

## Collection of Wild Leguminous Crop Relatives in Ishikawa, Gifu, and Toyama Prefectures in Japan in 2016

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### Summary

We surveyed Ishikawa, Gifu, and Toyama prefectures in Japan, from October 27 to 30, 2016, to collect wild azuki bean (*Vigna angularis* (Willd.) Ohwi et H. Ohashi var. *nipponensis* (Ohwi) Ohwi et H. Ohashi) and wild soybean (*Glycine soja* Siebold et Zucc.). We surveyed 46 collection sites and collected 48 accessions, among which 43 were wild azuki bean and five were wild soybean specimens. As in our last survey, in 2015, wild azuki bean was prevalent in the lower lands of western Japan, that look onto the Sea of Japan, while it was often found in the relatively higher lands (300-700 m. a. s. l.) of eastern Japan, looking onto the Pacific Ocean. Although we could not collect many wild soybean specimens, one accession was collected from a riverbed, which might therefore, have flooding tolerance.

KEY WORDS: wild legumes, *Vigna*, *Glycine*, genetic resources

### Introduction

The NARO Genebank project has been conducting field surveys to collect and conserve germplasm of *Vigna* and *Glycine* throughout Japan (Vaughan *et al.* 2010; Tomooka *et al.* 2010, see also Annual Report on Exploration and Introduction of Plant Genetic Resources, [https://www.gene.affrc.go.jp/publications.php#plant\\_report](https://www.gene.affrc.go.jp/publications.php#plant_report)). Because wild relatives of crop species are also important genetic resources (McCouch *et al.* 2013), we have recently focused on collecting those of two important legume crops; azuki bean (*Vigna angularis* (Willd.) Ohwi & H. Ohashi, Japanese name: azuki), and soybean (*Glycine max* (L.) Merr., Japanese name: daizu). In Japan, the ancestors of the two crops, wild azuki bean (*Vigna angularis* var. *nipponensis* (Ohwi) Ohwi & H. Ohashi, Japanese name: yabutsuru azuki) and wild soybean (*Glycine soja* Siebold & Zucc., Japanese name: tsuru mame) are prevalent; thus, we continue surveying to collect these

materials from all prefectures.

Since our 2015 survey, we have explored the central region of the Honshu island, because we had already collected a few accessions in this region (Muto *et al.* 2016). In this survey we surveyed the west side of the Noto Peninsula in Ishikawa prefecture, the northern part of Gifu prefecture, and the southern part of Toyama prefecture, where we left unsurveyed in 2015.

## Methods

Table 1 shows the schedule of this field survey. On the first day we started from Noto airport, drove north to Wajima city, then around the west side of the Noto Peninsula until we reached Shika town. On the second day we surveyed the rest of the Noto Peninsula, including Hakui city, Nakanoto town, Hodatsushimizu town, Kahoku city, Tsubata town in Ishikawa prefecture, and Oyabe city and Tonami city in Toyama prefecture. On the third day we drove south to survey Nanto city in Toyama prefecture, and Shirakawa village, Gujo city, and Gero city in Gifu prefecture. On the fourth day we surveyed Hida city and Takayama city in Gifu prefecture and Toyama city in Toyama prefecture (Fig.1).

Prior to the field survey we selected collection sites by previewing these areas on Google Earth. The selected collection sites were river banks, edges of canals, and borders between paddy fields and shrines or dwellings.

We recorded addresses, altitudes, latitudes, longitudes, habitat sketch maps and other ecological data from each collection site as passport data. GPS data were obtained by GPSMAP 62SC (GERMIN). When we found populations of *V. angularis* var. *nipponensis* or *G. soja*, we collected bulked seed samples from each population.

