

Collaborative Exploration of *Capsicum* Plant Genetic Resources in Northwest Myanmar, 2019

Fumiya KONDO ¹⁾, Ohm Mar Saw ²⁾, Kenichi MATSUSHIMA ³⁾

1) Department of Agriculture, Graduate School of Science and Technology, Shinshu University, 8304 Minamiminowa, Nagano 399-4598, Japan

2) Department of Agricultural Research, Ministry of Agriculture, Livestock and Irrigation, Yezin, Nay Pyi Taw, Republic of the Union of Myanmar

3) Institute of Agriculture, Academic Assembly Faculty, Shinshu University, 8304 Minamiminowa, Nagano 399-4598, Japan

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Corresponding author: K. MATSUSHIMA (e-mail: matuken@shinshu-u.ac.jp)

Summary

Under the Plant Genetic Resources in Asia project, the National Agriculture and Food Research Organization (NARO) and the Department of Agriculture Research, Myanmar have conducted several collaborative explorations in Myanmar since 2014. As part of the project, we mainly surveyed and gathered *Capsicum* plant genetic resources in Northwest Myanmar from November 3-11, 2019. In the survey, we visited Hkamti, Lahe, and Lay Shi townships in the Sagaing division and collected 61 accessions from farmers' storages, backyards, or fields. The accessions included 52 chili peppers (*Capsicum* spp.) and nine other vegetables. Regarding the collected *Capsicum* plant accessions, we observed two major pungent types: one was called "Kala Aw" and the other "Shwe Lan Bo" in Burmese. "Kala Aw" mainly belonged to *C. frutescens* and had elliptic or elongate-formed fruits. In contrast, "Shwe Lan Bo" was identified as *C. chinense* and exhibited fusiform fruit shapes. They also had *C. chinense*-specific strong pungent and fruity flavors, which were similar to those of "Bhut Jolokia" (*C. chinense*) cultivated by the Naga ethnic group in northeast India. Although both "Kala Aw" and "Shwe Lan Bo" are pungent chili peppers, the later was preferably cultivated and utilized in Northwest Myanmar. Half of the collected seeds were preserved in the Seed Bank in Myanmar, and the subsets were also transferred to the Gene Bank in NARO under the standard material transfer agreement.

KEY WORDS: plant genetic resources, Myanmar, chili pepper

Introduction

In the progress of further breeding or genetic analysis, plant genetic resources are significantly important, thus their genetic diversity must be maintained. However, plant genetic resources have rapidly disappeared due to recent modernization, standardization of variety, global warming, etc. As an attempt for their conservation, the Plant Genetic

Resources in Asia project was launched in 2014; the National Agriculture and Food Research Organization (NARO) and the Gene banks in Asian countries have conducted collaborative research to facilitate the utilization of plant genetic resources. Plant genetic resources in Myanmar have been investigated since 2015, and more than thousands of accessions have been collected (Wakui *et al.* 2016; Yoshida *et al.* 2017, 2019;

Ohm Mar Saw *et al.* 2018). In particular, Northwest Myanmar is known for its mountainous areas with high altitude and the traditional lifestyles of the Naga ethnic groups (Domon *et al.* 2015a). Previous explorations revealed that there were various kinds of landrace crops and vegetables. Regarding chili peppers (*Capsicum* spp.), several accessions used for spice have already been collected in this area (Domon *et al.* 2015b; Min San Thein *et al.* 2017; Naito *et al.* 2017). However, there has been no exploration specific to chili peppers, thus little information is available regarding morphological traits or utilization of chili peppers in this area. In addition, modernization in Northwest Myanmar was rapidly proceeding, so it was discussed that the field observation and collection of minor crop varieties needed to be studied as soon as possible (Domon *et al.* 2015b). The present study aimed to investigate and collect *Capsicum* plant genetic resources in Northwest Myanmar.

Methods

In the present survey, the Sagaing division in Northwest Myanmar was explored from November 3-11, 2019 (Table 1), and we visited Hkamti, Lahe, and Lay Shi townships to collect mainly *Capsicum* plant genetic resources (Fig. 1). For transportation, we mostly used two cars, but we also needed to use a ship to go down the Chindwin river in traveling between Hta Man Thi and Hkamti. We collected seed and fruit samples from farmers' storages, backyards, or fields. As a survey of each accession, we first identified the species based on the morphological traits of the fruit and corolla. *C. annuum* was distinguished from other species based on *C. annuum*-specific white colored corolla, and the shape of the calyx. The accessions that had light green colored

corollas were assigned to *C. frutescens* or *C. chinense*, and *C. chinense* was distinguished from *C. frutescens* based on the shapes of the fruit and calyx. Afterwards, local names and utilization of each accession were recorded by interviewing local farmers. Additionally, we also recorded the place name, latitude, longitude, and altitude of each collection site; latitudes, longitudes, and altitudes were measured using Garmin eTrex20J GPS technology (Garmin International Inc., Olathe, KS, USA).

