

Collaborative Exploration of Plant Genetic Resources in Vietnam, 2016

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Summary

The National Agriculture and Food Research Organization (NARO) and the Plant Resources Center (PRC) of the Vietnamese Academy of Agricultural Science conducted a collaborative exploration of plant genetic resources in Vietnam in 2016. The exploration was done within the framework of Plant Genetic Resources Asia (PGRAsia) project funded by the Ministry of Agriculture, Forestry and Fisheries, Japan. The project started in 2014, and here we report the findings from the third year of collaborative exploration in Vietnam. In October 2016, we surveyed the Muong Lat district and the Ba Thuoc district of Thanh Hoa province, and the Con Cuong district of Nghe An province. A total of 77 accessions were collected. These included: 35 amaranths (*Amaranthus* ssp.), 22 pumpkins (*Cucurbita moschata*), 9 cucumbers (*Cucumis sativus*), 9 melons (*Cucumis melo*), 1 watermelon (*Citrullus lanatus*), and 1 sesame (*Sesamum indicum*). All accessions were stored as seeds at PRC, and subsets were transferred to the Genetic Resources Center, NARO.

KEY WORDS: Amaranth, Pumpkin, Cucumber, Melon, Genetic resource, Vietnam

Introduction

Collection of novel plant genetic resources is crucial for developing new crop varieties that show desirable traits, such as resistance to pests or diseases, high quality, or high yield. In order to promote collection of plant genetic resources, a new research project started in 2014 - the Plant Genetic Resources Asia (PGRAsia) project -, which is funded by the Ministry of Agriculture, Forestry and Fisheries of Japan.

The objective of this project is to characterize, evaluate, and utilize plant genetic resources for food and agriculture (PGRFA) through collaboration between Japan and other Asian countries, and to develop open databases for effective use of PGRFA. In this project NARO started collaborative research with Vietnam, Laos, and Cambodia in 2014, and with Nepal and Myanmar in 2015. One of the research areas in Vietnam is to survey and collect plant genetic resources, such as cucurbitaceous plants and amaranths (*Amaranthus* spp.). In the first survey, in 2014, 59 samples were collected: 33 *Cucurbita moschata*, 19 *Cucumis sativus*, and 7 *Cucumis melo* (Sugiyama *et al.* 2015). In the second survey, in 2015, 97 samples were collected: 10 *Cucumis sativus*, 30 *Cucurbita moschata*, 21 *Amaranthus* spp., 12 *Capsicum* spp., 9 *Brassica* spp., 5 *Solanum* spp., 4 *Cucumis melo*, 2 *Luffa* spp., 1 *Momordica charantia*, *Lagenaria siceraria*, *Coriandrum sativum*, and *Trichosanthes cucumerina* (Shimomura *et al.* 2016). Here, we report the results of our third survey. This time we surveyed the northcentral Vietnam (Thanh Hoa province and Nghe An province), and collected 77 samples.

Methods

A car (PRADO, TOYOTA Motor Corporation, Aichi, Japan) was used to travel the surveyed region from October 3 to 14, 2016. We visited Thanh Hoa city, Muong Lat district, Ba Thuoc district of Thanh Hoa province, and Vinh city and Con Cuong district of Nghe An province (Table 1, Fig. 1). In Thanh Hoa province, we first visited the Department of Agriculture and Rural Development (DARD) of Thanh Hoa province; then visited DARD of Muong Lat district and DARD of Ba Thuoc district. In Nghe An province, we first visited DARD of Nghe An province, and then visited DARD of Con Cuong district. In each district, we visited DARD, communes, then villages, and surveyed mainly cucumbers, pumpkins, and amaranths. We collected fruit and seed samples of local or wild landraces of crops from farmer fields, backyards, and roadsides. During our journey we took seeds out of the collected fruits, washed the seeds under tap water, put them into nets, and dried them in the air. We collected information on each sample from farmers, including local plant name, sowing date, harvest date, usage, and cultivation methods. We also recorded the name of the location, latitude and longitude, elevation, and characteristics of each collection site. Latitude, longitude, and elevation were measured using Garmin eTrex20J GPS technology (Garmin International Inc., Olathe, KS, USA).

