

## Collection and Conservation of Leguminous Crop Wild Relatives on Ishigaki, Miyako, Kurima, Irabu and Ikema islands, Okinawa, Japan, 2014

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### Summary

A field survey for collecting leguminous crop wild relatives was done on Ishigaki, Miyako, Irabu, Ikema and Kurima islands, Okinawa prefecture, Japan, on 3<sup>rd</sup> to 7<sup>th</sup> July, 2014. A total of 27 samples which contained two samples of *Vigna luteola*, 19 samples of *Vigna marina* and six samples of *Vigna riukiensis* were collected in five islands. All samples are accessioned, conserved and propagated in NIAS Genebank. These accessions will be grown and evaluated in 2015, and will become available for research, breeding and educational purpose.

KEY WORDS : wild legumes, *Vigna*, Okinawa islands, genetic resource

### Introduction

The NIAS (National Institute of Agrobiological Sciences) Genebank have conducted exploration of genetic resources in Japan and also overseas in collaboration with research institutes of other countries. Collected genetic resources have been propagated, conserved and provided widely for research use. The previous exploration reports are available on web site shown below:

NIAS Genebank: [https://www.gene.affrc.go.jp/publications\\_en.php](https://www.gene.affrc.go.jp/publications_en.php)

The genus *Vigna* which belongs to family Leguminosae consists some cultivated species such as azuki bean (*V. angularis*), mungbean (*V. radiata*) and cowpea (*V. unguiculata*). Their wild relatives are regarded as valuable genetic resources because of their diverse range of growing environments. Recently we achieved remarkable works represented by genome sequencing (Sakai *et al.* 2015), salt tolerance screenings (Chankaew *et al.* 2014, Yoshida *et al.* 2015), and elucidating domestication origins (Wang *et al.* 2015), using *Vigna* collections conserved in NIAS Genebank.

This report is about exploration conducted in five islands of Okinawa prefecture for collecting and

observing of mainly *V. marina*, *V. luteola* and *V. riukiensis*. The objectives of this survey were to follow up collection sites ever visited, and to find new natural habitats and to collect seeds for conservation.

## Methods

The exploration conducted from 3<sup>rd</sup> to 7<sup>th</sup> July, 2014 (Table 1, Fig. 1). Bulk seed samples were collected from each population. Information of collection sites including latitude, longitude, habitat sketch map and some ecological data were recorded on passport data sheets.

GPS data was measured by GPSMAP 62SC (GARMIN). NaCl concentration values of soil were estimated at each site by Soil Testing device PNT3000 (STEP Systems). The values of three points at one site were measured and averaged.

Table 1. Itinerary of the field survey in Okinawa (Ishigaki, Miyako, Irapu, Kurima and Ikema islands)  
日程表 沖縄 (石垣島・宮古島・伊良部島・来間島・池間島)

Date	itinerary	stay
7/3	Tsukuba -- Haneda AP 11:55 (ANA 091) -- 15:00 Ishigaki AP (Ishigaki island) -- Ishigaki island exploration	Ishigaki island
7/4	Ishigaki island exploration -- Ishigaki AP 14:20 (ANA1792) --Miyako AP 14:50 (Miyako island) -- Miyako island exploration	Miyako island
7/5	Hirara P 07:30 (Miyako island) -- (Ferry boat) -- 08:00 Sarahama P (Irapu island) -- Irapu island exploration -- Sarahama P 12:35 (Irapu island) -- (Ferry Boat) -- 12:55 Hirara P (Miyako island) -- Miyako island exploration	Miyako island
7/6	Miyako, Ikema, Kurima islands exploration	Miyako island
7/7	Miyako AP 08:50 (JTA552) (Miyako island) -- 09:40 Naha AP 10:10 -- 12:35 Haneda AP -- Tsukuba	

AP: Airport, P: Port

## Results and Discussion

A total of 27 samples which contained two samples of *V. luteola*, 19 samples of *V. marina* and six samples of *V. riukiensis* were collected at five islands (Table 2). All were wild populations and collected as bulked seed samples from each population. Population habitats of collection sites are shown in Photos 1 through 25. Population sizes and values of NaCl concentration are shown in Tables 3 and 4, respectively. Passport data obtained are summarized in Table 5. All samples are accessioned, conserved and will be propagated in NIAS Genebank. These accessions will be grown and evaluated in 2015, and will become available for research, breeding and educational purposes.

