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Original Paper

Collection and Field Survey of Wild *Vigna* Genetic Resources in the Yaeyama Archipelago, Okinawa Prefecture, Japan, 8 th to 14 th July, 2013

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Summary

We conducted a field survey of genus *Vigna* plants in the Yaeyama archipelago (Ishigaki, Iriomote, Hateruma and Yonaguni islands), Okinawa prefecture, from 8th to 14th July, 2013. A total of 26 accessions were collected from 3 species in the genus *Vigna*. These included 1 accession of *Vigna luteola* (Jacq.) Benth., 22 accessions of *V. marina* (Burm.) Merr. and 3 accessions of *V. riukiuensis* (Ohwi) Ohwi & Ohashi. At several habitats, roots were observed by digging the soil, and pH levels and NaCl concentrations of the soils were measured. Collected seeds were conserved in the National Institute of Agrobiological Sciences (NIAS) genebank. We plan to multiply the seeds and evaluate their growth traits.

KEY WORDS : *Vigna*, genetic resource, Okinawa islands, soil pH, soil NaCl, typhoon

Introduction

The genus *Vigna* belongs to the legume family (Leguminosae), and includes several crop species such as cowpea (*V. unguiculata* (L.) Walp.), mungbean (*V. radiata* (L.) Wilczek) and azuki bean (*V. angularis* (Willd.) Ohwi & Ohashi). Their wild relatives grow in a diverse range of environments such as arid areas, coastlines and lime stone mountains. Therefore, it is expected that these wild relatives might be suitable as the breeding materials to develop stress tolerant crops (Tomooka *et al*. 2014). For this reason, we have been concentrating on the collection and evaluation of the wild *Vigna.* Seven wild *Vigna* species distribute in Japan. Those are *Vigna angularis* (willd.) Ohwi & Ohashi var. *nipponensis* (Ohwi) Ohwi & Ohashi, *V. nakashimae* (Ohwi) Ohwi & Ohashi, *V. vexillata* (L.) A. Rich., *V. marina* (Burm.) Merr., *V. luteola* (Jacq.) Benth., *V. riukiuensis* (Ohwi) Ohwi & Ohashi and *V. reflexo-pilosa* Hayata. Among them, four species, i.e., *V. marina*, *V. luteola*, *V. riukiuensis* and *V. reflexo-pilosa* distribute in Yaeyama archipelago. Hence, we decided to survey Yaeyama archipelago. This is a report of the field survey on the collection of these wild *Vigna* plants in Ishigaki, Iriomote, Hateruma and Yonaguni islands. These islands are part of the Yaeyama archipelago, which is located south west of the main island of Okinawa.

Table 1. Itinerary of the field survey in the Yaeyama archipelago, 2013

Date	Itinerary	Stay
7/8	Haneda AP 10:00 --(ANA129)-- 12:35 Naha AP 13:10 --(ANA1773)-- 14:10 Ishigaki AP (Ishigaki island exploration)	Ishigaki island
7/9	Ishigaki P -- (high speed boat)-- Iriomote P (Iriomote island exploration) Iriomote P --(high speed boat)-- Ishigaki P	Ishigaki island
7/10	Ishigaki P --(high speed boat)-- Hateruma P (Hateruma island exploration) Hateruma P --(high speed boat)-- Ishigaki P	Ishigaki island
7/11	Ishigaki AP 10:45 --(RAC741)-- 11:15 Yonaguni AP (Yonaguni island exploration)	Yonaguni island
7/12	(stay at hotel because of the typhoon, Yonaguni island)	Yonaguni island
7/13	(survey of the habitat to check the effects of typhoon, Yonaguni island)	Yonaguni island
7/14	Yonaguni AP 12:00 --(RAC724)-- 13:30 Naha AP 14:20 --(JAL914)-- 16:45 Haneda AP	

AP: airport, P: port

Table 2. A summary of collected seed samples on each island

Scientific name	Ishigaki	Iriomote	Hateruma	Yonaguni	Total
Vigna luteola	1				1
Vigna marina	2	3	10	7	22
Vigna riukiuensis			1	2	3
Total	3	3	11	9	26

Methods

A field survey was conducted from 8th to 14th of July, 2013. We started a survey on Ishigaki island, and went to Iriomote and Hateruma islands by high-speed boat and to Yonaguni island by airplane (Table 1). The survey within 4 islands was conducted by car. When we saw wild *Vigna* plants from the car or saw the environment where wild *Vigna* plants seemed to grow, we stopped our car and searched the area. Identification of the *Vigna* species was based on a taxonomic key (Tomooka *et al.* 2002). As a passport data, the place name, latitude, longitude, altitude, characteristics of the collection site and plant population were recorded. The latitude, longitude and altitude were measured by Garmin GPSmap 60CSx using WGS84 world geodetic system. Soil samples were collected at several wild *Vigna* habitats to characterize the soil environment. After returned to Tsukuba, the soil samples were dried and blended with 5 times distilled water by weight, then the pH levels and NaCl concentrations were measured.

An accession of *V. marina* collected at Haemida beach ('IRIO-1') was grown in green house in Tsukuba, Japan. Plants were propagated by stem cuttings and cultured in hydroponic culture solution in a container made of Styrofoam (20 x 30 x 20 cm). The culture solution was prepared by mixing equal amount of diluted solution of Otsuka house No. 1 (1.5 g/L) and Otsuka house No. 2 (1g/L) (Otsuka Chemical Co., Osaka, Japan: N, P, K, Ca and Mg = 18.6, 5.1, 8.6, 8.2 and 3.0 mEq/l, respectively). The final solution was adjusted to 4L and an EC of 100 mS/m with water. Phenol red was added to serves as a visible marker of changing pH of the culture solution. Two weeks after start stem cutting culture, pH was adjusted to 10 by adding K_2CO_3 (1.85 g/L, 13.4 mM). The pH of a solution was measured every day for 20 days after alkaline treatment. pH was measured using pH meter (TOA DKK Co., Tokyo, Japan: HM-30P).

