

Collaborative Exploration of Cucurbitaceae Vegetable Genetic Resources in Western Nepal, in 2016

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Summary

This report describes the first exploration of cucurbitaceous vegetable genetic resources in western Nepal, jointly conducted by the National Agriculture and Food Research Organization (NARO), Japan, and the Nepal Agricultural Research Council (NARC), Nepal. A field survey was conducted in western Nepal from November 1 to 15, 2016. We collected a total of 27 accessions, 14 of *Cucumis sativus* L., 3 of *C. melo* L., 2 of *Cucurbita maxima* Duchense ex Lam., 2 of *C. moschata* Duchense, 1 of *C. pepo* L., 2 of *Luffa acutangula* (L.) Roxb., 1 of *L. cylindrica* (L.) Roem., 1 of *Momordica charantia* L., and 1 of *Bryonopsis* sp. All accessions were stored as seeds at the NARC and subsets were transferred to the Genetic Resources Center, NARO using the standard material transfer agreement (SMTA).

KEY WORDS: Nepal, genetic resources, cucumber, pumpkin, melon

Introduction

The exploration of cucurbitaceous vegetable genetic resources in the western Nepal district was jointly conducted by the National Agriculture and Food Research Organization (NARO), Japan and the

Nepal Agricultural Research Council (NARC), Nepal.

The Federal Democratic Republic of Nepal is a long and slender country running from the northwest to the southeast, located between 26°22' to 30°27' N and 80°4' to 88°12' E, in South Asia, and south of the Himalayas. There is a considerable altitude gradient from the southern Terai plain (about 100 m above sea level) to the mountain range (over 8,000 m) which includes Everest, the highest point in the world, and there are diverse agricultural ecological environments along this gradient, which covers an area of 147,181 km² and hosts a wide range of plant genetic diversity at both, species and intra-species levels (Gupta 2012).

South Asia is one of the most important area when it comes to cucumber and melon diversity. Cucumber is considered to have originated in this area and introduced to other parts of the world (De Candolle 1886; Bisht *et al.* 2004). Furthermore, a wild ancestor of melon should have originated in Africa and the secondary center of genetic diversity was considered as the Middle and Near East and India (Robinson and Decker-Walters 1997). Thus, this area is believed to be a promising source of genetic variability for cucurbits (Yoshida *et al.* 1997; Saito T *et al.* 2005; Sakata *et al.* 2008; Saito A *et al.* 2009; Matsunaga *et al.* 2010, 2015; Sugiyama *et al.* 2015). We expected to find genetic resources with wide variation for various traits, such as fruit shape, pest, disease, and environmental stress resistance, among others. For example, East and South Asian melon are known as important genetic resources, having resistance to powdery mildew, downy mildew, gummy stem blight, fusarium wilt, *Aphis gossypii* and several viruses (Pryor *et al.* 1946; Whitaker and Bohn 1954; Whitaker and Davis 1962; Kishaba *et al.* 1971; Takada *et al.* 1979; Wako *et al.* 2000). In the past, several foreign explorers have conducted explorations for collecting plant genetic resources in Nepal. However, explorations for collecting cucurbitaceous vegetable genetic resources have not been conducted (Gupta 2012). Therefore, our objective was to explore and collect mainly cucurbitaceous genetic resources, in the western Nepal.

Methods

From November 1 to 15, 2016, we explored and collected the cucurbitaceous vegetable genetic resources in the rural areas of Bardiya district in Province No. 5, Baitadi, Dadeldhura, Doti and Kailali district in province No. 7 of western Nepal (Table1, Fig. 1). The genetic resources were collected from Bardiya and Kailali district at an altitude of around 150 m, and from Doti, Baitadi, and Dadeldhura district at an altitude of 1,800 to 2,000 m.

When we collected genetic resources, we interviewed farmers about the local names, cultivation methods (sowing and harvest season), harvesting methods, seed preservation methods and other information about cultivation. We also recorded the name of the location, latitude and longitude, elevation, and characteristics of each collection site. Latitude, longitude, and elevation were determined using a GPS receiver (Gramin Ltd., Switzerland). When we collected fruits, we recorded characteristics such as shape, color, and weight of fruit. Seeds were picked and dried immediately after cutting the fruit for study. Fruits were preserved under dry condition.

Results and discussion

In this survey, we collected a total of 27 accessions, 14 of *C. sativus*, 3 of *C. melo*, 2 of *C. maxima*, 2 of *C. moschata*, 1 of *C. pepo*, 2 of *L. acutangula*, 1 of *L. cylindrica*, 1 of *M. charantia* and 1 of *Bryonopsis* sp. (Table 2).

