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ブータン王国におけるマメ類および雑穀類の植物遺伝資源多様性の保全２００７年

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Collection and Conservation of Crops and Their Wild Relatives in Bhutan, 2007

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Summary

Based on the Memorandum of Understanding between the National Institute of Agrobiological Sciences, Japan and the National Biodiversity Center, Bhutan, a field survey was conducted in Bhutan from September 25 to October 18, 2007. As a result, 10 accessions of *Eleusine coracana*, 2 of *Fagopyrum esculentum*, 3 of *Fagopyrum tataricum*, 2 of *Hordeum vulgare*, 5 of *Oryza sativa*, 1 of *Setaria italica*, 2 of *Sorghum bicolor*, 1 of *Triticum aestivum*, 1 of *Zea mays*, 1 of *Echinochloa* sp. (wild), 1 of *Setaria* sp. (wild), 9 of *Glycine max*, 1 of *Macrotyloma* sp. (wild), 5 of *Phaseolus vulgaris*, 2 of *Phaseolus coccineus*, 3 of *Vigna angularis* (cultivated), 26 of *Vigna angularis* (wild), 5 of *Vigna mungo*, 1 of *Vigna radiata* (cultivated), 11 of *Vigna radiata* (wild), 2 of *Vigna umbellata*, 3 of *Vigna unguiculata* and 3 of *Vigna vexillata* (wild) were collected. For leguminous plants, seed samples as well as root nodules were collected if they were available. Plant herbarium specimens were made for most of the wild plants collected and were deposited in the Herbarium, National Biodiversity Center, Bhutan. All the seed materials collected were deposited in the Gene Bank, Bhutan National Biodiversity Center, Bhutan.

Introduction

In order to facilitate collaborative research activities on the plant genetic resources, the

National Institute of Agrobiological Sciences, Japan and the National Biodiversity Center, Ministry of Agriculture, Bhutan agreed to establish the Memorandum of Understanding (MOU) on Joint Research of Genetic Resources between Bhutan and Japan in 2007. This is the first report of collaborative field survey in Bhutan under this MOU.

Method

We surveyed throughout Bhutan by car from 25th September to 18th October, 2007 as shown in Table 1 and Fig. 1. Seeds, herbarium specimens and root nodules (if available for legumes) were collected. Information on collection sites including village name, altitude, latitude, longitude, habitat, cultural practices and other ecological data together with detailed sketch map of the collection sites were recorded as passport data (Table 4). Identification of wild *Vigna* was done based on a key prepared by Tomooka *et al*. (2002, p.26-28).

Results and Discussion

A total of 124 accessions consisting of 21 species were recorded (Table 4). Among them, seed samples could be collected for 96 accessions (Table 2).

Cereals and wild relatives

Nine species of cultivated cereal/pseudocereals were collected (Table 2). They were *Eleusine coracana* (finger millet, 10 accessions), *Fagopyrum esculentum* (common buckwheat, 2), *Fagopyrum tataricum* (tartary buckwheat, 3), *Hordeum vulgare* (barley, 2), *Oryza sativa* (rice, 5), *Setaria italica* (foxtail millet, 1), *Sorghum bicolor* (sorghum, 2), *Triticum aestivum* (wheat, 1), and *Zea mays* (maize, 1). *Eleusine coracana* accessions were mainly collected from eastern and southern Bhutan (altitude 683m - 2437m). They include 2 types of panicle shape, closed and open (Photo 2). Finger millet is mainly used for preparing an alcoholic drink locally called “Ara”. “Ara” can be prepared from several kinds of cereal powder. However, “Ara” prepared from finger millet powder is preferred in Bhutan. Many farmers grow finger millet for this reason, according to the interviews. Accessions of *Sorghum bicolor* were collected in Trashigang, Mongar, Sarpan and Thimphu provinces. Most of the sorghum was grown as a ratoon crop in a kitchen garden (Photo 3). The brix (sugar content) and other major traits of *Sorghum bicolor* are shown (Table 3). Brix data indicates that sorghum accessions in Bhutan have high sugar content (8.5-18.0%). Only one accession (B59) of *Setaria italica* was found in Kanglung (alt. 2188m), Trashigang province (Photo 4). Plant height of this accession is 150-160cm and panicle length is about 20cm.

Five accessions of *Oryza sativa* were collected in the eastern Bhutan (Trashigang and Pemagatsel provinces). Rice in Bhutan is usually non-glutinous. Glutinous rice is reported to be cultivated only in Trashigang province. Two accessions (B49, 52) called “Handa Bara (glutinous rice variety)” were collected in Radi village (alt. 1469m, Photo 5). “Handa Thengma” (flat glutinous rice cake) is prepared and eaten during festivals. “Handa Thengma” is also used as a gift. In the same village, we collected one non-glutinous rice (B50) called “Sorbang”. Upland rice was rare in the visited areas of Bhutan. Only two farmers in Zobel village, Pemagatsel province (alt. 2014m, B72), and in Bomdeling village, Trashiyangtse province (alt. 1918m, B81), started

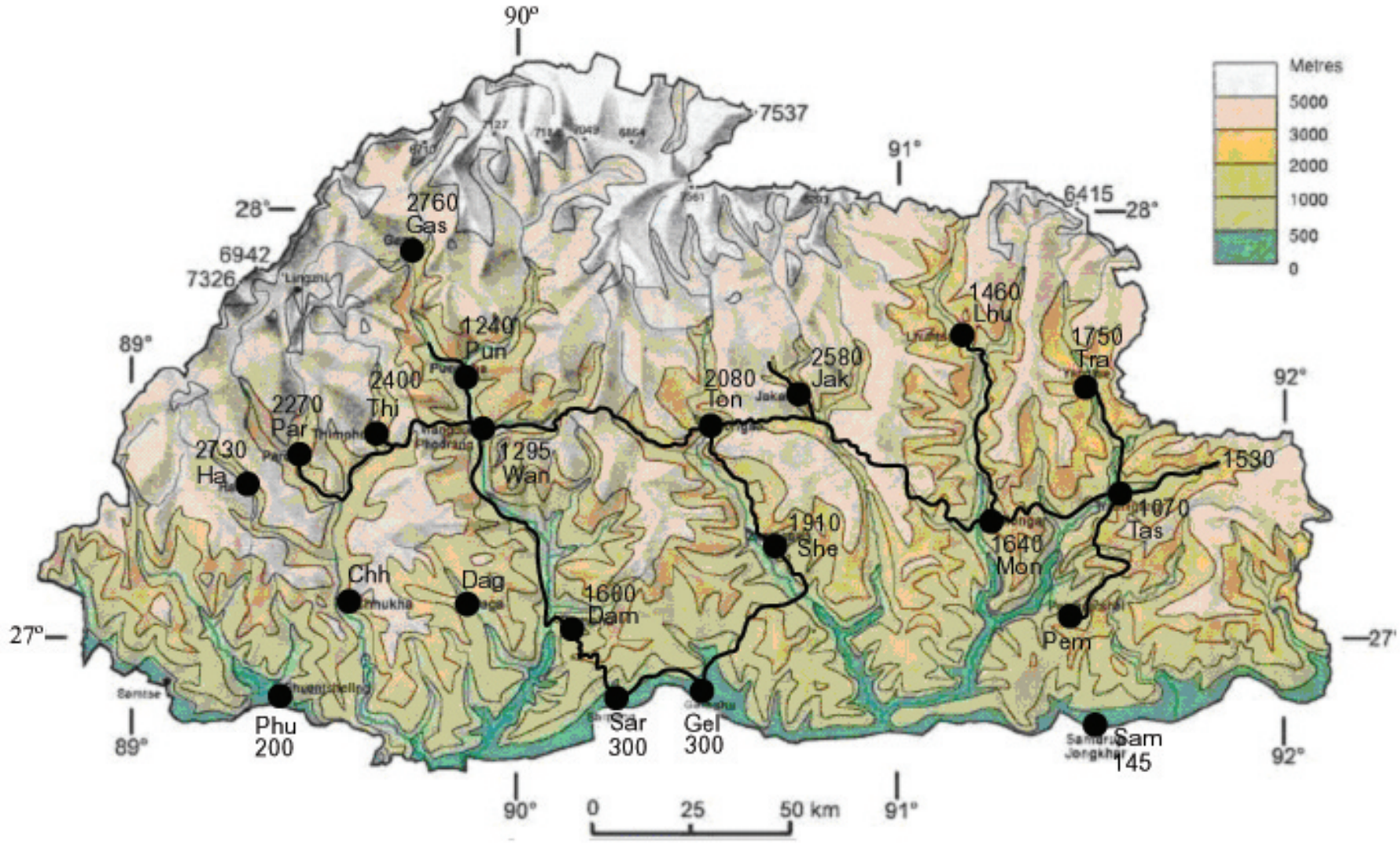

Fig. 1. Exploration route (—) and major towns (●) in Bhutan

Figure on each town name indicates altitude (m).

Town name abbreviations:

Chh (Chhukha), Dag (Dagana), Dam (Damphu), Gas (Gasa), Gel (Gelephug), Jak (Jakar), Lhu (Lhuntshi), Mon (Mongar), Par (Paro), Pem (Pemagatsel), Phu (Phuentsholing), Pun (Punakha), Sam (Samdrup Jongkhar), Sar (Sarpang), She (Shemgang), Tas (Tashigang), Thi (Thimphu), Ton (Tongsa), Tra (Trashi Yangtse), Wan (Wangdi Phodrang)

a trial cultivation of upland rice in 2007. They said the seeds were supplied from the extension workers.

