

Field Survey and Collection of Leguminous Genetic Resources in Tokushima and Kochi Prefectures of Japan in 2018

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Original Paper

Field Survey and Collection of Leguminous Genetic Resources in Tokushima and Kochi Prefectures of Japan in 2018

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Summary

We conducted a field survey to collect leguminous genetic resources and investigate their distribution in Tokushima and Kochi Prefectures, in the Shikoku region of Japan, from October 22 to 26, 2018. In this survey, we focused on collecting wild adzuki beans because the number of wild adzuki accessions collected from both prefectures was considerably less than that for wild soybean in the past surveys. In all, 53 accessions were collected, including 23 wild adzuki bean (Japanese name, Yabutsuru-azuki) accessions, one intermediate-type adzuki bean (Japanese name, Zasshu-azuki), one cultivated adzuki bean (Japanese name, Azuki) accession, 25 wild soybean (Japanese name, Tsuru-mame) accessions, and three cowpea (Japanese name, Sasage) accessions. All collected seeds are conserved at the National Agriculture and Food Research Organization (NARO) Genebank of Japan. We plan to multiply the seeds of the collected accessions and evaluate their growth traits at our experimental field in Tsukuba in 2019. The multiplied seeds will become available upon request for research, breeding, and educational purposes.

KEY WORDS: leguminous genetic resources, Yabutsuru-azuki, Tokushima, Kochi, Japan

Introduction

The genera *Glycine* and *Vigna* belong to the legume family Leguminosae and include various crops such as soybean (*Glycine max* [L.] Merr.; Japanese name, Daizu), adzuki bean (*Vigna angularis* [Willd.] Ohwi & H. Ohashi, Azuki), and cowpea (*Vigna unguiculata* [L.] Walp., Sasage). The National Agriculture and Food Research Organization (NARO) Genebank has been conducting field surveys for the

collection and conservation of *Glycine* and *Vigna* germplasms distributed in Japan (see Annual Report on the Exploration and Introduction of Plant Genetic Resources, https://www.gene.affrc.go.jp/publications.php#plant_report). Thus far, five surveys have been conducted to collect wild soybean (*Glycine soja* Sieb. & Zucc.) and wild adzuki bean (*V. angularis*) in the Shikoku region of Japan (Vaughan *et al.* 1999; Kikuchi *et al.* 2005; Saruta *et al.* 2007, 2009, 2011). Wild adzuki beans (34 accessions) collected in those surveys were considerably fewer than wild soybean (174 accessions). The difference between the collected number of adzuki bean and soybean was outstanding in Tokushima and Kochi Prefectures: the ratio of wild adzuki bean to wild soybean was 5 to 57 in Tokushima and 19 to 97 in Kochi, whereas it was 11 to 21 in Ehime and zero to one in Kagawa. Therefore, we conducted this field survey to mainly collect wild adzuki beans from Tokushima and Kochi Prefectures.

Low annual precipitation has been thought to be one of the reasons why wild adzuki beans were hardly found in the north of Shikoku region in the previous survey (Vaughan *et al.* 1999). Indeed, no accession was found in Kagawa Prefecture, and only five accessions were found in Tokushima. The number of collected accessions in a particular area of Shikoku region seemed to be well correlated with the annual precipitation of the area. Considering this fact, wild adzuki beans are expected to be found around central mountainous areas and south coastline of Tokushima Prefecture where annual rainfall would be sufficient to grow adzuki beans (see “Overview”. Tokushima Prefecture. <https://www.pref.tokushima.lg.jp/en/japanese/about/summary>). In addition, we could collect more wild adzuki bean accessions from Kochi since the annual precipitation in Kochi Prefecture is almost the same as that in the central mountainous areas of Tokushima Prefecture (see “Taiheiyougawa no Tau to Setonaikaigawa no Syouu 太平洋側の多雨と瀬戸内側の少雨.” Takamatsu Meteorological office. <https://www.jma-net.go.jp/takamatsu/11/sub2.html>: written in Japanese).

Methods

A field survey of Tokushima and Kochi Prefectures, Japan, was conducted by car from October 22 to 26, 2018. The survey began at Tokushima airport and ended at the same airport (the itinerary is shown in Table 1; the survey routes are shown in Fig. 1). When we found naturally growing leguminous wild plants, or located a habitat with conditions suitable for finding these legumes, we stopped our car and searched the area for natural populations.

Bulk seed samples were generally collected from each population. When a population contained plants with different traits, the seeds of each morphotype were collected separately.

Passport data recorded included the location of collection sites, i.e., latitude, longitude, and altitude; we sketched the maps of the habitat and noted any special characteristics of the sampled plants (Table 3). This information was stored in our gene bank database when the sampled plants were registered as accessions. Latitude and longitude were measured using the WGS84 world geodetic system and a handheld GPS device, GPSMAP 60sc (Garmin INC., Olathe, KS).

Results and Discussion

In total, 53 accessions, including 25 of *G. soja*, 25 of *V. angularis*, and three of *V. unguiculata*, were recorded, and seed samples of each were collected (Table 2, Fig. 1). The collection consisted of one cultivated accession, three escaped accessions, one intermediate (between cultivated and wild) accession, and 48 wild-type accessions. Passport information for each accession is shown in Table 3, and seed

photographs of each accession are included at the end of this report.

