

## Field Survey and Collection of “chinbao”, *Hibiscus* spp. in Chin State of Myanmar (20th of December 2017 – 1st of January 2018)

Mami NAGASHIMA <sup>1)</sup>, Saki YOSHIDA <sup>1)</sup>, Hidehiko KIKUNO <sup>2)</sup>,  
Kenji WAKUI <sup>3)</sup>, Yoshiaki NISHIKAWA <sup>4)</sup>,  
Ohm Mar Saw <sup>5)</sup>, Sander Moe <sup>5)</sup>, Kenji IRIE <sup>1)</sup>

- 1) *International Agricultural Development, Graduate School of Agriculture, Tokyo University of Agriculture, Sakuragaoka 1-1-1, Setagaya, Tokyo 156-8502, Japan*
- 2) *Faculty of International Agriculture and Food Studies, Tokyo University of Agriculture, Gusukubehukusato 72-2, Miyakosi, Okinawa 906-0103, Japan*
- 3) *Department of Bioresource Development, Tokyo University of Agriculture, Hunakoshi 1737, Atugishi, Kanagawa 243-0034, Japan*
- 4) *Faculty of Economics, Ryukoku University, Tsukamoto-cho 67, Fukakusa, Fushimi-ku, Kyoto 612-8577, Japan*
- 5) *Seed Bank, Biotechnology, Plant Genetic Resources and Plant Protection Division, Department of Agricultural Research, Ministry of Agriculture, Livestock and Irrigation, Yezin, Nay Pyi Taw, Myanmar*

Communicated by T. NISHIKAWA (Genetic Resources Center, NARO)

Received Sep. 10, 2018, Accepted Jan. 9, 2019

Corresponding author: K. IRIE (e-mail: k3irie@nodai.ac.jp)

### Summary

In Myanmar, the leaves and calyx of five *Hibiscus* species are used as a food source. Those five species have been classified taxonomically based on the morphologies of the above mentioned edible parts and their seeds. The Burmese people of Myanmar call both these hibiscus plants as well as food sourced from them “chinbao”. We have conducted a field study investigating the genus *Hibiscus* in the Chin State of Myanmar from December 20<sup>th</sup>, 2017, to January 1<sup>st</sup>, 2018. A total of 35 biological samples were collected during the survey: *H. sabdariffa* (16), *H. cannabinus* (2), *H. radiatus* (12) and *H. acetosella* (5). We found that *H. radiatus* and *H. acetosella* were the most popular species used for food in this area, while other species were known to be used in other areas. The cold hardiness of both *H. acetosella* and *H. radiatus* may be the reason for their popularity in the region as they can survive at temperatures below 5 °C. Furthermore,

we discovered that both *H. acetosella* and *H. radiatus* had flower colors that differed from those reported in other regions of the country.

KEY WORDS: chinbao, genetic resources, *Hibiscus*, Chin State, on farm conservation, Myanmar

## Introduction

In Myanmar, five species of the genus *Hibiscus* are collectively called “chinbao” and are consumed as a commonly used traditional vegetable that is well established in the daily food culture of Myanmar (Nagashima *et al.* 2016; Kitano 1984). Previously, the genetic resources of *Hibiscus* plants in Myanmar have not been widely studied. Many *Hibiscus* species found in this part of Asia are believed to have originated from tropical Africa (Hotta *et al.* 1989). Their diversity is expanding in Southeast Asia and it is known that there is a once mentioned domesticated in India and then suggest a secondary center (McClellan 1973). Previously, we conducted a comprehensive botanical survey and collected seeds (total of 205) mainly from the country’s central dry zone and eastern highland areas. However, surveys focusing on chinbao in Myanmar’s mountainous areas, over 1,500 m above sea level (a.s.l.), have never been conducted. In addition to the authors’ preliminary investigations, we received information from Dr. Kenji Irie of Tokyo University of Agriculture that villagers from the mountainous regions of the Chin State had been using chinbao in 2004 (Photo 1). In this investigation, we collected *Hibiscus* plants and their closely related wild species from the northern, mountainous area (1,600-1,800 m a.s.l.) of the Chin State bordering India.