We totally visited 14 sites in five islands. Bunatabaru-kobashi (2014Ishigaki1), Tojinbaka (2014Ishigaki2) and Ibaruma beach (2014Ishigaki3) in Ishigaki island, Agarihennazaki (2014Miyako1), Sunayama beach (2014Miyako2) and Maibama beach (2014Miyako3) in Miyako island, Toguchinohama beach (2014Irapu2) in Irapu island, Masakadatsu beach (2014Ikema2) in Ikema island, Nagasakihama beach (2014Kurima2) and Nagamahama beach (2014Kurima4) in Kurima island had been surveyed in 2004, 2011, 2012, and 2013 (Tomooka *et al.* 2005, 2012, 2013, Takahashi *et al.* 2014). On the other hand, we visited four new sites with seed collection at Tojinbaka (2014Ishigaki2-2) in Ishigaki island, Ikizu beach (2014Ikema1) in Ikema island, Kurima beach (2014Kurima1) and Musunun beach (2014Kurima3) in Kurima island. We also visited Makiyama park (2014Irapu1) in Irapu island, but could not collect seed samples. The *Vigna*

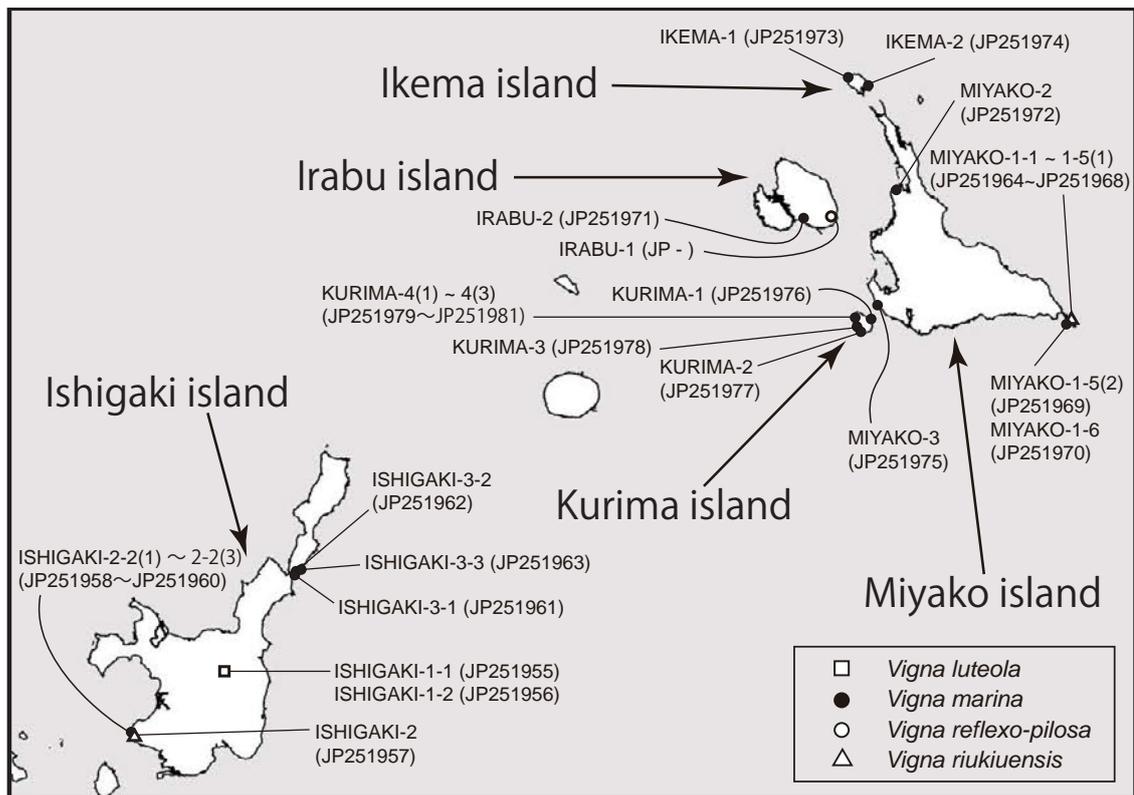


Fig. 1. A map of the collected materials in Okinawa, 2014

Table 2. A summary of collected seed accessions from each island

Species	Ishigaki	Miyako	Irabu	Ikema	Kurima	Total
<i>Vigna luteola</i>	2	0	0	0	0	2
<i>Vigna marina</i>	6	4	1	2	6	19
<i>Vigna riukiensis</i>	1	5	0	0	0	6
Total	9	9	1	2	6	27

populations were found at all re-visited sites. It is considered that these sites had quite stable habitat even with some disturbance such as typhoon and human activities.