## Results and Discussion

In this survey we collected 48 accessions, among which, 43 were wild azuki bean and five were wild soybean (Tables 2 and 3, Fig. 1). Of the 43 azuki bean accessions, 21 had larger seeds or brighter colors on the seed coat, which are typical characters of weedy forms (escapes of cultivars or hybrids between cultivars and wild forms (Muto *et al.* 2016). In all, we surveyed 46 sites, and found at least one of these species at 38 sites; however, we were unable to collect seeds at one sites (Table 4, Fig. 1). This site was Noto13 (No. 8 in Fig. 1), where we found a wild azuki bean plant which did not set any seeds, probably because that site was recently mown (Fig. 1, Table 3). We could not find any of the species at eight sites in Gifu prefecture, among which, six were more than 700 m in altitude (Fig. 1).

Table 1. Itinerary of the field survey in 2016

Date	Itinerary	Stay
2016/10/27	Noto airport (Ishikawa) → Wajima → Shika	Shika (Ishikawa)
2016/10/28	Shika (Ishikawa) → Hakui → Nakanoto → Hodatsushimizu → Kahoku → Tsubata → Oyabe (Toyama) → Tonami	Tonami (Toyama)
2016/10/29	Tonami (Toyama) → Nanto → Shirakawa (Gifu) → Gujo → Gero	Gero (Gifu)
2016/10/30	Gero (Gifu) → Hida → Takayama → Toyama (Toyama)	

Table 2. Summary of samples collected in each prefecture

Species	Ishikawa	Gifu	Toyama	Total
<i>Vigna angularis</i> var. <i>nipponensis</i>	26	13	4	43
<i>Glycine soja</i>	3	1	1	5
Total	29	14	5	48

Table 4. Summary of collection sites

	Ishikawa	Gifu	Toyama	Total
Collected	22	10	5	37
<i>Vigna angularis</i> var. <i>nipponensis</i> *	21	10	4	35
<i>Glycine soja</i> **	3	1	1	5
Not collected	2	6	1	9
Total	24	16	6	46

\*,\*\* The number of sites are double counted if the two species were found at the same site.

### *Vigna angularis* var. *nipponensis*

As in our 2015 survey (Muto *et al.* 2016), it was easy to find and collect seeds of wild azuki bean in the areas towards the Sea of Japan (in Ishikawa and Toyama prefectures) (Fig. 2). These we found this species in 28 of the 30 surveyed sites, although we could not collect seeds from a plant at Noto13. Together with the results from our last survey, we conclude that wild azuki bean is prevalent in the Hokuriku Region.

In Gifu prefecture, we found wild azuki bean at 11 of the 17 surveyed sites. This was much better than the results of our last survey (Muto *et al.* 2016), where we found it only at three sites out of 14. The difference between the last survey and this survey was in altitudes of the sites surveyed. In 2015 we focused on surveying areas below 100 m above sea level, while in 2016 we focused on areas >300 m above sea level (Fig. 2). Except for altitudes greater than 700 m, we found wild azuki bean samples at all survey sites. Otherwise, however, we found it at only one site out of seven (Table 3, Fig. 1). Since we did not find any wild azuki bean in Nobi Plain across Gifu, Aichi, and Mie prefectures (<50 m in altitude) in the last survey (Muto *et al.* 2016) (Fig. 2), it might be better to survey areas higher altitudes for wild azuki bean on the Pacific Ocean side of Honshu island.

### *Glycine soja*

In this survey we collected only five accessions of wild soybean (Table 3). The collection sites of these accessions were Nos. 2, 9, 23, 31 and 46 in Fig. 1. We also had difficulty in finding this species in Toyama, Ishikawa, and Fukui prefectures in the last survey (Muto *et al.* 2016); thus, we consider wild soybean not to be dominant in the Hokuriku Region. In Gifu prefecture, the area we surveyed was probably too high for wild soybean to grow.

Among the five soybean accessions collected, four were in drier habitats, than those of wild azuki bean. However, accession JP257385, collected in Noto14 (No. 9 in Fig. 1), was in a riverbed, which was the wettest habitat visited during this survey (Photo 1). This accession might be a good source of flooding tolerance for soybean breeding.