***V. angularis* (Japanese name: Yabutsuru-azuki for wild bean and Azuki for cultivated bean)**

According to a previous study (Kikuchi *et al.* 2005), Yabutsuru-azuki plants (wild adzuki bean) were rarely found in the Yoshino basin, especially in the lower and middle parts. In order to investigate the cause of this observation, we started our survey from the lower part of the Yoshino basin. We tried to find a candidate of Yabutsuru-azuki habitat such as a rim of rice field, but no Yabutsuru-azuki plant was found, whereas *G. soja* (wild soybean, Japanese name: Tsuru-mame) was easily collected at the same place. Around TK2 (Fig. 1), a rim of a fallow paddy field (Photo 2) where one accession of Tsuru-mame (Photo 1) was collected, sweet potato and lotus root fields intermingled with rice fields were found. The soil properties seemed to be sandy, which is not suitable for *V. angularis* (Yabutsuru-azuki and Azuki). Because

Table 1. Itinerary of the field survey in Tokushima and Kochi Prefectures, Japan (October 22–26, 2018)

Date	Itinerary	Stay
2018/10/22	Tsukuba -- (train) -- Haneda Airport -- (airplane) -- Tokushima Airport; Exploration on the Tokushima plains in Tokushima prefecture (car)	Tokushima-shi
2018/10/23	Exploration on the east seaside area and center mountainous area in Tokushima prefecture (car)	Miyoshi-shi
2018/10/24	Exploration on the center mountainous area of Shikoku in Tokushima prefecture and Kochi prefecture (car)	Kochi-shi
2018/10/25	Exploration on the south seaside area in Kochi prefecture (car)	Kaifu-gun Mugi-cho
2018/10/26	Exploration on Kaifu-gun in Tokushima prefecture (car); Tokushima Airport -- (airplane) -- Haneda Airport -- (train)--Tsukuba	

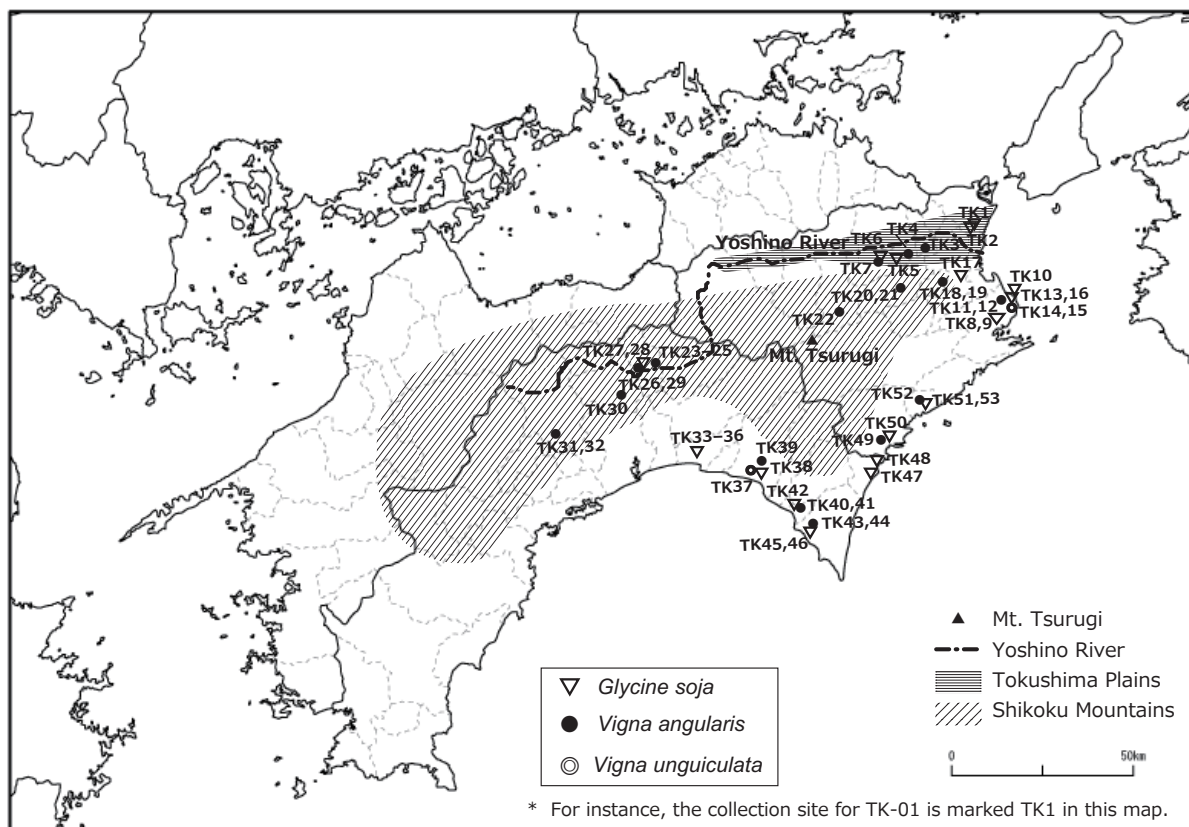


Fig. 1. Survey and collection sites in Tokushima and Kochi Prefectures in 2018.

* For instance, the collection site for TK-01 is marked TK1 in this map.