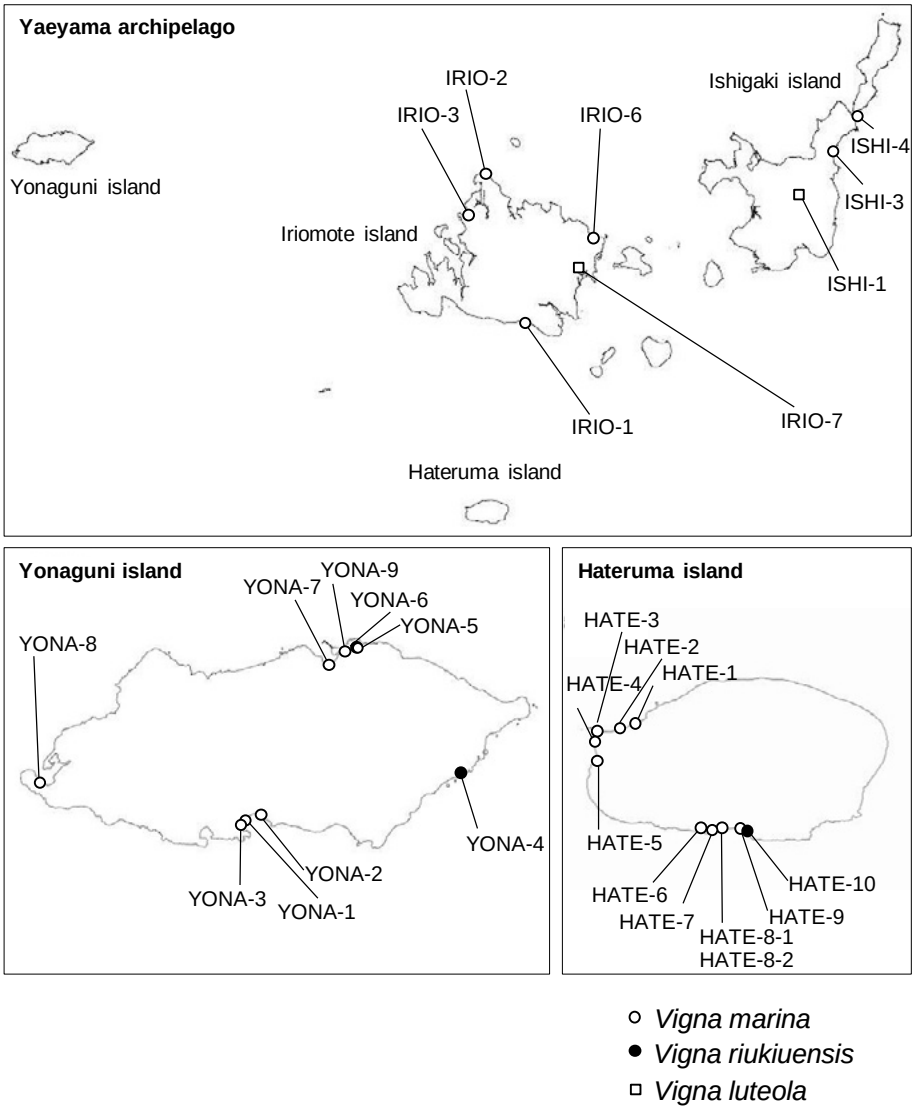

Fig. 1. A map of the collection or survey sites on each island

Results and Discussions

A total of 26 accessions was collected from 3 species in the genus *Vigna* (Table 2). These include 1 accession of *Vigna luteola*, 22 accessions of *V. marina* and 3 accessions of *V. riukiuensis*. Collection sites were shown in Fig. 1. The pH levels and NaCl concentrations were summarized in Table 3. The characteristics of each accession are summarized as passport information in Table 4 and observations on some of the selected accessions from each species are described below.

***Vigna marina* (Burm.) Merr.**

Vigna marina is a pan tropical species growing mainly on sandy beach (Tomooka *et al*. 2010). This species is reported to be used by some African farmers as a cover crop and a green manure (Maxted *et al*. 2004). Several habitats of *V. marina* plants had been discovered in Ishigaki and Iriomote islands by the previous surveys (Tomooka *et al.* 2012, 2013). These sites were re-visited to monitor their growth and to investigate the soil environment of the habitat and their root system, because our previous studies had shown that *V. marina* has high salt and alkaline tolerance (Chankaew *et al*. 2014).

The roots of *V. marina* at Inoda sandy beach (‘ISHI-3’, Ishigaki island) branched laterally at about

20 cm below the soil surface (Photo 1). Soil samples were taken at depths of about 5 cm, 20 cm and 50 cm. On Iriomote island, the roots of *V. marina* growing at Haemida sandy beach ('IRIO-1') branched sideways at about 50 cm below the soil surface. Soil samples were taken at depths of about 5 cm and 50 cm around this plant. At Funara-bashi (Iriomote island), many *V. marina* plants ('IRIO-6') were found growing on the stone embankment, and there was a sandy beach below the embankment. The roots of *V. marina* growing on the sandy beach at a few meters from the high tidemark elongated to the depth deeper than 60 cm (Photo 2). There was water seeping in the soil at a depth of 60 cm, but this water did not taste salty. Inland water might have contributed to this seeping, because there was an estuary near this site. Soil samples were taken at depths of about 20 cm and 60 cm around this plant. At Hoshidate sandy beach ('IRIO-3', Iriomote island), many young seedlings of *V. marina* were observed at places near the accumulated sediments around water's edge at high tide. The roots of a seedling branched laterally at about 20 cm below the soil surface (Photo 3), and the lateral roots elongated particularly long near the soil surface (Photo 4). At this site, a seedling which had a blackish root surface was found (Photo 5, blackish root surface indicated by white arrows). This blackish material surrounding *V. marina* root was thought to be a bark of small tree branch fallen on a sandy beach. The root of *V. marina* seemed to penetrate in a small fallen tree branch vertically. A large *V. marina* plant was found in place where there was shrub vegetation nearby. This plant had thick lateral roots from which a number of shoots emerged. At Hoshizuna sandy beach ('IRIO-2', Iriomote island), several *V. marina* plants were found, but they did not set pods. It seemed that some kind of nutrient deficiency occurred at this site judging from their small leaves with yellow pigmentations (Photo 6).