## Materials and Methods

The field survey was conducted from the 20<sup>th</sup> of December 2017, to the 1<sup>st</sup> of January 2018, with the permission of the Department of Agricultural Research (DAR) of the Ministry of Agriculture, Livestock

Table 1. Itinerary of the field survey in Chin State, Myanmar (2017-2018)

D-M-Y	Itinerary	Exploring activities	Stay
20-Dec-2017	Narita ⇒ Yangon	Moving day	Yangon
21-Dec-2017	Yangon ⇒ Toungoo	Field study along the route	Toungoo
22-Dec-2017	Toungoo ⇒ Yezin	Moving day	Yezin
23-Dec-2017	Yezin	Visit to Myanmar Seed Bank and DAR <sup>1)</sup> head office	Yezin
24-Dec-2017	Yezin ⇒ Monywa	Moving day	Monywa
25-Dec-2017	Monywa ⇒ Kalemyo	Field study along the route, Visit to Gangaw DAR office	Kalemyo
26-Dec-2017	Kalemyo ⇒ Tiddin	Field study along the route	Tiddin
27-Dec-2017	Tiddin	Field study along the route, Visit to Falam SAI <sup>2)</sup> office	Tiddin
28-Dec-2017	Tiddin ⇒ Falam	Field study along the route, Visit to Falam SAI <sup>2)</sup> office	Falam
29-Dec-2017	Falam	Field study along the route, Visit to Falam MoALI <sup>3)</sup> office	Falam
30-Dec-2017	Falam ⇒ Hakha	Field study along the route	Hakha
31-Dec-2017	Hakha	Field study along the route, Visit to Hakha DAR office	Hakha
1-Jan-2018	Hakha ⇒ Monywa	Field study along the route	Monywa