Table 1. Itinerary of the exploration of plant genetic resources in Vietnam, 2016

Date (month/day)	Day	Itinerary	Stay
10/3	Mon	Ha Noi - Thanh Hoa City	Thanh Hoa City
10/4	Tue	Thanh Hoa City - Muong Lat District	Muong Lat District
10/5	Wed	Muong Lat District	Muong Lat District
10/6	Thu	Muong Lat District - Ba Thuoc District	Ba Thuoc District
10/7	Fri	Ba Thuoc District	Ba Thuoc District
10/8	Sat	Ba Thuoc District	Ba Thuoc District
10/9	Sun	Ba Thuoc District - Vinh City	Vinh City
10/10	Mon	Vinh City - Con Cuong District	Con Cuong District
10/11	Tue	Con Cuong District	Con Cuong District
10/12	Wed	Con Cuong District	Con Cuong District
10/13	Thu	Con Cuong District - Ha Noi	

Results and Discussion

We collected a total of 77 samples, including 35 amaranths (*Amaranthus* spp.), 22 pumpkins (*Cucurbita moschata*), 9 cucumbers (*Cucumis sativus*), 9 melons (*Cucumis melo*), 1 watermelon (*Citrullus lanatus*), and 1 sesame (*Sesamum indicum*) (Tables 2 and 3). Collection sites are shown in Fig. 1. Collected seed samples were stored in the PRC gene bank, and subsets were transferred to the NARO gene bank in compliance with the terms of the MOU signed by the PRC and NARO. The species which were collected every year from 2014 to 2016 were *C. moschata*, *C. sativus*, and *C. melo*. Fruit shapes of collected *C. moschata* were diverse each year, but we did not find differences of *C. moschata* collections among the three surveys. Because most samples of *C. sativus* and *C. melo* collected each year were not fruits but seeds, we did not find differences of *C. sativus* or *C. melo* collections among the three surveys. Differences might be found by future phenotyping or genotyping. We will explore Vietnam for genetic resources continuously during the term of PGRAsia project.



Fig. 1. Sites in northcentral Vietnam where plant genetic resources were collected. Collection numbers 1-51 were collected in Thanh Hoa province, while collection numbers 52-77 were collected in Nghe An province.

Table 2. Summary of collected genetic resources in Vietnam in 2016

Province	District	<i>Amaranthus</i> spp.	<i>Cucurbita</i> <i>moschata</i>	<i>Cucumis</i> <i>sativus</i>	<i>Cucumis</i> <i>melo</i>	<i>Citrullus</i> <i>lanatus</i>	<i>Sesamum</i> <i>indicum</i>	Total
Thanh Hoa Province	Thanh Hoa City	1	0	0	0	0	0	1
Thanh Hoa Province	Quan Hoa District	1	0	0	0	0	0	1
Thanh Hoa Province	Muong Lat District	7	9	5	3	1	0	25
Thanh Hoa Province	Ba Thuoc District	16	6	2	0	0	0	24
Nghe An Province	Con Cuong District	10	7	2	6	0	1	26
Total		35	22	9	9	1	1	77

Pumpkin

We collected 19 pumpkin fruit samples and 3 pumpkin seed samples from farmers. They were all *Cucurbita moschata*. Through interviews with them, we learned that most farmers do not use any pesticides or fertilizers for pumpkin cultivation. As an exception to this rule, we registered that organic fertilizer was used for accession No. 71. Pumpkins are cultivated in association with rice, maize, legume or eggplant, and fruits are used for human consumption or as pig fodder. Pumpkin seeds are usually sown from January to May, and fruits are harvested from June to October. The farmer who harvested accession No. 55 reported that pumpkin seeds were sown in September or October and fruits were harvested in January. The farmer who harvested accession No. 71 recalled that pumpkin seeds were sown in March and October, while fruits were harvested in August and February, respectively. The farmer who harvested accession Nos. 74 and 75 recalled that pumpkin seeds were sown in October and fruits were harvested in January. Farmers who grow pumpkins in winter live in Nghe An province, where temperature is higher than that in Thanh Hoa province. The collected fruits weighed between 0.72 and 7.94 kg. The heaviest fruit was from accession No. 31 and the lightest one was accession No. 62. Fruit shapes were flattened (Nos. 6, 10, 31, 32, 33, 48, 55, and 61), globular (Nos. 8 and 9), elongate form (No. 7), pyriform (Nos. 18, 19, 27, 35, 42, 60, and 62), or triangular shaped (No. 14). Accession Nos. 7, 8, 9, and 10 were collected in the same village, but the fruit shapes were different. The farmers in the village said that they cut pumpkin fruits and look at the color to diagnose fruit quality. If a cut fruit shows a green line near the skin, like Nos. 8 and 10, the fruit will be sweeter and tastier. The skin color of most fruits was brown, while the skin of Nos. 27 and 55 was greenish. The flesh color of No. 48 was orange, which indicates good quality. The flesh color of other samples was yellow to green. We tasted boiled fruits of Nos. 6 and 33, and found the taste was good.

Amaranth

We collected 35 samples of amaranths (*Amaranthus* spp.) on roadsides or in yards. People usually do not cultivate amaranths but harvest young leaves of naturally growing amaranth, and use them for cooking. There were differences in color and shape among samples. Nos. 2, 39, 46, 49, 52, 53, 67, and 77 were green plants, Nos. 25, 54 and 66 were purple, and Nos. 1, 3, 26, 38, 40, 41, 44, 45, 47, 50, 51, 56, 68, 72, and 76 were partially purple. Nos. 2, 3, 4, 37, 38, 39, 49, 53, 56, 72, 76, and 77 had spines on the stems, while Nos. 1, 13, 15, 40, 41, 46, 50, 51, 52, 54, 66, 67, and 68 had no spine. Only one collection was reported to have spines in the second survey, in 2015 (Shimomura *et al.* 2016), while many collections showed spines in this survey. Cultivated amaranths usually have no spine, and they were collected in the second survey, in 2015.

