation (No. A67, A69, and A70). The farmers who used these additives cultivated melons for selling. Many farmers sow melon seeds in May and harvest fruits from July to August (Remarks in Table 3).

Cucumber

We collected seven samples of cucumber seeds from the farmers. All of them were collected in Mondul Kiri Province, which is at a higher altitude than the other provinces in this survey. The altitude of the collection site of one sample (No. A40) was 134 m, and the altitude of the other collection sites of cucumber was between 524 m and 728 m. We could not find cucumber landraces in other provinces. Farmers usually store cucumber seeds with other crops. One sample (No. A22) had not been mixed with other crops, but five samples had been mixed with melon seeds, and one sample (No. A40) was mixed with melon and pumpkin seeds. Seeds were sown from April to May, and fruits were harvested from June to September. Farmers said that they did not use any fertilizers or chemicals for cucumber cultivation. Cucumbers were often cultivated with upland rice, and the harvested cucumber fruits are consumed at home and sometimes sold in local markets.

Watermelon

One watermelon sample (No. A01) was collected in this study. It was collected from a roadside shop in Ksarch Kandal District of Kandal Province, and the seller said that the fruit had been harvested in Skun District of Kampon Cham Province.

Chili pepper

We collected seven samples of chili pepper fruits from the farmers. They are all *Capsicum frutescens* and were grown in the backyards of farmers' houses.

Eggplant

One eggplant sample (No. A68) was collected in this study. The fruits were collected from a home garden in the Korng Meas District of Kampon Cham Province.

Summary of cucurbitaceous vegetables (melon, pumpkin, and cucumber) collected in Cambodia from 2014 to 2019

Under the PGRAsia Project, which began in 2014, various cucurbitaceous vegetables have been collected every year in Cambodia (Matsunaga *et al.* 2015; Tanaka et al. 2016, 2017, 2019; Okuizumi *et al.* 2017; Matsushima *et al.* 2018; Yashiro *et al.* 2019). Figure 2 shows the collection sites of melon (Fig. 2A), pumpkin (Fig. 2B), and cucumber (Fig. 2C) from 2014 to 2019. The number of collected melons was 41 in 2014 (Matsunaga *et al.* 2015), 62 in 2015 (Tanaka *et al.* 2016), 70 (Tanaka *et al.* 2017) and 15 (Okuizumi *et al.* 2017) in 2016, 6 (Matsushima *et al.* 2018) and 101 (Tanaka *et al.* 2019) in 2017, 9 (Kondo *et al.* 2019) and 31 (Yashiro *et al.* 2019) in 2018, and 27 in 2019 (this study). The total number of collected melons from 2014 to 2019 was 362.

The number of collected pumpkins was 13 in 2014 (Matsunaga *et al.* 2015), 32 in 2015 (Tanaka *et al.* 2016), 23 (Tanaka *et al*. 2017) and 22 (Okuizumi *et al.* 2017) in 2016, 9 (Matsushima *et al*. 2018) and 10 (Tanaka *et al.* 2019) in 2017, 11 (Kondo *et al.* 2019) and 3 (Yashiro *et al.* 2019) in 2018, and 27 in 2019 (this study). The total number of pumpkins collected from 2014 to 2019 was 150.

The number of cucumber collected was 30 in 2015 (Tanaka *et al.* 2016), 3 (Tanaka *et al.* 2017) and 3 (Okuizumi *et al*. 2017) in 2016, 2 (Matsushima *et al.* 2018) and 7 (Tanaka *et al.* 2019) in 2017, 3 (Kondo *et al.*