Hateruma island is the southernmost inhabited island in Japan. At Nishihama sandy beach, 5 accessions from 'HATE-1' to 'HATE-5' were collected. 'HATE-1' was found around a sea side hut, located at a little higher place from the beach (Photo 7). The leaves had wilted under the dry conditions, but there were many mature seeds on the ground shattered from the pods. At 'HATE-2' site on the sandy beach, several young seedlings were found. The roots of a *V. marina* seedling branched and elongated radially at about 10 cm below the soil surface (Photo 8, indicated by white arrows). Several root nodules were found on the roots of this plant. At 'HATE-3' site, a *Vigna marina* plant had inserted its roots into the fibrous fruit of Pandanus odoratissimus, and nodules were found on the roots of this plant (Photo 9). 'HATE-4' was showed severe damage from the parasitic plant *Cassytha filiformis* (Photo 10). 'HATE-5' was found growing in a crack space of coral rock (Photo 11). Root nodules were collected from this plant.

At Pemuchi sandy beach area, accessions from 'HATE-6' to 'HATE-9' were found. At the roadside leading to Pemuchi beach, 'HATE-6' was found growing on a boulder embankment. 'HATE-7' was found growing on coral rocks on the way to the beach (Photo 12). Many of the seeds on these plants showed feeding damage from caterpillars. 'HATE-8' and 'HATE-9' were growing on the beach made from coral grains (Photo 13). At 'HATE-8' site, 2 accessions (one accession growing on sandy beach and another accession growing on coral rock) were collected. The sand grain size of this coral beach was larger than other beaches. Soil was sampled at depth of about 10 cm.

Yonaguni island is located at westernmost place in Japan. When we were staying in Yonaguni island, the typhoon no. 7 (Soulik) hit the Yonaguni island squarely. Therefore, we could conduct field survey before and after the typhoon. The typhoon no. 7 was a strong typhoon. The weather station on Yonaguni island recorded a sea surface pressure of 948 hPa, and a maximum wind speed of 60.2 m/s. The first site observed in this island was Hikawa beach where accessions from 'YONA-1' to 'YONA-3' were

collected (Photo 14, 'YONA-1' collection site). This beach was full of wracks floated from the sea and had small coral stones. At this site, we observed that roots of a *V. marina* plant pierced a small coral stone (Photo 15). Soil was collected from this place before and after the typhoon. After the typhoon, the sand had been scraped away, hence the underground parts of *V. marina* were exposed. Crawling shoots and exposed underground parts of *V. marina* plants were entwined with shoots of *Ipomoea pes-caprae* (L.) R. Brown making a rope like structure (Photo 16, indicated by white arrows). At both ends of Hikawa sandy beach, there were areas of exposed rocks. Shrub and weed vegetation were developed on the eastern side (Photo 17). 'YONA-2' was found at this eastern side growing between rocks and shrub vegetation on the hillside. The pods of *V. marina* in this population were in good condition showing no feeding damage from caterpillars. At the western side of Hikawa beach, there was a site consist of rocks and clay soil. There was a shrub vegetation at this site (Photo 18), which included some large *V. marina* plants growing between rocks (Photo 19). The clay soil was collected from between the rocks before and after the typhoon. On the northern side of Yonaguni island, a *V. marina* population 'YONA-5' was found growing around Urano cemetery (Photo 20). The wind was particularly strong at a site facing to the sea, and no caterpillar feeding damage was observed at this site. We have observed blue greenish shining bees (possibly *Stilbum cyanurum pacificum* Linsenmaier) visiting *V. marina* flowers, suggesting that it is probably one of the pollinators of *V. marina*. 'YONA-8' was found growing on Nāma sandy beach located on western side of Yonaguni island. After the typhoon, a lot of *V. marina* plants were buried under the sand, and the leaves above ground were blanched by sea water, though the pods were not much damaged (Photo 21). Soil samples at a depth of about 10 cm were taken before and after the typhoon. At Sonai town area, 'YONA-9' was found hanging from a concrete wall of a home garden (Photo 22). No caterpillar feeding damage was seen in this population. The internodes of the hanging vertical stems were long without flower buds, while their horizontally elongating lateral branches had short internodes with a lot of flower buds.

***Vigna luteola* (Jacq.) Benth.**

Vigna luteola is a pan tropical species which has been used as a fodder crop in Australia and USA (Tomooka *et al*. 2010). This species is closely related to *V. marina* with which it is cross compatible. While *V. marina* grows in coastal areas, *V. luteola* grows in inland wet habitat such as riverbank and lake side. On Ishigaki island, an accession of *V. luteola* ('ISHI-1') was found on riverbank at Bunatabaru-ko-bashi (Photo 23). Seeds of *V. luteola* had been collected previously from the same place (Tomooka *et al.* 2012, 2013). The soil of the riverbank was gray colored hard clay, and a sample of soil was taken at a depth of 20 cm. On Iriomote island, *V. luteola* plants ('IRIO-7') were found growing in a fallow paddy field near the Iriomote Wildlife Conservation Center (Photo 24). Compared with the situation in 2012 (Tomooka *et al*. 2013), this population has now reduced in its size. The soil was brown colored clay, and the soil samples were taken from depths of about 5 cm and 30 cm (Photo 25).