Cucumber

We collected 3 samples of cucumber fruits and 6 samples of cucumber seeds from farmers. Cucumber seeds from accession No. 20 had been mixed with melon seeds (No. 21) and watermelon seeds (No. 22), thus, first we separated these three species. Farmers said that they did not use any pesticides or fertilizers for cucumber cultivation. Seeds are sown from February to May, and fruits are harvested from June to October. They are often cultivated with rice, and harvested cucumber fruits are consumed at home and sometimes sold at local markets. Collected fruits weighed between 0.85 and 1.83 kg. The heaviest fruit was No. 12 and the lightest one was No. 11. Fruit shapes were all cylindrical. The skin color of fruits was yellow (No. 11), light green (No. 12), or brown (No. 30). The flesh color of Nos. 11 and 12 was yellow to orange, while the flesh color of No. 30 was white.

Melon

We collected 2 samples of melon fruits and 7 samples of melon seeds from farmers. Melon seeds from No. 21 had been mixed with cucumber seeds (No. 20) and watermelon seeds (No. 22), thus, first we separated these three species. Farmers said that they did not use any pesticides or fertilizers for melon cultivation. Seeds are sown from April to June, and fruits were harvested from July to October. They were often cultivated with rice, and harvested melon fruits are consumed at home and sometimes sold at local markets. Fruits from Nos. 57 and 73 weighed 1.65 kg and 1.22 kg, respectively. Fruit No. 57 had yellow to green flesh, yellow and green colors of the skin, and had white short stripes on the upper and lower part of the skin. Skin and flesh color of fruit No. 73 was yellow, and it had white stripes on the skin.

Watermelon

One watermelon sample (No. 22) was collected. The collected seeds had been mixed with cucumber seeds (No. 20) and melon seeds (No. 21); thus, first we separated these three species. People do not use any pesticides and fertilizers for watermelon cultivation. Seeds are sown in May, and fruits are harvested in August.

Sesame

One sesame sample (No. 63) was collected. People do not use any pesticides or fertilizers for sesame cultivation. Seeds are sown in June and harvested in September.

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References

- Shimomura K, Sugiyama K, Yoshioka Y, Hoai TTT, Kien NV (2016) Collaborative exploration of plant genetic resources in Vietnam, 2015. AREIPGR 32: 159-181.
- Sugiyama M, Ebana K, Kami D, Hoai TTT, Kien NV (2015) Collaborative exploration of cucurbitaceous crops in Vietnam, 2014. AREIPGR 31: 189-201.

ベトナムにおける植物遺伝資源の共同探索，2016 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）とベトナム植物資源センター（PRC）は2016年、ベトナム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収集・提供強化」の予算により実施された。本プロジェクトは2014年に始まり、今回はベトナムにおける3年目の共同探索について報告する。2016年10月に Thanh Hoa Province の Muong Lat District と Ba Thuoc District, および Nghe An Province の Con Cuong District において探索を行った。その結果、アマランサス (*Amaranthus* ssp.) 35 点、カボチャ (*Cucurbita moschata*) 22 点、キュウリ (*Cucumis sativus*) 9 点、メロン (*Cucumis melo*) 9 点、スイカ (*Citrullus lanatus*) 1 点、ゴマ (*Sesamum indicum*) 1 点を収集した（合計 77 点）。収集された遺伝資源の種子は、PRC に保存され、一部は農研機構遺伝資源センターに送付された。