The numbers in sample name indicates the site, population, and subpopulation, respectively. For example, “Ishigaki2-2(1)” indicates the site: Ishigaki2, population: 2, and subpopulation: (1).

### ***Vigna luteola***

*V. luteola* is a tropical species distributed mainly in wet habitats near rivers or marshes (Tomooka *et al.* 2011). We re-visited Bunatabaru-kobashi site of Ishigaki island (Photo 1). This site had a bushy landscape along a river. *V. luteola* grew winding around other plants. Populations were at flowering and maturing stages. Two samples were collected at this site. Seed size and color seemed different between the two accessions. The one (JP251955) was bigger and darker than the other (JP251956).

### ***Vigna riukiensis***

*V. riukiensis* is a cliff species found endemic to Taiwan and Okinawa islands (Egawa *et al.* 1990, Tomooka *et al.* 2011). This species has tolerance to salt, drought and heat stress (Egawa *et al.* 1999) and is

Table 3. Population size and distance from the water's edge of *V. marina*

JP No.	Population Code	Soil	Population size (m <sup>2</sup> )	Distance from water's edge (m)	
				low tide	flood tide
251958	2014Ishigaki2-2(1)	coral sand	18.0 x 8.0	15.0	3.0
251959	2014Ishigaki2-2(2)	coral sand	3.5 x 5.0	13.0	3.4
251960	2014Ishigaki2-2(3)	coral sand	12.0 x 5.0	13.0	4.0
251969	2014Miyako1-5(2)	organic soil	10.0 x 5.0	-	-
251971	2014Irabu2	coral sand	-	25.0	8.0
251972	2014Miyako2	coral sand	5.0 x 10.0	-	-
251973	2014Ikema1	coral sand	5.7 x 9.8	12.8	9.1
251974	2014Ikema2	coral sand	10.4 x 77.0	12.8	5.7
251977	2014Kurima2	coral sand	4.1 x 8.2	15.6	8.8
251978	2014Kurima3	coral sand	7.0 x 7.7	12.2	7.6
251979	2014Kurima4(1)	coral sand	3.0 x 3.0	-	-
251981	2014Kurima4(3)	coral sand	3.8 x 25.8	17.5	10.0

expected as a valuable genetic resource because of its cross compatibility with azuki bean (*V. angularis*) and rice bean (*V. umbellata*) (Tomooka *et al.* 2002). A total of six accessions were collected at two sites (Table 2), one from Ishigaki (Photo 2) and five from Miyako island (Photo 9-13). Both of these sites had been surveyed before. The vegetation sites were gradual slopes of lawn grass in the parks facing the sea. Some populations were distributed on the top of the cliff (Photo 12). Populations were at flowering and maturing stages.

### ***Vigna reflexo-pilosa***

*V. reflexo-pilosa* var. *reflexo-pilosa* is a tetraploid species (2n=44) (Egawa *et al.* 1990), which is regarded as the wild ancestor of a domesticated species known as creole bean (*V. reflexo-pilosa* var. *glabra*). A population of *V. reflexo-pilosa* was found in a bush along the promenade to Makiyama observatory, Irabu island (Photo 15). This population was at vegetative growth stage, so seed samples were not collected (Photo 16).

### ***Vigna marina***

*V. marina* is mainly distributed on a tropical sandy beach (Tomooka *et al.* 2011). This species has the highest level of salt and alkaline tolerance (Chankaew *et al.* 2014). A total of 19 samples of *V. marina* were collected in five islands (Table 2); six from Ishigaki island (Photo 3-8), four from Miyako island (Photo 14, 18, 21), one from Irabu island (Photo 17), two from Ikema island (Photo 19, 20), and six from Kurima island (Photo 22-25). Most populations were observed on a coral sandy beach, but a population at Agarihennazaki of Miyako island (2014Miyako1-5(2) and 1-6) was found on organic soil in the bushes (Photo 14). All *V. marina* populations were at flowering and maturing stages (Photo 26, 27).