***Vigna riukiuensis* (Ohwi) Ohwi & Ohashi**

Vigna riukiuensis is a wild species and its cultivation has not been recorded. However, it could be used as breeding materials for azuki bean (*V. angularis*) and rice bean (*V. umbellata*), since these two crops can be artificially crossed with *V. riukiuensis*. On Hateruma island, 'HATE-10' was found growing on a small path connecting road and Pemuchi beach (Photo 26). There was shrub vegetation on this site, and it was not far from the sea (Photo 27). On Yonaguni island, 'YONA-4' was found growing beside a

path to the Tachigami-iwa observatory (Photo 28). Soil was made up of hard clay and gravel, and a soil sample was taken after the typhoon at a depth of about 5 cm. 'YONA-6' was found at the Urano cemetery (Photo 29). It was found close to the sea coast where the *V. marina* ('YONA-5') plants were also growing. However, the *V. riukiuensis* plants were found only at rather inland site of the cemetery grounds.

Soil analysis

The pH levels and NaCl concentrations of the collected soil samples were determined in NIAS, Tsukuba (Photo 30, Table 3). The pH of clay soils where *V. luteola* and *V. riukiuensis* plants were growing ranged from pH 6.1 to 8.3. In contrast, coral sand where most of the *V. marina* plants grew showed a strong alkaline, ranging from pH of 9.1 to 9.8 (Table 3). Based on the hydroponic culture experiment in NIAS, it was revealed that *V. marina* plants could reduce pH of hydroponic culture solution gradually from about 10 to 8 (Fig. 2). Therefore, it is thought that the roots of *V. marina* plants might secrete organic acids or some other chemical compounds that can reduce pH around the roots and also can melt coral rocks, allowing them to grow on coral sandy beach with high alkaline conditions or to grow directly on coral rocks.

Sandy beaches were periodically affected by seawater, hence had been thought to be highly saline environments. However, measured NaCl concentrations of the coral sand where *V. marina* plants growing were very low ranging from 0.00 to 0.02 % before typhoon (Table 3). The NaCl concentrations of 2 coral sandy beaches after typhoon measured at 10 cm depth were 0.06 and 0.07 %, respectively. The NaCl concentrations of the clay soils that accumulated on a rocky site of Hikawa beach was only 0.16 % even after typhoon. Since the Yaeyama archipelago has a subtropical marine climate without conspicuous dry season (e.g., there is no month with less than 100 mm precipitation on Ishigaki island), it is thought that NaCl is washed out by rainwater rapidly even if the beaches are affected by seawater. Surprisingly, it was revealed that *V. marina* plants developed laterally elongating shallow branching roots near the soil surface. It would be interesting to clarify the adaptive reason why this trait was evolved in *V. marina*.

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Table 3. Soil pH levels and NaCl concentrations in the Yaeyama archipelago, 2013

Scientific name	Island	Collection site	Coll. No.	Soil type	Typhoon	Depth (cm)	pH	NaCl (%)
Vigna luteola	Ishigaki	Bunatabaru-kobashi	ISHI-1	Clay	Before	20	8.1	0.01
	Iriomote	Iriomote Wildlife	IRIO-7	Clay	Before	5	6.1	0.02
		Conservation Center		Clay	Before	30	6.6	0.01
Vigna marina	Ishigaki	Inoda beach	ISHI-3	Coral sand	Before	5	9.4	0.00
				Coral sand	Before	20	9.5	0.00
				Coral sand	Before	50	9.4	0.00
	Iriomote	Haemida beach	IRIO-1	Coral sand	Before	5	9.7	0.00
				Coral sand	Before	50	9.7	0.00
		Hoshidate beach	IRIO-3	Coral sand	Before	20	9.5	0.02
		Funarabashi	IRIO-6	Coral sand	Before	20	9.2	0.01
				Coral sand	Before	60	9.1	0.00
	Hateruma	Nishihama beach	HATE-2	Coral sand	Before	5	9.7	0.00
				Coral sand	Before	20	9.8	0.00
		Pemuchi beach	HATE-8-1	Coral sand	Before	10	9.8	0.01
	Yonaguni	Nāma beach	YONA-8	Coral sand	Before	10	9.8	0.01
				Coral sand	After	10	9.4	0.07
		Nanta beach	YONA-7	Coral sand	Before	20	9.8	0.00
		Hikawa beach	YONA-3	Clay	Before	5	8.0	0.10
				Clay	After	5	8.3	0.16
				Clay	After	5	8.5	0.16
			YONA-1	Coral sand	Before	10	9.5	0.00
				Coral sand	After	10	9.3	0.06
Vigna riukiuensis	Yonaguni	Tachigami-iwa	YONA-4	Clay	After	5	8.3	0.02