### **Acknowledgement**

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# 石川県，岐阜県，および富山県におけるマメ科植物 遺伝資源の探索収集，2016年

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## 和文摘要

本報告は2016年10月27日から30日にかけて実施した石川・岐阜・富山の3県におけるマメ科作物近縁野生種の探索についての報告である。本調査において46箇所の収集地点を探索し、43系統のヤブツルアズキ (*V. angularis* var. *nipponensis*) と5系統のツルマメ (*G. soja*) を収集した。2015年の探索と同様に、ヤブツルアズキは日本海側の地域では低地で見つかりやすい一方、太平洋側では比較的標高の高い地域（海拔300-700 m）において見つかることが多かった。ツルマメの収集点数は少なかったが、1点は川床から収集されたものであるため、耐湿性に優れる可能性がある。

Table 3. Passport data of materials collected

JP No	Site No	Coll No	Code of Collection sites in Fig 1	Coll Date (2016)	Species Name	Status	Collection Site	Latitude	Longitude	Altitude (m)	Land use	Habitat	Shading	Degree of disturbance	Population size	Stage	Disease		Pest		Seed
																	leaf	pod/seeds	leaf	pod/seeds	
257375	Noto7	2016Noto7-1	1	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Mii, Wajima, Ishikawa	N37-17-12	E136-55-41	154	canal bank	grassland	open	med	3x20	mature	-	-	-	-	Bulk
257376	Noto7	2016Noto7-2	1	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Mii, Wajima, Ishikawa	N37-17-12	E136-55-41	154	canal bank	grassland	open	med	3x3	mature	-	-	-	-	Bulk
257377	Noto8	2016Noto8-1	2	28-Oct	<i>Glycine soja</i>	wild	Nagasawa, Mii, Wajima, Ishikawa	N37-18-50	E136-54-4	111	park	grassland	open	med	2x2	mature	-	-	-	-	Bulk
257378	Noto8	2016Noto8-2	2	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Nagasawa, Mii, Wajima, Ishikawa	N37-18-50	E136-54-4	111	park	grassland	open	med	2x2	mature	-	-	-	-	Bulk
257379	Noto8	2016Noto8-3	2	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nagasawa, Mii, Wajima, Ishikawa	N37-18-50	E136-54-4	111	park	grassland	open	med	2x2	mature	-	-	-	-	Bulk
257380	Noto9	2016Noto9-1	3	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Kitatani, Wajima, Ishikawa	N37-21-30	E136-54-27	40	riverbank	grassland	open	med	3x3	mature	-	-	-	-	Bulk
257381	Noto10	2016Noto10-1	5	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Nagai, Wajima, Ishikawa	N37-22-20	E136-52-37	18	riverbank	grassland	open	low	10x100	mature	-	-	-	-	Bulk
257382	Noto10	2016Noto10-2	5	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Nagai, Wajima, Ishikawa	N37-22-20	E136-52-37	18	riverbank	grassland	open	low	10x100	mature	-	-	-	-	Bulk
257383	Noto11	2016Noto11-1	6	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Urakami, Monzenmachi, Wajima, Ishikawa	N37-18-50	E136-48-7	48	riverbank	grassland	open	med	10x20	mature	-	-	-	-	Bulk
257384	Noto12	2016Noto12-1	7	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Mochida, Monzenmachi, Wajima, Ishikawa	N37-20-46	E136-45-16	18	cultivated	grassland	open	high	3x10	mature	-	-	-	-	Bulk
	Noto13	None	8	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Shimizu, Monzenmachi, Wajima, Ishikawa	N37-17-27	E136-45-55	15	cultivation field	cultivated	open	high	1 plant	flowering	-	-	-	-	Bulk