Population size ranged widely from the 3x3 m<sup>2</sup> to 10.4x77 m<sup>2</sup> (Table 3). In beach populations, the stems ran from the edge of the bush towards the sea. The distance from the water's edge to the population was measured (Table 3). In low tide, the distance ranged from 12 to 25 m, and the average was 15.2 m. In flood tide, it ranged from 3 to 10 m and the average was 6.6 m. The biggest population at Masakadatsu beach of Ikema island (2014Ikema2) seemed to be recovering from the damage by a storm surge. The population at Maibama beach in Miyako island (2014Miyako3) have been seemed to be recently buried in the sand.

At Ibaruma beach of Ishigaki island, we observed different root characters of *V. marina*. One plant had

a 3.5 m - long root running in the horizontal direction (2014Ishigaki3-1, Photo 5), and the other had densely branching roots (2014Ishigaki3-2, Photo 7). It seemed that *V. marina* had the plasticity to efficiently catch rainwater in sandy beaches. In addition, a plant was found growing not in sand but on the outcrop of a rock (2014Ishigaki3-3, Photo 8), indicating high adapting potential of *V. marina*.

### Companion species of *V.marina* in sandy beaches

Some companion plant species at sandy beaches were identified. *Ipomoea pes-caprae* (beach morning glory, Photo 28) was the most frequent companion plant with *V. marina*. The stem was creeping on the sand and quite similar to *V. marina*. It is considered that this is the most competitive species for the habitat for *V. marina*. Second, *Vitex rotundifolia* (beach vitex, Photo 29) and *Cassytha filiformis* (love-vine, Photo 30) were often found. *C. filiformis* is a parasitic plant. *Crinum asiaticum* var. *japonicum* (poison bulb, Photo 31) was found sometimes sympatric to *V. marina*. At Kurima beach in Kurima island, a population of *Spinifex littoreus* (Ravan's Moustache, Photo 32) was found. This species was found only at this site during this survey. The population of *V. marina* rooted inside of *Spinifex littoreus* and extended out of it.

### NaCl concentration of soil

NaCl concentration of soil was measured at each site (Table 4). The average values of all collection sites were 0.20% with *V. reflexo-pilosa*, 0.19% with *V. luteola*, 0.21% with *V. riukiensis*, and 0.08% with

Table 4. NaCl concentration of soil at each sites

Species name	Island	Population Code	Soil	NaCl average (%)
<i>Vigna reflexo-pilosa</i>	Irabu	2014Irabu1	organic soil	0.20
<i>Vigna luteola</i>	Ishigaki	2014Ishigaki1-1	clay	0.16
		2014Ishigaki1-2	clay	0.22
<i>Vigna riukiensis</i>	Ishigaki	2014Ishigaki2	clay	0.03
	Miyako	2014Miyako1-1	organic soil	0.27
		2014Miyako1-2	organic soil	0.34
		2014Miyako1-3	organic soil	0.18
		2014Miyako1-4	organic soil	0.24
		2014Miyako1-5(1)	organic soil	-
<i>Vigna marina</i>	Ishigaki	2014Ishigaki2-2(1)	coral sand	0.00
		2014Ishigaki2-2(2)	coral sand	0.00
		2014Ishigaki2-2(3)	coral sand	0.00
		2014Ishigaki3-1	coral sand	0.00
		2014Ishigaki3-2	coral sand	0.00
		2014Ishigaki3-3	coral sand	-
	Irabu	2014Irabu2	coral sand	0.00
	Ikema	2014Ikema1	coral sand	0.00
		2014Ikema2	coral sand	0.08
	Kurima	2014Kurima1	coral sand	0.00
		2014Kurima2	coral sand	0.07
		2014Kurima3	coral sand	0.02
		2014Kurima4(1)	coral sand	-
		2014Kurima4(2)	coral sand	0.20
		2014Kurima4(3)	coral sand	0.21
		2014Kurima4(3)	coral sand	0.21
	Miyako	2014Miyako2	coral sand	0.00
		2014Miyako3	coral sand	0.01
		2014Miyako1-5(2)	organic soil	-
		2014Miyako1-6	organic soil	0.65

NaCl percentage value was calculated as the mean of three points averaged at each site.