Table 4. A passport data of collected materials　収集品のパスポートデータ

JP No.	Coll. No. (2013-)	Coll. Date (2013)	Species name	Status	Collection Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Nodule sampling	Remarks
251341	ISHI-1	8-Jul	*Vigna luteola*	wild	Bunatabaru-kobashi, Maezato-Omoto, Ishigaki, Okinawa	N24-24-41	E124-12-40	19	organic soil	bulk	no	River side. Organic clay soil near the river was sampled
251339	ISHI-3	8-Jul	*Vigna marina*	wild	Inoda beach, Ishigaki, Okinawa	N24-28-2	E124-15-8	1	sand	bulk	no	Sandy beach. Roots of *V. marina* spread laterally at about 10 cm below the surface of sandy soil.
251340	ISHI-4	8-Jul	*Vigna marina*	wild	Ibaruma beach, Ishigaki, Okinawa	N24-30-31	E124-17-1	1	sand	bulk	no	Sandy beach. A few mature pods could be collected.
251342	IRIO-1	9-Jul	*Vigna marina*	wild	Haemida beach, Toyobaru, Taketomi, (Iriomote island), Yaeyama, Okinawa	N24-16-20	E123-50-03	5	sand	bulk	no	Sandy beach. Soil was sampled at a site about 25 m apart from water's edge
-	IRIO-2	9-Jul	*Vigna marina*	wild	Hoshizuna beach, Sumiyoshi, Uehara, Taketomi, (Iriomote island), Yaeyama, Okinawa	N24-26-12	E123-46-40	1	sand	no	no	Sandy beach. A population appeared again which could not be found last year's survey. No mature pods found. Leaf tip became yellowish possibly because of nutrient defficiency.
251345	IRIO-3	9-Jul	*Vigna marina*	wild	Hoshidate beach, Hoshidate, Taketomi, (Iriomote island), Yaeyama, Okinawa	N24-23-42.0	E123-45-14.8	3	sand	bulk	yes	Sandy beach. New seedlings grew sporadically along the line of water's edge at high tide.
251344	IRIO-6	9-Jul	*Vigna marina*	wild	Funarabashi, Taketomi, (Iriomote island), Yaeyama, Okinawa	N24-22-0.5	E123-55-20.0	8	sand	bulk	no	Sandy beach. Shoots of *V. marina* elongated and grew near the water's edge. Roots grew deep to 70cm below surface.
251343	IRIO-7	9-Jul	*Vigna luteola*	wild	beside the junction of "YASEI-Center", Taketomi, (Iriomote island), Yaeyama, Okinawa	N24-19-36.69	E123-54-38.94	8	organic soil	no	no	Fallow paddy field. Roots grew not deeply and spread laterally in clay paddy soil
251237	HATE-1	10-Jul	*Vigna marina*	wild	Nishihama beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-3-51.836	E123-45-44.491	5	sand	bulk	no	Sandy beach. Growing beside small sea side hut, many seeds already shattered on the ground.
251238	HATE-2	10-Jul	*Vigna marina*	wild	Nishihama beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-3-48.252	E123-45-31.692	3	sand	bulk	yes	Sandy beach.
251239	HATE-3	10-Jul	*Vigna marina*	wild	east end of Nishihama beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-3-46.332	E123-45-15.934	2	sand	bulk	no	Sandy beach.
251240	HATE-4	10-Jul	*Vigna marina*	wild	Pehama beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-3-40.636	E123-45-15.934	4	sand	bulk	no	Sandy beach. Many *V. marina* plants were damaged by parasitic weed, *Cassytha filiformis*
251241	HATE-5	10-Jul	*Vigna marina*	wild	Pehama beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-3-31.965	E123-45-17.694	4	sand	bulk	yes	Sandy beach. Near rocky place. Nodules were collected from a plant growing on a rock.
251242	HATE-6	10-Jul	*Vigna marina*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-55.65	E123-46-31.608	16	unknown	bulk	no	Road side stone wall beside pond.
251243	HATE-7	10-Jul	*Vigna marina*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-50.978	E123-46-36.287	4	gravel	bulk	no	Sandy beach among rock stones.
251244	HATE-8-1	10-Jul	*Vigna marina*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-51.298	E123-46-39.007	3	sand	bulk	no	Sandy beach.
251245	HATE-8-2	10-Jul	*Vigna marina*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-51.298	E123-46-39.007	3	sand	bulk	no	Growing on a rock in sandy beach.
251246	HATE-9	10-Jul	*Vigna marina*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-52.899	E123-46-53.886	3	sand	bulk	no	Sandy beach beside rocky stones.
251247	HATE-10	10-Jul	*Vigna riukiuensis*	wild	Pemuchi beach, Hateruma, Taketomi (Hateruma island), Yaeyama, Okinawa	N24-2-51.619	E123-46-59.165	3	gravel	bulk	no	Growing beside a small path from road to sandy beach.
251248	YONA-1	11-Jul	*Vigna marina*	wild	Hikawa beach, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-26-33.607	E122-59-0.038	2	sand	bulk	yes	On a eastern side of sandy beach.
251249	YONA-2	11-Jul	*Vigna marina*	wild	Hikawa beach, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-26-35.015	E122-59-3.638	1	sand	bulk	no	Stony place in eastern side of a beach. Good pod setting.
251250	YONA-3	11-Jul	*Vigna marina*	wild	Hikawa beach, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-26-30.407	E122-58-53.639	5	red soil	bulk	no	Growing on red soil accumulated among rock stones in the seashore.
251251	YONA-4	11-Jul	*Vigna riukiuensis*	wild	Tachigami-iwa observation deck, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-27-1.174	E123-01-45.463	8	red soil	bulk	no	Growing beside a path to Tachigami-iwa observation deck.
251252	YONA-5	11-Jul	*Vigna marina*	wild	Urano cemetery beisde the port, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-28-23.165	E123-00-20.456	8	gravel	bulk	no	Growing around URANO cemetery. Plants growing near the sea suffered less damage to the pods by butterfly.
251253	YONA-6	11-Jul	*Vigna riukiuensis*	wild	Urano cemetery beisde the port, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-28-23.165	E123-00-20.456	9	gravel	bulk	no	Growing around URANO cemetery.
251254	YONA-7	11-Jul	*Vigna marina*	wild	Nanta beach, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-28-10.349	E123-00-1.711	2	sand	bulk	no	Sandy beach.
251255	YONA-8	11-Jul	*Vigna marina*	wild	Nama beach, Kubura, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-26-54.307	E122-56-18.112	10	sand	bulk	no	Sandy beach. A few damage by butterfly
251256	YONA-9	11-Jul	*Vigna marina*	wild	Sonai Area, Yonaguni (Yonaguni island), Yaeyama, Okinawa	N24-28-19.229	E123-00-14.21	18	sand	bulk	no	Growing in a home garden in Sonai town. Plants grew vigorously over the fence. No butterfly dameges seen on the pods.