Table 3. Genetic resources collected in Vietnam in 2016

JP No	Coll No	Coll Date Oct , 2016	Species name	Local Name	Type of sample	status of sample	Coll Source	Province	District	Commune	Town or Village name	Latitude	Longitude	Altitude (m)	Remarks
258315	1	3	<i>Amaranthus</i> spp	Rau den ta	seeds	wild	wild	Thanh Hoa	An Hoach ward	-	05, LK16, Dong Son	N19-47-59-36	E105-45-32-52	18	no spine, pink on lower part of stems, from Dr Ky, a head of Agriulture and Rural Development (DARD) of Thanh Hoa Province
258316	2	4	<i>Amaranthus</i> spp	Rau gien gai	seeds	wild	wild	Thanh Hoa	Ba Thuoc	Thiet Ke	13 km from Hoi Xuan Town	N20-19-06-40	E105-09-59-17	54	with spines, green stem, H120cm
258317	3	4	<i>Amaranthus</i> spp	Rau gien gai	seeds	wild	wild	Thanh Hoa	Ba Thuoc	Thiet Ke	13 km from Hoi Xuan Town	N20-19-06-40	E105-09-59-17	54	with spines, H105cm, from a roadside, red stem
258318	4	4	<i>Amaranthus</i> spp	Rau gien gai	seeds	wild	wild	Thanh Hoa	Quan Hoa	4 km from Hien Kiet Commune	13 km from Hoi Xuan Town	N20-26-59-49	E104-45-19-99	616	with spines, H110cm, from a roadside
258319	5	4	<i>Amaranthus</i> spp	Pha hom	seeds	wild	wild	Thanh Hoa	Muong Lat	Tam Chung	Lat Village	N20-32-42-36	E104-36-22-77	180	H62cm, from a roadside
258320	6	4	<i>Cucurbita moschata</i>	Mac uc	2 fruits	landrace	farmland	Thanh Hoa	Muong Lat	Tam Chung	Lat Village	N20-32-12-70	E104-36-11-32	173	2 43kg (average), cultivated with rice, 10-15 fruits per plant, Sowing: May, Harvest: Sep-Oct
258321	7	5	<i>Cucurbita moschata</i>	Tau da te	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-50-89	E104-34-47-35	730	Tau da = pumpkin, te = long, 1 23kg, H20cm x W12cm, cultivated with maize, Sowing: May, Harvest: Aug-Oct
258322	8	5	<i>Cucurbita moschata</i>	Tau da khenh	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-50-89	E104-34-47-35	730	Tau da = pumpkin, khenh = round, 1 53kg, H16cm x W18cm, cultivated with maize
258323	9	5	<i>Cucurbita moschata</i>	Tau da	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-50-89	E104-34-47-35	730	Tau da = pumpkin, 1 07kg, H15cm x W14cm, cultivated with maize
258324	10	5	<i>Cucurbita moschata</i>	Tau da te	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-50-89	E104-34-47-35	730	Tau da = pumpkin, te = long, 2 48kg, H12 5cm x W23cm, cultivated with maize
258325	11	5	<i>Cucumis sativus</i>	Di me	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-44-90	E104-34-52-19	762	Di = cucumber, me = small, 0 85kg, H18cm x W9cm, cultivated with rice, about 20 fruits per plant, Sowing: May, Harvest: Aug-Oct
258326	12	5	<i>Cucumis sativus</i>	Di lo	3 fruits	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Com Village	N20-26-44-90	E104-34-52-19	762	Di = cucumber, lo = big, 1 83kg (average), H21cm x W11cm (average), cultivated with rice
258327	13	5	<i>Amaranthus</i> spp	Lai Le xi	seeds	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Ha Son Village	N20-29-57-88	E104-35-14-40	308	H30cm, Lai Le = Amaranthus, xi = red, all purple color, no spine
258328	14	5	<i>Cucurbita moschata</i>	Phung bau	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Ha Son Village	N20-29-57-88	E104-35-14-40	308	1 54kg, H12cm x W15 5cm, cultivated with maize, Sowing: May, Harvest: Sep-Oct
258329	15	5	<i>Amaranthus</i> spp	Lai Le meng	seeds	wild	wild	Thanh Hoa	Muong Lat	Pu Nhi	Ha Son Village	N20-29-42-53	E104-35-08-13	319	H33cm, Lai Le = Amaranthus, meng = green, from a roadside, no spine
