

パプアニューギニアにおけるマメ類および共生微生物 遺伝資源多様性の現地調査と保全

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Ecological Survey and Conservation of Legume - symbiotic Rhizobia Genetic Diversity in Papua New Guinea, 2004

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Summary

A field survey was conducted for conservation of legumes and symbiotic rhizobia genetic diversity in Papua New Guinea (Port Moresby area, Alotau area and eastern Highlands area - Ramu river valley) from June 20 to July 10, 2004. The food legumes, hyacinth bean (*Lablab purpureus*), lima bean (*Phaseolus lunatus*), winged bean (*Psophocarpus tetragonolobus*) and yard long bean (*Vigna unguiculata*) were collected. The wild species, *Canavalia rosea*, *Glycine tomentella*, *Macroptilium atropurpureum*, *Vigna radiata* var. *sublobata*, *Vigna reflexo-pilosa* and *Vigna marina* were collected. Seed samples as well as root nodules were collected if they are available and are deposited in Papua New Guinea and Japan genebanks.

Introduction and Methods

The National Agricultural Research Institute (NARI), Papua New Guinea (PNG) and National Institute of Agrobiological Sciences (NIAS), Japan signed an MOA and a workplan related to collaboration on plant genetic diversity conservation in October 2003. This is the first report on a survey conducted in PNG for the conservation of legumes and symbiotic rhizobia genetic

diversity in relation to the workplan developed. Papua New Guinea has a land area of 462,243 km² stretching from 141° E to 156° E and 1° S to 11° S. It is an ecologically diverse country. The highest peak Mt. Wilhelm has an elevation of 4,793 m, in the Owen Stanley Ranges.

The field survey was conducted from June 20 to July 10 (Table 1). A map of the surveyed area is shown in Fig.1. Seeds, herbarium specimens and root nodules were collected when they are available. Information on collection sites including village names, altitudes, latitudes, longitudes, habitat status and other ecological data together with detailed sketch maps of the sites were recorded as passport data and summarized in Tables 2 & 3.

Results

A total of 37 seed samples consisting of 10 legume species were collected together with root nodules if available (Table 2). The surveyed area was divided into 3 areas, Port Moresby, Alotau, and Eastern Highlands and Ramu river valley (Fig. 1). The main results in each area are summarized below.

Port Moresby

We have surveyed around Port Moresby to the southeast as far as Kwikila (ca. 70 km SE of Port Moresby) and to the northwest as far as Bereina (ca. 150 km NW of Port Moresby) along the road. The altitude ranged from 10 m to 85 m. Ten seed samples consisting of 3 wild species, *Glycine tomentella*, *Macroptilium atropurpureum* and *Vigna radiata* var. *sublobata*, were collected in this area.

This area is characterized by dry savannah type grasslands distributed on sandy soil. Eucalyptus trees are seen sporadically. In this vegetation, wild mungbean (*Vigna radiata* var. *sublobata*) is a common component as a twiner or crawler. *Glycine tomentella* seems less common but is also considered as a member of this vegetation. *Macroptilium atropurpureum* is considered to be an established escape after introduction as a forage crop.

Alotau

Alotau is the capital city of Milne Bay province which is located in the southeastern peninsula of mainland PNG. We surveyed from Alotau to the east end of East Cape peninsular along the road facing the Milne Bay by car. We also surveyed the area around Dogura, Rabaraba, Awayama and Garuahi which is located on the north coast facing the Goodenough Bay by boat.

The area around Alotau is characterized by tropical rain forest climate and the main land use is oil palm plantation. Near the end of East Cape, the vegetation changed to savannah type grasslands with pandanus trees. We could not find wild *Glycine* or wild *Vigna* in this area. Yard long bean (*Vigna unguiculata*) sold in an open market in East Cape was collected. This crop seems to be recently introduced according to comments by local people.