*V. marina*. The concentration was lower in the collection sites of *V. marina* than others probably because the coral sand was too dry for measuring NaCl concentration. As such, to measure NaCl concentration in coral sands, it might be necessary to measure after rainfall or manually sprinkling some water.

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# 沖縄県石垣島，宮古島，来間島，伊良部島，池間島における マメ科植物遺伝資源の探索収集 2014 年

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## 和文摘要

本報告は沖縄県石垣島，宮古島，来間島，伊良部島，池間島におけるマメ科植物遺伝資源の調査報告である。調査は2014年7月3日～7月7日にかけて行われた。調査の結果，ナガバハマササゲ (*Vigna luteola*) 2点，ハマササゲ (*Vigna marina*) 19点，ヒナアズキ (*Vigna riukiensis*) 6点，合計27点の遺伝資源を収集保存した。これらの遺伝資源は2015年度につくば市の農業生物資源研究所において栽培し，特性評価，種子増殖を行い配布可能なアクティブコレクションとして農業生物資源ジーンバンクにおいて保存する計画である。

Table 5. A passport data of collected materials

## 収集品のパスポートデータ

JP No.	Coll. No.	Coll. Date (2014)	Species name	Status	Collection Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Remarks	population size (m <sup>2</sup> )	Distance from water edge	
														low tide (m)	flood tide (m)
251955	2014Ishigaki1-1	3-Jul.	<i>Vigna luteola</i>	wild	Bunatabaru-kobashi, Ohama, Ishigaki-shi, Okinawa (Ishigaki island)	N24-24-40.6	E124-12-41.3	26	clay	bulk	no	small leaflet, along a river bank	5.5 x 5.5	-	-
251956	2014Ishigaki1-2	3-Jul.	<i>Vigna luteola</i>	wild	Bunatabaru-kobashi, Ohama, Ishigaki-shi, Okinawa (Ishigaki island)	N24-24-43.3	E124-12-41.8	22	clay	bulk	no	bank along a river	-	-	-
251957	2014Ishigaki2	3-Jul.	<i>Vigna riukiensis</i>	wild	Tojinbaka, Arakawa, Ishigaki-shi, Okinawa (Ishigaki island)	N24-21-55.5	E124-06-45.2	10	clay	bulk	no	lawn at the park	-	-	-
251958	2014Ishigaki2-2(1)	3-Jul.	<i>Vigna marina</i>	wild	100m West from Tojinbaka, Arakawa, Ishigaki-shi, Okinawa (Ishigaki island)	N24-21-59.0	E124-06-42.2	1	coral sand	bulk	no	beach, coral sand	18 x 8	15	3
251959	2014Ishigaki2-2(2)	3-Jul.	<i>Vigna marina</i>	wild	100m West from Tojin-baka, Arakawa, Ishigaki-shi, Okinawa (Ishigaki island)	N24-21-59.0	E124-06-42.2	1	coral sand	bulk	no	beach, coral sand	3.5 x 5	13	3.4
251960	2014Ishigaki2-2(3)	3-Jul.	<i>Vigna marina</i>	wild	100m West from Tojinbaka, Arakawa, Ishigaki-shi, Okinawa (Ishigaki island)	N24-21-59.0	E124-06-42.2	1	coral sand	bulk	no	beach, coral sand	12 x 5	13	4
251961	2014Ishigaki3-1	4-Jul.	<i>Vigna marina</i>	wild	Ibaruma, Ishigaki-shi, Okinawa (Ishigaki island)	N24-30-30.6	E124-17-01.0	16	coral sand	bulk	no	beach, coral sand	-	-	-
251962	2014Ishigaki3-2	4-Jul.	<i>Vigna marina</i>	wild	Ibaruma, Ishigaki-shi, Okinawa (Ishigaki island)	N24-30-36.1	E124-17-09.0	9	coral sand	bulk	no	100 m east along a beach from 2014Ishigaki3-1 place. coral sand	-	-	-
251963	2014Ishigaki3-3	4-Jul.	<i>Vigna marina</i>	wild	Ibaruma, Ishigaki-shi, Okinawa (Ishigaki island)	N24-30-35.3	E124-17-15.3	13	coral sand	bulk	no	100 m east along a beach from 2014Ishigaki3-2 place. growing from the sand at the rocky place. Some are growing on the rock. coral sand	-	-	-
251964	2014Miyako1-1	4-Jul.	<i>Vigna riukiensis</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-16.0	E125-27-58.8	29	organic soil	bulk	no	beside promenade	9.4 x 6	-	-
251965	2014Miyako1-2	4-Jul.	<i>Vigna riukiensis</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-13.65	E125-28-02.69	-	organic soil	bulk	no	beside promenade	-	-	-
251966	2014Miyako1-3	4-Jul.	<i>Vigna riukiensis</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-12.13	E125-28-06.08	-	organic soil	bulk	no	growing in the shrubbery under the lighthouse	-	-	-
251967	2014Miyako1-4	4-Jul.	<i>Vigna riukiensis</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-10.34	E125-28-07.93	-	organic soil	bulk	no	Stem color green. growing in the shrubbery bottom of the lighthouse.	-	-	-
251968	2014Miyako1-5(1)	4-Jul.	<i>Vigna riukiensis</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-10.06	E125-28-03.06	-	organic soil	bulk	no	-	10 x 5	-	-
251969	2014Miyako1-5(2)	4-Jul.	<i>Vigna marina</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	N24-43-10.06	E125-28-03.06	-	organic soil	bulk	no	-	10 x 5	-	-
251970	2014Miyako1-6	4-Jul.	<i>Vigna marina</i>	wild	Agarihennazaki, Gusukubebora, Miyakojima-shi, Okinawa (Miyako island)	-	-	-	organic soil	bulk	no	growing at the bottom of the lighthouse	-	-	-