Results

In the present survey, we explored the Sagaing division in Northwest Myanmar and collected a total of 61 accessions, including 52 chili peppers (*Capsicum* spp.) and nine other vegetables (Table 2). The 52 accessions of chili peppers were morphologically classified into 15 *C. annuum* L., 19 *C. chinense* Jacq., and 18 of *C. frutescens* L. In addition, the remaining nine accessions included four amaranths (*Amaranthus* sp.), two of buckwheat (*Fagopyrum cymosum* Meissn.), and one accession each of *Chenopodium* sp., tomato (*Solanum lycopersicum* L.), and *Solanum santiwongsei*. Half of the collected seeds were first transferred to the Seed Bank in Myanmar, and then, the other half seeds were transferred to the Gene Bank in NARO under the standard material transfer agreement. The complete list of collected accessions is available in Table 3, and the pictures of the samples are provided at the end of this paper.

Exploration sites

On the November 2, we first traveled to Hkamti township from Mandalay by airplane. In the present

Table 1. Itinerary plan followed during the 2019 survey in Northwest Myanmar

Date	Day	Itinerary	Stay
1-Nov	Fri	Narita 11:00 (NH813) -- 16:25 Yangon	Yangon
2-Nov	Sat	Yangon 7:00 (UB-103) -- 8:05 Mandalay 12:50 (UB-587) -- 14:15 Hkamti	Hkamti
3-Nov	Sun	Hkamti -- Lahe	Lahe
4-Nov	Mon	around Lahe (Ma Kyam, San Ton villages)	Lahe
5-Nov	Tue	Lahe -- Hkamti	Hkamti
6-Nov	Wed	Hkamti -- Hta ManThi -- Lay Shi (Yan Nway, 25 mile villages)	Lay Shi
7-Nov	Thu	Lay Shi (Sap Pyar, Pein Ne Gone villages)	Lay Shi
8-Nov	Fri	Lay Shi (Somra, Kuki villages)	Lay Shi
9-Nov	Sat	Lay Shi (Sone Kin, Lhan Lain Hla villages)	Lay Shi
10-Nov	Sun	Lay Shi (Daing Ka Lain away village)	Lay Shi
11-Nov	Mon	Lay Shi -- Hkamti	Hkamti
12-Nov	Tue	Hkamti 14:30 (UB-588) -- 15:55 Mandalay -- Yezin	Yezin
13-Nov	Wed	Visit Department of Agricultural Research (DAR)	Yezin
14-Nov	Thu	Yezin -- Yangon 22:10 (NH814) -- 6:45 Narita (Next morning)	Yangon

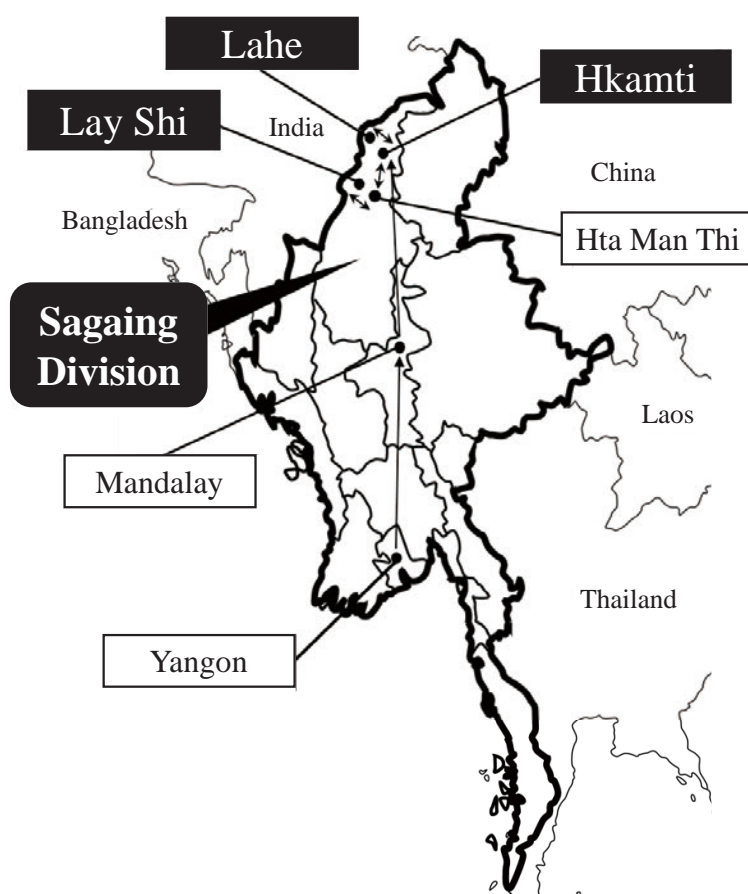


Fig. 1. Exploration route of the field survey and collection site (Hkamti, Lahe, and Lay Shi township) in Northwest Myanmar 2019.

Table 2. Samples collected during the 2019 survey in Northwest Myanmar

Family	Genus	Species	Township			Total
			Hkamti	Kahe	Lay Shi	
Amaranthaceae	<i>Amaranthus</i>	<i>blitum</i>	0	0	3	3
		<i>spinosus</i>	1	0	0	1
Chenopodiaceae	<i>Chenopodium</i>	sp.	0	1	0	1
Polygonaceae	<i>Fagopyrum</i>	<i>cymosum</i>	0	0	2	2
Solanaceae	<i>Capsicum</i>	<i>annuum</i>	0	6	9	15
		<i>chinense</i>	3	3	13	19
		<i>frutescens</i>	5	6	7	18
	<i>Solanum</i>	<i>lycopersicum</i>	0	1	0	1
		<i>sanitwongsei</i>	0	0	1	1
Total			9	17	35	61