Table 2. A summary of collected materials in Tokushima and Kochi Prefectures

Species	Wild	Intermediate	Escaped	Cultivated	Total
<i>Vigna angularis</i>	23	1		1	25
<i>Glycine soja</i>	25				25
<i>Vigna unguiculata</i>			3		3
Total	48	1	3	1	53

the Yoshino River has long been known to cause heavy floods repeatedly, most of the area surrounding this river would have sandy soil.

To avoid the sandy soil, we focused on the middle part of the Tokushima plains and surveyed candidates of Yabutsuru-azuki habitat near the base of the Shikoku Mountains (Figure 1, TK3-TK7). Three accessions of Yabutsuru-azuki were collected at their typical habitat, adjacent a rice field (Photos 4 and 5). TK-03 had long pods (Photo 3) and pale colored seeds (Seed photo TK-03), unlike other Yabutsuru-azuki accessions. TK-03 seemed to be an intermediate type between wild and cultivated adzuki beans. We found TK-07 toward nightfall, and a farmer had just finished mowing around his rice field; hence, we could find only young pods of TK-07 (Seed photo TK-07) and collected no seeds. If the survey at Tokushima plains was conducted for a sufficient time, we could have collected more Yabutsuru-azuki accessions.

In the Shikoku Mountains, we planned to survey at mountainous rural villages along national road 439, which is famous as a mountainous tough road in poor condition. Moving through R439 by car was more difficult than we had thought; it required longer than we anticipated. Furthermore, roads leading to mountainous small villages from R439 were very narrow and steep, and hence, we could not reach there in our car. In the future, we intend to use a compact car with four-wheel drive to survey deeper areas of the Shikoku Mountains. However, we could collect five Yabutsuru-azuki accessions from Tokushima Prefecture and seven from the Kochi. Thus, Yabutsuru-azuki plants were found in about 80 % of the candidate sites surveyed by foot.

In the villages along R439, we found Yabutsuru-azuki at rough vacant lands such as deeply fallow fields and gravel parking spaces (Photos 14-17, 20, and 25), which resembled the typical Tsuru-mame habitat rather than the ordinary Yabutsuru-azuki habitat. Notably, TK-22 (Photo 17, Seed photo TK22) was collected from a fallow field at an altitude of over 500 m. Yabutsuru-azuki habitats rarely exceed 500 m, except in Nagano Prefecture.

Many landrace adzuki beans were collected from these mountainous villages during three surveys for landrace crops in the 1990s (Nakayama *et al.* 1993; Okuno *et al.* 1994; Nakamura *et al.* 1997). In this survey, a village person in Nishi-iyayama-son informed us that many farmers used to cultivate Azuki; however, at present, none of the farmers did. Nevertheless, a salesperson of a produce-stand in the village said that she could obtain Azuki from neighboring villages. Indeed, we could find cultivated adzuki bean in Ino-cho of Kochi Prefecture (Photo 26, Seed photo TK-32).

On the south coastline of Kochi and Tokushima Prefectures, we could collect only seven Yabutsuru-azuki accessions, whereas 13 Tsuru-mame accessions were collected. Unlike in the mountainous area, we often found only Tsuru-mame at the typical Yabutsuru-azuki habitat. The ratio of collected Yabutsuru-azuki to Tsuru-mame was especially low at the east coast of Cape Muroto (TK47-53; Fig. 1, Table 3). This area is characterized by heavy rain and often damaged by typhoons. Thus, excessive rainfall might have affected the ratio.

Wild-type soybeans (*G. soja*, Japanese name: Tsuru-mame)

Basically, Tsuru-mame is found around Yabutsuru-azuki habitat. Therefore, we expected that the number of Tsuru-mame accessions collected would be similar to that of *V. angularis* (Yabutsuru-azuki and Azuki) accessions in this survey, although we aimed at finding Yabutsuru-azuki. As expected, we could finally collect 25 accessions of Tsuru-mame: the same number as that for *V. angularis*. Nonetheless, the progress showed some differences from our expectations.

In the mountainous villages of the Shikoku Mountains, we could collect 12 accessions of Yabutsuru-azuki, but only two accessions of Tsuru-mame. We could not find Tsuru-mame growing sympatrically with Yabutsuru-azuki in this area, except for at a heliport at Shimotsuno, Motoyama-cho, Nagaoka-gun (TK-26-29; Fig. 1, Table 3).

In contrast, Tsuru-mame accessions could be easily collected from the south coastline of Kochi and Tokushima Prefectures. In these areas, 13 Tsuru-mame accessions, exceeding the number of Yabutsuru-azuki collected, were collected. Tsuru-mame often grew at the rim of rice and fallow fields, which resembled the typical Yabutsuru-azuki habitat.

Cowpea (*V. unguiculata*, Japanese name: Sasage)

Two Sasage accessions, which produce black seeds (Photo 12, Seed photos TK-14 and 15), were collected at a roadside between a paddy field and an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park, a bird sanctuary that holds the record for the most sightings of wild bird species in Tokushima Prefecture. We could also collect two Yabutsuru-azuki and Tsuru-mame accessions each at the same roadside (Photos 10 - 13). Many kinds of plants of foreign origin, including *Vigna umbellata* (Thunb.) Ohwi et Ohashi, had been previously recorded around the Wild Bird Park (Kimura *et al.* 1995). Wild *V. umbellata* found around the Wild Bird Park were thought to have escaped from cultivated *V. umbellata* of Indian origin (Kimura *et al.* 1995). We believe that wild birds would contribute to the spread of seeds of leguminous plants such as *V. umbellata*, *V. unguiculata* (Sasage), *V. angularis* (Yabutsuru-azuki), and *G. soja* (Tsuru-mame). The Sasage accessions, TK-14 and TK-15, might have escaped from cultivation, and their seed dispersion may have been mediated by wild birds visiting the bird sanctuary. The Yabutsuru-azuki and Tsuru-mame accessions, TK-11-13 and TK-16, may also have been dispersed by wild birds.