Table 5 (Continued).

JP No.	Coll. No.	Coll. Date (2014)	Species name	Status	Collection Site	Latitude	Longitude	Altitude (m)	Soil	Seed	Herbarium	Remarks	population size (m <sup>2</sup> )	Distance from water edge	
														low tide(m)	flood tide(m)
251971	2014Irabu2	5-Jul.	<i>Vigna marina</i>	wild	Toguchinomaha beach, Irabu-irabu, Miyakojima-shi, Okinawa (Irabu island)	N24-48-43.7	E125-10-55.9	9	coral sand	bulk	no	-	-	25	8
251972	2014Miyako2	5-Jul.	<i>Vigna marina</i>	wild	Sunayama beach, Hirara-nikadori, Miyakojima-shi, Okinawa (Miyako island)	N24-50-20.9	E125-16-50.2	11	coral sand	bulk	no	beside a path to the beach. slope about 10°. coral sand.	5 x 10	-	-
251973	2014Ikema1	5-Jul.	<i>Vigna marina</i>	wild	Ikizu beach, Hirara-maezato, Miyakojima-shi, Okinawa (Ikema island)	N24-55-48.0	E125-13-59.8	8	coral sand	bulk	no	few rhizobium	5.7 x 9.8	12.8	9.1
251974	2014Ikema2	5-Jul.	<i>Vigna marina</i>	wild	Masakadatsu beach, east side of bottom of the Ikema Ohashi Bridge to Ikema island, Hirara-ikema, Miyakojima-shi, Okinawa (Ikema island)	N24-55-29.6	E125-15-19.7	-	coral sand	bulk	no	Died plants suffered from the seawater were found	10.4 x 77	12.8	5.7
251975	2014Miyako3	6-Jul.	<i>Vigna marina</i>	wild	Maibama beach, Shimoyiyonaha, Miyakojima-shi, Okinawa (Miyako island)	N24-44-08.1	E125-15-42.0	3	coral sand	bulk	no	large seeds	-	-	-
251976	2014Kurima1	6-Jul.	<i>Vigna marina</i>	wild	Kurima beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-43-29.9	E125-15-17.0	3	coral sand	bulk	no	Found with <i>Spinifex littoreus</i> (Burn. f.) Merr. population.	-	-	-
251977	2014Kurima2	6-Jul.	<i>Vigna marina</i>	wild	Nagasakahama beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-42-51.0	E125-14-43.2	3	coral sand	bulk	no	-	4.1 x 8.2	15.6	8.8
251978	2014Kurima3	6-Jul.	<i>Vigna marina</i>	wild	Musunun beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-43-03.7	E125-14-25.3	6	coral sand	bulk	no	many rhizobium	7 x 7.7	12.2	7.6
251979	2014Kurima4(1)	6-Jul.	<i>Vigna marina</i>	wild	Nagamahama beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-43-27.2	E125-14-22.5	6	coral sand	bulk	no	-	3 x 3	-	-
251980	2014Kurima4(2)	6-Jul.	<i>Vigna marina</i>	wild	Nagamahama beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-43-27.2	E125-14-22.5	6	coral sand	bulk	no	-	-	-	-
251981	2014Kurima4(3)	6-Jul.	<i>Vigna marina</i>	wild	Nagamahama beach, Shimojikurima, Miyakojima-shi, Okinawa (Kurima island)	N24-43-27.2	E125-14-22.5	6	coral sand	bulk	no	Some white spots seen on the leaf (salt?).	3.8 x 25.8	17.5	10