survey, Hkamti was a transit point for moving to Lahe and Lay Shi township, so the farmers' houses there were hardly visited. However, we went to a local market near our hotel and collected chili pepper accessions on the morning of November 3. After the brief survey, we moved to the Lahe township by two cars. On November 4, we deeply explored Lahe township and visited two local villages (Ma Kyam and San Ton villages). Lahe was a mountainous and high-altitude area, and the residents mostly belonged to the Naga ethnic group. On the way to the villages, slash-and-burn fields were

observed on the slope of the mountain, and upland rice was mainly cultivated as described by Domon *et al.* (2015b) (Photo 1). On the morning of November 5, we surveyed the local market in Lahe, and then returned to Hkamti. On November 6, we traveled to Hta Man Thi from Hkamti by going down the Chindowin river. Subsequently, we traveled to Lay Shi township, and then visited several farmer's houses and collected samples along the way. From November 7-10, we explored some local villages in Lay Shi (Sap Pyar, Pien Ne Gone, Somra, Kuki, Sone Kin, Lhan Lai Hla, and Daing Ka



Photo 1. Slash-and-burn fields for upland rice on slopes of mountains in Lahe.



Photo 2. Fresh fruits of “Kala Aw” (No. 2) in Hkamti local market.

Lain away villages). Similar to Lahe township, Lay Shi was also a mountainous area with high altitudes, and we observed several kinds of Naga ethnic groups, including Para Naga, Kuki Naga, and Magri Naga.

Collected plant genetic resources

In the present survey, we observed several types of chili peppers. Chili peppers called “Kala Aw” in Burmese or “Pha Sa” in Naga language were widely cultivated in Northwest Myanmar. “Kala Aw” is a pungent chili pepper variety, and its local name implies chili peppers that Indians cannot eat without crying. This unique local name metaphorically described its high pungency. Of the 18 accessions of *C. frutescens*, 17 were commonly called “Kala Aw” or “Pha Sa Sa,” indicating that these local names were mainly used when indicating chili peppers corresponding to *C. frutescens*. However, No. 12, No. 17, and No. 20 were also called “Kala Aw,” although they were morphologically classified into *C. annuum*. The fruit shape of “Kala Aw” varied from elliptic to elongate, as shown in No. 7 and No. 12, and their mature fruits exhibited vermilion or red colors. Exceptionally, No. 9 exhibited white fruits. “Kala Aw” fruits were of various sizes. For instance, No. 21 and No. 28 had small elliptic fruits (1- to 2-cm long), while No. 12 and No. 17 had large elongate fruits (5- to 8-cm long). In the local market in Hkamti and Lahe, both dried and fresh fruits of “Kala Aw” were commercially sold as spices (Photos 2 and 3). In addition, we often saw “Kala Aw” being grown in farmers’ backyards for self-consumption (Photo 4). Under these cultivation conditions, the plants were generally uncared for, and some farmers never remembered sowing seeds for these plants.

Then, chili peppers called “Shwe Lan Bo” in Burmese (“Asa Sa Tu Tu” in Naga language) were also popular in Northwest Myanmar. “Shwe Lan Bo” were quite highly pungent chili peppers belonging to *C. chinense*. They had fusiform fruit shapes with rough surfaces (4- to 7-cm long), and the fruits had a strong



Photo 3. Dry fruits of “Kala Aw” (No. 4) in Hkamti local market.



Photo 4. Plant of “Kala Aw” (No. 33), which was cultivated in a farmer’s backyard in Lay Shi.

fruity flavor, which were similar to “Bhut Jolokia” (*C. chinense*) cultivated in Northeast India (Bosland and Baral 2007). “Shwe Lan Bo” exhibited greenish-yellow colors in immature fruits, and their colors changed to orange in mature fruit stages as showed in No. 50. In the local market in Hkamti and Lahe, mature fresh and dried fruits, as well as immature fresh fruits, were being sold (Photos 5 and 6). It was observed that one woman used a plastic back as a glove when she handled the fruits, to prevent their pungent stimulation (Photo 7), implying “Shwe Lan Bo” is quite pungent. Although “Shwe Lan Bo” were used as the spice as



Photo 5. Dry fruits of “Shwe Lan Bo” in Hkamti local market.



Photo 6. Fresh fruits of “Shwe Lan Bo” (No. 8) in Hkamti local market.



Photo 7. Woman used plastic back as glove to treat fruits of “Shwe Lan Bo” (No. 24) in Lahe local market.

with “Kala Aw,” they were predominantly preferred by local people of the Naga ethnic groups in any village. Specifically, the local people commonly preferred the strong pungency and fruity flavor in “Shwe Lan Bo;” some local farmers said they did not eat chili peppers except for “Shwe Lan Bo.” Regarding cultivation of “Shwe Lan Bo,” their seeds were sown in May or June, and the fruits were harvested in October or November. The plants were cultivated in the slash-and-burn field on the slope of the mountain as in Photo 1. These fields were generally far from the villages we visited, so we hardly observed the actual cultivation of “Shwe Lan Bo”

in the present exploration. However, we heard that their plants were usually cultivated on the ridge in the slash-and-burn field of upland rice. In addition, most local farmers said that low temperature and fertile soil were appropriate for their growth, such that cultivating them was not easy, compared to other chili peppers such as “Kala Aw.” Because of such difficulties in cultivation, the yield of “Shwe Lan Bo” was lower than that of other chili peppers, and the fruits were expensive in the local market.