Zea mays is a staple food in eastern Bhutan. One accession of maize was collected in southern Bhutan (Tsirang province). This accession (B110) has a black colored kernel (Photo 6). A farmer who cultivated this accession told us that this accession is resistant to the storage pests. She uses this variety for food, preparing “Ara” or for animal feed.

Accessions of *Fagopyrum esculentum* (B30), *Fagopyrum tataricum* (B22, 28, 29), *Hordeum vulgare* (B21, 27) and *Triticum aestivum* (B20) were collected in a village at the highest altitude (Dur village, Bumtang province, alt. ca. 2900m) among visited villages. In this village, rice and other grain millets were not cultivated because of low temperature. Potato is the main food in this area. Powders of *Fagopyrum* crops are used to prepare “Klui” (pan cake) or “Puta” (noodle, Photo 7). Powders of *Hordeum* and *Triticum* are eaten mixed with hot water and sugar. They are also used to prepare alcoholic drinks “Ara”.

Wild cereals were also collected such as *Setaria* sp. (B18) and *Echinochloa* sp. (B17).

Table 1. Itinerary of the field survey in Bhutan, 2007
ブータンにおける探索調査日程，2007 年

Date	Day	Itinerary	Stay
25 Sept	Tue	Narita 11:00 -- TG641 -- 15:30 Bangkok	Bangkok
26 Sept	Wed	Bangkok 5:50 -- KB121 -- 9:10 Paro -- Thimphu	Thimphu
27 Sept	Thu	Thimphu, National Biodiversity Center (NBC)	Thimphu
28 Sept	Fri	Thimphu, NBC	Thimphu
29 Sept	Sat	Thimphu, Sabji Bazar, Decheling	Thimphu
30 Sept	Sun	Thimphu -- Punakha -- Wangdue	Wangdue
1 Oct	Mon	Wangdue -- Jakar	Jakar
2 Oct	Tue	Jakar, Chokhor	Jakar
3 Oct	Wed	Jakar -- Lhuentse	Lhuentse
4 Oct	Thu	Lhuentse -- Trashigang	Trashigang
5 Oct	Fri	Trashigang, Redi, Kanglung	Trashigang
6 Oct	Sat	Trashigang, Pemagatshel	Trashigang
7 Oct	Sun	Trashigang -- Trashi Yangtse	Trashi Yangtse
8 Oct	Mon	Trashi Yangtse -- Jakar	Jakar
9 Oct	Tue	Jakar -- Trongsa, Weling -- Zhemgang	Zhemgang
10 Oct	Wed	Zhemgang -- Gelephu	Gelephu
11 Oct	Thu	Gelephu -- Sarpang -- Damphu	Damphu
12 Oct	Fri	Damphu -- Wangdue	Wangdue
13 Oct	Sat	Wangdue -- Punakha -- Thimphu	Thimphu
14 Oct	Sun	Thimphu, NBC	Thimphu
15 Oct	Mon	Thimphu, NBC	Thimphu
16 Oct	Tue	Thimphu, NBC	Thimphu
17 Oct	Wed	Thimphu -- Paro 8:40 -- KB120 -- 13:55 Bangkok	Bangkok
18 Oct	Thu	Bangkok 7:35 -- TG676 --15:45 Narita	

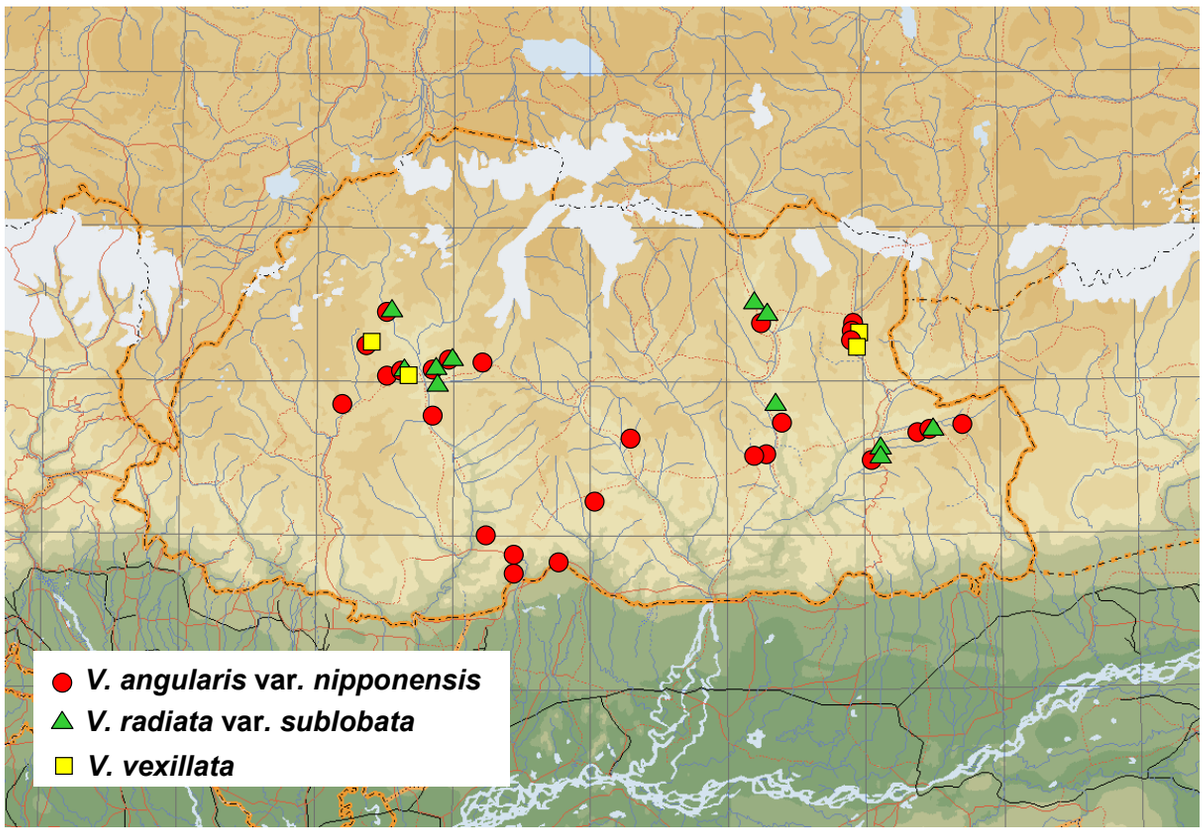

Fig. 2. Distribution of 3 wild *Vigna* species in Bhutan.
Vigna angularis var. *nipponensis* and *Vigna radiata* var. *sublobata* are new records to Bhutan.

Legume Crops

Eight cultivated species were collected (Table 2). They are *Glycine max* (soybean, 9 accessions), *Phaseolus vulgaris* (common bean, 5), *Phaseolus coccineus* (scarlet runner bean, 2), *Vigna angularis* (azuki bean, 3), *Vigna mungo* (black gram, 5), *Vigna radiata* (mungbean, 1), *Vigna umbellata* (rice bean, 2) and *Vigna unguiculata* (cowpea and yard long bean, 3).

Accessions of *G. max* were collected in eastern and southern Bhutan (Photo 9). The altitude of collection sites ranged from 1428m to 2188m. Soybean was grown mixed with maize in several sites. Seed color is either yellow, brown or black. Soybean is eaten either as roasted mature seeds or as boiled immature seeds. Fermented soybean seeds called “Zhitpa” or “Kinama” is also a common seasoning (Photo 8).

Phaseolus vulgaris is widely cultivated in Bhutan. Common bean is usually grown together with maize. Both mature seeds and young green pods are boiled and eaten. *Phaseolus coccineus* is less common and is found as a kitchen garden crop at higher altitudes (2830m for B7 and 2893m for B24). Boiled mature seeds are eaten.

Vigna angularis accessions were not cultivated commonly but could be found at several sites. The altitude of the village where azuki bean was grown ranged from 1320m to 2437m. Seed size of Bhutanese azuki bean is much smaller (100 seed weight 3- 5g, Photo 11) compared with that of East Asian azuki bean. Seed color is either dark red or tan. It is sometimes cultivated mixed with maize. The mature seeds are boiled and prepared as a dal soup or cooked with

rice. A farmer, Ms. Lhamo, living in Weling village of Tongsa province, told us that azuki bean has a special importance in the Buddhist ceremony, and she was asked by the Zhong (An administrative and religious provincial office) of Tongsa to grow azuki bean for the ceremony held at the Zhong. For the religious ceremony, azuki bean seeds are boiled and prepared as sweet soup, which is specially called as "Dyonm" (Photo 12). The name of sweet soup "Dyonm" comes from the highland medicinal plant which is also called "Dyonm" (personal communication with Dr. K. Matsushima, Shinshu University, Japan). The dried roots of "Dyonm" are used for making sweet taste (Sugar is usually used at present because of the low availability of "Dyonm" plant). For the preparation of "Dyonm" soup, cheese made from the yak (*Bos grunniens*, a long-haired cow-like herd animal) milk is added to the sweet soup.

Vigna mungo was widely cultivated in eastern and southern Bhutan. We saw this crop growing on the ridges of paddy fields (Photo 13). The altitude of collection sites ranged from 325m to 1250m. Seed color is either shiny green or shiny black. Black gram is used for making dal soup. In contrast to the common cultivation of black gram, we did not see cultivation of mungbean. We collected one accession of mungbean in a market of Thimphu. It was a product of Tsholingkhar village, Tsirang province.