257385	Noto14	2016Noto14-1	9	28-Oct	<i>Glycine soja</i>	wild	Ikeda, Monzenmachi, Wajima, Ishikawa	N37-15-39	E136-43-29	0	riverbed	grassland	open	Med	10x0	mature	-	-	-	-	Bulk
257386	Noto15	2016Noto15-1	10	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Tsurugiji, Monzenmachi, Wajima, Ishikawa	N37-13-49	E136-42-26	0	riverbank	grassland	open	med	5x5	mature	-	-	-	-	Bulk
257387	Noto16	2016Noto16-1	11	28-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Daifukuji, Monzenmachi, Wajima, Ishikawa	N37-11-14	E136-42-53	58	fallow field	grassland	open	med	5x5	mature	-	-	-	-	Bulk
257388	Noto17	2016Noto17-1	12	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakahama, Shikamachi, Hakui, Ishikawa	N37-9-22	E136-43-13	5	cultivation field	grassland	open	med	8x8	mature	-	-	-	-	Bulk
257389	Noto17	2016Noto17-2	12	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakahama, Shikamachi, Hakui, Ishikawa	N37-9-22	E136-43-13	5	cultivation field	grassland	open	med	8x8	mature	-	-	-	-	Bulk
257390	Noto17	2016Noto17-3	12	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakahama, Shikamachi, Hakui, Ishikawa	N37-9-22	E136-43-13	5	cultivation field	grassland	open	med	8x8	mature	-	-	-	-	Bulk
257391	Noto18	2016Noto18-1	13	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Kusagi, Shikamachi, Hakui, Ishikawa	N37-6-25	E136-45-44	62	riverbank	bushes	open	med	1 plant	mature	-	-	-	-	Bulk
257392	Noto19	2016Noto19-1	14	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakahata, Shikamachi, Hakui, Ishikawa	N37-5-24	E136-45-55	50	fallow field	bushes	open	med	3x3	past maturity	-	-	-	-	Bulk
257393	Noto20	2016Noto20-1	15	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakahata, Shikamachi, Hakui, Ishikawa	N37-5-16	136-45-51	34	canal bank	cultivated/ grassland	open	med	5x5	mature	-	-	-	-	Bulk
257394	Noto21	2016Noto21-1	16	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Nashitani-Koyama, Shikamachi, Hakui, Ishikawa	N37-1-53	E136-47-44	7	riverbank	grassland	open	med	3x3	mature	-	-	-	-	Bulk
257395	Noto22	2016Noto22-1	17	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Tachi, Shikamachi, Hakui, Ishikawa	N36-59-34	E136-48-1	12	riverbank	grassland	open	med	5x20	mature	-	-	-	-	Bulk
257396	Noto23	2016Noto23-1	18	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Chi, Jikemachi, Hakui, Ishikawa	N36-55-32	E136-45-57	28	paddy field	cultivated	open	high	5x10	mature	-	-	-	-	Bulk
257397	Noto24	2016Noto24-1	19	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Ru, Kanemaru-Demachi, Hakui, Ishikawa	N36-56-25	E136-50-37	6	riverbank	grassland	open	low	10x10	past maturity	-	-	-	-	Bulk
257398	Noto25	2016Noto25-1	20	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Ke-Koh, Kue, Nakanotomachi, Kashima, Ishikawa	N36-57-1	E136-53-2	29	riverbank	grassland	open	med	5x5	mature	-	-	-	-	Bulk