The area facing Goodenough Bay has rather dry weather conditions and is characterized by savannah type grasslands with pandanus and sago trees (eastern part around Garuahi and Awayama) or with eucalyptus trees (western part around Rabaraba and Dogura). Wild legumes, *Glycine tomentella* and *Vigna radiata* var. *sublobata* were found growing in grasslands with eucalyptus vegetation. Two accessions of *G. tomentella* were collected in hilly areas around Dogura town. Two accessions of *V. radiata* var. *sublobata* were collected in Rabaraba and Dogura. *V. radiata* seems to be more common in this area and is also found in savannah

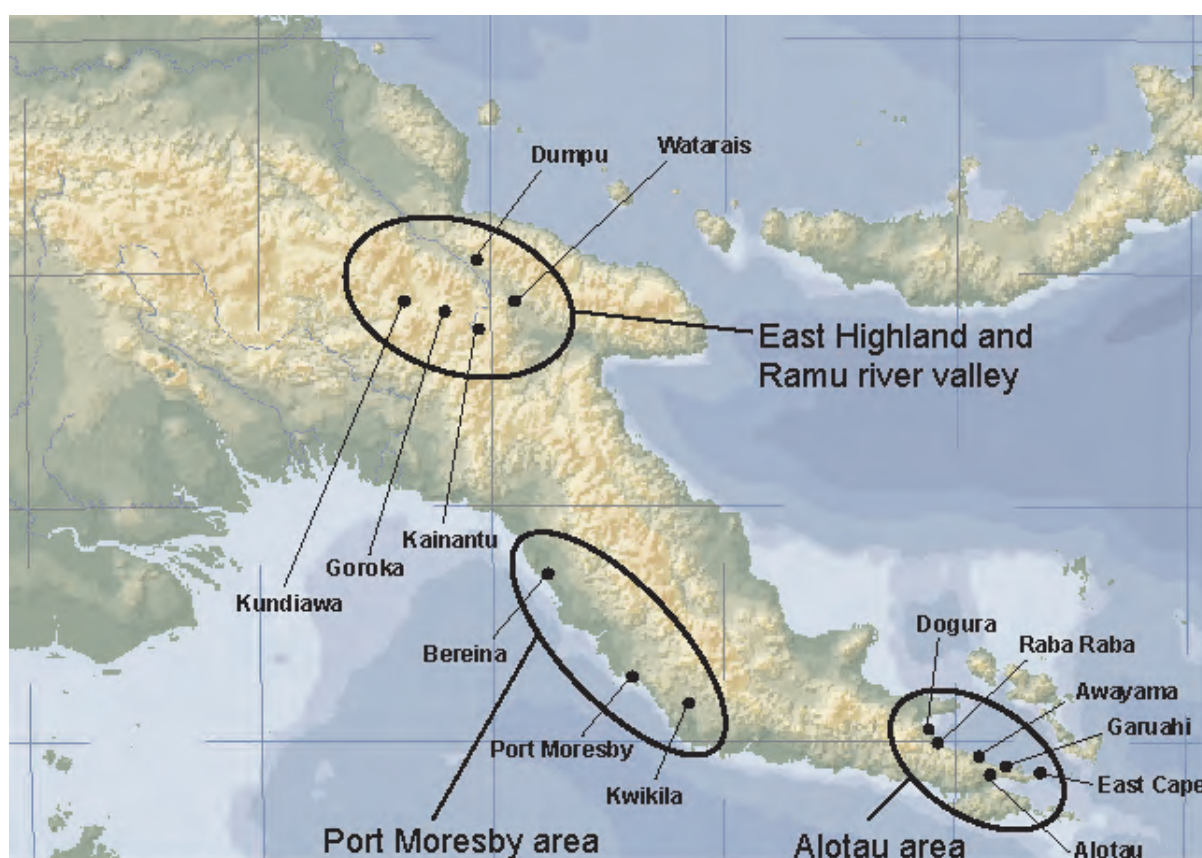


Fig.1. A map of the surveyed area in Papua New Guinea, 2004

Table 1. Itinerary of the field survey in Papua New Guinea, 2004

Day	Date	Day	Itinerary	Work	Stay
1	20-Jun	Sun	Tsukuba 21:25 (QF060) → Cairns 5:55 (flight)	move	on flight
2	21-Jun	Mon	Cairns 12:00 (PX093) → Port Moresby 13:35 (flight)	discussion at NARI	Port Moresby
3	22-Jun	Tue	near Port Moresby (Napa Napa) (car)	survey	Port Moresby
4	23-Jun	Wed	east of Port Moresby (Kwikila) (car)	survey	Port Moresby
5	24-Jun	Thu	west of Port Moresby (Bereina) (car)	survey	Port Moresby
6	25-Jun	Fri	Port Moresby 6:05 (PX954) → Alotau 7:05, Discussion with local staff	move	Alotau
7	26-Jun	Sat	Alotau → East Cape (car)	survey	Alotau
8	27-Jun	Sun	Alotau → North coast (car)	survey	Alotau
9	28-Jun	Mon	Alotau → Dogura (boat)	survey	Dogura
10	29-Jun	Tue	Dogura → Raba Raba → Dogura (boat)	survey	Dogura
11	30-Jun	Wed	Dogura → Alotau (boat)	survey	Alotau
12	1-Jul	Thu	near Alotau, Alotau 16:30 (PX159) → Port Moresby 17:20 (flight)	survey, move	Port Moresby
13	2-Jul	Fri	Port Moresby 9:15 (PX960) → Goroka → Kundiawa (flight)	move	Kundiawa
14	3-Jul	Sat	west of Kundiawa (car)	survey	Kundiawa
15	4-Jul	Sun	between Kundiawa → Goroka (car)	survey	Goroka
16	5-Jul	Mon	south of Goroka	survey	Goroka
17	6-Jul	Tue	east of Goroka (Kainantu)	survey	Goroka
18	7-Jul	Wed	Goroka → Watarais → Ramu Sugar (car)	survey	Ramu Sugar
19	8-Jul	Thu	Ramu Sugar → Lae 16:35 (PX109) → Port Moresby 17:20 (flight)	Plant quarantine	Port Moresby
20	9-Jul	Fri	Port Moresby 18:25 (PX98) → Cairns 19:50 (flight)	move	Cairns