Other than “Kala Aw” and “Shwe Lan Bo,” we also observed pungent chili peppers that produced elongated red fruits, for example, No. 22, No. 25, and No. 32. They commonly belonged to *C. annuum*, but their local names differed depending on the accessions. Similar to “Kala Aw,” these chili peppers were also grown in farmer’s backyards for self-consumption, and they were hardly taken care of. In contrast, we also collected nine other accessions including amaranths, buckwheat, wild spinach, tomato, and eggplant. We also collected the seeds of authigenic buckwheat (*Fagopyrum cymosum*) in Somra and Daing Ka La in-away village. As described by Naito *et al.* (2017), we often observed authigenic buckwheat on the shady roadside (Photo 8). This accession had white flowers and greenish-yellow or reddish immature seeds. In Northwest Myanmar, buckwheat seeds were hardly used, but the young leaves were utilized as medicine. We observed *S. santiwongsei*, which had rounded small fruits (No. 40), and the plants were cultivated in a farmer’s backyard. *S. santiwongsei* was previously observed and collected in Western Myanmar (Saito *et al.* 2006), and we confirmed their presence in Northwest Myanmar. According to local farmers, their immature green fruits were used as vegetables.

Discussion

In the present survey, we aimed to explore *Capsicum* plant genetic resources and investigate



Photo 8. Authigenic buckwheat observed on the roadside in Lay Shi.

its utilization in the Sagaing Division in Northwest Myanmar. This region is a mountainous and high-altitude area located at low latitudes and exhibits climate ranging from torrid to temperate zones, depending largely on the altitude. Owing to these conditions, we expected various vegetation and plant genetic resources adapted to the differing environment. From the results of the present field survey, we could observe and collect morphologically various *Capsicum* plant genetic resources. Globally, five species of chili pepper are domesticated (*C. annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, and *C. pubescens*). Of these, *C. annuum* and *C. frutescens* are the dominant species cultivated in East and Southeast Asia (Matsushima 2020). As expected, *C. annuum* and *C. frutescens* were generally cultivated in Northwest Myanmar. In particular, the pungent chili pepper “Kala Aw” was often observed in these areas, in which mainly *C. frutescens* was cultivated. “Kala Aw” plants were often grown in local farmer’s backyards, but these plants were almost uncared for. These crude cultivation styles are also observed in Cambodia. The chili pepper called “Mate Ach Sath” in Khmer is a Cambodian popular variety, and local farmers usually cultivate it in their backyards for self-consumption (Matsunaga *et al.* 2015; Kondo *et al.* 2019). It is said that the seeds of “Mate Ach Sath” are spread by birds, and local farmers hardly care for these plants. These cultivation practices were similar to those of “Kala Aw,” and the crude cultivation style of chili peppers might be a common characteristic seen in Southeast Asia. In contrast, we also observed that *C. chinense* was preferably cultivated and utilized in Northwest Myanmar, and the chili peppers were called “Shwe Lan Bo” in Burmese (“Asa Sa Tu Tu” in Naga language). In East and Southeast Asia, *C. chinense* is rarely cultivated, except in countries such as Indonesia (Yamamoto *et al.* 2014). Thus, our exploration provided new insights regarding the cultivation areas of *C. chinense*. Surprisingly, “Shwe Lan Bo” was extremely preferred by the local Naga ethnic group, although several types of chili peppers other than “Shwe Lan Bo” were also cultivated. Few *C. chinense* varieties, such as “Habanero” (Andrews 1995) and “Shwe Lan Bo,” are known for their strong pungency. In addition to these pungent traits, the fusiform shape and rough surface of their fruits were morphologically similar to those of “Bhut Jolokia” (*C. chinense*). “Bhut Jolokia” is known as a chili pepper cultivated and used by the Naga ethnic group in Northeast India. We assumed that as “Shwe Lan Bo” was also observed in the villages occupied by the Naga ethnic group, both “Bhut Jolokia”

and “Shwe Lan Bo” may be the common chili pepper varieties utilized by the Naga tribes, although their variety names are different depending on the cultivated areas. For further research, their genetic relationship and derivation should be investigated by molecular genetic approaches. These morphological similarities implied propagation of “Bhut Jolokia”-like chili peppers between Northeast India and Northwest Myanmar. Furthermore, we found that a high temperature was not suitable for the growth of “Shwe Lan Bo,” and this variety was hardly cultivated in the flatlands with low altitudes owing to torrid climates. Considering this ecological characteristic of “Shwe Lan Bo,” this cultivar might have been maintained in mountainous areas with high altitudes and adapted to the temperate climates there. Hence, their detailed adaptabilities regarding temperature should be investigated by further cultivation. In the present study, many *Capsicum* plant genetic resources were collected, which had various morphological characteristics. In addition, chili peppers were familiar to the local people in Northwest Myanmar, and these plant genetic resources can be expected to be used as plant materials for further breeding programs and genetic analyses.