Vigna umbellata, a close relative of azuki bean, was cultivated at an altitude ranging from 998m to 1551m, lower than azuki bean. Rice bean is cultivated in various sites such as kitchen garden, ridges of paddy fields or upland fields. It is sometimes grown mixed with maize in upland fields (Photo 10). Rice bean is usually eaten as a dal soup or mixed with rice.

Three accessions of *Vigna unguiculata* were collected. One accession (B45) was growing naturally in the grassland beside road. It is thought to be an escaped and naturalized population, since plants in this population has easy shattering habit. Seed color of this accession was shiny black. Another accession (B64) was grown on a slope mixed with maize (Trashigang province). Although this accession seems to be a cultivar group Unguiculata (cowpea), the farmer who grows this crop said she uses this crop as a vegetable (young pods). Accession B97 was collected from a farmer's seed stock in Sarpang province. Although we could not observe the growth of this accession, this accession seems to be cultivar group Sesquipedalis (yard long bean) based on the pod and seed morphology.

Wild legumes

As wild relatives of legume crops, one accession of *Macrotyloma* sp., 22 of *Vigna angularis* var. *nipponensis*, 11 of *Vigna radiata* var. *sublobata* and 3 of *Vigna vexillata* were collected (Table 2, Fig. 2).

Vigna angularis var. *nipponensis* is considered to be the wild ancestor of cultivated azuki bean. According to previous studies, Bhutanese cultivated azuki bean has a distinct DNA profile compared with East Asian azuki bean, suggesting the possibility of independent domestication (伊勢村ら, 2002, Miura *et al*., 2000, Xu *et al*., 2008, Xu *et al*., 2000a, b, Zong *et al*., 2003). However, in these studies, a few accessions of wild azuki bean were used for the analysis. Therefore, accessions collected in this survey are important materials to shed new insight to the origin of azuki bean.

V. angularis var. *nipponensis* was commonly found growing in a wet open habitats such as

Table 2. A list of crops and their wild relatives collected in Bhutan, 2007
ブータンにおける収集品の内訳

Japanese name (Scientific name)	No.	Japanese name (Scientific name)	No.	Total
穀類等 Cereals/Pseudocereals	**29**	**マメ類 Legumes**	**67**	**96**
ヒエ属野生種 (*Echinochloa* sp.)	1	ダイズ (*Glycine max*)	9	
シコクビエ (*Eleusine coracana*)	10	マクロティロマ属野生種 (*Macrotyloma* sp.)	1	
ソバ (*Fagopyrum esculentum*)	2	インゲンマメ (*Phaseolus vulgaris*)	5	
ダッタンソバ (*Fagopyrum tataricum*)	3	ベニバナインゲン (*Phaseolus coccineus*)	2	
オオムギ (*Hordeum vulgare*)	2	アズキ (*Vigna angularis*)	3	
イネ (*Oryza sativa*)	5	ヤブツルアズキ (*Vigna angularis* var. *nipponensis*)	22	
アワ (*Setaria italica*)	1	ケツルアズキ (*Vigna mungo*)	5	
アワ属野生種 (*Setaria* sp.)	1	リョクトウ (*Vigna radiata*)	1	
ソルガム (*Sorghum bicolor*)	2	リョクトウ祖先野生種 (*Vigna radiata* var. *sublobata*)	11	
コムギ (*Triticum aestivum*)	1	ツルアズキ (*Vigna umbellata*)	2	
トウモロコシ (*Zea mays*)	1	ササゲ (*Vigna unguiculata*)	3	
		アカササゲ (*Vigna vexillata*)	3	

Table 3. Major traits of *Sorghum bicolor* (sorghum) collected in Bhutan
ブータンで収集したソルガムの主要特性

Individual ID	B44-1	B44-2	B57-1	B57-2	B87-1
Collection No.	B44	B44	B57	B57	B87
Culm length	2.5m	2.0m	3.2m	3.6m	2.5m
Number of tillers	1	1	1	1	1
Panicle length	23cm	22cm	22cm	23cm	20cm
Panicle shape	Spindle	Spindle	Spindle	Spindle	Spindle
Panicle type	Compact	Compact	Compact	Compact	Compact
Leaf length	72cm	70cm	80cm	100cm	80cm
Leaf width	11cm	9cm	9cm	12cm	10cm
Brix	16.5%	10.2%	10.4%	18.0%	10.3%
Note	Goose neck	Goose neck	Goose neck	Goose neck	Goose neck

Individual ID	B87-2	B95-1	B95-2	B120-1	B120-2
Collection No.	B87	B95	B95	B120	B120
Culm length	2.5m	1.8m	2.1m	3.7m	3.3m
Number of tillers	1	1	1	1	1
Panicle length	20cm	30cm	30cm	23cm	22cm
Panicle shape	Spindle	Lax corn	Lax corn	Lax corn	Lax corn
Panicle type	Compact	intermediate	intermediate	intermediate	intermediate
Leaf length	100cm	70cm	110cm	85cm	100cm
Leaf width	10cm	7cm	9cm	8cm	9cm
Brix	10.5%	-	8.5%	14.0%	16.6%
Note	Goose neck				

surrounding area of paddy fields in Bhutan (Photo 14). The altitude of collection sites ranged from 310m to 2454m. Among the populations found, plants growing at low altitude (B101: 376m, B102: 310m, both in Sarpang province near Indian border) showed larger flowers, leaves and thicker stems. Further morphological and molecular investigation is necessary for the accurate identification of these accessions. In some populations (B8, B10, B19), seed color variation was observed. In these populations, plants with black mottled seeds (normal wild azuki bean seed color) and plants with tan seeds were growing together. Based on our experience, this type of seed color variation within a natural population has been found only for the species, which have crop counter part (cultivated azuki bean in this case). For example, natural populations with seed color variation are frequently found for *Vigna angularis* (azuki bean crop complex) in Japan (Xu *et al*., 2000a,b), and for *Vigna umbellata* (rice bean crop complex) in Thailand (Seehalak *et al*., 2006). The origin of these populations with seed color variation is considered to be natural hybridization between cultivated and wild plants. Therefore, it is considered that *Vigna angularis* forms azuki bean crop complex consisting of cultivated, weedy and wild populations in Bhutan.

Vigna radiata var. *sublobata*, wild mungbean, was also common in Bhutan. The populations were found at the altitude ranged from 690m to 1629m (Photo 15). In some localities, wild mungbean and wild azuki bean grew sympatrically (B10 & 11, B12 & 13, B15 &16, B33 & 34, B53 &54, B122 & 123). At these sites, wild mungbean matures earlier than wild azuki bean. At one site (B15, Thangu village, Wangdi province), wild mungbean and wild azuki bean grew along the small path in paddy fields. Black gram (B14) was cultivated on the ridges of paddy fields in this place. A farmer told us that he collected and ate wild mungbean seeds but not wild azuki bean seeds. The use of wild mungbean seeds is the same as those of black gram (soup) he said.

Vigna vexillata was found at 4 sites (B6, 77, 79, 124) and seeds could be collected from 3 sites (Photo 16). In all the 4 sites, *Vigna angularis* var. *nipponensis* was also found. At site B124, plants of *Vigna radiata* var. *sublobata* were also found. *V. vexillata* was found at the altitude from 1629m to 2455m. They were found growing at wet habitat, and therefore sympatric with wild azuki bean. In Ethiopia, cultivated form of *V. vexillata* was reported to be grown for its edible tuber production.

Vigna flora of Bhutan

A series of books titled "Flora of Bhutan" was published by Royal Botanic Garden, Edinburgh, in 1987. Flora of *Leguminosae* was compiled in Volume 1, Part 3 of this series. This book describes not only wild flora but also cultivated plants in Bhutan. However, cultivated azuki bean (*Vigna angularis* var. *angularis*), wild azuki bean (*V. angularis* var. *nipponensis*), cultivated black gram (*V. mungo* var. *mungo*) and wild mungbean (*V. radiata* var. *sublobata*) are not listed. These taxa found in the present survey are new records in Bhutan.

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We are grateful to Dr. K. Matsushima, Shinshu University, for the valuable information regarding to the special use of azuki bean soup "Dyonm" for Buddhism Ceremony. The detailed

information and photographs of “Dyonm” are from Ms. K. Yamamoto.