258330	16	5	<i>Amaranthus</i> spp	Lai Le pua	seeds	landrace	farmland	Thanh Hoa	Muong Lat	Pu Nhi	Ha Son Village	N20-29-42-53	E104-35-08-13	319	H120cm, Lai Le = Amaranthus, pua = big
258331	17	5	<i>Cucumis sativus</i>	Di mong	seeds	landrace	farmland	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	cultivated with rice, Sowing: April, Harvest: July
258332	18	5	<i>Cucurbita moschata</i>	Tau da ve da	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	Tau da = pumpkin, ve da = neck bottle, 2 02kg, H20cm x W17cm
258333	19	5	<i>Cucurbita moschata</i>	Tau da ve da	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	Tau da = pumpkin, ve da = neck bottle, 1 11kg, H17 5cm x W14cm, Sowing: May, Harvest: Aug-Oct
258334	20	5	<i>Cucumis sativus</i>	Di mong	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	cultivated with rice, Sowing: May, Harvest: Aug
258335	21	5	<i>Cucumis melo</i>	Di pa	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	cultivated with rice, Sowing: May, Harvest: July
258336	22	5	<i>Citrullus lanatus</i>	Di cua	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	cultivated with rice, 4-5 fruits per plant, Sowing: May, Harvest: Aug
258337	23	5	<i>Cucumis melo</i>	Di pa	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Nhi Son	Pa hoc Village	N20-28-18-83	E104-37-16-61	739	cultivated with rice, 6-8 fruits per plant, Sowing: April, Harvest: July
258338	24	6	<i>Amaranthus</i> spp	Phac hom le	seeds	wild	wild	Thanh Hoa	Muong Lat	Ten Tan	Na Kha Village	N20-30-51-90	E104-31-08-67	207	H112cm
258339	25	6	<i>Amaranthus</i> spp	Phac hom danh	seeds	wild	wild	Thanh Hoa	Muong Lat	Ten Tan	Na Kha Village	N20-30-51-90	E104-31-08-67	207	H136cm, all purple color, Phac hom = Amaranth
258340	26	6	<i>Amaranthus</i> spp	Phac hom	seeds	wild	wild	Thanh Hoa	Muong Lat	Ten Tan	Buon Village	N20-31-10-78	E104-32-32-96	182	H34cm, green leaves, pink stems and inflorescence
258341	27	6	<i>Cucurbita moschata</i>	Ma uc	1 fruit	landrace	farmland	Thanh Hoa	Muong Lat	Ten Tan	Buon Village	N20-31-11-37	E104-32-36-40	183	4 18kg, H24cm x W22cm, fruit shape: neck bottle, cultivated with maize, Sowing: April, Harvest: Sep
258342	28	6	<i>Cucumis melo</i>	Ma tanh lai	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Ten Tan	Buon Village	N20-31-11-37	E104-32-36-40	183	cultivated with maize or cucumber, Sowing: Apr, Harvest: July
258343	29	6	<i>Cucumis sativus</i>	Ma tanh khau	seeds	landrace	farmstore	Thanh Hoa	Muong Lat	Ten Tan	Buon Village	N20-31-11-37	E104-32-36-40	183	cultivated with maize or melon, Sowing: Apr, Harvest: Aug-Sep
258344	30	7	<i>Cucumis sativus</i>	Mac teenh	1 fruit	landrace	farmland	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-32-70	E105-11-47-64	956	1 81kg, H25cm x W12 5cm, 6-7 fruits per plant, Sowing: Mar, Harvest: July-Sep
258345	31	7	<i>Cucurbita moschata</i>	Mac u pan	1 fruit	landrace	farmland	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-32-70	E105-11-47-64	956	Mac u = pumpkin, 7 94kg, H17cm x W30cm, used for pigs, about 10 fruits per plant, Sowing: Mar, Harvest: Aug-Oct
258346	32	7	<i>Cucurbita moschata</i>	Mac u	1 fruit	landrace	farmland	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-32-70	E105-11-47-64	956	4 46kg, H15cm x W24cm, Sowing: Mar, Harvest: Aug-Oct
258347	33	7	<i>Cucurbita moschata</i>	Mac u e	1 fruit	landrace	farmland	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-32-70	E105-11-47-64	956	e = small, 2 44kg, H10 5cm x W19cm, Sowing: Mar, Harvest: Aug-Oct