沖縄県八重山列島における *Vigna* 属植物遺伝資源の探索収集 ２０１３年

高橋 有 [1), 2)], 内藤 健 [1)], 小木曽 - 田中 映理 [1)], 井上 潤二 [1)],
平島 信也 [1)], 友岡 憲彦 [1)]

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和文摘要

本報告は、沖縄県八重山列島におけるマメ科ササゲ属植物遺伝資源の収集調査報告である．調査は 2013 年 7 月 8 日～ 14 日にかけて行った．その結果，ナガバハマササゲ（*Vigna luteola*）2 点，ハマササゲ（*Vigna marina*）22 点，ヒナアズキ（*Vigna riukiuensis*）3 点，計 27 点の遺伝資源を収集した．いくつかの自生地では土を掘って根系を観察し，土壌サンプリングを行って pH と塩分濃度を測定することにより，自生地の土壌環境を調べた．収集した種子は農業生物資源研究所ジーンバンクに保存するとともに，特性評価と種子増殖を行う計画である．

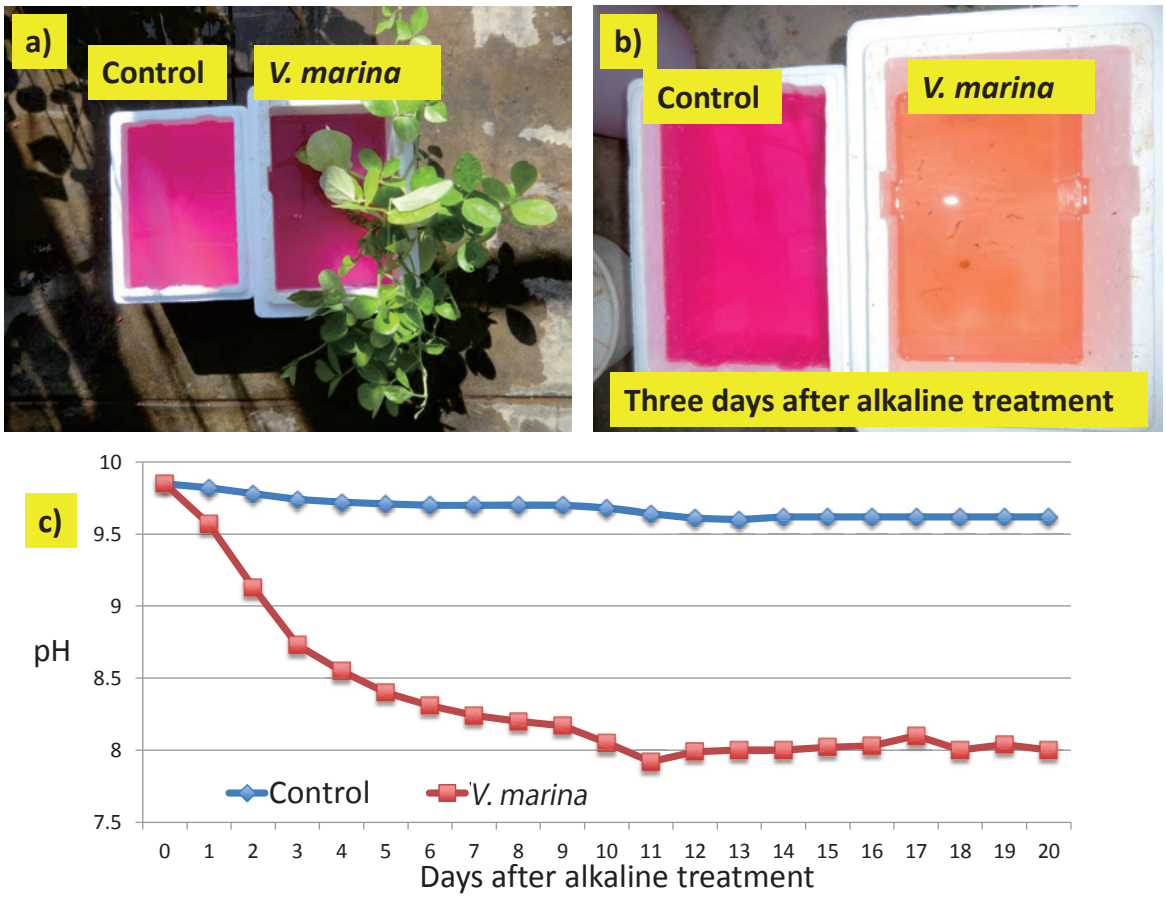


Fig. 2. Ability of *Vigna marina* plants to reduce pH of the solution under hydroponic culture condition. a) photo of *V. marina* plant on starting day of alkaline treatment, b) color of the hydroponic culture solution of control and *V. marina* growing containers on 3 days after alkaline treatment, c) pH of the hydroponic culture solution of control and *V. marina* growing container from 0 to 20 days after alkaline treatment. Phenol red was added to serves as a visible marker of changing pH of the culture solution.