<sup>1)</sup> DAR: Department of Agricultural Research, Myanmar

<sup>2)</sup> SAI: State Agricultural Institute, Myanmar

<sup>3)</sup> MoALI: Ministry of Agriculture, Livestock and Irrigation, Myanmar

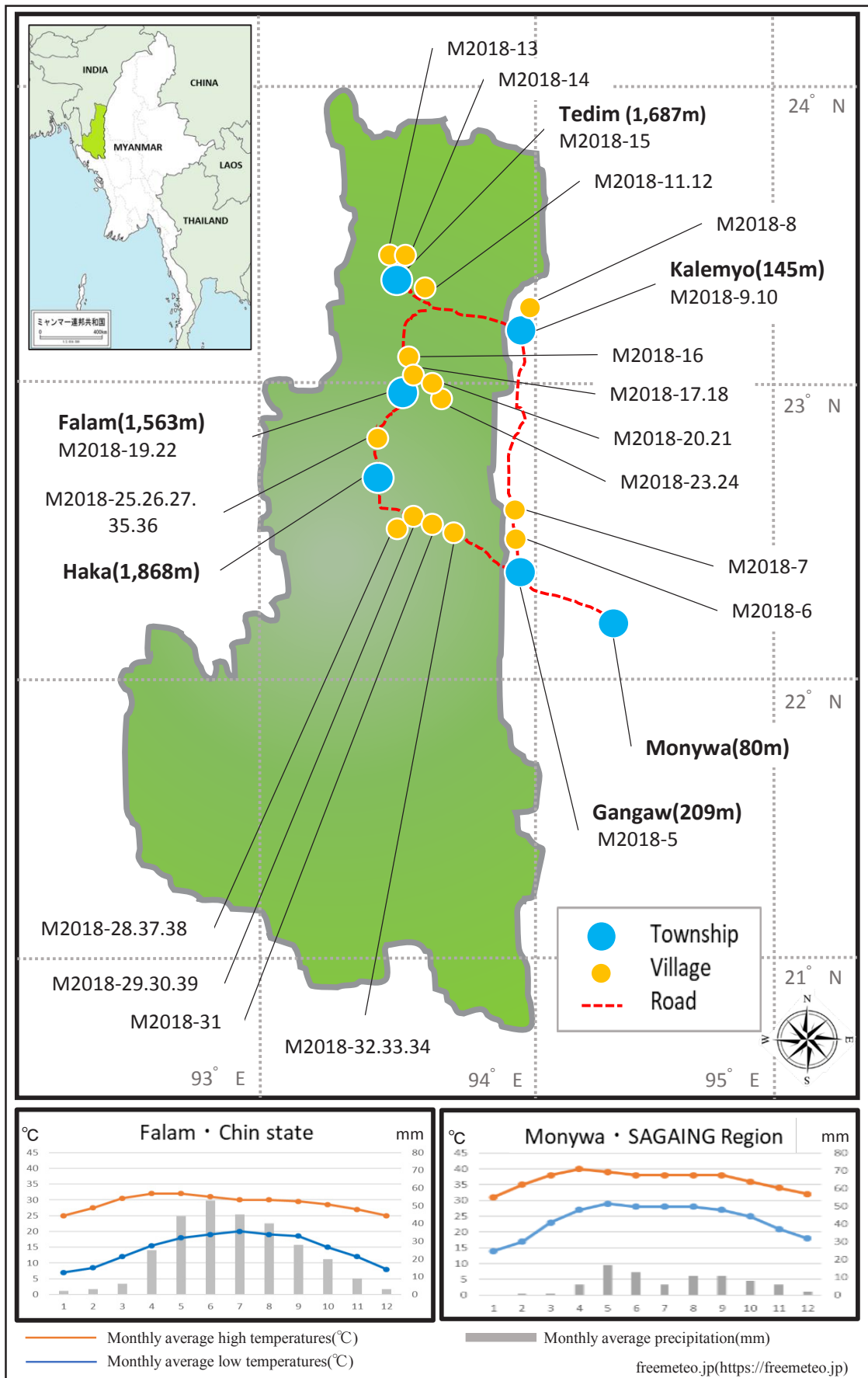


Fig. 1. Collection sites and numbers for the chinbao samples from Chin State, the monthly averages for high and low temperatures and the precipitation in Hakha and Monywa.

and Irrigation, Myanmar (MoALI). We visited and gathered samples from 26 houses, farmlands, or local markets in Chin State (Table 1, Fig. 1). In addition, we interviewed farmers about the local *Hibiscus* plants to collect data on crop names, sowing times, uses, selling prices and cultivation areas. Half of the collected samples were conserved in the Seed Bank, DAR, MoALI, Myanmar, and the other half were brought to Japan (Tokyo University of Agriculture) in accordance with the Standard Material Transfer Agreement (SMTA) of the International Treaty on Plant Genetic Resources for Food and Agriculture. After receiving the phytosanitary certificate and export permission from the DAR, MoALI, Myanmar, the material was checked and cleared at the plant quarantine station at the Narita Airport of Japan.

## Research and Collection

*Hibiscus* genetic resources that were collected from Chin State are shown in Table 1 and collection points are shown in Fig.1

Gangaw Township: In the Kwan-dap village market, an unidentified plant of the family Polygonaceae was being sold as a raw vegetable. This plant is commonly called “mon-chinbao” (mon = Mon tribe) and is similar to chinbao because of its sour taste. In the Monywa city, the same Polygonaceae plant was also called “para-chinbao” (para = cumin), and its seeds resembled cumin seeds. The plant is mainly used in soup or sometimes fried. We searched villages and markets on the route from the town of Gangaw to the city of Kalemyo, where we collected six seed samples (Coll. No. M2018-5-10; Table 2).