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北西ミャンマーにおけるトウガラシ属遺伝資源の 共同探索，2019 年

近藤 文哉¹⁾・Ohm Mar Saw²⁾・松島 憲一³⁾

1) 信州大学 大学院 総合理工学研究科 農学専攻

2) ヤンマー連邦共和国 農業畜産灌漑省 農業研究局

3) 信州大学 学術研究院農学系

和文摘要

本報告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」のもと実施された、北西ミャンマーにおける植物遺伝資源の共同探索・収集に関する報告である。本探索は国立研究開発法人農業・食品産業技術総合研究機構（NARO）とミャンマー農業省農業研究局間で締結された共同研究協定に基づいて2019年11月3～11月11日に行われた。調査では、北西ミャンマーに位置するザガイン地方域のカムティ、ラヘおよびレイシーにて、トウガラシ属植物を主とする植物遺伝資源の探索を行い、現地の市場をはじめ、農家の裏庭などから成熟果実および種子の収集を行った。調査の結果、トウガラシ属植物52点および、その他9点を合わせた合計61点の植物遺伝資源が収集された。果実形態や花冠色に基づき、トウガラシ属植物の種同定を行った結果、収集された52点は、アニューム種15点、フルテッセンス種18点、ならびにキネンセ種19点に分類された。北西ミャンマーでは現地名で‘カラオ’と呼ばれる強い辛味をもつフルテッセンス種のトウガラシがみられたほか、‘シェーランブー’と呼ばれる辛味が非常に強いキネンセ種のトウガラシがみられた。‘シェーランブー’は北インド在来の辛味品種‘ブートジョロキア’とその果実形態が類似しており、北西ミャンマーで暮らすナガ族の食文化において重要なトウガラシであった。収集された種子のうち、半量はミャンマーのシードバンクに保存され、残りの半量は標準材料移転契約（SMTA）に基づいてNAROのジーンバンクに移転・保存された。

Table 3. List of collected plant genetics in Northwest Myanmar, 2019

JP No.	Individual No.	Date	Division	District	Township	Village	Latitude	Longitude	Altitude (m)	Scientific name	Local name	Collection place	Sample source	Tribe
270719	1	2-Nov	Sagaing	Hkamti	Hkamti	Aung Thar Yar	N26-00-54.1	E95-40-7.5	139	<i>Amaramthus spinosus</i>	Hin Nu New Su Bauk	Roadside	Seed	Myanmar
270720	2	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum frutescens</i>	Ka La Aw	Hkamti market	Fresh fruit	Myanmar
270721	3	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum chinense</i>	Shwe Lan Bo	Hkamti market	Dry fruit	Myanmar
270722	4	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum frutescens</i>	Ka La Aw	Hkamti market	Dry fruit	Myanmar
270723	5	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum frutescens</i>	Ka La Aw	Hkamti market	Dry fruit	Myanmar
270724	6	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum chinense</i>	Shwe Lan Bo	Hkamti market	Fresh fruit	Myanmar
270725	7	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum frutescens</i>	Ka La Aw	Hkamti market	Fresh fruit	Myanmar
270726	8	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum chinense</i>	Shwe Lan Bo	Hkamti market	Fresh fruit	Myanmar
270727	9	3-Nov	Sagaing	Hkamti	Hkamti	-	N26-00-6.3	E95-41-30.2	152	<i>Capsicum frutescens</i>	Ka La Aw	Hkamti market	Fresh fruit	Myanmar
270728	10	3-Nov	Sagaing	Hkamti	Lahe	Lawng Naug	N26-9-22.5	E95-31-16.3	881	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's backyard	Fresh fruit	Myanmar
270729	11	4-Nov	Sagaing	Hkamti	Lahe	Ma Kyam	N26-23-53.5	E95-27-49.8	1,615	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's storage	Fresh fruit	Naga
270730	12	4-Nov	Sagaing	Hkamti	Lahe	Ma Kyam	N26-23-53.5	E95-27-49.8	1,615	<i>Capsicum annuum</i>	Ka La Aw	Farmer's storage	Fresh fruit	Naga
270731	13	4-Nov	Sagaing	Hkamti	Lahe	Ma Kyam	N26-23-53.5	E95-27-49.8	1,615	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Seed	Naga
270732	14	4-Nov	Sagaing	Hkamti	Lahe	San Ton	N26-25-56.0	E95-31-11.3	1,226	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's storage	Dry fruit	Naga
270733	15	4-Nov	Sagaing	Hkamti	Lahe	San Ton	N26-26-17.8	E95-21-39.0	1,333	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Seed	Naga