Photo 1. *Vigna marina*, IS-3, JP251339, Inoda, Ishigaki

Photo 2. *Vigna marina*, IR-6, JP251242, Funarabashi, Iriomote

Photo 3. *Vigna marina*, IR-3, JP251345, Hoshidate, Iriomote

Photo 4. *Vigna marina*, IR-3, JP251345, Hoshidate, Iriomote

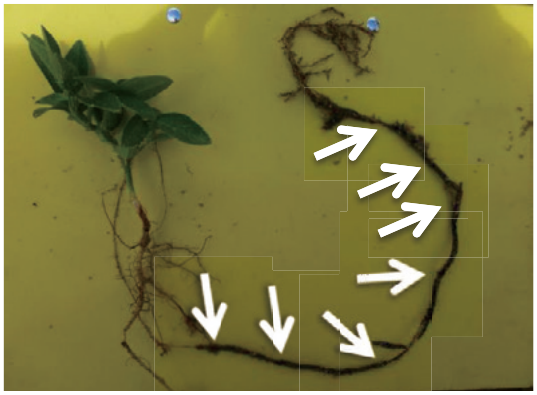


Photo 5. *Vigna marina*, IR-3, JP251345, Hoshidate, Iriomote

Photo 6. *Vigna marina*, IR-2, JP251238, Hoshizuna, Iriomote

Photo 7. *Vigna marina*, H-1, JP251237, Nishihama, Hateruma

Photo 8. *Vigna marina*, H-2, JP251238, Nishihama, Hateruma

Photo 9. *Vigna marina*, H-3, JP251239, Nishihama, Hateruma

Photo 10. *Vigna marina*, H-4, JP251240, Pehama, Hateruma

Photo 11. *Vigna marina*, H-5, JP251241, Pehama, Hateruma

Photo 12. *Vigna marina*, H-7, JP251243, Pemuchihama, Hateruma

Photo 13. Habitat of *Vigna marina*, Pemuchihama, Hateruma

Photo 14. Habitat of *Vigna marina*, Hikawanohama, Yonaguni

Photo 15. *Vigna marina*, Hikawanohama, Yonaguni

Photo 16. Habitat of *Vigna marina* (after typhoon), Hikawanohama, Yonaguni

Photo 17. Habitat of *Vigna minima*, Y-2, JP251249, Hikawanohama, Yonaguni

Photo 18. Habitat of *Vigna marina*, Hikawanohama, Yonaguni

Photo 19. Habitat of *Vigna marina*, Hikawanohama, Yonaguni

Photo 20. Habitat of *Vigna marina*, Y-5, JP251252, Urano cemetery, Yonaguni

Photo 21. *Vigna marina* (after typhoon), Y-8, JP251255, Namahama, Yonaguni

Photo 22. *Vigna marina*, Y-91, JP251256, Sonai, Yonaguni

Photo 23. Habitat of *Vigna luteola*, IS-1, JP251341, Bunatabaru-kobashi, Ishigaki

Photo 24. Flower of *Vigna luteola*, IR-7, Iriomote

Photo 25. Soil sampling at IR-7 site, *Vigna luteola*, Iriomote

Photo 26. *Vigna riukiuensis* twining on Pandanus odoratissimus, H-10, JP251247, Pemuchihama, Hateruma

Photo 27. Habitat of *Vigna riukiuensis*, H-10, JP251247, Pemuchihama, Hateruma

Photo 28. Habitat of *Vigna riukiuensis*, Y-4, JP251251, Tachigamiiwa, Yonaguni

Photo 29. *Vigna riukiuensis*, Y-6, JP251253, Urano cemetary, Yonaguni

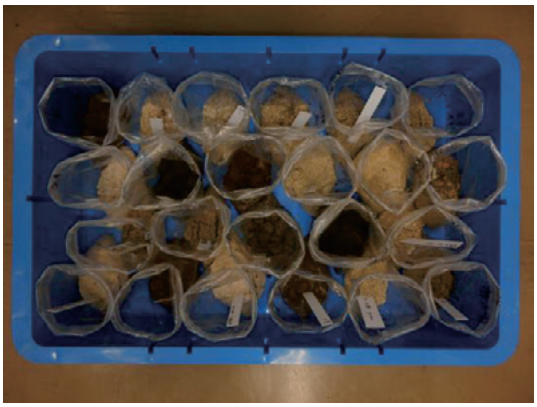
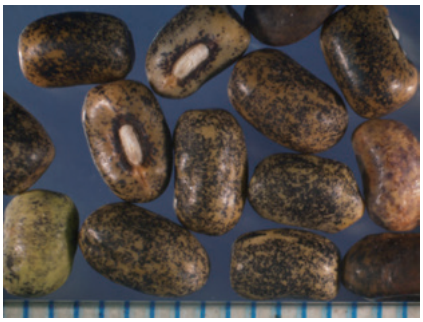


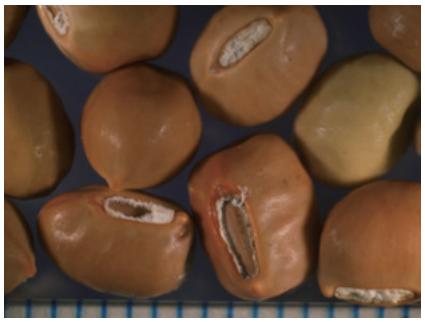
Photo 30. Soil samples collected during exploration survey