Photo 1. Ishigaki 1-1



Photo 2. Ishigaki 1-2



Photo 3. Ishigaki 2-2



Photo 4. Ishigaki 3-1



Photo 5. Ishigaki 3-1



Photo 6. Ishigaki 3-2



Photo 7. Ishigaki 3-2



Photo 8. Ishigaki 3-3



Photo 9. Miyako 1-1



Photo 10. Miyako 1-2



Photo 11. Miyako 1-3



Photo 12. Miyako 1-3



Photo 13. Miyako 1-4



Photo 14. Miyako 1-5



Photo 15. Irabu 1



Photo 16. Irabu 1



Photo 17. Irabu 2



Photo 18. Miyako 2



Photo 19. Ikema 1



Photo 20. Ikema 2



Photo 21. Miyako 3



Photo 22. Kurima 1



Photo 23. Kurima 2



Photo 24. Kurima 3



Photo 25. Kurima 4



Photo 26. Kurima 4 Flowering *Vigna marina*



Photo 27. Kurima 4 Maturing *Vigna marina*



Photo 28. Ishigaki 3-2 *Ipomoea pes-caprae* at Ishigaki



Photo 29. *Vitex rotundifolia* at 2014 Ishigaki 2-2



Photo 30. *Cassytha filiformis* at Ishigaki 3-2



Photo 31. *Crinum asiaticum* at Ishigaki 3-1



Photo 32. *Spinifex littoreus* at Kurima 1



Ishigaki 1-1, JP251955,  
*Vigna luteola*



Ishigaki 1-2, JP251956,  
*Vigna luteola*



Ishigaki 2, JP251957,  
*Vigna riukiensis*



Ishigaki 2-2 (1), JP251958,  
*Vigna marina*



Ishigaki 2-2 (2), JP251959,  
*Vigna marina*



Ishigaki 2-2 (3), JP251960,  
*Vigna marina*



Ishigaki 3-1, JP251961,  
*Vigna marina*



Ishigaki 3-2, JP251962,  
*Vigna marina*



Ishigaki 3-3, JP251963,  
*Vigna marina*



Miyako 1-1, JP251964,  
*Vigna riukiensis*



Miyako 1-2, JP251965,  
*Vigna riukiensis*



Miyako 1-3, JP251966,  
*Vigna riukiensis*



Miyako 1-4, JP251967,  
*Vigna riukiensis*



Miyako 1-5 (1), JP251968,  
*Vigna riukiensis*



Miyako 1-5 (2), JP251969,  
*Vigna marina*



**Miyako 1-6, JP251970,  
*Vigna marina***



**Irabu 2, JP251971,  
*Vigna marina***



**Miyako 2, JP251972,  
*Vigna marina***



**Ikema 1, JP251973,  
*Vigna marina***



**Ikema 2, JP251974,  
*Vigna marina***



**Miyako 3, JP251975,  
*Vigna marina***



**Kurima 1, JP251976,  
*Vigna marina***



**Kurima 2, JP251977,  
*Vigna marina***



**Kurima 3, JP251978,  
*Vigna marina***



**Kurima 4 (1), JP251979,  
*Vigna marina***



**Kurima 4 (2), JP251980,  
*Vigna marina***



**Kurima 4 (3), JP251981,  
*Vigna marina***