Kaleymo Township: Kalemyo is a city in Chin located at 145 m a.s.l. at the foot of the mountains. From Kalemyo, the altitude rises sharply to 1,500 and 2,000 m a.s.l.. In the Ta-ha market of Kalemyo, one bunch of chinbao was sold for 100 Myanmar kyat (MMK). This price was 2 to 5 times higher than the market price in the Sagaing region where chinbao cultivation is thriving. The road from Kalemyo to the town of Tedim (687 m a.s.l.) was very poor due to landslides that occurred frequently during the rainy season. In the gardens of local houses along the road, we observed *Prunus cerasoides* (Himalayan cherry), *Persea americana* (avocado), *Parkia speciose* (stink beans) and *Solanum betaceum* (tree tomato), as well as wild orchids.

Tedim Township: In Tedim, we met DAR staff, and surveyed four villages where we gathered six seeds (Coll. No. M2018-11-16). We found seeds and calyxes of *Hibiscus sabdariffa* being dried on a deck of a farmer’s house (Photo 2). Although all the *Hibiscus* leaves had fallen off, it was still possible to collect ripe seeds (Coll. No. M2018-17 and 18). Ngen-nurug village is located along a ridge at an altitude of 1,206 m a.s.l.. The houses are densely packed on the few flat places of the ridge, where they have longer daylight hours. The arable land is limited, and therefore, the actual cultivated area is limited in this mountainous village, which is a severe agricultural reality common to the whole the Chin State. Nonetheless, *H. radiatus* and *H. acetosella* are cultivated in local home gardens for use in soups (Photo 3). The villagers called these them “Anthol”.

According to the farmer, vegetable production in these areas is limited by both water shortage and low-temperature conditions during the winter season. Therefore, in the mountainous areas, the storage of various dried vegetables is frequent in order to compensate for the shortage of fresh vegetables in winter. There are many preserved foods (e.g., chinbao, mustard, taro stems, etc.) produced by the farmers and local

market entrepreneurs by salting and drying (Photo 4). Among these dried foods, the demand for “chinbao-keu”, which comprises the dried leaves and calyx of *H. sabdariffa*, is very high.

Falam Township: In the city of Falam, we confirmed the cultivation of *H. sabdariffa*, *H. cannabinus*, *H. radiatus* and *H. acetosella*. Photo 5 shows four *Hibiscus* fruits. On the slopes on the outskirts of Falam city, we observed a field of *H. sabdariffa* (Photo 6). However, only *H. radiatus* and *H. acetosella* retained their leaves on the stems and were edible at the time of our visit, all other *Hibiscus* leaves had already fallen from the plant stems. According to Sawano and Tsukamoto (1963), *H. sabdariffa* stops growing at around 10 °C, and the leaves fall at around 5 °C (Sawano and Tsukamoto 1963). The minimum night temperature was 5.2 °C during our visit to Falam (Freemeteo.jp. 2018). This suggests that *H. radiatus* and *H. acetosella* are cold hardy to a temperature of at least 5 °C.

In Chun-chung village, *H. cannabinus*, *H. radiatus* and *H. acetosella* were being cultivated, and three seed samples were collected (Coll. No. M2018-25-27). We were unable to collect *H. acetosella* seeds as it had just bloomed. Most of the leaves of *H. acetosella* do not fall throughout the winter, making it a good source of food. It is difficult to collect ripe seeds, so propagation of the plant by the villagers was carried out using cuttings. In Falam Township, *H. sabdariffa* can grow from June to October, but it cannot be cultivated there due to water shortage and low temperatures in winter.

Hakha Township: In Zo-khua village and Lua-van village, we found *H. acetosella* with yellow flowers and *H. radiatus* with red flowers (Photos 8-11). Both of these were cultivated in local home gardens. It was found that even in the town of Hakha where the night temperatures are below 5 °C, the leaves did not drop. We recorded the use of those two plants as vegetables for the first time in Myanmar. We could not collect seed samples from these plants, but we gathered cuttings instead (Coll. No. M2018-38 and 39).