Table 3. (Continued).

JP No	Coll No	Coll Date Oct , 2016	Species name	Local Name	Type of sample	status of sample	Coll Source	Province	District	Commune	Town or Village name	Latitude	Longitude	Altitude (m)	Remarks
258348	34	7	<i>Amaranthus</i> spp	Phac hom	seed	wild	farm land	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-32-70	E105-11-47-64	956	H245cm
258349	35	7	<i>Cucurbita moschata</i>	Mac u	1 fruit	landrace	farmland	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-40-76	E105-11-33-04	936	2 45kg, H15cm x W20cm, Sowing: Mar, Harvest: Aug-Oct
258350	36	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	wild	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-40-76	E105-11-33-04	936	H75cm
258351	37	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	wild	Thanh Hoa	Ba Thuoc	Lung Cao	Muoi Village	N20-30-40-76	E105-11-33-04	936	H70cm, spine
258352	38	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	roadside	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-27-59-67	E105-07-23-05	517	H30cm, pink stems, green leaves and inflorescence, spine
258353	39	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	roadside	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-27-59-67	E105-07-23-05	517	H54cm, all green color, small leaves, spine
258354	40	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	farm land	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-28-01-30	E105-07-20-24	519	H53cm, green leaves and inflorescence, a little pink on stems, no spine
258355	41	7	<i>Amaranthus</i> spp	Phac hom	seeds	wild	farm land	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-28-01-30	E105-07-20-24	519	H80cm, all green color except a little pink stripes on stems, no spine
258356	42	7	<i>Cucurbita moschata</i>	Mac u	1 fruit	landrace	home garden	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-28-01-46	E105-07-19-50	523	1 22kg, H16 5cm x W14cm, Sowing: Mar, Harvest: Aug
258357	43	7	<i>Cucumis sativus</i>	Lai Rua	seeds	landrace	farmstore	Thanh Hoa	Ba Thuoc	Thanh Son	Bang village	N20-30-25-60	E105-05-09-28	518	skin color: green (young), orange, then brown (mature), Sowing: Feb, Harvest: June
258358	44	8	<i>Amaranthus</i> spp	Lung Khung	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-20-21-16	E105-15-03-97	61	small leaves, pink leaves and stems, green inflorescence
258359	45	8	<i>Amaranthus</i> spp	Sau trenh	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-20-21-16	E105-15-03-97	61	pink stems, green leaves and inflorescence
258360	46	8	<i>Amaranthus</i> spp	Rau gien canh	seeds	landrace	farmland	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-20-21-99	E105-15-03-82	57	Rau gien =Amaranthus, canh = soup, H110cm, all green color, dark green color of leaves, no spine
258361	47	8	<i>Amaranthus</i> spp	Sau trenh kai	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-20-32-33	E105-15-55-81	56	green leaves and inflorescence, a little pink stems, long inflorescence
258362	48	8	<i>Cucurbita moschata</i>	Klay pu	1 fruit	landrace	home garden	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-28-01-46	E105-07-19-50	58	1 76kg, H12cm, W18cm, Sowing: Apr, Harvest: Sep
258363	49	8	<i>Amaranthus</i> spp	Sau trenh kai	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Ai Thuong	Thung Village	N20-21-05-54	E105-16-53-20	61	Sau tenh = Amaranthus, kai = spine, all green color, many small leaves
258364	50	8	<i>Amaranthus</i> spp	Rau gien com	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Dien Lu	Dien Ly Village	N20-18-21-91	E105-18-52-01	41	Raugien = Amaranthus, com = rice, H45cm, pink stems, green small leaves, green inflorescence, not many seeds in inflorescence, no spine, soft stems, from sugarcane field
258365	51	8	<i>Amaranthus</i> spp	Rau gien com	seeds	wild	farmland	Thanh Hoa	Ba Thuoc	Dien Lu	Dien Ly Village	N20-18-21-91	E105-18-52-01	41	Rau = Vegetable, gien = Amaranthus, com = rice, H22cm, pink stems, green small leaves with purple color of vein, green inflorescence, no spine, from sugarcane field
258366	52	10	<i>Amaranthus</i> spp	Rau gien xanh	seeds	landrace	farmland	Nghe An	Con Cuong	-	No 3, Con Cuong Town	N19-03-12-39	E104-52-49-38	31	Rau = Vegetable, gien = Amaranthus, xanh = green, H230cm, no spine, wide and big leaves, all green
258367	53	10	<i>Amaranthus</i> spp	Rau gien gai	seeds	landrace	farmland	Nghe An	Con Cuong	-	No 3, Con Cuong Town	N19-03-12-39	E104-52-49-38	31	Rau = Vegetable, gien = Amaranthus, gai = spine, H67cm, many spines, all green, small leaves
258368	54	10	<i>Amaranthus</i> spp	Rau gien do	seeds	landrace	farmland	Nghe An	Con Cuong	-	No 3, Con Cuong Town	N19-03-12-39	E104-52-49-38	31	Rau = Vegetable, gien = Amaranthus, do = red, H67cm, all purple, no spine, round inflorescence, dead plants when collected
258369	55	10	<i>Cucurbita moschata</i>	Bu ro	1 fruit	landrace	farmland	Nghe An	Con Cuong	-	No 3, Con Cuong Town	N19-03-12-39	E104-52-49-38	31	1 17kg, H12cm, W16cm, Sowing: Sep-Oct, Harvest: Jan
258370	56	11	<i>Amaranthus</i> spp	Phac hom	seeds	wild	wild	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-16-46	E104-53-19-88	232	H107cm, spine, pink stems, green leaves and inflorescence, many small leaves
258371	57	11	<i>Cucumis melo</i>	Tanh lai	1 fruit	landrace	farmland	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-48	E104-53-19-34	232	Tanh = Cucumis, lai = stripe, 1 65kg, H15cm, W15cm, about 10 fruits per plant, Sowing: Jun, Harvest: Oct
258372	58	11	<i>Cucumis melo</i>	Tanh lai	seeds	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-48	E104-53-19-34	232	Tanh = Cucumis, lai = stripe, cultivated with rice, Sowing: Jun, Harvest: Oct
258373	59	11	<i>Cucumis sativus</i>	Tanh khau	seeds	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-48	E104-53-19-34	232	cultivated with rice, green color (young), then brown (mature), about 20 fruits per plant, about 20 fruits per plant, Sowing: Jun, Harvest: Oct
258374	60	11	<i>Cucurbita moschata</i>	Ma u	1 fruit	landrace	farmland	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-48	E104-53-19-34	232	2 60kg, H25cm, W18cm, cultivated with eggplant and maize and regume, about 20 fruits per plant, Sowing: Mar or Jun, Harvest: June or Oct
258375	61	11	<i>Cucurbita moschata</i>	Ma u	1 fruit	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-20	E104-53-09-61	228	2 28kg, H11cm, W22cm, Sowing: Mar, Harvest: Jul
258376	62	11	<i>Cucurbita moschata</i>	Ma u	1 fruit	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-20	E104-53-09-61	228	0 72kg, H11 5cm, W11cm, Sowing: Mar, Harvest: Jul
258377	63	11	<i>Sesamum indicum</i>	Nga	seeds	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-20	E104-53-09-61	228	Sowing: Jun, Harvest: Sep
258378	64	11	<i>Cucumis melo</i>	Tanh lai	seeds	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-20	E104-53-09-61	228	cultivated with rice, Sowing: Jun, Harvest: Sep
258379	65	11	<i>Cucumis sativus</i>	Tanh khau	seeds	landrace	farmstore	Nghe An	Con Cuong	Binh Chuan	Tong Village	N19-14-17-20	E104-53-09-61	228	cultivated with rice, Sowing: Jun, Harvest: Sep