270734	16	4-Nov	Sagaing	Hkamti	Lahe	San Ton	N26-26-17.8	E95-31-39.0	1,333	<i>Solanum lycopersicum</i>	Than Byu Tho	Farmer's storage	Seed	Naga
270735	17	4-Nov	Sagaing	Hkamti	Lahe	-	N26-19-28.0	E95-25-28.0	990	<i>Capsicum annuum</i>	Ka La Aw Tha (in Naga)	Farmer's storage	Dry fruit	Naga
270736	18	4-Nov	Sagaing	Hkamti	Lahe	-	N26-19-28.0	E95-25-28.0	990	<i>Capsicum frutescens</i>	Ka La Aw Tha (in Naga)	Farmer's backyard	Fresh fruit	Naga
270737	19	4-Nov	Sagaing	Hkamti	Lahe	-	N26-19-28.0	E95-25-28.0	990	<i>Chenopodium</i> sp.	Kha Kha Sha Ne	Farmer's backyard	Seed	Naga
270738	20	4-Nov	Sagaing	Hkamti	Lahe	-	N26-19-15.9	E95-27-1.0	868	<i>Capsicum annuum</i>	Ka La Aw	Farmer's backyard	Fresh fruit	Naga
270739	21	4-Nov	Sagaing	Hkamti	Lahe	-	N26-19-15.9	E95-27-1.0	868	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's backyard	Fresh fruit	Naga
270740	22	5-Nov	Sagaing	Hkamti	Lahe	Lahe	N26-29-25.0	E95-26-31.8	994	<i>Capsicum annuum</i>	A Se Yay	Lahe market	Fresh fruit	Naga
270741	23	5-Nov	Sagaing	Hkamti	Lahe	Lahe	N26-29-25.0	E95-26-31.8	994	<i>Capsicum frutescens</i>	Ka La Aw	Lahe market	Fresh fruit	Naga
270742	24	5-Nov	Sagaing	Hkamti	Lahe	Lahe	N26-29-25.0	E95-26-31.8	994	<i>Capsicum chinense</i>	Shwe Lan Bo	Lahe market	Fresh fruit	Naga
270743	25	5-Nov	Sagaing	Hkamti	Lahe	Lahe	N26-29-25.0	E95-26-31.8	994	<i>Capsicum annuum</i>	Atawt Shay	Lahe market	Fresh fruit	Naga
270744	26	5-Nov	Sagaing	Hkamti	Lahe	Lahe	N26-29-25.0	E95-26-31.8	994	<i>Capsicum annuum</i>	A Se Yay	Lahe market	Fresh fruit	Naga
270745	27	6-Nov	Sagaing	Hkamti	Lay Shi	Yan Nway	N25-24-40.4	E95-11-26.1	236	<i>Capsicum annuum</i>	Si Pyay Nga Yolse	Farmer's backyard	Fresh fruit	Naga
270746	28	6-Nov	Sagaing	Hkamti	Lay Shi	Yan Nway	N25-24-40.4	E95-11-26.1	236	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's backyard	Fresh fruit	Naga
270747	29	6-Nov	Sagaing	Hkamti	Lay Shi	25 mile	N25-26-52.3	E94-4-32.0	668	<i>Capsicum annuum</i>	Taung Paw Nga Yoke	Farmer's storage	Fresh fruit	Chinl + Naga
270748	30	6-Nov	Sagaing	Hkamti	Lay Shi	25 mile	N25-26-52.3	E94-4-32.0	668	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's backyard	Fresh fruit	Chinl + Naga
270749	31	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-3.6	E94-56-33.2	1,096	<i>Capsicum chinense</i>	Shwe Lan Bo Asa Sa Tu Tu (in Naga)	Farmer's backyard	Dry fruit	Para Naga
270750	32	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-3.6	E94-56-33.2	1,096	<i>Capsicum annuum</i>	Asa Sa Chi (Naga)	Farmer's backyard	Dry fruit	Para Naga
270751	33	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-3.6	E94-56-33.2	1,096	<i>Capsicum frutescens</i>	Ka La Aw Pha Sa Sa (in Naga)	Farmer's backyard	Fresh fruit	Para Naga
270752	34	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-3.6	E94-56-33.2	1,096	<i>Amaranthus blitum</i>	Hin Nu New	Farmer's backyard	Seed	Para Naga
270753	35	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-1.1	E94-56-31.3	1,114	<i>Amaranthus blitum</i>	Hin Nu New	Farmer's backyard	Seed	Para Naga
270754	36	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-1.1	E94-56-31.3	1,114	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Para Naga