#### **Discovery of a new flower colors variety**

Our field survey confirmed that *H. sabdariffa*, *H. cannabinus*, *H. radiatus* and *H. acetosella* are used as food resources in Chin State. The flower color of *H. radiatus* confirmed in other areas was yellow, but for those newly discovered in the Tedim township, the petal color was red (Photos 8 and 9). Likewise, the flower color of *H. acetosella* confirmed in other areas was red, but those newly discovered in the Hakha township, were yellow (Photos 10 and 11). These two morphotypes were different from the general morphotype and have not been previously recorded in other areas of Myanmar; we could distinguish them based on their embryoid bodies (Photo 7). They were used in food preparation by being added to soups or frying, as is the case generally with other *Hibiscus* spp. Finally, they did not die back in the cold winter temperatures where they were grown. However, the cold temperatures of the mountainous areas does prevent the seed from maturing and thus, cuttings must be used for propagation.

#### **Conclusion**

This field survey has shown that valuable *Hibiscus* genetic resources have been preserved on local farm in Chin State, as a product of adaptations to the mountainous environment. Unfortunately, the seeds of improved *Hibiscus* varieties, imported from Thailand and China, were observed in local markets. Currently, genetic disturbances to the local *Hibiscus* genetic resources are limited due to the difficulty in accessing their cultivation areas because of poor road conditions. It is easy to imagine the loss of local

species and cultivar. To protect *Hibiscus* genetic resources in Myanmar, we believe that the collection and *ex-situ* conservation of *Hibiscus* plants is urgently needed, as well as, the dissemination of information to local farmers about the importance of maintaining and preserving Myanmar's native genetic resources.

### Acknowledgments

This survey was conducted as part of Grant-in-Aid for Scientific Research (JSPS KAKENHI) (B) Research Project (Grant Number 17H04627; Program Leader: Yoshiaki NISHIKAWA, Ryukoku University) and JSPS KAKENHI (A) Research Project (Grant Number 17H01682; Program Leader Kazuo WATANABE, University of Tsukuba). We are grateful to the Department of Agricultural Research staff who cooperated in the survey and the generosity of the farmers who provided us with the plant material.

### References

- Freemeteo.jp. "Monthly weather history", 23 Oct. 2018.  
[URL: <https://freemeteo.jp/weather/?language=english&country=myanmar>], [accessed 23 Oct.2018].
- Hotta M, Ogata K, Nitta A, Hoshikawa K, Yanagi M and Yamazaki K (1989) *Hibiscus* genus. In: Useful plants of the world. Heibonsha, Tokyo, pp. 525-527.
- Kitano Y (1984) Handbook of Tropical Plants and Trees. *Nettai Shokubutsu Kenkyuukai*. Yokendo, Tokyo, pp. 294-295.
- McClellan K (1973) Roselle (*Hibiscus sabdariffa* L.) as a cultivated edible plant. Sudan Food Research Centre, AGS-SUD. SUD/70/543 project working paper, FAO, Rome.
- Nagashima M, Irie K, Than Than Soe, Nishikawa Y, Koksaka R and Watanabe K (2016) Survey and collection of cultivated *Hibiscus* species in Myanmar (15th Dec. 2015-21th Feb. 2016). AREIPGR 32: 263-287.
- Sawano M and Tsukamoto M (1963). Influence of short-day treatment on flowering of rozelle plant. The science reports of the Hyogo University of Agriculture. Series agriculture 6 (1): 55-58.