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和文摘要

本報告は，独立行政法人農業生物資源研究所ジーンバンクとブータン王国生物多様性センターとの間で 2006 年に締結した協同研究協定（MOU）に基づいて行われたブータンにおける植物遺伝資源の調査報告である．調査は，2007 年 9 月 25 日から 10 月 18 日に行った．調査の結果，在来作物の栽培は著しく減少していることが明らかになった．穀類では，シコクビエ 10 系統，ソバ 2 系統，ダッタンソバ 3 系統，オオムギ 2 系統，イネ 5 系統，アワ 1 系統，ソルガム 2 系統，コムギ 1 系統，トウモロコシ 1 系統，および 2 種の野生種（*Setaria* 属 1 系統，*Echinochloa* 属 1 系統）を収集した．このうち，ソルガムは，ブータン・ジーンバンクにおけるはじめてのコレクションである．豆類では，ダイズ 9 系統，インゲンマメ 5 系統，ベニバナインゲン 2 系統，アズキ 3 系統，ケツルアズキ 5 系統，リョクトウ 1 系統，ツルアズキ 2 系統，ササゲ 3 系統，および 4 種の野生種（*Vigna angularis* var. *nipponensis*：アズキの野生種 26 系統，*Vigna radiata* var. *sublobata*：リョクトウの野生種 11 系統，*Vigna vexillata*：アカササゲ 3 系統，*Macrotyloma* sp.：ホースグラムの野生種 1 系統）を収集した．このうち，アズキ，ケツルアズキ，アズキの野生種，リョクトウの野生種は，エジンバラ植物園が 1987 年に発行した Flora of Bhutan に記載されていない，ブータン新記載種である．

Table 4. Passport data of the collected materials in Bhutan

収集品のパスポートデータ

Col. No.	Date	Genus species	Cultivar or local name	Sample [1]	Status [2]	Locality (Province, Village)	Latitude				Longitude				Altitude (m)
B1	26th Sept	*Vigna angularis* var. *nipponensis*	-	P	1	Paro, Khasadrapchu, Kharabje, between Paro & Thimphu	N	27	21	55.8	E	89	34	1.0	2193
B2	29th Sept	*Vigna angularis*	Sem kuchum	P	3	Paro, Dawakha	-	-	-	-	-	-	-	-	2400
B3	29th Sept	*Vigna mungo*	Kalo dal	P	3	Chuka, Phuentsholing, Pachu	-	-	-	-	-	-	-	-	-
B4	29th Sept	*Vigna radiata*	Pahelo dal	P	3	Dagana, Goshi, Dagapela	-	-	-	-	-	-	-	-	1800
B5	29th Sept	*Vigna angularis* var. *nipponensis*	Semchum	P	1	Thimphu, 2km from Decheling, Kabisa	N	27	32	14.6	E	89	39	8.6	2455
B6	29th Sept	*Vigna vexillata*	Semchum	P	1	Thimphu, 2km from Decheling, Kabisa	N	27	32	24.0	E	89	39	8.7	2455
B7	30th Sept	*Phaseolus coccineus*	Semchum huem	P	3	Thimphu, Honso vill.	N	27	28	48.0	E	89	43	26.5	2830
B8	30th Sept	*Vigna angularis* var. *nipponensis*	-	P	1	Thimphu, Thinlay gang	N	27	31	29.4	E	89	49	5.6	1726
B9	30th Sept	*Vigna angularis* var. *nipponensis*	-	P	1	Thimphu, Thinlay gang	N	27	31	39.7	E	89	39	5.1	1723
B10-1	30th Sept	*Vigna angularis var. nipponensis*	-	P	1	Punakha, Kabisa, Sushi	N	27	38	0.6	E	89	48	9.7	1340
B10-2	30th Sept	*Vigna angularis var. nipponensis*	-	P	1	Punakha, Kabisa, Sushi	N	27	38	0.6	E	89	48	9.7	1340
B10-3	30th Sept	*Vigna angularis* var. *nipponensis*	-	P	1	Punakha, Kabisa, Sushi	N	27	38	0.6	E	89	48	9.7	1340
B11	30th Sept	*Vigna radiata var. sublobata*	-	P	1	Punakha, Kabisa, Sushi	N	27	38	1.5	E	89	48	9.0	1342
B12	30th Sept	*Vigna radiata* var. *sublobata*	-	P	1	Thimphu, Lobesa, 2km from Misina	N	27	31	30.4	E	89	52	3.0	1239
B13	30th Sept	*Vigna angularis* var. *nipponensis*	-	P	1	Thimphu, Lobesa, 2km from Misina	N	27	31	30.4	E	89	52	3.0	1239
B14	1st oct	*Vigna mungo*	-	H	3	Wangdi, Thangu	N	27	30	39.2	E	89	53	25.4	1206
B15	1st oct	*Vigna radiata* var. *sublobata*	-	In	1	Wangdi, Thangu	N	27	30	39.2	E	89	53	25.4	1206
B16	1st oct	*Vigna angularis* var. *nipponensis*	-	P	1	Wangdi, Thangu	N	27	30	39.2	E	89	53	25.4	1206
B17	1st oct	*Echinochloa* sp.	-	P	1	Wangdi, Bjena, Ngawa tserina	N	27	29	53.4	E	90	2	35.4	1735
B18	1st oct	*Setaria* sp.	-	P	1	Wangdi, Bjena, Ngawa tserina	N	27	29	53.4	E	90	2	35.4	1735
B19	1st oct	*Vigna angularis* var. *nipponensis*	-	In	2	Wangdi, Bjena, Ngawa tserina	N	27	29	53.2	E	90	2	37.5	1731
B20	2nd Oct	*Triticum aestivum*	Ka (Wheat)	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B21	2nd Oct	*Hordeum vulgare*	Na (Barley), Janath (Variety name)	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B22	2nd Oct	*Fagopyrum tataricum*	Gontho/Gyuntho	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B23	2nd Oct	*Fagopyrum* sp.	-	H	1	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy [3]	Site [4]	Stoni-ness [5]	Soil texture [6]	Drainage [7]	Habitat, Major traits, Note	Notes Name & Address
? - Oct	-	-	-	6	2	3	1	2	Road side beside paddy, flowering stage	-
Mar - Aug/ Sep or May - Nov	Mono crop	Ceremony, Festival	Red insect	5	1	-	4	2	Dark red and tan seeds mixed, broadcasting, weeding twice	Ms. Dema Sabji, Thimphu market
Jun/Jul - Nov/Dec	Ridge of paddy	Ceremony, Festival (Dasai)	Caterpillar and beetles on leaf	5	2	-	3	3	A little twining	Ms. Mongali Monger, Thimphu market
Jul-Nov, Dec	Mono crop, two seeds per hole	Dessert, Ceremony, Daily food	No	5	1	-	3	2	She said *V. mungo* is used for medical purpose	Ms. Monmaya Gurungi, Thimphu market
? - Oct/Nov	-	-	-	5	2	1	3	2	Beside paddy field, mature stage	-
? - Oct	-	-	-	5	2	1	3	2	Beside paddy field, mature stage. Tuberous roots	-
Feb/Mar - Oct/Nov	Staking done	Mature seeds boiled & consumed	Leaf spot	5	2	1	3	2	Voluntarily emerged seedlings are given staking at later stage	Ms. Karma Yangchen
? - Oct	-	-	No	5	2	1	3	2	In the *Lablab* and chili field, surrounded by terraced paddy field. Tan seed color	Mr. Thinley
? - Oct	-	-	No	5	2	1	3	2	In the *Lablab* and chili field, surrounded by terraced paddy field. Tan seed color	Mr. Thinley
? - Oct	-	-	No	5	2	1	3	1	Paddy field, big leaves, black mottoled seeds	-
? - Oct	-	-	No	5	2	1	3	1	Paddy field, beside Azuki bean field, tan seeds, slender leaves	-
? - Oct	-	-	No	5	2	1	3	1	Paddy field, beside road	-
? - Oct	-	-	No	5	2	1	3	1	Beside paddy field	-
? - Oct	-	-	No	5	2	3	1	3	Edge of paddy filed, beside river	-
? - Oct	-	-	No	5	2	3	1	3	Edge of paddy filed, beside river	-
? - Nov	Ridge of paddy	-	-	3	1	1	1	3	Paddy field	Mr. Daw
? - Oct	-	-	-	3	1	1	1	3	Paddy field, a passer by farmer use mature seed for dal soup	Mr. Daw
? - Nov	-	-	-	3	1	1	1	3	Paddy field	Mr. Daw
? - Nov	-	-	-	5	1	1	4	2	Above the house, on the walls & ridges of paddy field	Mr. Driver Pema
? - Nov	-	-	-	5	1	1	4	2	Above the house, on the walls & ridges of paddy field	Mr. Driver Pema
? - Nov	-	-	-	5	1	2	4	2	On the retaining wall, small stream near by, also above the house. Dark tan seeds	Mr. Driver Pema
Oct/Nov - Jun/Jul	Broadcast	Ara (Alcoholic drinks), Roti (Disk), Kapchi (Fried & powdered wheat)	-	5	2	3	2	4	Potato, buckwheat, barley, wheat, apple, walnut are major crops in this high altitude village, undulating topography	Ms. Peldon
Sep/Oct - Apr/May	Broadcast	Kapchi (Fried & powdered barley)	-	5	2	3	2	4	Short awn type	Ms. Peldon
Jun - Oct,Nov	Broadcast	Kapchi, Puta (Noodle), Momo (Dumpling)	-	5	2	3	2	4	Taste better among 3 varieties she mentioned	Ms. Peldon
? - Oct	Broadcast	-	-	5	1	3	2	2	Weed in kitchen garden	Ms. Peldon

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Drainage, 1:poor, 2:moderate, 3:good, 4:excessive

Table 4 (continued).