TK-37, a Sasage accession with red seeds (Photo 29, Seed photo TK-37), was found in a fallow field (Photo 30). At the slope of a railway embankment close to a fallow field, Sasage plants similar to TK-37 grew in clusters. These should have escaped from a backyard garden of the nearest farmer's house.

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徳島県および高知県におけるマメ科植物遺伝資源の 探索収集，2018 年 10 月 22 日～26 日

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和文摘要

本報告は，2018 年 10 月 22 日～26 日に実施した徳島県および高知県でのマメ科植物遺伝資源の調査報告である．今回の調査では，両県において実施された過去 5 回の調査で収集点数が少なかった野生アズキ (*V. angularis*, ヤブツルアズキ) を収集することを主目的とした．結果として，野生アズキ (*V. angularis*, ヤブツルアズキ) 23 点，雑種アズキ (*V. angularis*) 1 点，栽培アズキ (*V. angularis*, アズキ) 1 点，野生ダイズ (*Glycine soja*, ツルマメ) 25 点，ササゲ (*V. unguiculata*) 3 点，合計 53 点のマメ科植物遺伝資源を収集した．収集したすべてのマメ科植物遺伝資源は，つくば市にある農業・食品産業技術総合研究機構 遺伝資源センター圃場で栽培し，特性評価と種子増殖を行う計画である．増殖種子は，農業・食品産業技術総合研究機構のジーンバンクで保存するとともに，研究や教育に利用するための配布可能な遺伝資源とする．

Table 3. Passport information of the collected materials

Col. No. / Map ID	JP No.	Scientific name	Japanese name	Col. Date	Status	Collection Site (Address)	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
TK-01	267735	<i>Glycine soja</i>	Tsuru-mame	22 Oct, 2018	Wild	Bingoeya Tarohachizu, Kitajima-cho, Itano-gun, Tokushima 徳島県 板野郡 北島町 太郎八須 備後江家	N34°08'00.5"	E134°33'45.9"	2	sandy loam	bulk	no	no	Between a paddy field and a fallow paddy field beside an irrigation ditch near Tokushima expressway
TK-02	267736	<i>Glycine soja</i>	Tsuru-mame	22 Oct, 2018	Wild	Fukujin Nakamura, Kitajima-cho, Itano-gun, Tokushima 徳島県 板野郡 北島町 福神 中村	N34°07'39.2"	E134°33'28.5"	3	sandy loam	bulk	no	no	At a fallow paddy field among lotus ponds and sweet potato fields near the Imakiri river
TK-03	267737	<i>Vigna angularis</i>	Zasshu-azuki	22 Oct, 2018	Intermediate	Jonouchi Ishii, Ishii-cho, Myozai-gun, Tokushima 徳島県 名西郡 石井町 石井	N34°03'44.9"	E134°25'54.6"	8	sandy loam	bulk	no	no	At a fallow paddy field beside rice fields
TK-04	267738	<i>Vigna angularis</i>	Yabutsuru-azuki	22 Oct, 2018	Wild	Kamiura, Kamojima-cho, Yoshinogawa-shi, Tokushima 徳島県 吉野川市 鴨島町 上浦	N34°03'52.7"	E134°23'50.3"	14	clay loam	bulk	no	no	At a vacant land near a graveyard beside rice field
TK-05	267739	<i>Glycine soja</i>	Tsuru-mame	22 Oct, 2018	Wild	Inoo, Kamojima-cho, Yoshinogawa-shi, Tokushima 徳島県 吉野川市 鴨島町 飯尾	N34°03'28.4"	E134°21'00.7"	18	clay loam	bulk	no	no	At a fallow paddy field beside rice fields
TK-06	267740	<i>Glycine soja</i>	Tsuru-mame	22 Oct, 2018	Wild	Kawashima, Kawashima-cho, Yoshinogawa-shi, Tokushima 徳島県 吉野川市 川島町 川島	N34°03'44.8"	E134°19'25.1"	41	clay loam	bulk	no	no	Beside a paddy field
TK-07	267741	<i>Vigna angularis</i>	Yabutsuru-azuki	22 Oct, 2018	Wild	Kawashima, Kawashima-cho, Yoshinogawa-shi, Tokushima 徳島県 吉野川市 川島町 川島	N34°03'44.8"	E134°19'25.1"	41	clay loam	bulk	no	no	Beside a paddy field
TK-08	267742	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Fujishima, Nakagawa-cho, Kamifukui, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 上福井 藤島	N33°57'05.8"	E134°40'19.2"	2	clay loam	bulk	no	no	Between a paddy field and an irrigation ditch near a road rest stop named Michinoeki Nakagawa along R55
TK-09	267743	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Fujishima, Nakagawa-cho, Kamifukui, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 上福井 藤島	N33°57'07.3"	E134°40'21.8"	4	clay loam	bulk	no	no	Between a paddy field and an irrigation ditch near a road rest stop named Michinoeki Nakagawa along R55
TK-10	267744	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Midoridai, Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 みどり台	N33°57'37.4"	E134°40'20.6"	7	gravel	bulk	no	no	At a junction of the garden paths of the Tokushima Prefectural Nakagawa Dejima Bird Sanctuary
TK-11	267745	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'28.3"	E134°40'24.3"	6	loam	bulk	no	no	At a roadside between a paddy field and an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-12	267746	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'27.7"	E134°40'26.3"	6	loam	bulk	no	no	At a roadside between a paddy field and an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-13	267747	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'27.5"	E134°40'27.1"	6	gravel	bulk	no	no	At a rim of irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-14	267748	<i>Vigna unguiculata</i>	Sasage	23 Oct, 2018	escaped	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'26.6"	E134°40'30.7"	7	clay loam	bulk	no	no	At a rim of paddy field beside the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-15	267749	<i>Vigna unguiculata</i>	Sasage	23 Oct, 2018	escaped	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'26.5"	E134°40'31.4"	7	loam	bulk	no	no	At a rim of irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-16	267750	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Takumuji Nakagawa-cho, Anan-shi, Tokushima 徳島県 阿南市 那賀川町 工地	N33°57'26.4"	E134°40'31.6"	7	loam	bulk	no	no	At a rim of irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park
TK-17	267751	<i>Glycine soja</i>	Tsuru-mame	23 Oct, 2018	Wild	Hata-cho, Tokushima-shi, Tokushima 徳島県 徳島市 八多町	N33°59'34.7"	E134°31'08.2"	29	gravel	bulk	no	no	At a vacant land between a bush and a paddy field along the Ogawa river
TK-18	267752	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Teradani Shimo Sanagouchi-son, Myodo-gun, Tokushima 徳島県 名東郡 佐那河内村 寺谷 下	N34°00'02.2"	E134°29'12.0"	52	loam	bulk	no	no	In a large fallow field beside prefectural road 18
TK-19	267753	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Teradani Shimo Sanagouchi-son, Myodo-gun, Tokushima 徳島県 名東郡 佐那河内村 寺谷 下	N34°00'02.5"	E134°29'09.2"	48	loam	bulk	no	no	In a large fallow field beside prefectural road 18