# ミャンマーにおけるハイビスカス属植物の 探索および収集 (2017年12月20日～2018年1月1日)

長嶋 麻美<sup>1)</sup>・吉田 沙樹<sup>1)</sup>・菊野 日出彦<sup>2)</sup>・和久井 健司<sup>3)</sup>・  
西川 芳昭<sup>4)</sup>・Ohm Mar Saw<sup>5)</sup>・Sander Moe<sup>5)</sup>・入江 憲治<sup>1)</sup>

- 1) 東京農業大学 大学院 農学研究科 国際農業開発学専攻
- 2) 東京農業大学 国際食料情報学部 国際食農科学科
- 3) 東京農業大学 農学部 生物資源開発学科
- 4) 龍谷大学 経済学部
- 5) ミャンマー農業畜産灌漑省 農業研究局 バイオテクノロジー・植物遺伝資源・植物保護課 シードバンク

## 和文摘要

ミャンマーでは5種のハイビスカス属植物の葉および副萼片を食用としている。これらは、主に副萼片および種子の形態の違いにより分類できる。ミャンマーの人々は、これらのハイビスカス植物を「chinbao」と呼んでいる。2017年12月20日から2018年1月1日の間に、Chin州においてハイビスカス属植物の探索・収集を行った。本探索において、全部で35サンプル (*H. sabdariffa* (16 サンプル), *H. cannabinus* (2), *H. radiatus* (12), *H. acetosella* (5)) を収集した。この地域では、他の地域とは異なり、主に *H. acetosella* および *H. radiatus* の2種が食されていた。このことは、非常に強い耐寒性を有するこれら2種が、この地域特有の5℃程度の低温環境下でも栽培できたことと深く関係していると考えられる。さらに、本探索において、これまでに他の地域では全く見られなかった花色の *H. acetosella* および *H. radiatus* も発見した。

Table 2. Passport date of the collected *Hibiscus* genus materials from Chin state, Myanmar (2017–2018)