21	10-Jul	Sat	Cairns 12:10 (QF167) → Tsukuba 18:45 (flight)	move	

Table 2. A summary of collected materials in each area

No.	Species	Port Moresby area	Alotau area	Eastern highland and Ramu valley	Total
1	<i>Canavalia rosea</i>	-	1	-	1
2	<i>Glycine tomentella</i>	1	2	-	3
3	<i>Lablab purpureus</i>	-	1	-	1
4	<i>Macroptilium atropurpureum</i>	1	-	-	1
5	<i>Phaseolus lunatus</i>	-	1	-	1
6	<i>Psophocarpus tetragonolobus</i>	-	-	9	9
7	<i>Vigna radiata</i> var. <i>sublobata</i>	8	4	2	14
8	<i>Vigna reflexo-pilosa</i>	-	1	4	5
9	<i>Vigna marina</i>	-	1	-	1
10	<i>Vigna unguiculata</i>	-	1	-	1
Total		10	12	15	37

grassland with pandanus trees around Garuahi and Awayama. *Canavalia rosea* and *Vigna marina* were found growing on the sandy beach at Rabaraba. An accession of *Vigna reflexo-pilosa* was collected beside a village path in Garuahi. In an open market in Dogura, young pods of hyacinth bean (*Lablab purpureus*) were sold as vegetables. Lima bean seems to be common in this area and an accession was collected in Dogura which was grown in a backyard garden.

Eastern Highlands area and Ramu river valley

The eastern part of the highlands was surveyed along the road around Kundiawa (Chimbu province), Goroka and Kainantu (Eastern Highland province). The altitude of the surveyed area ranged from 1,336 m to 2,110 m. In both areas, winged bean (*Psophocarpus tetragonolobus*) is commonly grown and 9 samples were collected. Every farmer recognized and grew several cultivars with different seed color, pod size and color, root size and shape. In the western part of the surveyed area (Chimbu province and a part of Western Highlands province), *Vigna reflexo-pilosa* were found in wet soil such as in ditches. However, we could not find any natural population of this species around Goroka or Kainantu (Eastern Highland province). *V. radiata* var. *sublobata* was not found on the highlands.

After the survey on the highland area, we went down to the Ramu river valley. The altitude of surveyed area in Ramu valley ranged between 265 m to 485 m. This area is a vast flood plain mainly used for sugarcane plantation or pasture land. *Vigna radiata* var. *sublobata* was found growing along the road and beside pasture in this area. Two samples were collected.