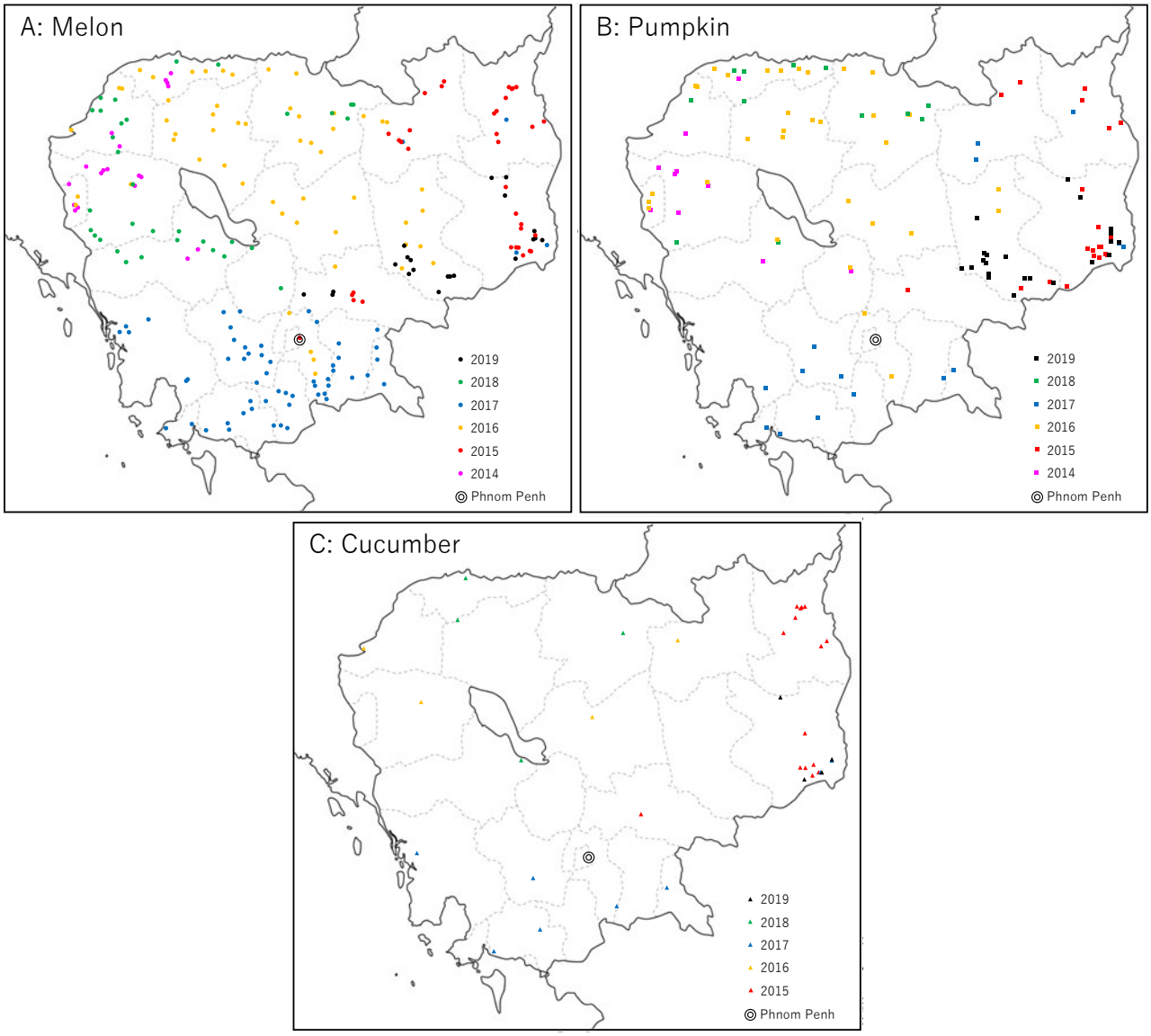

Fig. 2. Sites where melons (A), pumpkins (B) and cucumbers (C) were collected in Cambodia from 2014 to 2019.

2019) and 1 (Yashiro *et al*. 2019) in 2018, and 27 in 2019 (this study). The total number of cucumbers collected from 2014 to 2019 was 76.

In these surveys, melons and pumpkins were collected from all over the country. In contrast, the number of collected cucumbers was less than that of melons or pumpkins, and many cucumbers collected were sourced from the eastern region of Cambodia, which is at a high altitude and has low temperature. This may be because cucumber is less heat-tolerant than melon and pumpkin (*C. moschata*).

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カンボジア東部における
ウリ科作物遺伝資源の共同探索，2019 年

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和文摘要

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）とカンボジア農業研究開発研究所（CARDI）は 2019 年，カンボジア東部において植物遺伝資源の共同探索・収集を実施した．この探索・収集は，農林水産省委託プロジェクト研究「海外植物遺伝資源の民間等への提供促進」（PGRAsia プロジェクト）の予算により実施された．本探索ではカンボジア東部の 4 つの州（Kandal，Kratie，Mondul Kiri，Kampon Cham Province）を訪問し，合計 72 点の遺伝資源を収集した．その内訳はニホンカボチャ（*Cucurbita moschata*）が 29 点，メロン（*Cucumis melo*）が 27 点，キュウリ（*C. sativus*）が 7 点，スイカ（*Citrullus lanatus*）が 1 点，トウガラシ（*Capsicum frutescens*）が 7 点，ナス（*Solanum melongena*）が 1 点である．収集された遺伝資源の種子の半分は CARDI に保管され，残りの半分は標準材料移転契約（SMTA）に基づいて農研機構遺伝資源センターに送付された．