With respect to cucumber, we collected accessions with fruit size ranging from about 10 cm with

Table 1. Itinerary of survey in western Nepal, 2016

Date	Day	Itinerary	Stay
11/1	Tue	Haneda 0:20 (TG661) -- 5:25 Bangkok; 10:30 (TG319) -- 12:45 Kathomandu	Bangkok
11/2	Wed	National Agriculture Genetic Resources Center, Genebank, Nepal Agricultural Research Council	Kathomandu
11/3	Thu	Kathomandu 16:10 (U4 405) -- 17:00 Nepalgunj	Nepalgunj
11/4	Fri	Nepalgunj -- Dhangadhi	Dhangadhi
11/5	Sat	Dhangadhi -- Dadeldhura	Dadeldhura
11/6	Sun	Dadeldhura -- Baidadi	Baidadi
11/7	Mon	Baidadi -- Dadeldhura	Dadeldhura
11/8	Tue	Dadeldhura -- Dipayal -- Dadeldhura	Dadeldhura
11/9	Wed	Dadeldhura -- Dhangadhi	Dhangadhi
11/10	Thu	Dhangadhi 12:35 (U4 252) -- 13:50 Kathomandu	Kathomandu
11/11	Fri	Visit Genebank, NARC and arrange the collected seeds	Kathomandu
11/12	Sat	Visit Genebank, NARC and arrange the collected seeds	Kathomandu
11/13	Sun	—	Kathomandu
11/14	Mon	Kathomandu 13:55 (TG320) -- 18:30 Bangkok	On flight
11/15	Tue	Bangkok (11/14, Mon) 23:15 (TG682) -- 6:55 Haneda Bangkok 0:05 (TG644) -- 7:30 Chubu	