Table 3. (Continued).

JP No.	Individual No.	Date	Division	District	Township	Village	Latitude	Longitude	Altitude (m)	Scientific name	Local name	Collection place	Sample source	Tribe
270755	37	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-1.1	E94-56-31.3	1,114	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Para Naga
270756	38	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-1.1	E94-56-31.3	1,114	<i>Capsicum annuum</i>	Nga Yote Thee	Farmer's storage	Fresh fruit	Para Naga
270757	39	7-Nov	Sagaing	Hkamti	Lay Shi	Sap Pyar	N25-30-1.1	E94-56-31.3	1,114	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's storage	Fresh fruit	Para Naga
270758	40	7-Nov	Sagaing	Hkamti	Lay Shi	Pein Ne Gone	N25-29-6.8	E94-57-59.8	942	<i>Solanum sanitwongsei</i>	Qhaire Kha Kha (in Naga)	Farmer's backyard	Fresh fruit	Para Naga
270759	41	7-Nov	Sagaing	Hkamti	Lay Shi	Pein Ne Gone	N25-29-0.0	E94-58-2.8	932	<i>Capsicum chinense</i>	Shwe Lan Bo Asa Sa Tu Tu (in Naga)	Farmer's storage	Fresh fruit	Para Naga
270760	42	7-Nov	Sagaing	Hkamti	Lay Shi	Pein Ne Gone	N25-29-0.0	E94-58-2.8	932	<i>Capsicum annuum</i>	Asa Asa Lam Bum Bun (Naga)	Farmer's storage	Fresh fruit	Tung Kun Naga
270761	43	8-Nov	Sagaing	Hkamti	Lay Shi	Sorma	N25-21-54.3	E94-41-18.1	1,887	<i>Fagopyrum cymosum</i>	Ma Ri Yan	Roadside	Seed	Tung Kun Naga
270762	44	8-Nov	Sagaing	Hkamti	Lay Shi	Sorma	N25-21-51.2	E94-41-15.7	1,885	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Tung Kun Naga
270763	45	8-Nov	Sagaing	Hkamti	Lay Shi	Sorma	N25-21-51.2	E94-41-15.7	1,885	<i>Capsicum annuum</i>	Kasin Thae Ka Nay Thar Ook	Farmer's storage	Dry fruit	Tung Kun Naga
270764	46	8-Nov	Sagaing	Hkamti	Lay Shi	Sorma	N25-21-51.2	E94-41-15.7	1,885	<i>Capsicum frutescens</i>	Ka La Aw	Farmer's storage	Dry fruit	Tung Kun Naga
270765	47	8-Nov	Sagaing	Hkamti	Lay Shi	Sorma	N25-21-51.2	E94-41-15.7	1,885	<i>Amaranthu blitum</i>	Hin Nu Nwe	Farmer's backyard	Seed	Tung Kun Naga
270766	48	8-Nov	Sagaing	Hkamti	Lay Shi	Kuki	N25-22-33.5	E94-49-3.2	1,579	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Kuki Naga
270767	49	8-Nov	Sagaing	Hkamti	Lay Shi	Kuki	N25-22-33.5	E94-49-3.2	1,579	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Kuki Naga
270768	50	9-Nov	Sagaing	Hkamti	Lay Shi	Sone Kin	N25-25-25.8	E95-1-46.5	926	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Chinl
270769	51	9-Nov	Sagaing	Hkamti	Lay Shi	Sone Kin	N25-25-25.8	E95-1-46.5	926	<i>Capsicum annuum</i>	Nga Yote Thee	Farmer's storage	Fresh fruit	Chinl
270770	52	9-Nov	Sagaing	Hkamti	Lay Shi	Sone Kin	N25-25-25.8	E95-1-46.5	926	<i>Capsicum frutescens</i>	Moe Myaw (in Chinl)	Farmer's storage	Fresh fruit	Chinl
270771	53	9-Nov	Sagaing	Hkamti	Lay Shi	Sone Kin	N25-25-27.4	E95-1-51.1	918	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Chinl
270772	54	9-Nov	Sagaing	Hkamti	Lay Shi	Lhan Lai Hla	N25-26-16.8	E95-3-42.4	697	<i>Capsicum chinense</i>	Shwe Lan Bo	Farmer's storage	Fresh fruit	Magri Naga
270773	55	9-Nov	Sagaing	Hkamti	Lay Shi	Lhan Lai Hla	N25-26-16.8	E95-3-42.4	697	<i>Capsicum annuum</i>	Ra Shun Zu (in Naga)	Farmer's storage	Fresh fruit	Magri Naga
270774	56	9-Nov	Sagaing	Hkamti	Lay Shi	Lhan Lai Hla	N25-26-27.8	E95-3-25.4	744	<i>Capsicum chinense</i>	Shwe Lan Bo Asa Ya Re Shin (in Naga)	Farmer's storage	Seed	Magri Naga
270775	57	10-Nov	Sagaing	Hkamti	Lay Shi	Daing Ka Lainaway	N25-28-10.9	E94-57-5.2	1,333	<i>Capsicum chinense</i>	Asa Sa Tu Tu (in Naga)	Farmer's field	Fresh fruit	Para Naga
270776	58	10-Nov	Sagaing	Hkamti	Lay Shi	Daing Ka Lainaway	N25-28-10.9	E94-57-5.2	1,333	<i>Capsicum frutescens</i>	Kyawt Pha Sa Sa (in Naga)	Farmer's backyard	Fresh fruit	Para Naga
270777	59	10-Nov	Sagaing	Hkamti	Lay Shi	Daing Ka Lainaway	N25-27-33.2	E94-36-42.5	1,358	<i>Fagopyrum cymosum</i>	-	Roadside	Seed	Para Naga
270778	60	10-Nov	Sagaing	Hkamti	Lay Shi	Daing Ka Lainaway	N25-27-24.6	E94-36-42.5	1,399	<i>Capsicum chinense</i>	Asa Sa Tu Tu (in Naga)	Farmer's backyard	Fresh fruit	Para Naga
270779	61	10-Nov	Sagaing	Hkamti	Lay Shi	Daing Ka Lainaway	N25-27-24.6	E94-36-42.5	1,399	<i>Capsicum annuum</i>	Asa Sa Lhun Fun Fun (in Naga)	Farmer's backyard	Fresh fruit	Para Naga

Photos of collected genetic resources samples



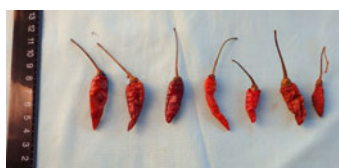
Sample Photo 1.
No. 1. *Amaranthus spinosus*



Sample Photo 2.
No. 2. *Capsicum frutescens*



Sample Photo 3.
No. 3. *Capsicum chinense*



Sample Photo 4.
No. 4. *Capsicum frutescens*



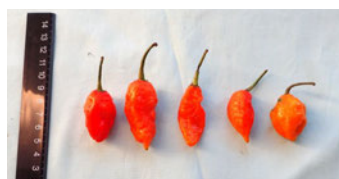
Sample Photo 5.
No. 5. *Capsicum frutescens*