Table 3. (Continued).

JP No	Site No	Coll No	Code of Collection sites in Fig 1	Coll Date (2016)	Species Name	Status	Collection Site	Latitude	Longitude	Altitude (m)	Land use	Habitat	Shading	Degree of disturbance	Population size	Stage	Disease		Pest		Seed
																	leaf	pod/seeds	leaf	pod/seeds	
257399	Noto26	2016Noto26-1	21	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Kawara, Hodatsushimizu, Hakui, Ishikawa	N36-49-22	E136-46-8	30	parking lot	none	open	med	5x5	past maturity	-	-	-	-	Bulk
257400	Noto27	2016Noto27-1	22	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Hachino, Kahoku, Ishikawa	N36-49-22	E136-46-3	29	riverbank	grassland	open	low	10x100	mature	-	-	-	-	Bulk
257401	Noto28	2016Noto28-1	23	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Kamikawai, Tsubatamachi, Kahoku, Ishikawa	N36-44-21	E136-47-46	126	cultivation field	cultivated	light	med	5x5	past maturity	-	-	-	-	Bulk
257402	Noto28	2016Noto28-2	23	29-Oct	<i>Glycine soja</i>	wild	Kamikawai, Tsubatamachi, Kahoku, Ishikawa	N36-44-21	E136-47-46	126	cultivation field	cultivated	light	med	5x5	past maturity	-	-	-	-	Bulk
257403	Ishikawa7	2016Ishikawa7-1	24	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Kamikawai, Tsubatamachi, Kahoku, Ishikawa	N36-40-11	E136-47-23	0	riverbank	grassland	open	high	1x1	past maturity	-	-	-	-	Bulk
257404	Toyama6	2016Toyama6-1	25	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Hanyu, Oyabe, Toyama	N36-40-6	E136-51-1	45	cultivation field	cultivated	open	high	3x3	past maturity	-	-	-	-	Bulk
257405	Toyama7	2016Toyama7-1	26	29-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Yasui, Oyabe, Toyama	N36-39-56	E136-52-1	39	park	grassland	open	high	5x5	past maturity	-	-	-	-	Bulk
257406	Toyama8	2016Toyama8-1	27	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Fukuyama, Tonami, Toyama	N36-35-58	E137-1-1	131	paddy field	cultivated	open	med	5x20	mature	-	-	-	-	Bulk
257407	Toyama9	2016Toyama9-1	29	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nishiakaomachi, Nanto, Toyama	N36-23-4	E136-52-15	326	riverbank	bushes	open	med	2x3	mature	-	-	-	-	Bulk
257408	Gifu15	2016Gifu15-1	30	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Iijima, Shirakawa, Ohno, Gifu	N36-16-32	E136-53-52	548	parking area	bushes	open	med	3x3	past maturity	-	-	-	-	Bulk
257409	Gifu16	2016Gifu16-1	31	30-Oct	<i>Glycine soja</i>	wild	Hatotani, Shirakawa, Ohno, Gifu	N36-16-21	E136-54-9	521	fallow field	bushes	open	med	2x2	past maturity	-	-	-	-	Bulk
257410	Gifu16	2016Gifu16-2	31	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Hatotani, Shirakawa, Ohno, Gifu	N36-16-21	E136-54-9	521	fallow field	bushes	open	med	2x2	past maturity	-	-	-	-	Bulk
257411	Gifu16	2016Gifu16-3	31	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Hatotani, Shirakawa, Ohno, Gifu	N36-16-21	E136-54-9	521	fallow field	bushes	open	med	2x2	past maturity	-	-	-	-	Bulk
257412	Gifu17	2016Gifu17-1	35	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Ohshima, Shiratori, Gujo, Gifu	N35-51-7	E136-51-54	339	paddy field	cultivated	open	med	5x10	mature	-	-	-	-	Bulk
257413	Gifu18	2016Gifu18-1	36	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Arisaka, Hachiman, Gujo, Gifu	N35-45-52	E136-56-19	227	riverbank	bushes	open	med	5x50	past maturity	-	-	-	-	Bulk
257414	Gifu19	2016Gifu19-1	37	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Miyaji, Wara, Gujo, Gifu	N35-44-26	E137-4-22	375	riverbank	bushes	light	med	2x20	past maturity	-	-	-	-	Bulk
257415	Gifu19	2016Gifu19-2	37	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Miyaji, Wara, Gujo, Gifu	N35-44-26	E137-4-22	375	riverbank	bushes	light	med	2x5	past maturity	-	-	-	-	Bulk
257416	Gifu20	2016Gifu20-1	38	30-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Hoido, Gero, Gifu	N35-44-38	E137-12-29	296	riverbank	grassland	open	med	2x2	mature	-	-	-	-	Bulk
257417	Gifu21	2016Gifu21-1	39	31-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Churo, Hagiwara, Gero, Gifu	N35-50-40	E137-13-43	387	paddy field	cultivated	open	med	2x2	mature	-	-	-	-	Bulk
257418	Gifu21	2016Gifu21-2	39	31-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Churo, Hagiwara, Gero, Gifu	N35-50-40	E137-13-43	387	paddy field	cultivated	open	med	2x2	mature	-	-	-	-	Bulk
257419	Gifu22	2016Gifu22-1	40	31-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	wild	Shimi, Hagiwara, Gero, Gifu	N35-55-43	E137-13-23	469	orchard	cultivated	open	high	1x1	mature	-	-	-	-	Bulk
257420	Gifu23	2016Gifu23-1	44	31-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Nakano, Furukawa, Hida, Gifu	N36-14-58	E137-9-46	483	paddy field	cultivated	open	med	5x20	mature	-	-	-	-	Bulk
257421	Gifu24	2016Gifu24-1	45	31-Oct	<i>Vigna angularis</i> var <i>nipponensis</i>	weedy	Fusegata, Kamioka, Hida, Gifu	N36-18-38	E137-14-58	732	paddy field	cultivated	open	med	1x1	mature	-	-	-	-	Bulk
257422	Toyama10	2016Toyama10-1	46	31-Oct	<i>Glycine soja</i>	wild	Nunoshiri, Toyama, Toyama	N36-31-32	E137-13-50	153	road	grassland	open	med	20x30	past maturity	-	-	-	-	Bulk