Table 3. (Continued).

Col. No. / Map ID	JP No.	Scientific name	Japanese name	Col. Date	Status	Collection Site (Address)	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
TK-20	267754	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Jinryo Kita, Kamiyama-cho, Myozai-gun, Tokushima 徳島県 名西郡 神山町 神領北	N33°58'02.4"	E134°20'21.6"	148	loam	bulk	no	no	In a vacant field where might be used as a kitchen garden among houses
TK-21	267755	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Jinryo, Kamiyama-cho, Myozai-gun, Tokushima 徳島県 名西郡 神山町 神領	N33°58'05.7"	E134°20'23.5"	148	gravel	bulk	no	no	In a vacant field where might be used as parking space beside the Akui river
TK-22	267756	<i>Vigna angularis</i>	Yabutsuru-azuki	23 Oct, 2018	Wild	Koyadaira, Mima-shi, Tokushima 徳島県 美馬市 木屋平	N33°53'26.4"	E134°08'49.9"	562	loam	bulk	no	no	In a fallow field beside national road 439
TK-23	267757	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Kamizeki, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 上関	N33°45'51.0"	E133°37'08.1"	240	clay loam	bulk	no	no	Beside a paddy field
TK-24	267758	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Kamizeki, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 上関	N33°45'49.2"	E133°37'08.3"	242	clay loam	bulk	no	no	Beside a paddy field
TK-25	267759	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Kamizeki, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 上関	N33°45'53.3"	E133°37'06.8"	242	loam	bulk	no	no	On a slope beside a paddy field
TK-26	267760	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Shimotsuno, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 下津野	N33°45'34.3"	E133°35'53.9"	246	gravel	bulk	no	no	Beside a gravel road toward a heliport
TK-27	267761	<i>Glycine soja</i>	Tsuru-mame	24 Oct, 2018	Wild	Shimotsuno, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 下津野	N33°45'34.3"	E133°35'53.9"	246	gravel	bulk	no	no	Beside a gravel road toward a heliport
TK-28	267762	<i>Glycine soja</i>	Tsuru-mame	24 Oct, 2018	Wild	Shimotsuno, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 下津野	N33°45'30.9"	E133°35'54.7"	246	gravel	bulk	no	no	Beside a gravel parking space adjoining a heliport
TK-29	267763	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Shimotsuno, Motoyama-cho, Nagaoka-gun, Kochi 高知県 長岡郡 本山町 下津野	N33°45'30.3"	E133°35'52.8"	247	gravel	bulk	no	no	In a tussock around a heliport
TK-30	267764	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Jizoji, Tosa-cho, Tosa-gun, Kochi 高知県 土佐郡 土佐町 地藏寺	N33°42'16.2"	E133°30'06.6"	317	clay loam	bulk	no	no	On a junction slope beside a paddy field
TK-31	267765	<i>Vigna angularis</i>	Yabutsuru-azuki	24 Oct, 2018	Wild	Kogawayanagino, Ino-cho, Agawa-gun, Kochi 高知県 吾川郡 いの町 小川柳野	N33°37'19.2"	E133°14'43.8"	255	gravel	bulk	no	no	In a vacant field beside a small bridge across Ogawa river
TK-32	267766	<i>Vigna angularis</i>	Azuki	24 Oct, 2018	cultivated	Kogawayanagino, Ino-cho, Agawa-gun, Kochi 高知県 吾川郡 いの町 小川柳野	N33°37'15.3"	E133°14'40.1"	269	loam	bulk	no	no	In a cultivated field
TK-33	267767	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Tokuoji, Kagami-cho, Konan-shi, Kochi 高知県 香南市 香我美町 徳王子	N33°32'54.4"	E133°43'57.5"	5	loam	bulk	no	no	Beside a paddy field next to a fallow green house
TK-34	267768	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Tokuoji, Kagami-cho, Konan-shi, Kochi 高知県 香南市 香我美町 徳王子	N33°32'57.8"	E133°43'58.5"	5	clay loam	bulk	no	no	Beside a paddy field next to a fallow green house
TK-35	267769	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Tokuoji, Kagami-cho, Konan-shi, Kochi 高知県 香南市 香我美町 徳王子	N33°33'01.7"	E133°43'55.6"	5	clay loam	bulk	no	no	Beside a paddy field near
