

## Collaborative Field Exploration and Collection of Plant Genetic Resources in Cambodia, April-May 2019

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## Collaborative Field Exploration and Collection of Plant Genetic Resources in Cambodia, April-May 2019

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### Summary

A collaborative field survey of plant genetic resources was conducted in eastern Cambodia from April 29 to May 9, 2019. During this survey, 15 genetic resources were collected, including 3 sorghum (*Sorghum bicolor*) accessions, 2 maize (*Zea mays*) accessions, and 10 erianthus (*Erianthus procerus*) accessions.

KEY WORDS: Cambodia, *Sorghum bicolor*, *Zea mays*, *Erianthus procerus*

### Introduction

The mission of the Genebank Project is to collect plant genetic resources for crop improvement, such as increased yield and enhanced stress tolerance. Thus, we conducted a collaborative field exploration in Cambodia.

In 2012, a Letter of Agreement (LOA) was signed between the National Institute of Agrobiological Sciences (NIAS) and Cambodian Agricultural Research and Development Institute (CARDI), following which several collaborative survey trips were undertaken (Tomooka *et al.* 2012, 2013; Takahashi *et al.* 2014, 2015). In 2014, a Joint Research Agreement (JRA) between NIAS and CARDI was signed within the frame of the Plant Genetic Resources in Asia Project (PGRAsia Project). Following the merger between the National Agriculture and Food Research Organization (NARO) and NIAS in April 2016, all obligations and rights of NIAS under this JRA were transferred to the NARO.

To date, over 10 survey trips targeting various plant species have been conducted in Cambodia (Matsunaga *et al.* 2015; Tanaka K *et al.* 2016; Tanaka Y *et al.* 2016; Sreynech *et al.* 2016). The present survey was conducted to collect the genetic resources of sorghum (*Sorghum bicolor* (L.) Moench), maize (*Zea mays* L.), and erianthus (*Erianthus procerus* (Roxb.) Raizada) in eastern Cambodia.

### Methods

The survey was conducted for 11 days from April 29 to May 9, 2019 (Table 1). We visited four provinces during the present field trip (Fig. 1). A rental car was used for transportation across the study sites. The survey team included a researcher from NARO, another researcher from CARDI, and a Cambodian driver. Samples were collected from the villagers or the field. We measured several traits, such as plant height and panicle length, of

the collected plant samples and obtained photographs. We also recorded the locality information using a global positioning system (GARMIN, foretrex301) and obtained the local name of the plant through interviews with the villagers. The names of localities in the present report follow the “MAP of CAMBODIA” (SERIC/Alain Gascuel Phnom Penh 2015) and the idiomatic spelling used by Cambodians.

## Results

We visited four provinces in eastern Cambodia and collected 15 accessions of plant genetic resources, including 3 *S. bicolor* accessions, 2 *Z. mays* accessions, and 10 *E. procerus* accessions (Table 2). Detailed results

on each day are summarized below.

Day 1: April 29, 2019

Site: Phnom Penh to Snuol, Kratie Province

Weather: Rainy or cloudy to sunny

It was the beginning of the rainy season. The survey team moved toward the east from Phnom Penh and stayed in Snuol.

Day 2: April 30, 2019

Site: Snuol to Sen Monorom, Mondulkiri Province

Weather: Sunny

Along the major road (Route 76) from Snuol to Sen Monorom, we collected the stems of *E. procerus*

Table 1. Itinerary of the survey in Cambodia

Date	Day	Itinerary	Collection
29-Apr	Sun	Phnom Penh - Snuol, Kratie Prov.	
30-Apr	Mon	Snuol - Sen Monorom, Mondul Kiri Prov.	C1 - 3
1-May	Tue	Sen Monorom - Ban Lung, Ratanak Kiri Prov.	C4 - 5
2-May	Wed	Ratanak Kiri Prov.	C6
3-May	Thu	Ban Lung - Stung Treng, Stung Treng Prov.	
4-May	Fri	Stung Treng Prov.	C7 -8
5-May	Sat	Stung Treng Prov.	C9
6-May	Sun	Stung Treng - Kratie, Kratie Prov.	C10
7-May	Mon	Kratie Prov.	C11 -12
8-May	Tue	Kratie - Snuol	C13 -15
9-May	Wed	Snuol - Phnom Penh	

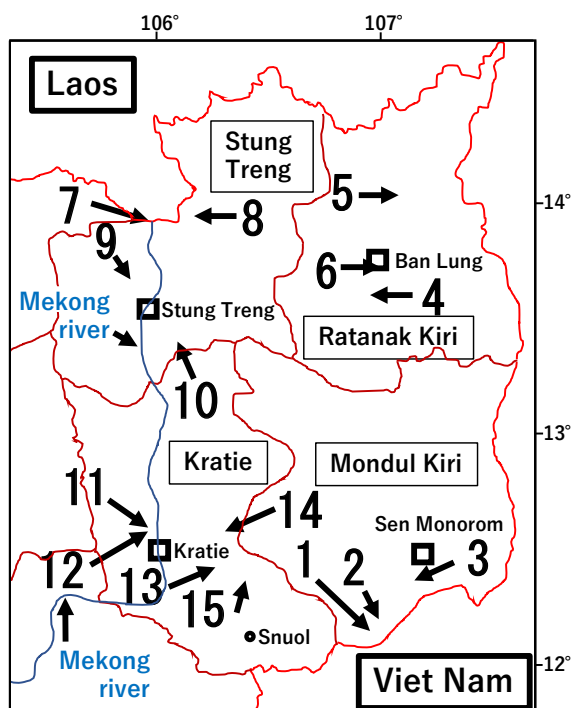


Fig. 1. Map of Cambodia and the collection sites (#1-15).