Discussion

Cultivated food legumes

A few food legumes have been cultivated traditionally in PNG (Verdcourt, 1979). Winged bean (*Psophocarpus tetragonolobus*) is one of a few traditional legumes and the flowers, leaves, young pods, seeds are all eaten. In some areas on the highlands, it is cultivated mainly for its tuberous root production. The root of winged bean contains 10-15% protein which is about 10 times as much as in kudzu, yams or sweet potatoes. The seed of winged bean is also famous for

its high protein content (30-40%). Various cultivars are still cultivated but many farmers told us that much more diverse cultivars had been cultivated before.

Lima bean (*Phaseolus lunatus*) is considered to have been domesticated in Central America and Andean highlands. Although it is not clear when this crop was introduced to PNG, it is considered to be an old food legume of the New Guinean highlands, and the leaves, young pods and seeds are all eaten. Another traditional food legume in PNG is hyacinth bean (*Lablab purpureus*). The leaves, young pods and seeds are eaten. A large edible root packed with starch is also palatable. Only one sample of lima bean and hyacinth bean could be collected in this survey. Further effort to collect these traditional food legumes in PNG is necessary.

Wild Vigna

Vigna reflexo-pilosa

Living materials of *Vigna reflexo-pilosa* were collected for the first time in PNG. This species is not described in the monograph “A manual of New Guinea Legumes” (Verdcourt, 1979). *V. reflexo-pilosa* is the only tetraploid species in the genus *Vigna* (Tomooka *et al.*, 2002). This species was domesticated and the cultivated form is the variety *V. reflexo-pilosa* var. *glabra* (= *V. glabrescens*). This underexploited crop has a potential to become a “new” crop considering its robust nature. Wild plants of this species were collected mainly from the highland area of PNG. New materials from PNG may provide a novel gene source for this crop as well as important research materials regarding the origin of this crop.

Vigna radiata* var. *sublobata

This wild legume is the wild ancestor of the important food legume, mungbean (*V. radiata* var. *radiata*). Wild plants of this species were collected around Port Moresby, northern coastal area of Alotau and Ramu river valley area. They seem to prefer dry sandy soils where savannah type grassland vegetation prevails.

References

- 1) Tomooka N., D.A. Vaughan, H. Moss and M. Maxted (2002) The Asian *Vigna* : genus *Vigna* subgenus *Ceratotropis* genetic resources. Kluwer Academic Publishers. 270 pages.
- 2) Verdcourt B. (1979) A manual of New Guinea Legumes. Kristen Press Inc. Madang, PNG.

和文摘要

農業生物資源研究所はパプアニューギニア農業研究所との間で共同研究協定を締結し、2004年から植物遺伝資源の多様性保全に関する共同調査研究を開始した。パプアニューギニアはヤムイモやタロイモを主食とする根菜農耕文化圏に属する地域であるが、シカクマメ、フジマメ、ライマメは伝統的マメ科作物と考えてよい。また、アジアのササゲ属野生種やダイズ属野生種も分布しており、独自の遺伝的変異が期待できる。本調査では、ポートモレスビー周辺、アロタウ周辺、ニューギニア高地東部およびラム川氾濫原を探索し、伝統的マメ科作物、その近縁野生種および共生している根粒菌の収集保全を行った。

Table 3. A passport data of collected materials.