TK-36	267770	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Doi, Noichi-cho, Konan-shi, Kochi 高知県 香南市 野市町 土居	N33°33'34.9"	E133°43'42.5"	7	clay loam	bulk	no	no	Beside a paddy field near
TK-37	267771	<i>Vigna unguiculata</i>	Sasage	25 Oct, 2018	escaped	Kawakitako, Aki-shi, Kochi 高知県 安芸市 川北甲	N33°29'58.0"	E133°55'00.5"	6	loam	bulk	no	no	In a fallow field between a broccoli field and a cowshed
TK-38	267772	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Kawakitako, Aki-shi, Kochi 高知県 安芸市 川北甲	N33°29'56.5"	E133°55'03.2"	6	loam	bulk	no	no	In a vacant field
TK-39	267773	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Kawakitako, Aki-shi, Kochi 高知県 安芸市 川北甲	N33°30'13.1"	E133°55'22.1"	9	clay loam	bulk	no	no	At a slope of an irrigation ditch beside a road through paddy fields
TK-40	267774	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Otsu, Nahari-shi, Aki-gun, Kochi 高知県 安芸郡 奈半利町 乙	N33°25'20.6"	E134°01'43.3"	15	clay loam	bulk	no	no	At a slope of an irrigation ditch beside a paddy fields
TK-41	267775	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Otsu, Nahari-shi, Aki-gun, Kochi 高知県 安芸郡 奈半利町 乙	N33°25'29.8"	E134°01'43.5"	14	loam	bulk	no	no	In a tussock beside a paddy field
TK-42	267776	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Otsu, Nahari-shi, Aki-gun, Kochi 高知県 安芸郡 奈半利町 乙	N33°25'31.0"	E134°01'44.9"	15	gravel	bulk	no	no	In a tussock between irrigation ditches

Table 3. (Continued).

Col. No. / Map ID	JP No.	Scientific name	Japanese name	Col. Date	Status	Collection Site (Address)	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Nodule	Remarks
TK-43	267777	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Hane-cho, Muroto-shi, Kochi 高知県 室戸市 羽根町	N33°22'13.1"	E134°03'41.3"	33	clay loam	bulk	no	no	At a bank beside a paddy field
TK-44	267778	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Hane-cho, Muroto-shi, Kochi 高知県 室戸市 羽根町	N33°22'14.0"	E134°03'40.1"	32	clay loam	bulk	no	no	At a bank beside a paddy field
TK-45	267779	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Hane-cho, Muroto-shi, Kochi 高知県 室戸市 羽根町	N33°22'13.5"	E134°03'41.6"	30	clay loam	bulk	no	no	Beside a paddy field upside
TK-46	267780	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Hane-cho, Muroto-shi, Kochi 高知県 室戸市 羽根町	N33°22'05.1"	E134°03'36.3"	18	clay loam	bulk	no	no	At a bank beside a paddy field
TK-47	267781	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	None, Toyo-cho, Aki-gun, Kochi 高知県 安芸郡 東洋町 野根	N33°30'17.5"	E134°16'02.2"	5	loam	bulk	no	no	Inside a fallow green house
TK-48	267782	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Ikumi, Toyo-cho, Aki-gun, Kochi 高知県 安芸郡 東洋町 生見	N33°31'29.7"	E134°16'30.7"	3	clay loam	bulk	no	no	Beside a fallow field near a irrigation ditch
TK-49	267783	<i>Vigna angularis</i>	Yabutsuru-azuki	25 Oct, 2018	Wild	Hibiharai, Kaiyou-cho, Kaifu-gun, Tokushima 徳島県 海部郡 海陽町 日比原	N33°33'55.9"	E134°17'11.6"	10	clay loam	bulk	no	no	Beside a fallow field
TK-50	267784	<i>Glycine soja</i>	Tsuru-mame	25 Oct, 2018	Wild	Hibiharai, Kaiyou-cho, Kaifu-gun, Tokushima 徳島県 海部郡 海陽町 日比原	N33°33'55.9"	E134°17'11.6"	10	clay loam	bulk	no	no	Beside a fallow field
TK-51	267785	<i>Glycine soja</i>	Tsuru-mame	26 Oct, 2018	Wild	Nada, Mugi-cho, Kaifu-gun, Tokushima 徳島県 海部郡 牟岐町 灘	N33°39'51.8"	E134°25'51.6"	5	loam	bulk	no	no	In a fallow field
TK-52	267786	<i>Vigna angularis</i>	Yabutsuru-azuki	26 Oct, 2018	Wild	Nada, Mugi-cho, Kaifu-gun, Tokushima 徳島県 海部郡 牟岐町 灘	N33°40'03.4"	E134°25'50.6"	7	clay loam	bulk	no	no	Beside a paddy field
TK-53	267787	<i>Glycine soja</i>	Tsuru-mame	26 Oct, 2018	Wild	Nada, Mugi-cho, Kaifu-gun, Tokushima 徳島県 海部郡 牟岐町 灘	N33°40'02.1"	E134°25'50.2"	7	clay loam	bulk	no	no	Beside a paddy field