No.	Coll. No.	Coll. Date	Scientific Name (flower color)	Collection Site		Status <sup>1)</sup>	GPS		Altitude (m)	Collection Source <sup>2)</sup>	Site <sup>3)</sup>	Topography <sup>4)</sup>	Soil <sup>5)</sup>	Sample
				District / State	Township, Village		Latitude	Longitude						
1	M2018-5	25-Dec-2017	<i>Hibiscus sabdariffa</i>	Sagaing	Gangaw city	1	21°89'45.99"N	94°37'77.70"E	199	3	2	-	-	seed
2	M2018-6	25-Dec-2017	<i>Hibiscus sabdariffa</i>	Sagaing	Gangaw, Kwan Dap village	1	22°15'54.48"N	94°06'04.02"E	209	2	1	3	3	seed
3	M2018-7	25-Dec-2017	<i>Hibiscus sabdariffa</i>	Sagaing	Gangaw, Kan village	1	22°24'25.32"N	94°04'56.76"E	172	2	1	3	3	seed
4	M2018-8	26-Dec-2017	<i>Hibiscus sabdariffa</i>	Sagaing	Kalemyo, Tahan Market	1	23°20'11.88"N	94°01'59.48"E	123	4	-	-	-	seed
5	M2018-9	26-Dec-2017	<i>Hibiscus sabdariffa</i>	Sagaing	Kalemyo, Ronji Shop	1	23°11'40.38"N	94°01'21.03"E	147	3	1	-	-	seed
6	M2018-10	26-Dec-2017	<i>Hibiscus radiatus</i>	Sagaing	Kalemyo, Ronji Shop	1	23°11'40.38"N	94°01'21.03"E	147	3	1	-	-	seed
7	M2018-11	27-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Tiddin, Ngen Nung village	1	23°22'59.04"N	93°42'10.80"E	1,206	2	2	5	3	seed
8	M2018-12	27-Dec-2017	<i>Hibiscus radiatus</i> (red)	Chin	Tiddin, Ngen Nung village	1	23°22'59.04"N	93°42'10.80"E	1,206	2	2	5	3	seed
9	M2018-13	27-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Tiddin, Tuazang village	1	23°25'23.80"N	93°39'02.95"E	1,398	2	2	5	3	seed
10	M2018-14	27-Dec-2017	<i>Hibiscus radiatus</i> (red)	Chin	Tiddin, Shan son village	1	23°23'43.27"N	93°40'11.78"E	1,617	2	2	5	3	seed
11	M2018-15	28-Dec-2017	<i>Hibiscus radiatus</i> (red)	Chin	Tiddin, Tiddin city	1	23°36'56.11"N	93°65'03.81"E	1,687	3	1	5	3	seed
12	M2018-16	28-Dec-2017	<i>Hibiscus radiatus</i>	Chin	Falam, Lone ban village	1	22°59'57.54"N	93°41'30.79"E	1,291	2	2	5	3	seed
13	M2018-17	28-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Falam river side	1	22°57'46.80"N	93°40'57.96"E	317	2	1	2	1	seed
14	M2018-18	28-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Falam river side	1	22°57'46.80"N	93°40'57.96"E	317	2	1	2	1	seed
15	M2018-19	29-Dec-2017	<i>Hibiscus radiatus</i> (yellow)	Chin	Falam city	1	22°59'13.86"N	93°67'58.61"E	1,563	3	2	5	3	seed
16	M2018-20	29-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Falam, Tai Sun village	1	22°55'46.14"N	93°41'36.24"E	1,187	3	2	5	3	seed
17	M2018-21	29-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Falam, Tai Sun village	1	22°55'46.14"N	93°41'36.24"E	1,187	3	2	5	3	seed
18	M2018-22	29-Dec-2017	<i>Hibiscus cannabinus</i>	Chin	Falam city	1	22°59'13.86"N	93°67'58.61"E	1,563	3	1	3	3	seed
19	M2018-23	29-Dec-2017	<i>Hibiscus radiatus</i>	Chin	Falam, Tai Sun village Center	1	22°55'58.92"N	93°42'38.22"E	865	3	2	5	3	seed
20	M2018-24	29-Dec-2017	<i>Hibiscus acetosella</i>	Chin	Falam, Tai Sun village Center	1	22°55'57.04"N	93°42'39.11"E	871	3	2	5	3	seed
21	M2018-25	30-Dec-2017	<i>Hibiscus cannabinus</i>	Chin	Hakha, Chun Chung village	1	22°45'56.95"N	93°34'07.72"E	1,642	2	2	5	3	seed
22	M2018-26	30-Dec-2017	<i>Hibiscus radiatus</i>	Chin	Hakha, Chun Chung village	1	22°45'56.95"N	93°34'07.72"E	1,642	3	2	5	3	seed
23	M2018-27	30-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Hakha, Chun Chung village	1	22°45'56.01"N	93°34'06.44"E	1,651	3	2	5	3	seed
24	M2018-28	31-Dec-2017	<i>Hibiscus radiatus</i> (yellow)	Chin	Hakha, Zo Khua village	1	22°32'16.66"N	93°41'11.32"E	1,422	3	2	5	3	seed
25	M2018-29	31-Dec-2017	<i>Hibiscus radiatus</i> (red)	Chin	Hakha, Lua Van village	1	22°30'43.16"N	93°44'31.63"E	1,484	3	2	5	3	seed
26	M2018-30	31-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Hakha, Lua Van village	1	22°30'43.16"N	93°44'31.63"E	1,484	3	2	5	3	seed
27	M2018-31	31-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Hakha, Li Nam village	1	22°29'09.82"N	93°46'10.73"E	1,262	3	1	3	3	seed
28	M2018-32	31-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Hakha, Lam Tuk village	1	22°28'52.86"N	93°48'09.79"E	1,220	3	2	5	3	seed
29	M2018-33	31-Dec-2017	<i>Hibiscus radiatus</i>	Chin	Hakha, Lam Tuk village	1	22°28'52.86"N	93°48'09.79"E	1,220	3	2	5	3	seed
30	M2018-34	31-Dec-2017	<i>Hibiscus sabdariffa</i>	Chin	Hakha, Lam Tuk village	1	22°28'50.59"N	93°48'00.04"E	1,225	3	2	5	3	seed
31	M2018-35	30-Dec-2017	<i>Hibiscus acetosella</i>	Chin	Hakha, Chun Chun village	1	22°45'56.95"N	93°34'07.72"E	1,642	3	2	5	3	branch
32	M2018-36	30-Dec-2017	<i>Hibiscus acetosella</i>	Chin	Hakha, Chun Chun village	1	22°45'56.95"N	93°34'07.72"E	1,642	3	2	5	3	branch
33	M2018-37	31-Dec-2017	<i>Hibiscus acetosella</i>	Chin	Hakha, Zo Khua village	1	22°32'16.66"N	93°41'11.32"E	1,422	3	2	5	3	branch
34	M2018-38	31-Dec-2017	<i>Hibiscus acetosella</i> (yellow)	Chin	Hakha, Zo Khua village	1	22°32'16.66"N	93°41'11.32"E	1,422	3	2	5	3	branch
35	M2018-39	31-Dec-2017	<i>Hibiscus radiatus</i> (red)	Chin	Hakha, Lua Van village	1	22°30'43.16"N	93°44'31.63"E	1,484	3	2	5	3	branch