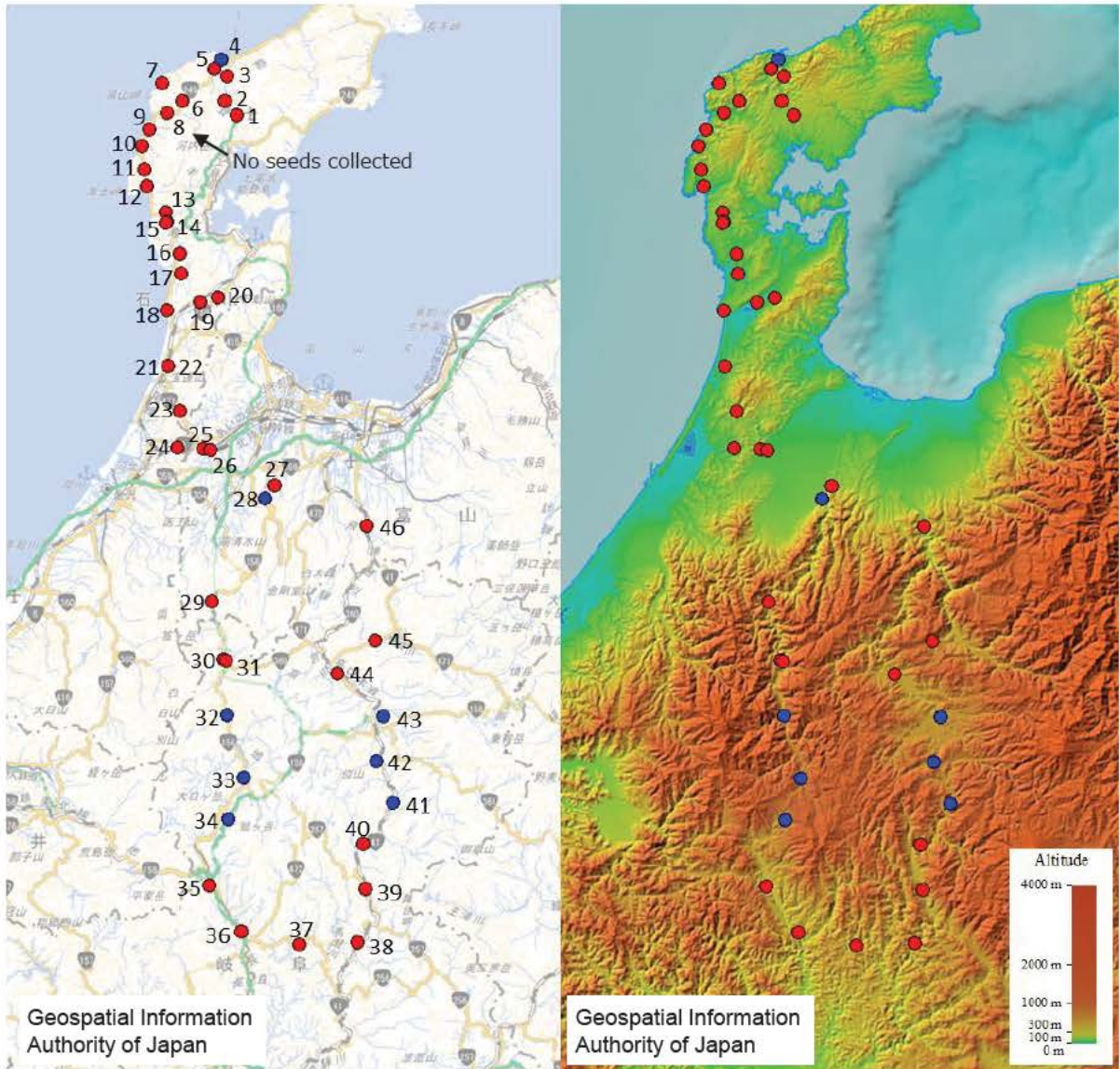


Fig. 1. Collection sites on a road map (left) and on an elevation map (right). Red circles indicate where we found wild azuki bean or wild soybean, while blue circles indicate where neither species was found. The numbers correspond to the collection sites indicated in Table 3. Both maps were provided by the Geospatial Information Authority of Japan.