Table 3. (Continued).

JP No	Coll No	Coll Date Oct , 2016	Species name	Local Name	Type of sample	status of sample	Coll Source	Province	District	Commune	Town or Village name	Latitude	Longitude	Altitude (m)	Remarks
258380	66	11	<i>Amaranthus</i> spp	Phac hom deng	seeds	wild	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-11-03	E104-49-41-69	64	deng = red, H120cm, all purple, no spine, wide leaves
258381	67	11	<i>Amaranthus</i> spp	Phac hom hao	seeds	wild	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-11-03	E104-49-41-69	64	hao = green, H127cm, all green, no spine
258382	68	11	<i>Amaranthus</i> spp	Phac hom khau	seeds	wild	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-11-03	E104-49-41-69	64	H30cm, no spine, pink stems, green leaves and inflorescence
258383	69	11	<i>Cucumis melo</i>	Tanh lai	seeds	landrace	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-13-13	E104-49-41-73	63	Sowing: May, Harvest: Jul
258384	70	11	<i>Cucumis melo</i>	Tanh lai	seeds	landrace	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-13-13	E104-49-41-73	63	cultivated with rice, Sowing: May, Harvest: Jul
258385	71	11	<i>Cucurbita moschata</i>	Ma u	seeds	landrace	farmstore	Nghe An	Con Cuong	Chi khe	Trung Dinh Village	N19-03-13-13	E104-49-41-73	63	Sowing: Oct or Mar, Harvest: Feb or Aug
258386	72	11	<i>Amaranthus</i> spp	Phac hom nam deng	seeds	wild	farmstore	Nghe An	Con Cuong	Chi khe	Son Khe Village	N19-02-48-78	E104-49-25-47	70	H128cm, spine, pink stems
258387	73	11	<i>Cucumis melo</i>	Tanh lai	1 fruit	landrace	farmstore	Nghe An	Con Cuong	Chi khe	Son Khe Village	N19-02-48-69	E104-49-24-24	60	1 22kg, H16 5cm x W12cm, cultivated with rice, Sowing: Jun, Harvest: Oct
258388	74	12	<i>Cucurbita moschata</i>	Pe pin	seeds	landrace	farmstore	Nghe An	Con Cuong	Thach Ngan	Thach Son Village	N19-08-06-80	E104-59-27-77	100	Sowing: Oct, Harvest: Jan
258389	75	12	<i>Cucurbita moschata</i>	Pe pin ta	seeds	landrace	farmstore	Nghe An	Con Cuong	Thach Ngan	Thach Son Village	N19-08-06-80	E104-59-27-77	100	ta = small, Sowing: Oct, Harvest: Jan
258390	76	12	<i>Amaranthus</i> spp	Clom	seeds	wild	farmland	Nghe An	Con Cuong	Thach Ngan	Bung Village	N19-08-06-34	E104-59-27-23	98	H118cm, spine, pink stems, green leaves and inflorescence, only for feeding pigs
258391	77	12	<i>Amaranthus</i> spp	Rau gien xanh co gai	seeds	wild	farmland	Nghe An	Con Cuong	Thach Ngan	Bung Village	N19-08-06-34	E104-59-27-23	98	Rau = vegetable, gien = Amaranthus, xanh = green, co gai = spine, H111cm, all green, spine



Photo 1. Member for the exploration. A driver, Kien, Kawazu, Kato and Hoai (from left to right).



Photo 2. Interviewing local people at Bang Village, Thanh Son, Ba Thuoc.



Photo 3. Collecting Amaranth seeds on a roadside.



Photo 4. Collecting Amaranth seeds in a backyard.



Photo 5. A net including seeds (No. 20, 21 and 22) for drying.



Photo 6. Pumpkins stored in a hut.



Photo 7. Taking seeds out of collected fruits.