Col.No.	Date	Genus species	Cultivar or local name	Sample [1]	Status [2]	Locality(Province,Village)	Latitude				Longitude				Altitude (m)
B24	2nd Oct	*Phaseolus coccineus*	Jakarpa shapen	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B25	2nd Oct	*Phaseolus vulgaris*	Bumthangpa shapen	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B26	2nd Oct	*Phaseolus vulgaris*	Bumthangpa shapen	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B27	2nd Oct	*Hordeum vulgare*	Na (Mixture of Janath, Manath, Broktola)	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B28	2nd Oct	*Fagopyrum tataricum*	Korba	P	3	Bumthang, Chokhor, Dur	N	27	36	52.0	E	90	39	52.8	2893
B29	2nd Oct	*Fagopyrum tataricum*	Jhow	P	3	Bumthang, Chokhor, Jambay Lhakhang,	N	27	34	11.5	E	90	44	10.0	2621
B30	2nd Oct	*Fagopyrum esculentum*	Cheray	P	4	Bumthang, Chokhor, Jambay Lhakhang,	N	27	34	11.5	E	90	44	10.0	2621
B31	3rd Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Lhuntse, Gangzor, Jang	N	27	39	41.0	E	90	11	13.8	1530
B32	3rd Oct	*Fagopyrum* sp.	-	H	1	Lhuntse, Gangzor, Jang	N	27	39	41.0	E	90	11	13.8	1530
B33	4th Oct	*Vigna radiata* var. *sublobata*	-	p	1	Lhuntse, Gangzor, Gangzor,	N	27	40	38.0	E	90	10	38.2	1301
B34	4th Oct	*Vigna angularis* var. *nipponensis*	-	p	1	Lhuntse, Gangzor, Gangzor,	N	27	40	38.0	E	90	10	38.2	1301
B35	4th Oct	*Vigna umbellata*	Gagpu	P	3	Lhuntse, Gangzor, Nimshong	N	27	42	37.0	E	90	9	13.3	1428
B36	4th Oct	*Glycine max*	Shawlin/Libi	P	3	Lhuntse, Gangzor, Nimshong	N	27	42	37.0	E	90	9	13.3	1428
B37	4th Oct	*Eleusine coracana*	Memja/Kongphu	H	3	Lhuntse, Gangzor, Nimshong	N	27	42	38.7	E	90	9	17.3	1400
B38	4th Oct	*Vigna radiata* var. *sublobata*	-	P	1	Lhuntse, Gangzor, Nimshong	N	27	42	38.7	E	90	9	17.3	1400
B39	4th Oct	*Vigna radiata* var. *sublobata*	-	P	1	Lhuntse, Tsengkhar, Rurubi, 5km N of Autsho	N	27	29	15.9	E	90	10	56.4	950
B40	4th Oct	*Macrotyloma* sp.	-	P	1	Lhuntse, Tsengkhar, Rurubi, 5km N of Autsho	N	27	29	15.7	E	90	10	55.6	950
B41	4th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Monger, Chali, 4 km to Phalangphu from Autsho	N	27	19	12.4	E	90	13	9.3	952
B42	4th Oct	*Glycine max*	Libi Tshanglu	P	3	Monger, Ngatshang, Ngatshang,	N	27	18	41.1	E	90	17	36.9	1810
B43	4th Oct	*Glycine max*	-	P	3	Monger, Ngatshang, Ngatshang,	N	27	18	41.1	E	90	17	36.9	1810
B44	5th Oct	*Sorghum bicolor*	Phinang	H	3	Trashigang, Radi, Depung/ Radipangthang	N	27	21	54.5	E	90	41	31.0	1441
B45	5th Oct	*Vigna unguiculata*	Goibi	P	2	Trashigang, Radi, Depung/ Radipangthang	N	27	21	54.5	E	90	41	31.0	1441
B46	5th Oct	*Vigna angularis*	Gagpu	H	3	Trashigang, Radi, Depung/ Radipangthang	N	27	21	54.5	E	90	41	31.0	1441

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy [3]	Site [4]	Stoni-ness [5]	Soil texture [6]	Drainage [7]	Habitat, Major traits, Note	Notes Name & Address
Feb/Mar - Aug/Oct	Dibbling, staking at later satge	Mature seed boiled	Caterpillar on leaves	5	1	3	2	2	Seed color variable (purple mottled, white mottled)	Ms. Peldon
Feb/Mar - Aug/Oct	Dibbling, staking at later satge	Green pod, mature seed	Stem cutter	5	1	3	2	2	White seed	Ms. Peldon
Feb/Mar - Aug/Oct	Dibbling, staking at later satge	Green pod, mature seed	Stem cutter	5	1	3	2	2	Seed color & size variable, smaller than B25	Ms. Peldon
Sep/Oct - Apr/May	Broadcast	Kapchi (Fried & powdered barley)	-	5	2	3	2	4	Broktola: no awn cultivar, Janath: short awn cultivar, Manath: long awn cultivar	Ms. Peldon
Jun - Oct/Nov	Broadcast	Kapchi, Puta (Noodle), Momo (Dumpling)	-	5	2	3	2	4	Gontho tast better than Korba	Ms. Peldon
Jun/Jul - Oct/Nov	Broadcast	Khuli/Roti, Puta (Noodle)	-	3	1	1	2	2	Farmer said that *F. tataricum* is good for health	Ms. Lhamo (younger), Ms. Cheki (old)
Jun/Jul - Oct/Nov	Broadcast	Khuli/Roti, Puta (Noodle)	-	3	1	1	2	2	*F. esculentum* mature later than F. tataricum here	Ms. Lhamo (younger), Ms. Cheki (old)
? - Nov	-	-	-	5	2	1	2	2	On the walls of paddy field	Mr.Karma Gyeltsen & Mr.Tsherrng Dhendup have been asked to collect seeds & deposit with DAO
? - Nov	-	-	-	5	2	1	2	2	On the walls of paddy field	-
? - Oct	-	-	-	5	2	1	2	4	Roadside, Napier grass above, Extension Officer for Livestock located above	-
? - Oct	-	-	-	5	2	1	2	4	-	-
Feb/Mar - Oct/Nov	Maize stem used for staking	Mixed with rice, Dal soup	-	5	1	3	2	2	Maize is main crop. Rice bean is broadcasted simultaneously with maize	Mr.Dorji
Feb/Mar - Sep/Oct	Broadcast	Mature seeds boiled	Badly damaged by rat	5	1	3	2	2	-	Mr.Dorji
May/Jun - Nov/Dec	Transplanted on Jul/Aug	Ara	-	5	1	3	2	2	Slope, dryland. Second crop after maize. Finger tightness is intermediate	Mr.Dorji
? - Oct	-	-	-	5	2	3	2	3	Beside road	Near finger millet field
? - Oct	-	-	-	5	1	1	2	3	In and around paddy field	-
? - Oct	-	-	-	5	2	4	2	4	In and around paddy field	-
? - Nov	-	-	-	5	2	4	2	1	Beside road, on the retaining wall	-
Feb/Mar - Oct/Sep	Broadcast	Zhitpa (Fermented soybean)	Stem cutter	5	2	3	3	2	Second crop after maize, Brown seed color	Ms.Muku
Feb/Mar - Oct/Sep	Broadcast	Zhitpa (Fermented soybean)	Stem cutter	5	2	3	3	2	Second crop after maize, Brown seed color	Ms.Muku
? - Nov	Broadcast	-	-	5	2	2	2	2	Ants nested under leaves, 16% sugar content, goose neck type	Mr. Chado
? - Nov	-	-	-	5	1	2	2	2	Beside road, escaped population	Below the field of Mr. Chado
Apr/May - Nov/Dec	Mixed with maize	Mixed with rice, soup	-	5	2	1	2	3	Maize broadcasted in Feb/Mar & Azuki broadcasted in April/May in the same field. Maize harvested in Aug/Sept & Azuki bean will be harvested in Nov.	Ms.Abi Goling

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Drainage, 1:poor, 2:moderate, 3:good, 4:excessive

Table 4 (continued).