1. IS-3, JP251339, *Vigna marina*

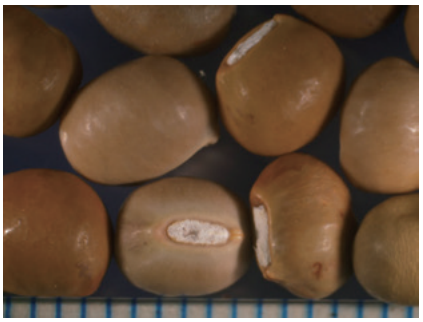
2. IS-4, JP251340, *Vigna marina*



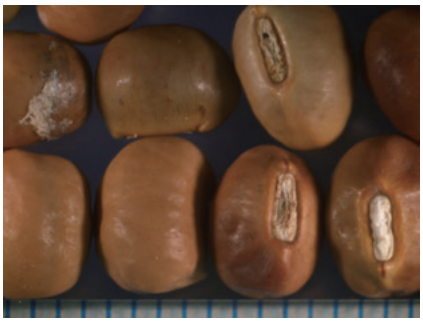
3. IS-1, JP251341, *Vigna luteola*



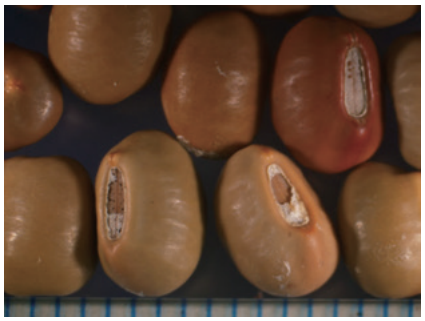
4. IR-1, JP251342, *Vigna marina*



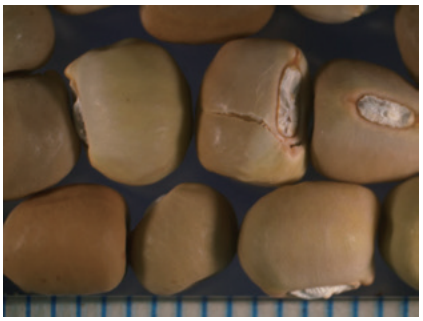
5. IR-6, JP251344, *Vigna marina*



6. IR-3, JP251345, *Vigna marina*



7. H-1, JP251237, *Vigna marina*

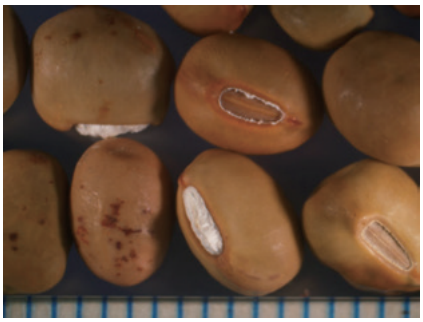


8. H-2, JP251238, *Vigna marina*

9. H-3, JP251239, *Vigna marina*

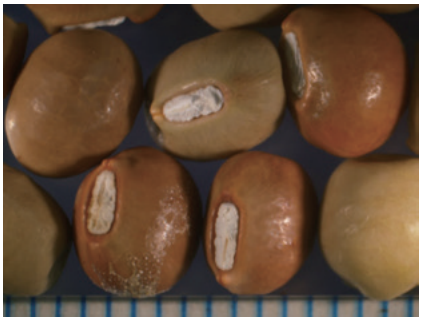
10. H-4, JP251240, *Vigna marina*

11. H-5, JP251241, *Vigna marina*

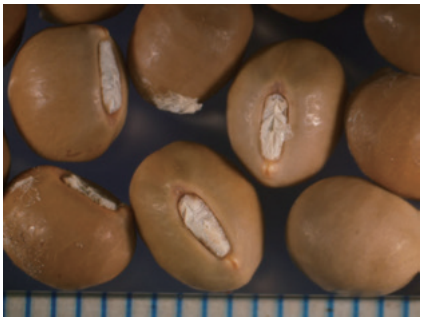


12. H-6, JP251242, *Vigna marina*

13. H-7, JP251243, *Vigna marina*

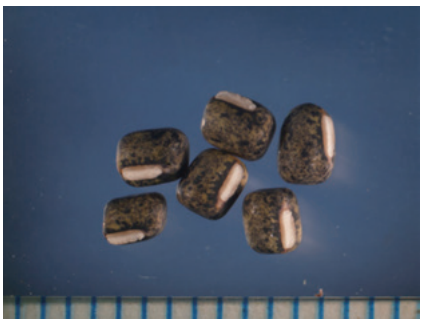


14. H-8-1, JP251244, *Vigna marina*



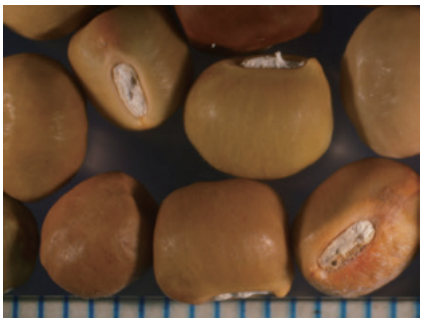
15. H-8-2, JP251245, *Vigna marina*

16. H-9, JP251246, *Vigna marina*



17. H-10, JP251247, *Vigna riukiuensis*

18. Y-1, JP251248, *Vigna marina*



19. Y-2, JP251249, *Vigna marina*

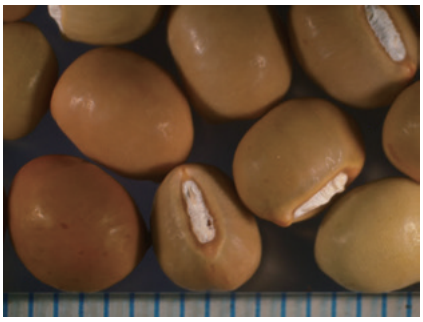
20. Y-3, JP251250, *Vigna marina*

21. Y-4, JP251251, *Vigna riukiuensis*

22. Y-5, JP251252, *Vigna marina*

23. Y-6, JP251253, *Vigna riukiuensis*

24. Y-7, JP251254, *Vigna marina*



25. Y-8, JP251255, *Vigna marina*

26. Y-9, JP251256, *Vigna marina*