Date	Col. No.	Species name	Status	Collection Site	Province	Alt.	Latitude	Longitude	Seed	Herbarium	Nodule	Soil	Remarks
Port Moresby area													
21-Jun	2004PNG-1	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	beside Lamana Hotel, Waigani City Centre, Port Moresby	Central	35m	S9-26-33.8	E147-10-47.0	yes	yes	no	silt	waste land and beside road, flower color: pale yellow, thick main root and stem
22-Jun	2004PNG-2-1	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Napa Napa, near Port Moresby	"	10m	S9-27-14.7	E147-6-5.3	yes	yes	no	sand	road side, very dry condition
	2004PNG-2-2	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	"	"	10m	S9-27-14.7	E147-6-5.3	yes	yes	no	sand	road side, very dry condition
	2004PNG-2.5	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	"	"	10m	S9-27-14.7	E147-6-5.3	yes	no	no	sand	road side, very dry condition
23-Jun	2004PNG-3	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	between Saroa and Kwikila, east of Port Moresby	"	85m	S9-48-47.7	E147-39-8.8	yes	yes	yes	sandy	beside road, flower color: pale yellow, stem: slender,
	2004PNG-4	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Manu Goro, east of Port Moresby	"	10m	S9-42-37.9	E147-27-56.5	yes	yes	yes	sandy	road side ditch
24-Jun	2004PNG-5	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	junction to Kubuna Mission, west of Port Moresby	"	50m	S8-45-31.5	E146-39-44.5	yes	yes	yes	sandy	beside road, slope: 5 ° small stipule, small flower, slender leaflet
	2004PNG-6-1	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	west of Port Moresby	"	24m	S8-56-54.2	E146-47-29.3	no	yes	yes	sandy	only nodules and specimens collected
	2004PNG-6-2	<i>Macroptilium</i> <i>atropurpureum</i>	wild	"	"	24m	S8-56-54.2	E146-47-29.3	no	yes	yes	sandy	only nodules and specimens collected
	2004PNG-6-3	<i>Glycine tomentella</i>	wild	"	"	24m	S8-56-54.2	E146-47-29.3	no	yes	no	sandy	only nodules and specimens collected
Alotau area													
26-Jun	2004PNG-26	<i>Vigna unguiculata</i>	cultivated	East cape	Milne Bay	1m	S10-13-51.7	E150-52-11.1	yes	no	no	sandy	market, sold as a vegetable
27-Jun	2004PNG-7	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Awayama Village, north of Alotau	"	13m	S10-14-14.7	E150-31-56.1	yes	yes	yes	silt	beside road, edge of savannah grassland
	2004PNG-8	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Garuahi, north of Alotau	"	18m	S10-13-7.1	E150-29-15.5	yes	yes	yes	clay	edge of savannah grassland
29-Jun	2004PNG-9	<i>Vigna marina</i>	wild	Raba Raba	"	0m	S9-58-52.9	E149-50-47.7	yes	no	yes	sandy	sandy beach
	2004PNG-10	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	"	"	25m	S9-58-32.1	E149-50-22.7	yes	yes	yes	black clay	savannah grassland on the hill
	2004PNG-11	<i>Canavalia rosea</i>	wild	"	"	0m	S9-58-52.9	E149-50-47.7	yes	yes	no	sand	sandy beach
	2004PNG-12	<i>Glycine tomentella</i>	wild	Dogura	"	36m	S10-5-26.9	E150-4-58.4	yes	yes	no	silt	beside road to Dogura high school, slope: 5°
	2004PNG-12.5	<i>Glycine tomentella</i>	wild	"	"	36m	S10-5-26.9	E150-4-58.4	yes	no	no	silt	beside road
	2004PNG-13	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	"	"	36m	S10-5-26.9	E150-4-58.4	yes	yes	yes	silt	beside road, slope: 5°
	2004PNG-14	<i>Lablab prupureus</i>	cultivated	"	"	36m	S10-5-26.9	E150-4-58.4	yes	no	no	silt	market, young pods used as a vegetable
	2004PNG-15	<i>Phaseolus lunatus</i>	cultivated	"	"	36m	S10-5-26.9	E150-4-58.4	yes	no	no	silt	farmer's garden
30-Jun	2004PNG-16	<i>Vigna reflexo-</i> <i>pilosa</i>	wild	Garuahi	"	1m	S10-13-52.7	E150-31-1.6	yes	yes	yes	sand	beside road, flower color: bright yellow

Table 3 (continued).