<sup>1)</sup> 1: landrace, 2: wild, 3: weedy, 4: improved, 5: others

<sup>2)</sup> 1: wild, 2: farmland, 3: backyard, 4: market, 5: laboratory / pilot farm, 6: others

<sup>3)</sup> 1: level, 2: slope, 3: summit, 4: depression

<sup>4)</sup> 1: swamp, 2: flood plain, 3: plain level, 4: undulating, 5: hilly, 6: mountainous, 7: others

<sup>5)</sup> 1: sand, 2: loam, 3: clay, 4: silt, 5: highly organic





Photo 1. The survey of Chin State in 2004.



Photo 2. Calyx and seeds of *Hibiscus sabdariffa* dried on the eaves of houses.



Photo 3. Traditional soup with the calyx and leaves of *Hibiscus sabdariffa*.



Photo 4. Dried preserved diet of Taro stems (a, a') and *Hibiscus sabdariffa*'s calyx (b) and leaves (c). It created in each family and is also sold in large quantities in the markets in winter.



Photo 5. Calyx of *Hibiscus sabdariffa* (a), *H. cannabinus* (b), *H. radiatus* (c) and *H. acetosella* (d).



Photo 6. *Hibiscus sabdariffa* cultivated in Falam township, Tai sun vill.



Photo 7. Classification by calyx shape. *Hibiscus radiatus* (a), *H. acetosella* (b).



Photo 8. Coll. No. M2018-14  
*Hibiscus radiatus* (red petal)  
New petal color. Cultivation use was confirmed only in Chin State, Myanmar.



Photo 9. Coll. No. M2018-19  
*Hibiscus radiatus* (yellow petal)  
General petal color. It is cultivated even on lowlands outside of Chin State.

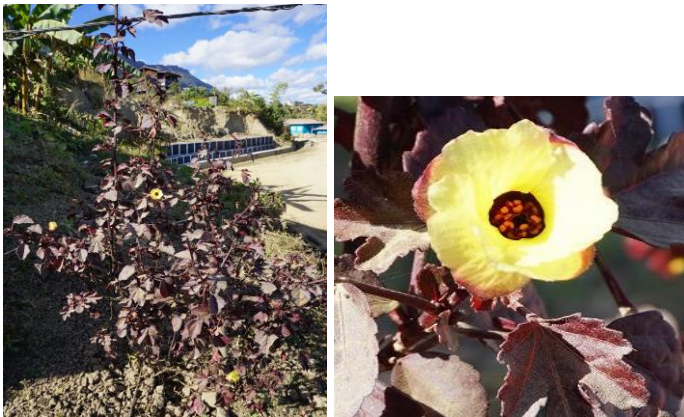


Photo 10. Coll. No. M2018-38  
*Hibiscus acetosella* (yellow petal)  
New petal color. Cultivation use was confirmed only in Chin State, Myanmar.



Photo 11. Coll. No. M2018-39  
*Hibiscus acetosella* (red petal)  
General petal color. It is cultivated on lowlands outside of Chin State.