Col.No.	Date	Genus species	Cultivar or local name	Sample [1]	Status [2]	Locality(Province,Village)	Latitude				Longitude				Altitude (m)
B47	5th Oct	*Vigna umbellata*	Sinjay	H	3	Trashigang, Radi, Depung/ Radipangthang	N	27	21	54.5	E	90	41	31.0	1441
B48	5th Oct	*Glycine max*	Libi	P	3	Trashigang, Radi, Depung/ Radipangthang	N	27	21	54.5	E	90	41	31.0	1441
B49	5th Oct	*Oryza sativa*	Handa/honda bara, Pho bara	P	3	Trashigang, Radi, Dekiling	N	27	22	8.6	E	90	41	59.1	1469
B50	5th Oct	*Oryza sativa*	Sorbang	P	3	Trashigang, Radi, Dekiling	N	27	22	8.6	E	90	41	59.1	1469
B51	5th Oct	*Vigna angularis* var. *nipponensis*		P	1	Trashigang, Radi, Dekiling	N	27	22	8.6	E	90	41	59.1	1469
B52	5th Oct	*Oryza sativa*	Handa/honda bara, Pho bara	P	3	Trashigang, Radi, Dekiling	N	27	22	8.6	E	90	41	59.1	1469
B53	5th Oct	*Vigna angularis var. nipponensis*	-	H	1	Trashigang, Shongphu, Buna	N	27	21	20.6	E	90	38	57.4	990
B54	5th Oct	*Vigna radiata* var. *sublobata*	-	-	1	Trashigang, Shongphu, Buna	N	27	21	20.6	E	90	38	57.4	990
B55	5th Oct	*Vigna angularis var. nipponensis*	-	P	1	Trashigang, Shongphu, 3 km W of Buna	N	27	20	43.7	E	90	36	41.4	885
B56	5th Oct	*Vigna radiata* var. *sublobata*	-	P	1	Trashigang, 10 km N of Rongthong	N	27	17	32.2	E	90	32	30.5	1191
B57	5th Oct	*Sorghum bicolor*	Ashum	P	3	Tashigang, Rongthong Ngatshang	N	27	16	54.8	E	90	32	38.0	1577
B58	5th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Tashigang, Rongthong Ngatshang	N	27	16	55.5	E	90	32	37.9	1566
B59	5th Oct	*Setaria italica*	Yangra	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B60	5th Oct	*Eleusine coracana*	Kongpu	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B61	5th Oct	*Glycine max*	Libi	P	23	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B62	5th Oct	*Vigna angularis*	Gagpu	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B63	5th Oct	*Phaseolus vulgaris*	Bumthangpa/ Brokchila Oray	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy [3]	Site [4]	Stoni-ness [5]	Soil texture [6]	Drainage [7]	Habitat, Major traits, Note	Notes Name & Address
Mar/Apr - Nov/Dec	Mixed with maize	Mixed with rice, soup	Beetles attack flowers	5	2	1	2	3	Maize stem used for staking	Ms.Abi Goling
Feb/Mar-Oct	Mixed with corn	Vegetable soybean, fried mature seeds, fermented soybean	-	5	2	1	2	3	Broadcasted together with maize in the same field.	Ms.Abi Goling
April sowing, after 20days tranplanting, Harvesting in Oct.	Transplanted	Handa Thengma (soak in water over night, add oil, powder & make thengma which is eaten during festival. Use as gift.	-	5	1	1	3	1	Hanada bara is glutinous. Marshy area. Five paddy varieties (Sorbang, Sungsung, wangdakarma, Asala & Handa/ Pho bara) were grown in that area	Mr.Tenchyozom
April sowing, after 21days tranplanting, Harvesting in Oct.	Transplanted	Sorbang used for making rice.	-	5	1	1	3	1	Sorbang is easy shatering & non-glutinous rice.	Mr.Tenchyozom
? - Oct/Nov	-	-	-	5	2	2	2	1	Wet place	On the way to Hanada bara field from the house
April sowing, after 20days tranplanting, Harvesting in Oct..	Transplanted	Handa Thengma (soak in water over night, add oil, powder & make thengma which is eaten during festival. Use as gift.	-	5	1	1	3	1	Hanada bara is glutinous. Marshy area. Five paddy varieties(Sorbang, Sungsung, wangdakarma, asala & Handa/Pho bara grown in that area including Handa varities are grown in that area	Mr.Tenchyozom
? - Oct/Nov	-	-	-	2	1	2	2	1	In and around paddy field, above Vocational Training Institute (VTI)	Mr.Pemchyojay
? - Oct	-	-	-	2	1	2	2	1	In and around paddy field, above VTI	Mr.Pemchyojay
- early Oct	-	-	-	2	1	4	1	3	On the river bank beside the road (above & below)	ca 3km from Buna, 100 m away from Miraculous Chorten
- Oct	-	-	-	5	1	4	1	3	Beside road (forest)	
Feb - Nov	Ratoon crop	Popped sorghum	-	5	1	1	2	2	In home garden, seeds obtained from Radi. Sugar content is 18% . Lots of ants. Sugarcane also grown beside.	Ms.Sonam Zangmo
? - Oct	-	-	-	5	2	3	2	3	Large leaflets. Many pods per peduncle	
Feb-Oct/Nov	Broadcast	Mix with rice or alone	-	5	2	1	3	3	Plant height 150-160cm. Panicle length 20cm.Original seed source from Radi village (Ms. Thshyangzom)	Ms. Dorji Norcham
Volunteer crop - Oct/ Nov	-	-	-	5	2	2	3	3	In kitchen garden, white grain type. Two types of fingers (tight/ compact & loose)	Ms. Dorji Norcham
Feb-Oct/Nov	Broadcast	Mature seeds roasted & consumed. Tender pods also boiled and consumed.	-	5	1	2	2	3	Slope. Black seeds and erect plants.	Ms. Dorji Norcham
Jun-Nov	Mixed with maize	Cooked with rice, soup/dal	Bruchids	5	1	2	2	3	Last year`s seeds	Ms. Dorji Norcham
Any time	Mixed with maize	Pods as vegetables	Root cutter	5	1	2	2	3	Maize field	Ms. Dorji Norcham

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Drainage, 1:poor, 2:moderate, 3:good, 4:excessive

Table 4 (continued).

Col.No.	Date	Genus species	Cultivar or local name	Sample 1)	Status 2)	Locality(Province , Village)	Latitude				Longitude				Altitude (m)
B64	5th Oct	*Vigna unguiculata*	Goibi	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B65	5th Oct	*Phaseolus vulgaris*	Oozrongpa Oray	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B66	5th Oct	*Phaseolus vulgaris*	Dungkhar Oray	P	3	Trashigang, Kanglung, Yonphula	N	27	16	24.6	E	90	30	43.5	2188
B67	5th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Tashigang, Rongthong, near bridge, boarder of Kanglung	N	27	16	21.3	E	90	31	53.1	1683
B68	6th Oct	*Eleusine coracana*	Kongpu	P	3	Trashigang, Lumang, Kheshing	N	27	7	53.2	E	90	33	39.6	1968
B69	6th Oct	*Fagopyrum esculentum*	Guntsung	P	3	Trashigang, Lumang, Kheshing	N	27	7	53.2	E	90	33	39.6	1968
B70	6th Oct	*Vigna umbellata*	-	H	3	Pemagatsel, Zobel, Ngangmalang	N	27	4	13.0	E	90	27	28.5	1551
B71	6th Oct	*Eleusine coracana*	-	P	3	Pemagatsel, Zobel, Ngangmalang	N	27	3	40.7	E	90	27	36.0	1825
B72	6th Oct	*Oryza sativa*	Pangbara	P	3	Pemagatsel, Zobel, Pangzor	N	27	3	1.0	E	90	27	33.5	2014
B73	6th Oct	*Glycine max*	Libi	P	3	Pemagatsel, Zobel, Pangzor	N	27	3	1.0	E	90	27	33.5	2014
B74	7th Oct	*Vigna radiata* var. *sublobata*	-	P	1	Trashigang, beside check point	N	27	20	11.4	E	90	32	46.4	690
B75	7th Oct	*Eleusine coracana*	Thray	P	3	Trashiyangtse, Chorten Kora	N	27	36	29.9	E	90	29	44.2	1719
B76	7th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Trashiyangtse, Chorten Kora	N	27	36	29.9	E	90	29	44.2	1719
B77	7th Oct	*Vigna vexillata*	-	H	1	Trashiyangtse, Chorten Kora	N	27	36	29.9	E	90	29	44.2	1719
B78	7th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Trashiyangtse, Bomdeling, near the bridge	N	27	36	44.8	E	90	29	20.7	1760
B79	7th Oct	*Vigna vexillata*	-	P	1	Trashiyangtse, Bomdeling, near the bridge	N	27	36	44.8	E	90	29	20.7	1760
B80	7th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Trashiyangtse, Bomdeling, Yangteng	N	27	39	7.9	E	90	27	27.0	1918
B81	7th Oct	*Oryza sativa*	Karponay	P	3	Trashiyangtse, Bomdeling, Yangteng	N	27	39	7.8	E	90	27	26.4	1918
B82	7th Oct	*Eleusine coracana*	Khosumokhrey	P	3	Trashiyangtse, Bomdeling, Yangteng	N	27	39	7.8	E	90	27	26.4	1918
B83	7th Oct	*Vigna angularis*	Kry	H	3	Trashiyangtse, Bomdeling, Teshiling,	N	27	37	2.5	E	90	29	26.8	1846
B84	8th Oct	*Vigna umbellata*	Senjay	P	3	Mongar, Ngatsang, Yadi	N	27	17	28.1	E	90	22	5.5	1490
B85	8th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Mongar, 100m above Khalanzi power house	N	27	17	29.8	E	90	12	31.9	749