Amaranth



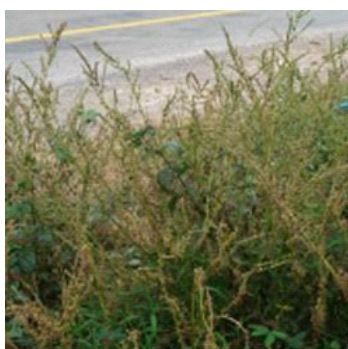
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No. 2



No. 3



No. 4



No. 5



No. 13



No. 15



No. 16



No. 24



No. 25



No. 26



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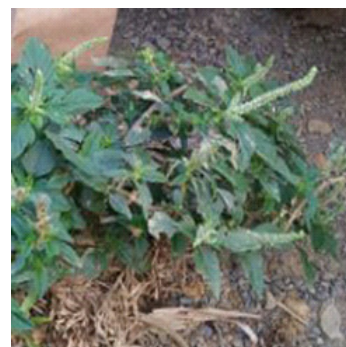
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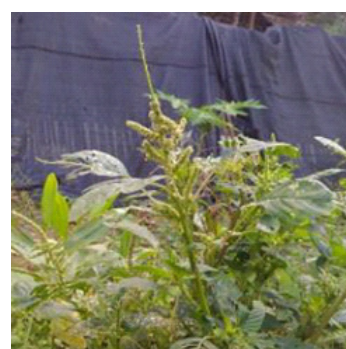
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No. 39



No. 40



No. 41



No. 44



No. 45



No. 46



No. 47



No. 49



No. 50

Amaranth



No. 51



No. 52



No. 53



No. 54



No. 56



No. 66



No. 67



No. 68



No. 72



No. 76



No. 77

Cucumber



No. 11



No. 12



No. 17



No. 20



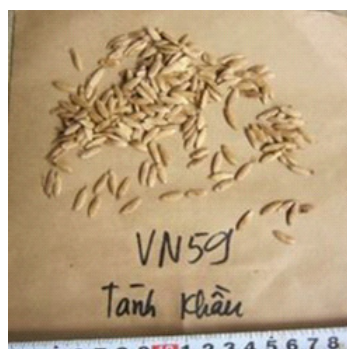
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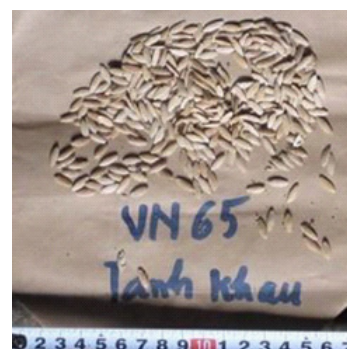
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No. 43



No. 59



No. 65

Melon



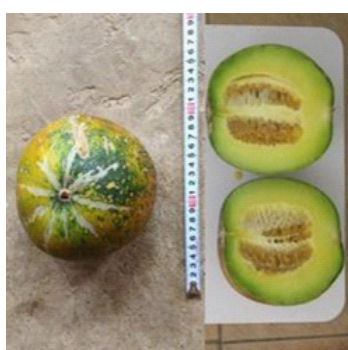
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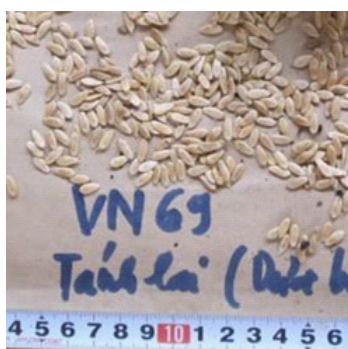
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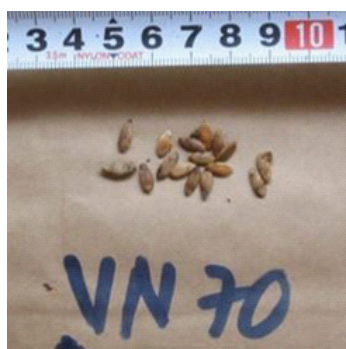
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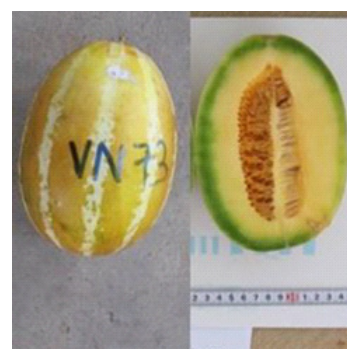
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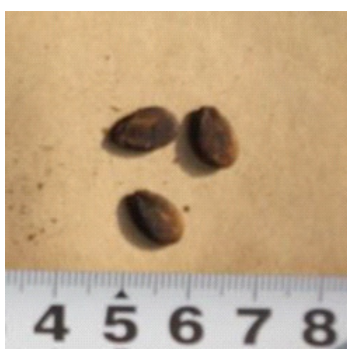


No. 70



No. 73

Watermelon



No. 22

Sesame



No. 63

Pumpkin



No. 6



No. 7



No. 8



No. 9



No. 10



No. 14



No. 18



No. 19



No. 27



No. 31



No. 32



No. 33

Pumpkin



No. 35



No. 42



No. 48



No. 55



No. 60



No. 61



No. 62



No. 71



No. 74



No. 75