Sample Photo 6.
No. 6. *Capsicum chinense*



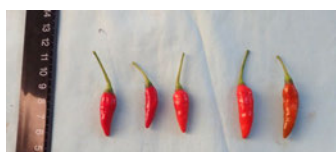
Sample Photo 7.
No. 7. *Capsicum frutescens*



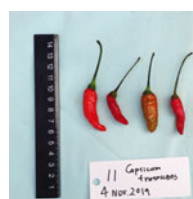
Sample Photo 8.
No. 8. *Capsicum chinense*



Sample Photo 9.
No. 9. *Capsicum frutescens*



Sample Photo 10.
No. 10. *Capsicum frutescens*



Sample Photo 11.
No. 11. *Capsicum frutescens*



Sample Photo 12.
No. 12. *Capsicum annuum*



Sample Photo 13.
No. 13. *Capsicum chinense*



Sample Photo 14.
No. 14. *Capsicum frutescens*



Sample Photo 15.
No. 15. *Capsicum chinense*

Photos of collected genetic resources samples



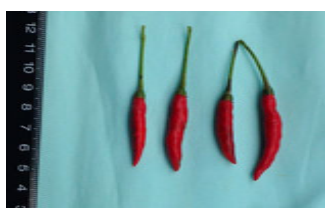
Sample Photo 16.
No. 17. *Capsicum annum*



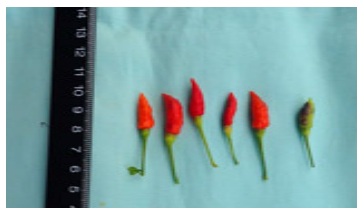
Sample Photo 17.
No. 18. *Capsicum frutescens*



Sample Photo 18.
No. 19. *Chenopodium* sp.



Sample Photo 19.
No. 20. *Capsicum annum*



Sample Photo 20.
No. 21. *Capsicum frutescens*



Sample Photo 21.
No. 22. *Capsicum annum*



Sample Photo 22.
No. 23. *Capsicum frutescens*



Sample Photo 23.
No. 24. *Capsicum chinense*



Sample Photo 24.
No. 25. *Capsicum annum*



Sample Photo 25.
No. 26. *Capsicum annum*



Sample Photo 26.
No. 27. *Capsicum annum*



Sample Photo 27.
No. 28. *Capsicum frutescens*



Sample Photo 28.
No. 29. *Capsicum annum*



Sample Photo 29.
No. 30. *Capsicum frutescens*



Sample Photo 30.
No. 31. *Capsicum chinense*

Photos of collected genetic resources samples



Sample Photo 31.
No. 32. *Capsicum annuum*



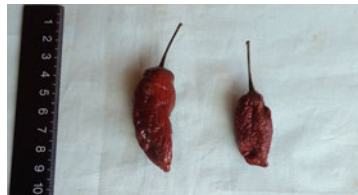
Sample Photo 32.
No. 33. *Capsicum frutescens*



Sample Photo 33.
No. 34. *Amaranthus blitum*



Sample Photo 34.
No. 35. *Amaranthus blitum*



Sample Photo 35.
No. 36. *Capsicum chinense*



Sample Photo 36.
No. 37. *Capsicum chinense*



Sample Photo 37.
No. 38. *Capsicum annuum*



Sample Photo 38.
No. 39. *Capsicum frutescens*



Sample Photo 39.
No. 40. *Solanum santiwongsei*



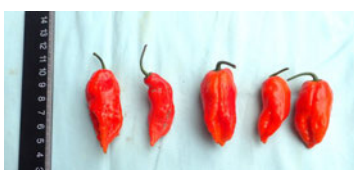
Sample Photo 40.
No. 41. *Capsicum chinense*



Sample Photo 41.
No. 42. *Capsicum annuum*



Sample Photo 42.
No. 43. *Fagopyrum cymosum*



Sample Photo 43.
No. 44. *Capsicum chinense*



Sample Photo 44.
No. 45. *Capsicum annuum*



Sample Photo 45.
No. 46. *Capsicum frutescens*

Photos of collected genetic resources samples



Sample Photo 46.
No. 47. *Amaranthus blitum*



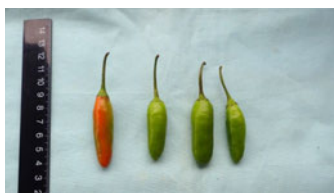
Sample Photo 47.
No. 48. *Capsicum chinense*



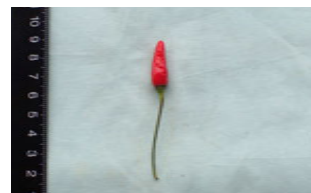
Sample Photo 48.
No. 49. *Capsicum chinense*



Sample Photo 49.
No. 50. *Capsicum chinense*



Sample Photo 50.
No. 51. *Capsicum annuum*



Sample Photo 51.
No. 52. *Capsicum frutescens*



Sample Photo 52.
No. 53. *Capsicum chinense*



Sample Photo 53.
No. 54. *Capsicum chinense*



Sample Photo 54.
No. 55. *Capsicum annuum*



Sample Photo 55.
No. 56. *Capsicum chinense*



Sample Photo 56.
No. 57. *Capsicum chinense*



Sample Photo 57.
No. 58. *Capsicum frutescens*



Sample Photo 58.
No. 59. *Fagopyrum cymosum*



Sample Photo 59.
No. 60. *Capsicum chinense*



Sample Photo 60.
No. 61. *Capsicum annuum*