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:Swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy [3]	Site [4]	Stoni-ness [5]	Soil texture [6]	Drainage [7]	Habitat, Major traits, Note	Notes Name & Address
May/Jun-Oct/Nov	Mixed with maize	Pods as vegetables	-	5	1	2	2	3	Maize field	Ms. Dorji Norcham
Any time	Mixed with maize	Pods as vegetables	-	5	1	2	2	3	Maize field	Ms. Dorji Norcham
Any time	Mixed with maize	Pods as vegetables	-	5	1	2	2	3	Maize field	Ms. Dorji Norcham
? - Oct	-	-	Leaf biten by some insects	5	1	4	1	3	Road side, early maturity	
-	Transplanting	Ara, Bangchang, Roti (Khuli, Kepthang)	-	5	2	3	2	2	Last years seeds	Ms. Ngawang Chodon Mr. Ngawang Sandro
-	-	Kepthang	-	5	2	3	2	2	-	Ms. Ngawang Chodon Mr. Ngawang Sandro
-	Stick	Vegetable ?	-	5	2	2	2	3	Kitchen garden, only two plants grown	Mr. Phuntsho, Ms. Pemchodon
? - Oct	-	-	-	5	1	2	2	3	Type of fingers tight	Mr. Phuntsho, Ms. Pemchodon
Mar/Apr - Oct	Transplanting	Mixed with cracked maize	Root cutter	5	1	1	3	2	Upland rice, poor seed filling, seeds obtained from extension agent, first trial this year	Mr. Tshewang Tezin, Ms. Monangki
Feb - Oct	Mixed with maize	Vegetable, fried mature seeds, fermented soybean	Root cutter	5	1	1	3	2	Brown seeds, brown seeded variety suitable for higher elevation compared with yellow seeded variety	Mr. Tshewang Tezin, Ms. Monangki
?-mid Oct	-	-	-	5	2	4	2	3	many plants growing on the slope beside road	-
Mar/Apr sowing -May/Jun transplanting - Oct harvesting	-	Ara, Roti (Khuli, Kepthang)	-	5	1	2	2	2	Plant height 70cm, finger type mostly tight, a few loose type	Ms. Sonam Kezang, Mr. Kelzang Rinchen will collect seeds
? - late Oct	-	-	-	5	1	2	2	2	A few plants beside paddy. Not mature yet. Asked Mr. Kelzang to collect mature seeds and keep	Mr. Kelzang Rinchen will collect seeds
? - late Oct	-	-	-	5	1	2	2	2	A few plants beside paddy. Not mature yet. Asked Mr. Kelzang to collect mature seeds and keep	Mr. Kelzang Rinchen will collect seeds
? - mid Oct	-	-	-	5	2	4	2	3	Road side slope, wet and shady place	-
? - mid Oct	-	-	-	5	2	4	2	3	Road side slope, wet and shady place	-
? - Oct	-	-	-	5	2	3	2	3	Road side and in and around upland rice / finger millet field	Ms. Dema Lhamo
June. broadcasting - Oct.	-	-	-	5	2	1	2	2	She cultivated upland rice for the first time. Seeds obtained from extension worker	Ms. Dema Chyozom
Mar/Apr sowing - Apr/May transplanting - Oct harvesting	-	Ara, Roti (Khuli, Kepthang)	-	5	2	1	2	2	Finger type: tight is more than loose	Ms. Dema Chyozom
Jun/Jul - Nov	-	Dal soup	-	5	2	1	2	2	Upland slope, red and tan seeds mixed. Eat azuki bean once in a week or two weeks	Ms. Dema Lhamo
Mar/Apr - Oct/Nov	Broadcast seeds with maize seeds	Mixed with rice, vegetable, soup	Leaf biten by some insects	5	2	3	2	2	Yellow seeds, white pod	Mr. Tashiwangchuk.Ms. Kecha Lhamo
? - Nov	-	-	-	5	2	2	2	3	Beside terrace paddy	-

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Drainage, 1:poor, 2:moderate, 3:good, 4:excessive

Table 4 (continued).

Col.No.	Date	Genus species	Cultivar or local name	Sample [1]	Status [2]	Locality(Province, Village)	Latitude				Longitude				Altitude
B86	8th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Mongar, Lingmithang, Thinangbi, Saling	N	27	17	17.7	E	90	8	47.8	872
B87	8th Oct	*Sorghum bicolor*	Songyon	H	3	Mongar, Thridangbi, Sarshithang	N	27	17	43.1	E	90	9	53.2	1517
B88	9th Oct	*Vigna angularis*	Kry	P	3	Trongsa, Nubi, Weling	N	27	30	42.8	E	90	30	4.1	2437
B89	9th Oct	*Eleusine coracana*	Kongpa	P	3	Trongsa, Nubi, Weling	N	27	30	42.8	E	90	30	4.1	2437
B90	9th Oct	*Vigna angularis* var. *nipponensis*		P	1	Trongsa, Drakteng, Eussa	N	27	25	36.2	E	90	29	8.8	1924
B91	9th Oct	*Eleusine coracana*	Kongpa	P	3	Trongsa, 5 km from Kuengarabten market, Samcholing	N	27	22	48.5	E	90	32	6.4	1650
B92	10th Oct	*Glycine max*	Bhatmas	P	3	Sarpang, Samkhara, Batasay	N	27	0	44.6	E	90	36	20.0	1537
B93	10th Oct	*Eleusine coracana*	Lorangay Kodo	H	3	Sarpang, Samkhara, Batasay	N	27	0	44.6	E	90	36	20.0	1537
B94	10th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Sarpang, Samkhara, Batasay	N	27	0	44.6	E	90	36	20.0	1537
B95	10th Oct	*Sorghum bicolor*	Junyalo	H	3	Sarpang, Suray, Samkhara	ca N	27	0	20.0	ca E	90	36	0.0	ca 1400
B96	10th Oct	*Vigna umbellata*	Banmara	H	3	Sarpang, Suray, Samkhara	ca N	27	0	20.0	ca E	90	36	0.0	ca 1400
B97	10th Oct	*Vigna unguiculata* (yard long bean type)	Thunabordi	P	3	Sarpang, Suray, Suray	N	27	0	41.0	E	90	35	7.8	1074
B98	10th Oct	*Vigna umbellata*	Mashyam	H	3	Sarpang, Suray, Bijgawan	N	27	0	44.2	E	90	34	15.9	998
B99	10th Oct	*Vigna mungo*	Kalo dal	H	3	Sarpang, Suray, Bijgawan	N	27	0	44.2	E	90	34	15.9	998
B100	10th Oct	*Vigna mungo*	Kalo dal	P	3	Sarpang, Sershog	N	26	55	28.4	E	90	31	43.2	325
B101	11th Oct	*Vigna angularis* var. *nipponensis*	Mas Lhari	H	1	Sarpang, Bhur, Bhur	N	26	54	25.8	E	90	25	51.2	376
B102	11th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Sarpang, near Sarpang bazar, near the river	N	26	52	10.1	E	90	15	51.1	310
B103	11th Oct	*Eleusine coracana*	-	H	3	Sarpang, Hillay, Nunpani	N	26	54	4.0	E	90	13	13.7	721
B104	11th Oct	*Vigna angularis* var. *nipponensis*	-	H	1	Sarpang, Hillay, Nunpani	N	26	54	3.7	E	90	13	13.1	725
B105	11th Oct	*Glycine max*	Mothray	P	3	Tsirang, Kikorthang, Mithun	N	26	59	40.0	E	90	7	20.3	1510
B106	11th Oct	*Vigna umbellata*	Banmara	H	3	Tsirang, Kikorthang, Mithun	N	26	59	40.0	E	90	7	20.3	1510
B107	12th Oct	*Vigna mungo*	-	P	3	Tsirang, Damphu, 1 km toward Sarpang	N	-	-	-	E	-	-	-	-

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:Swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy3)	Site [4]	Stoni-ness [5]	Soil texture [6]	Drai-nage [7]	Habitat, Major traits, Note	Notes Name & Address
- Oct	-	-	-	5	2	2	2	3	Abundant in abandoned terrace paddy	-
Feb/Mar - Nov.	Ratoon crop	Ara	Birds	5	1	1	2	2	Goose neck, sugar content ca.10%, internode rather short, flowering stage - 3 days after heading	Ms. Dechenmo
May - Oct.	Mono crop after barley	Dyonm (a special soup for religious ceremony), with rice, Dal soup	Bruchid beetle	5	2	2	2	2	Stem 1m and lateral branches crawling, only this farmer still grows azuki bean in this village	Ms. Lhamo
May - Nov. Dec	Not tranplanted because of labour shortage	Kepthang, Ara, Dengo (sobagaki),Yeast Medium	-	5	1	2	2	2	Plant height ca.80 cm, finger type tight	Ms. Lhamo
? - Oct	-	-	Catapiller found in a pod	5	2	2	2	3	On the ridge of terrace paddy, many plants growing	-
May - Oct: tight finger type , May - Nov: loose finger type	-	Ara, Keptang, Dengo	-	5	2	2	2	3	Loose finger type matures later	Mr. Karma
Jul - Oct	-	Roast & eat	Small holes on leaves	5	2	1	3	2		Mr. Birkha Bdr Rai
June: sowing, July: transplant, Nov: harvest	-	Rakshi (Ara), Jaod (Bangchang)	-	5	2	1	3	2	Finger type: loose, plant height 70-80cm	Mr. Birkha Bdr Rai
- late Oct	-	-	Holes on leaves	5	2	1	3	2	In and beside finger millet field, many	Mr. Birkha Bdr Rai
Feb - Nov	Ratoon crop	-	-	5	1	1	1	2	Ratoon crop, many shoots, plant height 1.8-2.1m, sugar cont. 8 - 9%	Mr. Damber Gurung
Feb - Nov	-	Dal soup	Bruchid	5	2	1	3	3	-	Mr. Damber Gurung
Feb - Oct/Nov	Stick	Vegetable	-	5	2	1	3	3	-	Mr. Jamtsho Dukpa
Jun/Jul - Nov	On the ridge of terrace paddy	Dal soup	Deer eat	5	1	1	3	2	-	Mr. Tulsi Ram
Jun/Jul - Nov	On the ridge of terrace paddy	Dal soup	Young plants	5	1	1	3	2	-	Mr. Tulsi Ram
Jul - Nov	On the ridge of terrace paddy	Dal soup	Bruchid	5	1	4	1	2	Beside paddy. Many leeches	Mr. Amber Gurung
? - Nov	-	-	Leaf eaten by insect	3	1	1	3	2	Edge of forage crop (*Pasparum* sp.)	RNR-RSC, Bhur Mr. Sangay Dorji
? - Nov.	-	-	-	2	2	3	1	3	In forage plants on road side slope on the retaining wall	-
Jun/Jul - Nov	Transplant	Rakshi	Badly damaged by rat	5	1	4	1	2	On terrace, plant height 30cm	Mr. Garjaman Darlami
? - Nov	-	-	-	5	2	4	1	3	In wild *Fagopyrum* plants	Mr. Garjaman Darlami
Feb - Oct	Mixed with maize	Roast & eat, Kinama	Caterpillar at tender pod stage	5	1	1	3	2	Broadcast in maize field when maize grow ca.1 feet tall, on terrace, brown seed	Mr. P.S.Tamang
Feb - Nov	Mixed with maize	Soup(dal)	Bruchid	5	1	1	3	2	Broadcast in maize field when maize grow ca.2 feet tall, on terrace, yellow and red seeds	Mr. P.S.Tamang
-	-	-	-	-	-	-	-	-	Seeds obtained from Damphu market last year, last years seeds	A lady waiting for a vehicle to Thimphu

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Deainage, 1:poor, 2:moderate, 3:good, 4:excessive

Table 4 (continued).