Photo 1. Pods of *G. soja* (TK-02) at a fallow paddy field among lotus ponds and sweet potato.



Photo 2. Habitat of *G. soja* (TK-02), Fukujin Nakamura, Kitajima-cho, Itano-gun, Tokushima.



Photo 3. Pods of *V. angularis* (TK-03) at a fallow paddy field adjacent to rice fields.



Photo 4. Habitat of *V. angularis* (TK-03), Jonouchi Ishii, Ishii-cho, Myozai-gun, Tokushima.



Photo 5. Habitat of *V. angularis* (TK-04), Kamiura, Kamojima-cho, Yoshinogawa-shi, Tokushima.



Photo 6. A plant of *V. angularis* (TK-04) at a vacant land near a graveyard adjacent a rice field.

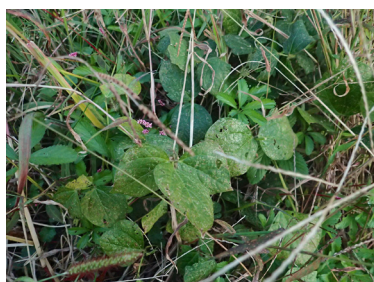


Photo 7. A plant of *V. angularis* (TK-07) adjacent a paddy field, Kawashima, Kawashima-cho, Yoshinogawa-shi, Tokushima.



Photo 8. Habitat of *G. soja* (TK-08 and TK-09), Fujishima, Nakagawa-cho, Kamifukui, Anan-shi, Tokushima.



Photo 9. Pods of *G. soja* (TK-09) between a paddy field and an irrigation ditch near a road rest stop named Michinoeki Nakagawa along R55.



Photo 10. A plant of *V. angularis* (TK-11) at a roadside between a paddy field and an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park.



Photo 11. Pods of *G. soja* (TK-13) at a rim of an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park.

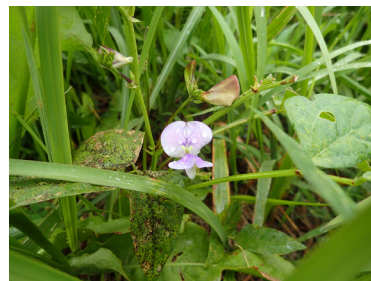


Photo 12. A flower of *V. unguiculata* (TK-15) at a rim of an irrigation ditch around the Tokushima Prefectural Nakagawa Dejima Wild Bird Park.



Photo 13. Habitat of *V. angularis*, *G. soja*, and *V. unguiculata* (TK-11 - 16), Takumuji Nakagawa-cho, Anan-shi, Tokushima.



Photo 14. Plants of *V. angularis* (TK-18) in a large fallow field adjacent to R18.



Photo 15. Habitat of *V. angularis* (TK-18 and TK-19), Teradani Shimo Sanagouchison, Myodo-gun, Tokushima.



Photo 16. Plants of *V. angularis* (TK-21) in a vacant field that was used as parking space adjacent the Akui river, Jinryo, Kamiyama-cho, Myozai-gun, Tokushima.



Photo 17. Plants of *V. angularis* (TK-22) in a fallow field adjacent to R438, Koyadaira, Mima-shi, Tokushima.



Photo 18. Habitat of *V. angularis* (TK-23 and TK-24), Kamizeki, Motoyama-cho, Nagaoka-gun, Kochi.

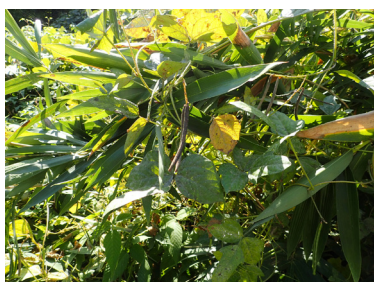


Photo 19. Plants of *V. angularis* (TK-24) adjacent a paddy field.



Photo 20. Plants of *V. angularis* (TK-26) adjacent a gravel road toward a heliport.

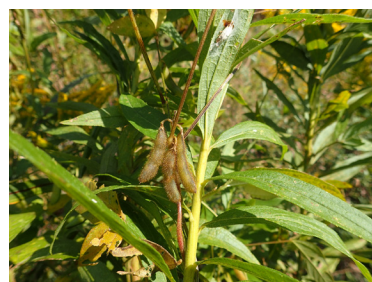


Photo 21. Pods of *G. soja* (TK-27) adjacent a gravel road toward a heliport



Photo 22. Habitat of *V. angularis* (TK-26) and *G. soja* (TK-27), Shimotsuno, Motoyama-cho, Nagaoka-gun, Kochi.