Date	Col. No.	Species name	Status	Collection Site	Province	Alt.	Latitude	Longitude	Seed	Herbarium	Nodule	Soil	Remarks
Eastern Highland													
3-Jul	2004PNG-17	<i>Vigna reflexopilosa</i>	wild	Kumgi Barawagi, west of Kundiawa	Chimbu	1,442m	S5-56-44.2	E144-50-7.1	yes	yes	yes	gravel	beside path, local name: Bin (bean) are (wild), flower color: yellow, leaflet: densely hairy
	2004PNG-18	<i>Vigna reflexopilosa</i>	wild	5 km east from No. 17 site, near Primary school, west of Kundiawa	"	1,494m	S5-56-40.5	E144-51-31.2	yes	no	no	gravel	waste land beside road
	2004PNG-19	<i>Vigna reflexopilosa</i>	wild	Pogorob, east of Mount Hagen	Western Highlands	1,550m	S5-50-4.0	E144-32-51.5	yes	yes	yes	clay	wet place near ditch beside road
	2004PNG-20-1	<i>Psophocarpus tetragonolobus</i>	cultivated	Kunabau, West of Kundiawa	Chimbu	1,494m	S5-56-40.5	E144-51-31.2	yes	no	no	clay	black seed variety
	2004PNG-20-2	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	1,494m	S5-56-40.5	E144-51-31.2	yes	no	no	clay	brown seed variety
	2004PNG-20-3	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	1,494m	S5-56-40.5	E144-51-31.2	yes	no	no	clay	black mottled seed variety
	2004PNG-21	<i>Vigna reflexopilosa</i>	wild	Kundiawa	"	1,366m	S6-1-57.3	E144-58-28.9	yes	yes	yes	clay	beside road, grows near the ditch
5-Jul	2004PNG-22-1	<i>Psophocarpus tetragonolobus</i>	cultivated	Kuru village, South of Goroka	Eastern Highland	2,110m	S6-24-55.2	E145-30-25.6	yes	no	no	clay	local name: Ephe: white seed, white long pod, long tuber, pick flower for good tuber production,
	2004PNG-22-2	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	2,110m	S6-24-55.2	E145-30-25.6	yes	no	no	clay	local name: Hitripha: black seed, short black pod, round short tuber
	2004PNG-22-3	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	2,110m	S6-24-55.2	E145-30-25.6	yes	no	no	clay	local name: Sumetha: mottled seed, white medium length pod, round short tuber
6-Jul	2004PNG-23-1	<i>Psophocarpus tetragonolobus</i>	cultivated	Isontenu, between Goroka and Kainantu	"	1,580m	S6-16-15.9	E145-55-3.5	yes	no	yes	silt	local name: Korahu: black seed, pink pod, short white round tuber local name: Tuanta: black seed, green pod, short brown tuber
	2004PNG-23-2	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	1,580m	S6-16-15.9	E145-55-3.5	yes	no	yes	silt	local name: Antuna: black mottled seed, green pod, short white round tuber
	2004PNG-23-3	<i>Psophocarpus tetragonolobus</i>	cultivated	"	"	1,580m	S6-16-15.9	E145-55-3.5	yes	no	yes	silt	local name: Daufa-e: brown seed, thick long pale green pod, long white or brown tuber
Ramu river valley													
7-Jul	2004PNG-24	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Marajabong, near Watarais	Morobe	485m	S6-8-25.0	E146-2-21.2	yes	yes	yes	gravel	local name: Upis (bean), many nodules
	2004PNG-25	<i>Vigna radiata</i> var. <i>sublobata</i>	wild	Dunpu, south of Madang	Madang	265m	S5-51-33.5	E145-42-11.8	yes	yes	yes	silt	beside forage grassland, not much stink bug damage, many nodules



Photo 1. Dry grassland with eucalyptus trees near Port Moresby, a habitat of *Vigna radiata* var. *sublobata*



Photo 2. *Glycine tomentella* found in Dogura



Photo 3. Dry habitat of *Vigna radiata* var. *sublobata*



Photo 4. *Vigna radiata* var. *sublobata*, growing under serious drought condition



Photo 5. Winged bean (*Psophocarpus tetragonolobus*) sold in a highland market (left) and its cooked tuberous roots (right)

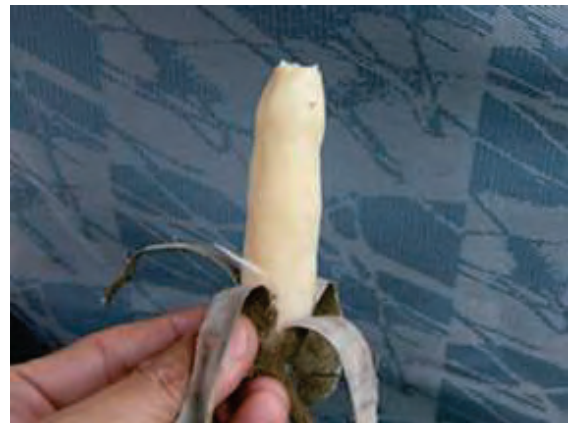


Photo 6. Morphological variation of the seeds of winged bean (*Psophocarpus tetragonolobus*)