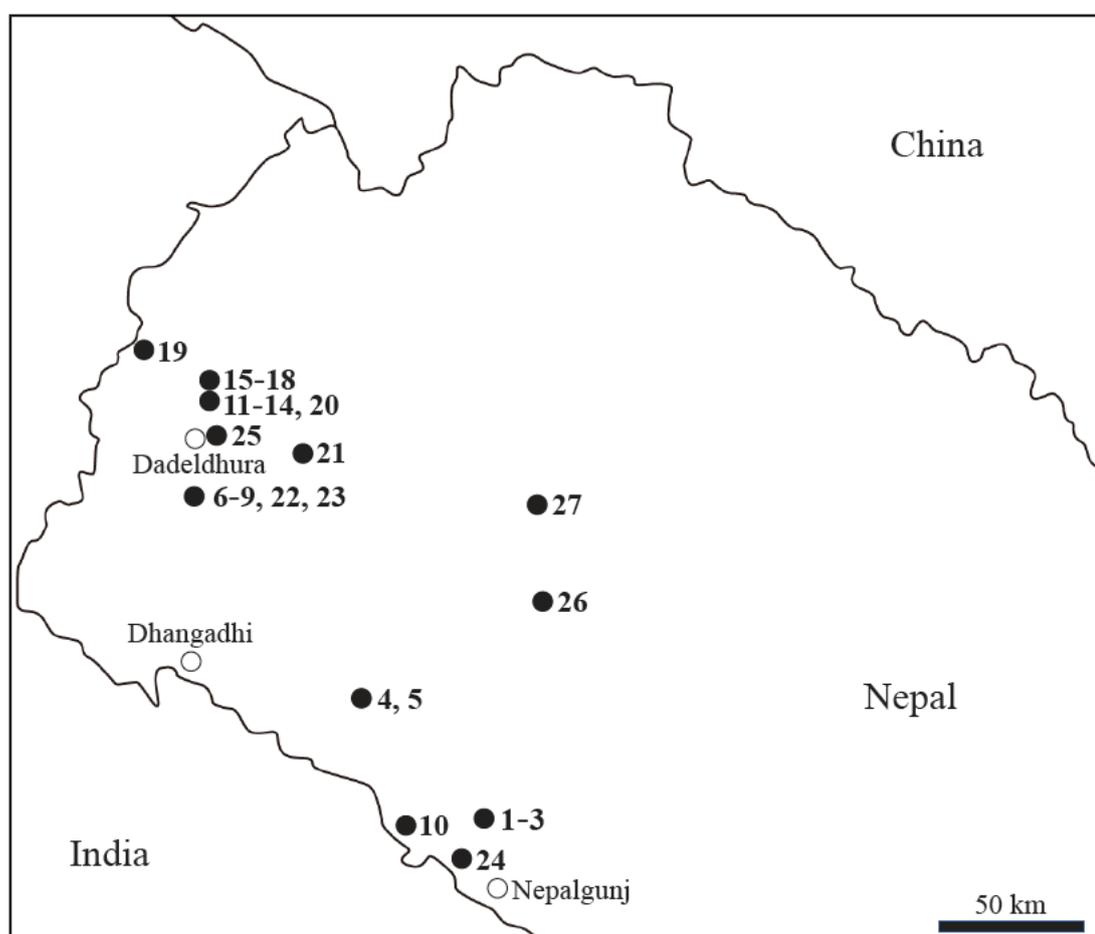


Fig. 1. Collection sites in western Nepal. Black dot; collection site, white dot; headquarters.

round shape to over 40 cm with cylindrical shape (Fig 2). Almost all of accessions seemed to become brown skin color at maturity. Local people mainly use the immature fruit in salads, while mature cucumber is used in pickles and occasionally also eaten in salads. The spicy and crunchy pickled cucumbers are

Table 2. List of collected genetic resources

Species	Number of samples
<i>Cucumis sativus</i>	14
<i>Cucumis melo</i>	3
<i>Cucurbita maxima</i>	2
<i>Cucurbita moschata</i>	2
<i>Cucurbita pepo</i>	1
<i>Luffa acutangula</i>	2
<i>Luffa cylindrica</i>	1
<i>Momordica charantia</i>	1
<i>Bryonopsis</i> sp.	1
Total	27

frequently part of the Nepali meal. Interestingly, at Ghanteshowr village development commune (VDC) in Doti district, mature fruits over 40 cm length are sliced longitudinally, covered with rice or wheat flour and then dried by sunlight. After that, they were preserved until they are cooked as ingredients of soups, etc. These mature fruits are also mixed with dried radish in this village (Fig. 3).

Interestingly, round shape cucumbers about 10 cm in length were collected in the forest near the rural area, and were speculated to be *C. sativus* var. *hardwickii* (Fig. 4). This variety is considered either a progenitor or a close relative of cultivated cucumber (Bisht *et al.* 2004). Local farmers frequently find them in wild environments between July and September. The fruit size varied from less than 10 cm to 20 cm, they may or may not be bitter. These observations suggested that these variations seemed to have evolved by natural hybridization between *C. sativus* var. *hardwickii* and cultivated cucumber in neighboring rural areas.

All collected melons were spherical weedy melon (*C. melo* var. *agrestis*) with a diameter of about 3 cm. They were all collected in Bardiya district of the Terai plain in the southwest (Fig. 5). Not many farmers cultivate melon, and it is not consumed in the western high-elevation mountain area. These weedy melons were seen everywhere in low elevation places, such as roads and river side. They set fruit around September. Farmers collect them for cooking. We collected two types of weedy melon in the same field (Fig. 5). Farmer who collected weedy melons basically dealt with them as if they were the same species; however, one type has stripes on the skin (No. 2), while the other one has no stripes (No. 3). Therefore, we collected them as two different accessions. A striped weedy melon was also collected at another place (No. 24).

The other cucurbitaceous collections, i.e., 2 of *C. maxima*, 2 of *C. moschata*, 1 of *C. pepo*, 2 of *Luffa acutangula* and 1 of *L. cylindrica*, were mainly used as pickles (pumpkin) or heat cooking (pumpkin, sponge gourd).

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ネパール西部におけるウリ科野菜遺伝資源の共同探索, 2016年

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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収集・提供強化」の予算により実施され、国立研究開発法人 農業・食品産業技術総合研究機構 遺伝資源センターとネパール国立農業遺伝資源センターとの間で締結した共同研究協定に基づいて行われたネパール極西部における野菜遺伝資源の探索・収集に関わる調査報告書である。調査は2016年11月1日～15日にかけて行った。ネパール西部のベーリ県、セティ県、マハカリ県において探索・調査を行った。その結果、キュウリ14点、メロン3点、セイヨウカボチャ2点、ニホンカボチャ2点、ペポカボチャ1点、トカドヘチマ2点、ヘチマ1点、ツルレイシ（ニガウリ）1点、オキナワスズメウリ属1点の合計27点のウリ科野菜遺伝資源を収集した。収集された遺伝資源は、ネパール国立農業遺伝資源センターで保存するとともに、我が国の遺伝資源センターに標準材料移転契約（SMTA）に基づいて移転され、農業研究や育種目的に利用可能な遺伝資源として保存される。

Table 3. List of cucurbitaceous samples collected in Nepal during the 2016 survey