Table 3. Genetic resources collected in Eastern Cambodia in 2019

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271411	A01	watermelon	*Citrullus lanatus*	Kandal	Ksarch Kandal	Prek Ta Mak	Miou	11.44.15.93	105.01.33.96	17	Roadside shop	fruit	-	-	Ov Leok	2.45 kg. H23.5 cm x W13.5 cm. Brix = 11.5 (Center of the fruit). The fruit was harvested in Skun District of Kampon Cham Province. For sell.
271412	A02	melon	*Cucumis melo*	Kratie	Snuol	Srei Ja	Kilo 74	12.00.15.91	106.21.30.34	63	Farm storage	seed	no	no	Trosok Srov	Trosok = Cucumber, Srov = rice. The original fruit was from market. Self polination for 3 years. Grow in a backyard. Sowing: May. Harvest: Jul. For family.
271413	A03	chili pepper	*Capsicum frutescens*	Kratie	Snuol	Srei Ja	Kilo 74	12.00.15.91	106.21.30.34	63	Backyard	fruit	-	-	Mates Ach Sat	Mates = Chili, Ach Sat=animal dropping. For family.
271414	A04	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Srei Ja	Doun Meas	12.00.10.66	106.21.00.29	75	Farm storage	fruit	use	Insecticide	Lapov	3.8 kg. H11.5 cm x W25.5 cm. The original fruit was from the other farmer. Self pollination for 5 years. Sowing: May. Harvest: Jul-Aug. For sell.
271415	A05	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Srei Ja	Doun Meas	12.00.10.66	106.21.00.29	75	Farm storage	fruit	use	Insecticide	Lapov Khlong	The same farmer as A04. 1.7 kg. H8.0 cm x W22.0 cm. Lapov = Pumpkin, Khlong = not smooth. The other information is the same as A04. For sell.
271416	A06	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Srei Ja	Doun Meas	12.00.10.66	106.21.00.29	75	Farm storage	fruit	use	Insecticide	Lapov	The same farmer as A04. 0.5 kg. H9.0 cm x W11.5 cm. The other information is the same as A04. For sell.
271417	A07	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Khseum	Khuseum Krav	12.10.15.30	106.27.46.26	70	Farm storage	seed	no	no	Lapov Roy	Roy = something not so improtant. Sowing: May. Harvest: Jul. For family.
271418	A08	melon	*Cucumis melo*	Kratie	Snuol	Khseum	Khuseum Krav	12.10.19.48	106.27.47.42	70	Farm storage	seed	no	no	Trosok Srov	Cashew nut farmer. The original fruit was from a market (yellow-oblong melon). Self polination for two years. Sowing: May. Harvest: Jul. For family.
271419	A09	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Khseum	Khuseum Krav	12.10.19.48	106.27.47.42	70	Farm storage	seed	no	no	Lapov	The same farmer as A08. The original fruit was from a neighbor. Self polination for 3 to 4 years. Sowing: May. Harvest: Jul. For family.
271420	A10	melon	*Cucumis melo*	Kratie	Snuol	Khseum	Khuseum Khnong	12.10.21.98	106.28.53.64	72	Farm storage	fruit	no	no	Trosok Srov	Green-white stripe-oblong melon. Seed were from a neighbor. Self polination for more than 20 years. Sowing: May. Harvest: Jul. For family.
271421	A11	chili pepper	*Capsicum frutescens*	Kratie	Snuol	Khseum	Khuseum Khnong	12.10.21.98	106.28.53.64	72	Backyard	fruit	-	-	Mates Sor	The same farmer as A10. Sor= white. Self polination for several years. For family

Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271422	A12	melon	*Cucumis melo*	Kratie	Snuol	Khseum	Mil	12.10.23.39	106.30.41.61	77	Farm storage	seed	no	no	Trosok Srov	The original seed wer efrom the owner's mother. The owner's mother cultivated the melon for several years. Mixed seeds (yellow, green or white melons). Sowig: May. Harvest: Jul. For family.
271423	A13	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Khseum	Mil	12.10.23.29	106.30.41.61	77	Farm storage	fruit	no	no	Lapov	The same farmer as A12. 1.25 kg. H11.5 cm x W14.5 cm. Sowing: May. Harvest: Jul. For family.
271424	A14	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Pi Thnou	Kror Nhoung Sen Chey	12.07.47.21	106.45.23.71	118	Roadside shop	fruit	-	-	Lapov Khlong	2.5 kg. H8.5 cm x W23.0 cm. The original seeds were from the owner's grand parents. The owner's mother cultivated them for 3 years.
271425	A15	pumpkin	*Cucurbita moschata*	Kratie	Snuol	Pi Thnou	Kror Nhoung Sen Chey	12.07.47.21	106.45.23.71	118	Roadside shop	fruit	-	-	Lapov	Same owner as A14. 1.06 kg. H9.5 cm x W13.5 cm. The other information is the same as A14. For sell.
271426	A16	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Bousra	Pau Lu	12.31.43.14	107.25.49.75	534	Farm storage	fruit	no	no	Lapov	4.05 kg. H22.0 cm x W19.0 cm. Flowers and shoots are used for cooking. Sowing: May. Harvest: Oct. For family.
271427	A17	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Bousra	Pau Lu	12.31.43.14	107.25.49.75	534	Farm storage	fruit	no	no	Lapov	The same farmar as A16. 1.65 kg. H15.5 cm x W12.5 cm. The other information is the same as A16. For family.
271428	A18	cucumber	*Cucumis sativus*	Mondul Kiri	Pechrea Da	Bousra	Pau Lu	12.31.46.09	107.25.46.85	529	Farm storage	seed	no	no	Ropang Ngin	Mixed seeds (A18 and A19). Local name comes from local language. Seed are planted with up land rice. The vine grows on the ground between rice plants. Sowing: May. Harvest: Jul-Aug.
271429	A19	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Bousra	Pau Lu	12.31.46.09	107.25.46.85	529	Farm storage	seed	no	no	Ropang Khor	Mixed seeds (A18 and A19). The same farmer as A1.8 Immature fruit is bitter. The other information is the same as A18. For family.
271430	A20	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Bousra	Lames	12.31.54.68	107.25.48.03	529	Farm storage	seed	no	no	Ropang Khor	Mixed seeds (A20 and A21). Grow with rice. Sowing: May. Harvest: Jun-Aug. For family.
271431	A21	cucumber	*Cucumis sativus*	Mondul Kiri	Pechrea Da	Bousra	Lames	12.31.54.68	107.25.48.03	529	Farm storage	seed	no	no	Ropang Ngin	Mixed seeds (A20 and A21). Grow with rice. Sowing: May. Harvest: Jun-Aug. For family.
271432	A22	cucumber	*Cucumis sativus*	Mondul Kiri	Pechrea Da	Bousra	Pou Rang	12.32.26.34	107.25.53.05	524	Farm storage	seed	-	-	Ropang Ngin	Grow with rice. Sowing: May. Harvest: Jul-Sep. For family.
271433	A23	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Bousra	Pou Rang	12.32.26.34	107.25.53.05	524	Farm storage	seed	-	-	Ropang Khor	The same farmer as A22. Yellow fruits. Sowing: May. Harvest: Jul-Sep. For family.
271434	A24	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Bousra	Pou Rang	12.32.26.34	107.25.53.05	524	Farm storage	seed	-	-	Lapov	Grow with rice. Fruits with deep groove. Sowing: May. Harvest: Jul-Sep. For sell.

Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271435	A25	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Bousra	Bousra	12.32.27.46	107.26.03.21	529	Farm storage	seed	no	no	Ropang Tork	Mixed seeds (A25 and A26). Grow with rice. Sowing: May. Harvest: Jul-Aug. For family.
271436	A26	cucumber	*Cucumis sativus*	Mondul Kiri	Pechrea Da	Bousra	Bousra	12.32.27.46	107.26.03.21	529	Farm storage	seed	no	no	Ropang Tark	Mixed seeds (A25 and A26). Grow with rice. Sowing: May. Harvest: Jul-Aug. For family.
271437	A27	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Sre Am Poum	Pou Radet	12.33.05.23	107.21.18.50	464	Farm storage	seed	no	no	Trosok Srov	Mixed seeds (A27 and A28). Sowing: May. Harvest: Jul. For family.
271438	A28	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Sre Am Poum	Pou Radet	12.33.05.23	107.21.18.50	464	Farm storage	seed	no	no	Lapov	Mixed seeds (A27 and A28). Sowing: May. Harvest: Jul. For family.
271439	A29	pumpkin	*Cucurbita moschata*	Mondul Kiri	O'Rang	Dak Dam	Pou Chhorb	12.25.19.01	107.17.52.83	567	Farm storage	fruit	no	no	Lapov	2.15 kg. H16.0 cm x W15.5 cm. Sowing: Apr-May. Harvest: Jun. For sell.
271440	A30	cucumber	*Cucumis sativus*	Mondul Kiri	O'Rang	Dak Dam	Pou Chhorb	12.25.19.01	107.17.52.83	567	Farm storage	seed	no	no	Trosok	The same farmer as A29. Mixed seeds (A30 and A31). Grow with rice. Sowing: Apr-May. Harvest: Jun. For sell.
271441	A31	melon	*Cucumis melo*	Mondul Kiri	O'Rang	Dak Dam	Pou Chhorb	12.25.19.01	107.17.52.83	567	Farm storage	seed	no	no	Trosok Srov	Mixed seeds (A30 and A31). Yellow fruit. The other information is the same as A30. Sowing: Apr-May. Harvest: Jun. For sell.
271442	A32	cucumber	*Cucumis sativus*	Mondul Kiri	O'Rang	Sen Monoron	Pou Hiam	12.20.21.36	107.08.51.68	728	Farm storage	seed	no	no	Trosok	Mixed seeds (A32 and A33). Grow with rice. Sowing: May. Harvest: Jul. For sell.
271443	A33	melon	*Cucumis melo*	Mondul Kiri	O'Rang	Sen Monoron	Pou Hiam	12.20.21.36	107.08.51.68	728	Farm storage	seed	no	no	Trosok Srov	Mixed seeds (A32 and A33). Grow with rice. Yellow fruit. Sowing: May. Harvest: Jul. For sell.
271444	A34	pumpkin	*Cucurbita moschata*	Mondul Kiri	O'Rang	Sen Monoron	Pou Hiam	12.20.21.36	107.08.51.68	728	Farm storage	seed	no	no	Lapov	The same farmer as A32. Sowing: May. Harvest: Jul. For sell.
271445	A35	melon	*Cucumis melo*	Mondul Kiri	Pechrea Da	Krang Tes	Krang Tes	12.37.22.61	107.20.55.11	457	Farm storage	seed	no	no	Trosok Srov	Grow with rice. Sowing: May. Harvest: Jul. For family.
271446	A36	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Krang Tes	Krang Tes	12.37.26.79	107.20.56.46	464	Farm storage	fruit	no	no	Lapov	1.60 kg. H10.0cm x W18.0cm. with rice. Sowing: May. Harvest: Jul. For family.
271447	A37	pumpkin	*Cucurbita moschata*	Mondul Kiri	Pechrea Da	Krang Tes	Pou Ro Pet	12.39.57.86	107.21.13.32	446	Farm storage	fruit	no	no	Lapov	1.45 kg. H13.5cm x W15.0cm. with cassava. Sowing: Apr. Harvest: Sep. For family.
271448	A38	pumpkin	*Cucurbita moschata*	Mondul Kiri	Koh Nheak	Ro Yor	Ro Vak	13.09.45.20	106.54.06.36	134	Farm storage	seed	no	no	Lapov	Mixed seeds (A38, A39 and A40). Cultivated with cassava and wax gourd. Sowing: May. Harvest: Jul. For family.

Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271449	A39	melon	*Cucumis melo*	Mondul Kiri	Koh Nheak	Ro Yor	Ro Vak	13.09.45.20	106.54.06.36	134	Farm storage	seed	no	no	Trosok Srov (yellow melon) / Khbar Dammy (green melon)	Mixed seeds (A38, A39 and A40). Melon seeds include yellow-stripe-oblong melon and green-stripe-round melon. Khbal Dammy = Elephant hat. The same farmer as A38. The other information is the same as A38. For family.
271450	A40	cucumber	*Cucumis sativus*	Mondul Kiri	Koh Nheak	Ro Yor	Ro Vak	13.09.45.20	106.54.06.36	134	Farm storage	seed	no	no	Trosok	Mixed seeds (A38, A39 and A40). The same farmer as A38. The other information is the same as A38. For family.
271451	A41	melon	*Cucumis melo*	Mondul Kiri	Koh Nhek	Ro Yor	Ro Yor	13.10.00.95	107.03.08.09	124	Farm storage	seed	no	no	Trosok Srov	Dark green-stripe- oblong melon. Two color types (green and yellow) fruit are selected and harvested to get seeds every year. Keep separately. Two types are grown in same field but not with other crops. Sowing: May. Harvest: Jul-Aug. For family and for sell to neighborhood.
271452	A42	melon	*Cucumis melo*	Mondul Kiri	Koh Nhek	Ro Yor	Ro Yor	13.10.00.95	107.03.08.09	124	Farm storage	seed	no	no	Trosok Srov	The same farmer as A41. Yellow- stripe-oblong melon. The other information is the same as A41. For family and for sell to neighborhood.
271453	A43	melon	*Cucumis melo*	Mondul Kiri	Koh Nhek	Sok San	Klong Le	12.59.03.89	107.02.20.02	141	Farm storage	seed	no	no	Trosok Srov	Cultivated alone or with rice. White fruits. Sowing: May. Harvest: Jul-Aug. For family and for sell (if overproduced).
271454	A44	pumpkin	*Cucurbita moschata*	Mondul Kiri	Koh Nhek	Sok San	Klong Le	12.59.03.89	107.02.20.02	141	Farm storage	seed	no	no	Lapov	The same farmer as A43. Cultivated alone or with rice. Sowing: May. Harvest: Jul-Aug. For family and for sell (if overproduced).
271455	A45	pumpkin	*Cucurbita moschata*	Mondul Kiri	Koh Nhek	Sok San	Klong Le	12.59.02.58	107.02.13.03	146	Farm storage	seed	no	no	Lapov	Every vegetable is cultivated separatry in each block area in same field. Sowing: May. Harvest: Jul-Aug. For family but mostly for sell.
271456	A46	melon	*Cucumis melo*	Mondul Kiri	Koh Nhek	Sok San	Klong Le	12.59.02.58	107.02.13.03	146	Farm storage	seed	no	no	Trosok Srov	The same farmer as A45. Two types of melon seeds are mixed (yellow-stripe-oblong and yellow-nonstripe-oblong. Nonstripe type has shorter fruit length than stripe one). The other information is the same as A45. For family but mostly for sell.

Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271457	A47	melon	*Cucumis melo*	Kratie	Prek Pro Sorb	Prek Pro Sorb	Prek Pro Sorb Leu	12.21.48.98	106.01.44.44	26	Farm storage	seed	no	no	Trosok Srov	Cultivated twice a year. Not cultivated with other crops. Fertilizer is used for rice but not for Cucurbitaceae. Sowing: Nov and May. Harvest: Jan and Aug. For family.
271458	A48	pumpkin	*Cucurbita moschata*	Kratie	Prek Pro Sorb	Prek Pro Sorb	Prek Pro Sorb Leu	12.21.48.98	106.01.44.44	26	Farm storage	seed	no	no	Lapov	The same farmer as A47. Shoots are used for cooking. Not cultivated with other crops. Sowing: Nov. Harvest: Jan. The other information is the same as A47. For family.
271459	A49	pumpkin	*Cucurbita moschata*	Kratie	Prek Pro Sorb	Chambok	Chambok	12.16.30.47	105.48.30.46	11	Farm storage	fruit	compost	no	Lapov	5.05 kg. H16.0cm x W27.0cm. Mixed seeds with green-mottled and orange fruits type. Grow under nuts trees. Sowing: Jun. Harvest: Oct. For sell.
271460	A50	melon	*Cucumis melo*	Kratie	Prek Pro Sorb	Tamao	Tamao Kroam	12.17.17.64	105.54.32.26	24	Farm storage	seed	no	no	Trosok Srov	Brown-white stripe- oblong fruits. Sell young fruits for pickles. Sowing: Jun. Harvest: Oct. For sell.
271461	A51	pumpkin	*Cucurbita moschata*	Kratie	Prek Pro Sorb	Tamao	Tamao Kroam	12.17.17.64	105.54.32.26	24	Farm storage	seed	no	no	Lapov	The same farmer as A50. Sowing: Jun. Harvest: Oct. For sell.
271462	A52	melon	*Cucumis melo*	Kratie	Prek Pro Sorb	Soab	Tamao Kroam	12.28.31.66	105.59.50.61	26	Farm storage	seed	no	no	Trosok Srov	Mixed seeds with brown-stripe-oblong type, yellow-stripe-oblong type and white-oblong type. Sell young fruits for pickles. Sowing: Nov. Harvest: Jan.
271463	A53	pumpkin	*Cucurbita moschata*	Kratie	Sambo	Sambo	Sambo	12.47.05.40	105.58.03.19	26	Farm storage	fruit	no	no	Lapov trou	0.95 kg. H30.5 cm x W8.5 cm. Trou= fish trap. Cucumber, pumpkin and melon are in the same field but separately in each block. Sowing: May. Harvest: Jul-Aug. For sell.
271464	A54	pumpkin	*Cucurbita moschata*	Kratie	Chet Borey	Korn Tout	Srae Norn	12.23.35.57	106.15.48.15	35	Farm storage	seed	no	no	Lapov	Not cultivated with other crops. Sowing: May. Harvest: Jun. For family.
271465	A55	chili pepper	*Capsicum frutescens*	Kratie	Chet Borey	Korn Tout	Srae Norn	12.23.33.98	106.15.48.14	35	Backyard	fruit	-	-	-	The same farmer as A54. For family.
271466	A56	pumpkin	*Cucurbita moschata*	Kratie	Chet Borey	Bos Leav	Prek Kov	12.24.45.75	106.04.32.25	30	Farm storage	fruit	no	no	Lapov	1.40 kg. H13.0 cm x W15.0 cm. Sowing: May. Harvest: Aug-Sep. For family.
271467	A57	chili pepper	*Capsicum frutescens*	Kratie	Chet Borey	Bos Leav	Prek Kov	12.24.45.75	106.04.32.25	30	Backyard	fruit	no	no	Mates Kuy Teav	The same farmer as A56. Kuy teav = noodle. Eat with breakfast noodle. For family.
271468	A58	pumpkin	*Cucurbita moschata*	Kratie	Chet Borey	Bos Leav	Preach Kon Long	12.26.01.43	106.02.30.73	26	Farm storage	seed	no	no	Lapov	Not cultivated with other crops. Sowing: Sep. Harvest: Nov. For sell (shoot and fruits).