Photo 23. Plants of *V. angularis* (TK-30) on a junction slope adjacent a paddy field.



Photo 24. Habitat of *V. angularis* (TK-30), Jizoji, Tosa-cho, Tosa-gun, Kochi.



Photo 25. Plants of *V. angularis* (TK-31) in a vacant field adjacent a small bridge across Ogawa river.



Photo 26. An adzuki bean field where TK-32 was collected, Kogawayanagino, Inocho, Agawa-gun, Kochi.



Photo 27. Habitat of *G. soja* (TK-33 and TK-34), Tokuoji, Kagami-cho, Konan-shi, Kochi.



Photo 28. Plants of *G. soja* (TK-34), adjacent a paddy field next to a fallow green house.



Photo 29. Plants of *V. unguiculata* (TK-37) in a fallow field between a broccoli field and a cowshed.



Photo 30. Habitat of *V. unguiculata* (TK-37), Kawakitako, Aki-shi, Kochi.



Photo 31. Plants of *V. angularis* (TK-44) at a bank adjacent a paddy field.



Photo 32. Plants of *G. soja* (TK-45), adjacent a paddy field next to the paddy field growing TK-44.



Photo 33. Habitat of *V. angularis* (TK-44) Tashiro, Hane-cho, Muroto-shi, Kochi.



Photo 34. Pods of *V. angularis* (TK-52) adjacent a paddy field.

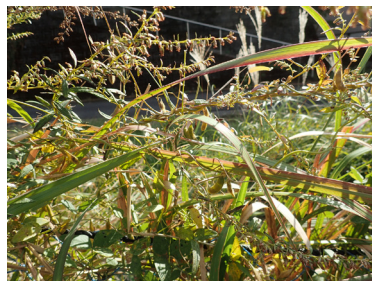


Photo 35. Pods of *G. soja* (TK-53) growing adjacent the same paddy field from where TK-52 was collected.



Photo 36. Habitat of *V. angularis* (TK-52) and *G. soja* (TK-53), Nada, Mugi-cho, Kaifu-gun, Tokushima.

Seed photos



TK-01, JP267735,
Glycine soja



TK-02, JP267736,
Glycine soja



TK-03, JP267737,
Vigna angularis (intermediate)



TK-04, JP267738,
Vigna angularis (wild)



TK-05, JP267739,
Glycine soja



TK-06, JP267740,
Glycine soja



TK-07, JP267741,
Vigna angularis (wild)



TK-08, JP267742,
Glycine soja



TK-09, JP267743,
Glycine soja



TK-10, JP267744,
Glycine soja



TK-11, JP267745,
Vigna angularis (wild)



TK-12, JP267746,
Vigna angularis (wild)



TK-13, JP267747,
Glycine soja



TK-14, JP267748,
Vigna unguiculata



TK-15, JP267749,
Vigna unguiculata

The scale on the ruler under the seeds indicates 1.0 mm.



TK-16, JP267750,
Glycine soja



TK-17, JP267751,
Glycine soja



TK-18, JP267752,
Vigna angularis (wild)



TK-19, JP267753,
Vigna angularis (wild)



TK-20, JP267754,
Vigna angularis (wild)



TK-21, JP267755,
Vigna angularis (wild)



TK-22, JP267756,
Vigna angularis (wild)



TK-23, JP267757,
Vigna angularis (wild)



TK-24, JP267758,
Vigna angularis (wild)



TK-25, JP267759,
Vigna angularis (wild)



TK-26, JP267760,
Vigna angularis (wild)



TK-27, JP267761,
Glycine soja



TK-28, JP267762,
Glycine soja



TK-29, JP267763,
Vigna angularis (wild)



TK-30, JP267764,
Vigna angularis (wild)

The scale on the ruler under the seeds indicates 1.0 mm.



TK-31, JP267765,
Vigna angularis (wild)



TK-32, JP267766,
Vigna angularis (cultivated)



TK-33, JP267767,
Glycine soja



TK-34, JP267768,
Glycine soja



TK-35, JP267769,
Glycine soja



TK-36, JP267770,
Glycine soja



TK-37, JP267771,
Vigna unguiculata



TK-38, JP267772,
Glycine soja



TK-39, JP267773,
Vigna angularis (wild)



TK-40, JP267774,
Vigna angularis (wild)



TK-41, JP267775,
Vigna angularis (wild)



TK-42, JP267776,
Glycine soja



TK-43, JP267777,
Vigna angularis (wild)



TK-44, JP267778,
Vigna angularis (wild)



TK-45, JP267779,
Glycine soja

The scale on the ruler under the seeds indicates 1.0 mm.



TK-46, JP267780,
Glycine soja



TK-47, JP267781,
Glycine soja



TK-48, JP267782,
Glycine soja



TK-49, JP267783,
Vigna angularis (wild)



TK-50, JP267784,
Glycine soja



TK-51, JP267785,
Glycine soja



TK-52, JP267786,
Vigna angularis (wild)



TK-53, JP267787,
Glycine soja

The scale on the ruler under the seeds indicates 1.0 mm.