Coll No	JP No	Coll date Nov 2016	Species name	Local name	Type of sample	Status of sample	Coll Source	Province	District	VDC	Village	Latitude	Longitude	Altitude (m)	Reference
1	258530	4	<i>Momordica charantia</i>	Kareli	vegetable	wild	farmland	No 5	Bardiya	Bansgadi-3	Bongmudua	N28-15-10 34	E81-34-18 30	152	From Mr Kali Ram Tharu, cooking with heat
2	258531	4	<i>Cucumis melo</i>	Gohima (Gol Kankri)	vegetable	weedy	farmland	No 5	Bardiya	Bansgadi-3	Bongmudua	N28-15-10 34	E81-34-18 30	152	From Mr Kali Ram Tharu, harvesting from Aug to Sep , stripe fruit skin, sour
3	258532	4	<i>Cucumis melo</i>	Gohima (Gol Kankri)	vegetable	weedy	farmland	No 5	Bardiya	Bansgadi-3	Bongmudua	N28-15-10 34	E81-34-18 30	152	From Mr Kali Ram Tharu, harvesting from Aug to Sep , non stripe fruit skin
4	258533	4	<i>Luffa acutangula</i>	Torai	vegetable	landrace	farmland	No 7	Kailali	Patharia-4	Matera	N28-35-28 27	E81-09-40 81	158	From Mr Khushi Ram, sowing from May to June, harvesting from Sep to Oct , cooking with heat
5	258534	4	<i>Luffa cylindrica</i>	Torai	vegetable	landrace	farmland	No 7	Kailali	Patharia-4	Matera	N28-35-28 27	E81-09-40 81	158	From Mr Khushi Ram
6	258535	5	<i>Cucumis sativus</i>	Kankro	vegetable	landrace	village market	No 7	Doti	Ghanteshwor-1	Goganpani	N29-08-42 84	E80-34-44 62	1758	Harvested from near village, making pickle and salad
7	258536	5	<i>Cucumis sativus</i>	Kankro	vegetable	landrace	village market	No 7	Doti	Ghanteshwor-1	Goganpani	N29-08-42 84	E80-34-44 62	1758	Harvested from near village, making pickle and salad
8	258537	5	<i>Cucumis sativus</i>	Hariyo Lamo (Kankro)	vegetable	landrace	village market	No 7	Doti	Ghanteshwor-9	Khai Gawn	N29-09-41 94	E80-35-59 45	1837	Sowing from May to June, harvesting from Sep to Oct , making pickle and salad
9	258538	5	<i>Cucumis sativus</i>	Chhote (Kankro)	vegetable	landrace	village market	No 7	Doti	Ghanteshwor-9	Khai Gawn	N29-09-41 94	E80-35-59 45	1837	Sowing from May to June, harvesting from Sep to Oct , making pickle and salad
10	258539	4	<i>Luffa acutangula</i>	Torai	vegetable	landrace	farmland	No 5	Bardiya	Gulariya-2	Khairapur	N28-14-38 76	E81-18-39 30	127	From Mr Chabilal Khaira
11	258540	6	<i>Cucurbita moschata</i>	Shyamphul	vegetable	landrace	farmland	No 7	Baitadi	Siddhapur-1	Gailek	N29-24-13 93	E80-37-59 45	1896	
12	258541	6	<i>Cucumis sativus</i>	Kankro	vegetable	landrace	farmland	No 7	Baitadi	Siddhapur-1	Gailek	N29-24-13 93	E80-37-59 45	1896	From Navraj Bohara, sowing from Apr to May, harvesting from June to July, and sowing at Jan , harvesting until June, making pickle and salad
13	258542	6	<i>Cucumis sativus</i>	Airaro	vegetable	wild	wild	No 7	Baitadi	Siddhapur-1	Gailek	N29-24-12 57	E80-38-06 20	1847	harvesting from near forest, use like as medicine, very bitter
14	258543	6	<i>Cucurbita maxima</i>	Daulo Kada	vegetable	landrace	farmland	No 7	Baitadi	Siddhapur-1	Gailek	N29-24-12 57	E80-38-06 20	1847	Sowing from Apr to May, harvesting from Sep to Nov, boil mature fruit
15	258544	6	<i>Cucumis sativus</i>	Kankro	vegetable	landrace	village market	No 7	Baitadi			N29-26-18 95	E80-38-06 67	2225	Khodpe market, Baitadi
16	258545	6	<i>Cucumis sativus</i>	Kankro	seed	landrace	farmland	No 7	Baitadi	Siddheshwor-4	Bhattedi	N29-27-53 29	E80-37-55 36	2020	Sowing from July to Aug , harvesting from Oct to Nov , making salad
17	258546	6	<i>Cucurbita pepo</i>	Shyamphul	vegetable	landrace	farmland	No 7	Baitadi	Siddheshwor-4	Bhattedi	N29-27-53 29	E80-37-55 36	2021	Sowing from Jan to Feb , harvesting at July, cookin with hear or making pickle
18	258547	6	<i>Cucurbita maxima</i>	Seto Pharsi	vegetable	landrace	farmland	No 7	Baitadi	Siddheshwor-4	Bhattedi	N29-27-53 29	E80-37-55 36	2022	Sowing from Jan to Feb , harvesting at July, making pickle
19	258548	7	<i>Cucumis sativus</i>	Kankro	vegetable	landrace	farmland	No 7	Baitadi	Musyachaur-8	Gurukhda	N29-53-35 24	E80-25-08 18	1526	Sowing from June to July, harvesting from Oct to Nov , immature fruit for salad and mature fruit for pickle
20	258549	6	<i>Cucurbita moschata</i>	Shyamphul	vegetable	landrace	farmland	No 7	Baitadi	Siddhapur-1	Gailek	N29-24-13 93	E80-37-59 45	1896	
21	258550	8	<i>Cucumis sativus</i>	Kankada	seed	landrace	farmland	No 7	Doti	Katiwada-7	Raukalla	N29-17-34 91	E80-56-32 59	1312	From Gore Sand, Chhettri tribe, sowing from Apr to May, harvesting from Sep to Oct , making pickle and salad
22	258551	8	<i>Cucumis sativus</i>	Airaro	vegetable	wild	wild	No 7	Doti	Ghanteswor-3	Caira	N29-08-45 64	E80-35-34 45	1862	harvesting from near forest, use like as medicine
23	258552	8	<i>Cucumis sativus</i>	Airaro	vegetable	wild	wild	No 7	Doti	Ghanteswor-3	Caira	N29-08-45 64	E80-35-34 45	1862	harvesting from near forest, use like as medicine, very bitter
24	258553	4	<i>Cucumis melo</i>	Gohima	vegetable	wild	wild	No 5	Bardiya	-	-	N28-08-52 15	E81-29-57 18	146	River side
25	258556	4	<i>Bryonopsis sp</i>	-	vegetable	wild	wild	No 7	Dadeldhura	-	-	N29-18-19 00	E80-39-24 20	1127	Road side
26	258554	3	<i>Cucumis sativus</i>	Ghiu Kankro	seed	landrace	farmland	No 6	Daiilekh	Narayan-1	Gahatari	N28-50-28 74	E81-42-50 52	1260	
27	258555	2	<i>Cucumis sativus</i>	Kankro	seed	landrace	farmland	No 6	Kalikot	Dahan-3	Daha	N29-06-51 66	E81-41-11 28	1613	