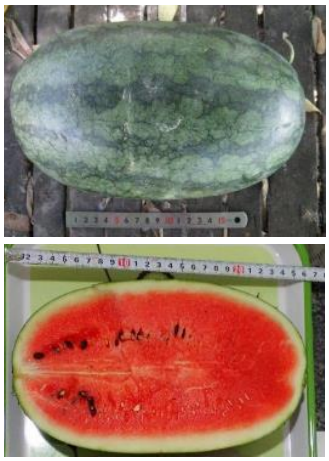
Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271469	A59	pumpkin	*Cucurbita moschata*	Kratie	Chhloung	Kanh Chour	Preach Kon Long	12.19.54.95	106.03.45.24	29	Farm storage	seed	no	no	Lapov	Mixed seeds with wax gourd and luffa. Cultivated between cashew trees. Sowing: May. Harvest: Jul-Aug. For family.
271470	A60	melon	*Cucumis melo*	Kratie	Chhloung	Kanh Chour	Preach Kon Long	12.19.54.95	106.03.45.24	29	Farm storage	seed	no	no	Trosok Srov	The same farmer as A59. Yellow- stripe-oblong fruit. Cultivated between cashew trees. Sowing: May. Harvest: Jul. For family.
271471	A61	melon	*Cucumis melo*	Kratie	Chhloung	Damrei Phong	Prolay Tri	12.14.40.45	106.05.47.61	55	Farm storage	seed	no	no	Trosok Srov	Either dark green-stripe-oblong type or white-oblong type fruit. Cultivated with cassava and maize. Sowing: May. Harvest: Jul-Aug. For family.
271472	A62	melon	*Cucumis melo*	Kratie	Chhloung	Damrei Phong	Prolay Tri	12.14.40.45	106.05.47.61	55	Farm storage	seed	no	no	Trosok Srov	The same farmer as A61. The other information is the same as A61. Sowing: May. Harvest: Jul-Aug. For family.
271473	A63	pumpkin	*Cucurbita moschata*	Kratie	Chhloung	Damrei Phong	Prolay Tri	12.13.39.60	106.05.41.60	56	Farm storage	seed	no	no	Lapov Khlong	Cultivated with cassava. Sowing: Nov. Harvest: Feb. For family.
271474	A64	pumpkin	*Cucurbita moschata*	Kratie	Chhloung	Pror Hout	Pror Hout	12.11.14.65	106.04.56.86	30	Farm storage	fruit	no	no	Lapov	2.70 kg. H10.0 cm x W23.0 cm. With cassava. Sowing: May. Harvest: Aug. For family.
271475	A65	chili pepper	*Capsicum frutescens*	Kratie	Chhloung	Pror Hout	Pror Hout	12.11.14.65	106.04.56.86	30	Backyard	fruit	no	no	Mates	The same farmer as A64. For family.
271476	A66	chili pepper	*Capsicum frutescens*	Kratie	Chhloung	Pror Hout	Pror Hout	12.12.00.11	106.03.16.04	65	Backyard	fruit	no	no	Mates Ach Sat	For family.
271477	A67	melon	*Cucumis melo*	Kratie	Chhloung	Pror Hout	Pror Hout	12.12.00.11	106.03.16.04	65	Farm storage	seed	use	Insecticide	Trosok Srov	The same farmer as A66. Immature fruits are bitter. Mature fruits is green-white stripe-oblong. Sowing: Jun-Jul. Harvest: Sep.
271478	A68	eggplant	*Solanum melongena*	Kampon Cham	Korng Meas	Prek Kro Bao	Ou Kandoa	12.00.20.52	105.16.01.12	17	Backyard	fruit	-	-	Trob	Cultivated in a home garden.
271479	A69	melon	*Cucumis melo*	Kampon Cham	Korng Meas	Prek Kro Bao	Ou Kandoa	12.00.27.76	105.16.04.00	15	Farm storage	seed	use	Insecticide	Trosok Srov	Owner has never bought seeds from markets. Seeds are harvested from the former fruits. Dark green-stripe-oblong fruit. Grow just melon without any other crop. Sowing: Jan. Harvest: May-Apr. For sell.

Table 3. (Continued).

JP No.	Coll. No.	Crop Name	Species	Province	District	Commune	Village	North Latitude	East Longitude	Altitude (m)	Collection		Fertilizer	Chemical	Local name	Remarks
											source	type				
271480	A70	melon	*Cucumis melo*	Kampon Cham	Korng Meas	Prek Kro Bao	Prek Oan Doung	11.59.34.41	105.15.36.69	15	Farm storage	seed	use	Insecticide	Trosok Srov	Sell immature fruits. Lndrace melon has yellow-stripe-oblong or dark green-stripe-oblong fruit. Commercial variety is grown near the landrace. Landrace seeds are bigger than the commercial variety. Sowing: Dec. Harvest: Feb-Mar. For sell.
271481	A71	melon	*Cucumis melo*	Kampon Cham	Ba Teay	Ba Teay	Srah Pring	11.59.34.07	104.57.31.41	14	Farm storage	seed	no	no	Trosok Srov	Yellow- stripe- oblong melon. Cultivated in mango fields. Sowing: May. Harvest: July. For family.
271482	A72	chili pepper	*Capsicum frutescens*	Kampon Cham	Ba Teay	Ba Teay	Srah Pring	11.59.38.26	104.57.22.83	16	Backyard	fruit	no	no	Mates Ach Sat	For family.