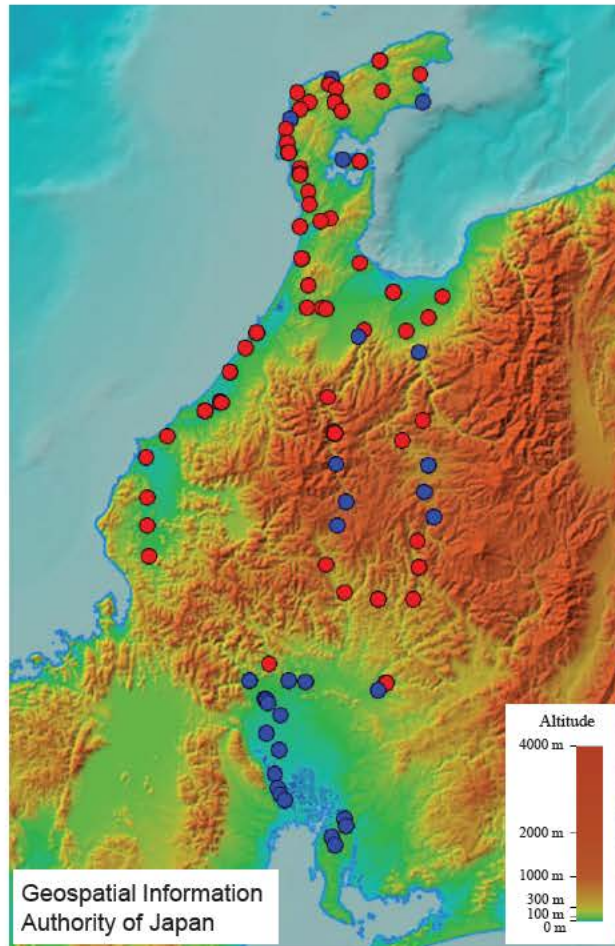


Fig. 2. Surveyed sites for wild azuki bean during 2015-2016. The red and blue circles indicate where we did and did not find wild azuki bean, respectively. The map was provided by the Geospatial Information Authority of Japan.



Photo 1. Noto14 (No. 9 in Fig. 1). A wild soybean population found on a riverbed.