Col.No.	Date	Genus species	Cultivar or local name	Sample [1]	Status [2]	Locality(Province, Village)	Latitude				Longitude				Altitude (m)
B108	12th Oct	*Eleusine coracana*	Sanga (Kodo)	P	3	Tsirang, Chanautay, Nebaray	N	26	58	53.2	E	90	7	19.7	1650
B109	12th Oct	*Glycine max*	Mothray/Bhatmas	P	3	Tsirang, Chanautay, Nebaray	N	26	58	53.2	E	90	7	19.7	1650
B110	12th Oct	*Zea mays*	Mlangai makai/ Kalo mokai	P	3	Tsirang, Chanautay, Nebaray	N	26	58	53.2	E	90	7	19.7	1650
B111	12th Oct	*Vigna mungo*	Kalo dal	H	3	Tsirang, Kikorthang, Salamy	N	27	0	48.6	E	90	8	51.9	1250
B112	12th Oct	*Vigna umbellata*	Mashyam	H	3	Tsirang, Kikorthang, Salamy	N	27	0	48.6	E	90	8	51.9	1250
B113	12th Oct	*Vigna angularis* var. *nipponensis*	-	P	1	Tsirang, Kikorthang, Salamy	N	27	0	44.4	E	90	8	45.5	1250
B114	12th Oct	*Eleusine coracana*	Kodo	H	3	Tsirang, Kikorthang, Salamy	N	27	0	43.4	E	90	8	43.1	1246
B115	12th Oct	*Vigna mungo*	Pahelo dal (Yellow gram)	P	3	Tsirang, Tsholingkhar, Lungsegang	N	27	1	19.2	E	90	4	49.3	679
B116	12th Oct	*Eleusine coracana*	Memjya	H	3	Tsirang, Tsholingkhar, Lungsegang	N	27	1	19.2	E	90	4	46.2	683
B117	12th Oct	*Vigna angularis* var. *nipponensis*	Gagpu ru	H	1	Wangdue, Gaselu, Lawakha	N	27	24	5.8	E	89	54	8.6	1174
B118	12th Oct	*Vigna radiata* var. *sublobata*	-	P	1	Wangdue, Lobesa, dragon nest hotel	N	27	29	20.3	E	89	53	42.7	1226
B119	12th Oct	*Vigna angularis*	-	H	3	Punakha, Kabisa, Sushi	N	27	38	3.7	E	89	48	7.6	1320
B120	12th Oct	*Sorghum bicolor*	Shingru	In	3	Thimphu, Thinlay gang, Sisiding	N	27	31	21.0	E	89	50	2.7	1593
B121	13th Oct	*Eleusine coracana*	Memjya	P	3	Thimphu, Thinlaygang, Mendelgang	N	27	31	33.5	E	89	49	53.0	1629
B122	13th Oct	*Vigna angularis* var. *nipponensis*	-	p	1	Thimphu, Thinlaygang, Mendelgang	N	27	31	33.5	E	89	49	53.0	1629
B123	13th Oct	*Vigna radiata* var. *sublobata*	-	p	1	Thimphu, Thinlaygang, Mendelgang	N	27	31	33.5	E	89	49	53.0	1629
B124	13th Oct	*Vigna vexillata*	-	p	1	Thimphu, Thinlaygang, Mendelgang	N	27	31	33.5	E	89	49	53.0	1629

1)Sample, P:Population, In:Individual, H:Herbarium. 2) Status, 1:Wild, 2:Weedy, 3:Landrace, 4.Improved, 3)Topography, 1:Swamp, 2:flood plain, 3:plain level, 4:undulating, 5:hilly, 6:mountainous, 7:other. 4)Site, 1:level, 2:slope, 3:summit, 4:depression

Crop season	Cultural practice	Usage	Disease and pects	Topog-raphy [3]	Site [4]	Stoni-ness [5]	Soil texture [6]	Drai-nage [7]	Habitat, Major traits, Note	Notes Name & Address
Jun/Jul - Nov	Transplant	Ara (Rakshi), Roti (Geng), Food for cow	Leaf spot result poor grain formation	5	2	2	3	2	Sporadic long hairs on leaf and stem. Plant height 60 - 100cm, figner type ; tight: 95% , loose : 5%	Mr. Tenzin Sherpa
Feb - Oct	Mixed with maize	Kinima	Stink bug	5	1	1	3	2	Brown seed	Mr. Dawa Dorji Tamang
Feb - Aug	-	Food Ara, Animal feed	Storage pest	5	1	1	3	2	According to Ms. Tamang, black seeded maize is resistant to storage pest	Mr. Dawa Dorji Tamang
Aug - Oct/ Nov	Terrace ridge	Dal soup	Caterpillar on leaf	5	1	2	2	2	Stems erect and short	Mr. Prakash Kaflay
Aug - Nov	Terrace ridge	Dal soup	Caterpillar on leaf	5	1	2	2	2	A little viny	Mr. Prakash Kaflay
? - Oct	-	-	Holes on leaves	5	2	3	2	2	Long pod	Mr. Karma
? - Nov.	-	-	-	5	2	2	2	2	Plant height 60 - 80m, finger type : tight 50% , loose 50%	-
Aug - Nov/ Dec	After maize	Dal soup	Bruchid	5	1	3	2	2	Mono crop	Mr. Sagay Dorji
Jul/Aug transplant - Nov/Dec	-	Ara	-	5	2	3	2	2	-	Mr. Sagay Dorji
? - late Oct	-	-	Many holes on leaf	5	2	2	2	2	-	Mr. Pema Chyojay
? - Oct	-	-	-	5	2	2	2	3	Beside hotel parking (Dragon Nest Hotel)	-
? - Nov	Mono crop	-	-	5	1	1	2	2	A little viny, slender stem, wild azuki growiing around the periphery.	-
Feb - Oct/Nov	Rotoon crop	Pigment to make Ara into red	-	5	2	2	2	3	3 panicles per plant, sugar 13 - 17% , long neck, plant height 3.3 - 3.7m. Seed brought from Beling, Tongsa	Mr. Wandi
May - June (transplant) - Oct	transplanting, harvest panicle	Ara, Bangchang	-	5	2	2	2	3	Finger type: tight 95% , loose 5%	Ms. Tshering Dem
? - Oct	-	-	-	5	2	2	2	1	Wet roadside slope	Ms. Tshering Dem
? - Oct	-	-	-	5	2	2	2	1	Wet roadside slope	Ms. Tshering Dem
? - Oct	-	-	-	5	2	2	2	1	Wet roadside slope	Ms. Tshering Dem

5)Stoniness, 1:none, 2:low, 3:medium, 4:rocky. 6)Soil Texture, 1:sand, 2:loam, 3:clay, 4:silt, 5:highly organic. 7)Deainage, 1:poor, 2:moderate, 3:good, 4:excessive

Photo 1. A field of *Eleusine coracana* on a slope at Bomdeling, Trashiyangtse province (B82, alt. 1918m).

Photo 2. Closed panicle type of *Eleusine coracana*, a typical panicle type seen in Tibet region.

Photo 3. A ratoon crop *Sorghum bicolor* found in front of a farmer's house at Tinley Gang, Thimphu (B120, alt. 1593m). Used as red pigment.

Photo 4. *Setaria italica* grown on a slope at Kanglung, Trashigang province (B59, alt. 2188m).

Photo 5. A glutinous rice variety "Handa Bara" grown at Radi, Trashigang province (B49, alt. 1469 m). Eaten during festival and used as a gift.

Photo 6. Black kernel corn (B110) cultivated at Tsirang province (alt. 1650m). She said black corn is more resistant to storage pests.

Photo 7. A noodle made from buckwheat powder called "Puta". "Khuli" (pan cake) and "Momo" (dampling) are also prepared from buckwheat.

Photo 8. Fermented soybean seeds called "Zhitpa" (Dzongkha language) or "Kinama" (Nepali) is a common seasoning.

Photo 9. Soybean plants harvested and dried on the roof of farmer's storage (Mongar province, alt. 1810m).

Photo 10. A kitchen garden in Gangzor, Lhuntse province (alt. 1428m), where corn and rice bean (*Vigna umbellata* B35) were grown in a mixture.

Photo 11. Azuki bean seeds (B88) preserved at farmer's house (Tongsa province, alt. 2437m). Seed is very small (100 seed weight about 4g).

Photo 12. Sweet azuki bean soup with yak cheese called "Dyonm" has a special importance in Buddhist Ceremony. Picture by Dr. K. Yamamoto.

Photo 13. *Vigna mungo* and *V. umbellata* were planted on ridges of the terrace paddy at Sarpang province.

Photo 14. Herbarium specimen of *Vigna angularis* var. *nipponensis* collected at Trashiyangtse province (B78, alt. 1760m). New record.

Photo 15. Herbarium specimen of *Vigna radiata* var. *sublobata* collected at Wangdue province (B118, alt. 1126m). New record.

Photo 16. Harbarium specimen of *Vigna vexillata* collected beside paddy at Thimphu province (B6, alt. 2454m).