Fig. 2. Cucumber fruit shape and size. Black bar: 10 cm.



Fig. 3. Dried fruit flesh of cucumber with dried radish covered with flour. The white one is cucumber, the light brown one is radish.



Fig. 4. Fruits of *C. sativus* var. *hardwickii*. These variations seemed to be hybridized to cultivated cucumber in neighboring rural areas under natural conditions.



Fig. 5. Weedy melon fruits. Striped and non-striped fruit skins were recorded as different accessions.

Photograph of collected samples



No. 1 *Momordica charantia*



No. 2 *Cucumis melo*



No. 3 *Cucumis melo*



No. 4 *Luffa acutangula*



No. 5 *Luffa cylindrica*



No. 6 *Cucumis sativus*



No. 7 *Cucumis sativus*



No. 8 *Cucumis sativus*



No. 9 *Cucumis sativus*



No. 10 *Luffa acutangula*



No. 11 *Cucurbita moschata*



No. 12 *Cucumis sativus*



No. 13 *Cucumis sativus*



No. 14 *Cucurbita maxima*



No. 15 *Cucumis sativus*



No. 16 *Cucumis sativus*



No. 17 *Cucurbita pepo*



No. 18 *Cucurbita maxima*



No. 19 *Cucumis sativus*



No. 20 *Cucurbita moschata*



No. 21 *Cucumis sativus*



No. 22 *Cucumis sativus*



No. 23 *Cucumis sativus*



No. 24 *Cucumis melo*



No. 25 *Bryonopsis* sp.



No. 26 *Cucumis sativus*



No. 27 *Cucumis sativus*