Photos of collected samples



Sample Photo 1.
A01. *Citrullus lanatus*

Sample Photo 2.
A02. *Cucumis melo*

Sample Photo 3.
A03. *Capsicum frutescens*

Sample Photo 4.
A04. *Cucurbita moschata*

Sample Photo 5.
A05. *Cucurbita moschata*

Sample Photo 6.
A06. *Cucurbita moschata*

Sample Photo 7.
A07. *Cucurbita moschata*

Sample Photo 8.
A08. *Cucumis melo*

Sample Photo 9.
A09. *Cucurbita moschata*

Sample Photo 10.
A10. *Cucumis melo*

Sample Photo 11.
A11. *Capsicum frutescens*

Sample Photo 12.
A12. *Cucumis melo*

Photos of collected samples

Sample Photo 13.
A13. *Cucurbita moschata*

Sample Photo 14.
A14. *Cucurbita moschata*

Sample Photo 15.
A15. *Cucurbita moschata*

Sample Photo 16.
A16. *Cucurbita moschata*

Sample Photo 17.
A17. *Cucurbita moschata*

Sample Photo 18.
A18. *Cucumis sativus*

Sample Photo 19.
A19. *Cucumis melo*

Sample Photo 20.
A20. *Cucumis melo*

Sample Photo 21.
A21. *Cucumis sativus*

Sample Photo 22.
A22. *Cucumis sativus*

Sample Photo 23.
A23. *Cucumis melo*

Sample Photo 24.
A24. *Cucurbita moschata*

Photos of collected samples

Sample Photo 25.
A25. *Cucumis melo*

Sample Photo 26.
A26. *Cucumis sativus*

Sample Photo 27.
A27. *Cucumis melo*

Sample Photo 28.
A28. *Cucurbita moschata*

Sample Photo 29.
A29. *Cucurbita moschata*

Sample Photo 30.
A30. *Cucumis sativus*

Sample Photo 31.
A31. *Cucumis melo*

Sample Photo 32.
A32. *Cucumis sativus*

Sample Photo 33.
A33. *Cucumis melo*

Sample Photo 34.
A34. *Cucurbita moschata*

Sample Photo 35.
A35. *Cucumis melo*

Sample Photo 36.
A36. *Cucurbita moschata*

Photos of collected samples

Sample Photo 37.
A37. *Cucurbita moschata*

Sample Photo 38.
A38. *Cucurbita moschata*

Sample Photo 39.
A39. *Cucumis melo*

Sample Photo 40.
A40. *Cucumis sativus*

Sample Photo 41.
A41. *Cucumis melo*

Sample Photo 42.
A42. *Cucumis melo*

Sample Photo 43.
A43. *Cucumis melo*

Sample Photo 44.
A44. *Cucurbita moschata*

Sample Photo 45.
A45. *Cucurbita moschata*

Sample Photo 46.
A46. *Cucumis melo*

Sample Photo 47.
A47. *Cucumis melo*

Sample Photo 48.
A48. *Cucurbita moschata*

Photos of collected samples

Sample Photo 49.
A49. *Cucurbita moschata*

Sample Photo 50.
A50. *Cucumis melo*

Sample Photo 51.
A51. *Cucurbita moschata*

Sample Photo 52.
A52. *Cucumis melo*

Sample Photo 53.
A53. *Cucurbita moschata*

Sample Photo 54.
A54. *Cucurbita moschata*

Sample Photo 55.
A55. *Capsicum frutescens*

Sample Photo 56.
A56. *Cucurbita moschata*

Sample Photo 57.
A57. *Capsicum frutescens*

Sample Photo 58.
A58. *Cucurbita moschata*

Sample Photo 59.
A59. *Cucurbita moschata*

Sample Photo 60.
A60. *Cucumis melo*

Photos of collected samples

Sample Photo 61.
A61. *Cucumis melo*

Sample Photo 62.
A62. *Cucumis melo*

Sample Photo 63.
A63. *Cucurbita moschata*

Sample Photo 64.
A64. *Cucurbita moschata*

Sample Photo 65.
A65. *Capsicum frutescens*

Sample Photo 66.
A66. *Capsicum frutescens*

Sample Photo 67.
A67. *Cucumis melo*

Sample Photo 68.
A68. *Solanum melongena*

Sample Photo 69.
A69. *Cucumis melo*

Sample Photo 70.
A70. *Cucumis melo*

Sample Photo 71.
A71. *Cucumis melo*

Sample Photo 72.
A72. *Capsicum frutescens*