(collection numbers 2019-4-C1 and 2019-4-C2; hereafter, C1 and C2; Photos 1 and 2-3, respectively) from hilly areas. There were over 100 individuals in both populations. The glumes were completely open, and we collected the panicles to obtain seeds.

Next, we visited the Pu Hem village in the Mondulkiri Province, which is located at only 2 km from Route 76. The way to this village was a narrow, unpaved road with bare soil and a steep slope, and the road seemed impossible to cross during the rainy season. Mr. Nhos Kam (Phnong tribe) from the village provided us a sorghum sample (C3, Photos 4-5). The sample was white sorghum, consumed as popped grains. Another person from a village near Pu Hem informed us that they had seen such white sorghum grains 8 years ago but not recently.

Table 2. Number of collected genetic resources

Species	Accessions
<i>Sorghum bicolor</i>	3
<i>Zea mays</i>	2
<i>Erianthus procerus</i>	10
Total	15



Photo 3. *Erianthus* (C2)



Photo 1. *Erianthus* (C1)



Photo 4. Provider of *Sorghum* (C3)



Photo 5. *Sorghum* (C3)



Photo 2. Habitat of *Erianthus* (C2)

Day 3: May 1, 2019

Site: Sen Monorom to Ban Lung, Ratanak Kiri Province

Weather: Sunny

We visited the major market in Sen Monorom at 6:00 am. There used to be an independent market of

ethnic minorities at the edge of the major market on the roadside along the airport. There were approximately 20 shops belonging to the Phnong tribe in 2015, but these shops have now been replaced by a gas station (Photo 6). We were informed that the ethnic minority market is no longer there. We only found two minority shops (stalls) (Photo 7) belonging to the Khmer tribe shops/stalls in the major market. They sold pineapples, avocados, bamboo shoots, and herbs. Many ethnic minorities live in the Mondulkiri Province, but they have very few opportunities to directly sell their agricultural products to people in the city.

Then, we left Sen Monorom and collected the stems



Photo 6. Gas station



Photo 7. Minority shop



Photo 8. Habitat of *Erianthus* (C4)

of *E. procerus* (C4, Photos 8-9) from the sides (plain level) of the major road to Ban Lung, Ratanak Kiri Province. According to the Khmer people living nearby, the local name of *Erianthus* is “Treng.” We found an isolated individual, and no other *Erianthus* was growing nearby. We collected the panicles to obtain seeds, but the glumes were completely open. We also collected another *E. procerus* sample (C5, Photo 10) along the roadside 33 km north of Ban Lung. There were over 100 individuals



Photo 9. *Erianthus* (C4)



Photo 10. *Erianthus* (C5)

in the population. The glumes were completely open, and we collected the panicles to obtain seeds.

Day 4: May 2, 2019

Site: Ratanak Kiri Province

Weather: Sunny

There were 30 minority shops in the major market of Ban Lung, which belonged to the Kuran, Charai, and Tompuan tribes. They sold eggplant, bitter melon, okra, red pepper, cucumber, onion, improved cabbage, pineapple, bamboo shoot, avocado, durian, jackfruit, rambutan, banana, mushroom, pumpkin, lotus flower, baby corn, and green onion.

Then, we visited the Lake Yeak Laom, which is located at 5 km south of Ban Lung. It is a crater lake (diameter, 800 m) created by volcanic eruptions. From a village near the lake, Ms. Lan Charp (Tom Poun) provided us white sorghum grains (C6, Photo 11). Its local name is “Katav.” We also visited the Lorn village of Tom Poun tribe and were informed that white sorghum had already disappeared 2-3 years ago. A person from the Lbang Pi village of the Proev tribe informed us that there used to be a white sorghum individual, but it was eaten by birds and lost 2 years ago. Another person in the next village informed us that they had stopped growing black sorghum since the previous year. A person belonging to the Prov tribe in the Komrou village informed us that they had stopped cultivating black sorghum since the past 3-4 years. According to members of the Kreong tribe in the Toury Tom village, black sorghum was present 5-6 years ago. Members of the Kreong tribe in the Cha Ong Krao village informed us that black sorghum had disappeared 5 years ago.

Day 5: May 3, 2019

Site: Ban Lung to Stung Treng, Stung Treng Province

Weather: Sunny

We moved from Ban Lung to Stung Treng in the



Photo 11. Sorghum (C6)

Stung Treng Province by a major road (Route 78). At a diversion (N13°32', E106°41'), we headed north by a minor road.

A person of the Leav (Lao) tribe in the Krabei village of the Stung Treng Province informed us that sorghum might be growing in their cashew nut field some distance away. Therefore, we drove and walked with the owner for 1.5 hours to their cottage on this cashew nut field; however, sorghum was not found.

Day 6: May 4, 2019

Site: Stung Treng Province

Weather: Sunny

We headed north from Stung Treng to the Laos border via Route 7. We were informed in 2015 that there is a sorghum cultivation on an island of the Mekong River. There was a small boat on the eastern bank of the Mekong River near the Laos border. We hired the boat to visit the Koh Cheorteal Thom island (Photo 12).

An elderly person of the Khmer tribe living near the port of the island informed us that sorghum is locally called “Khaofang” the same pronunciation and spelling of sorghum in Laos. We walked for 5 minutes from there to visit a farmer’s house next to an elementary school and found black sorghum (C7, Photo 13). An elderly person informed us that it is called “Om Pov.”



Photo 12. Small boat for the island



Photo 13. Sorghum (C7)

We drove eastward from the Laos border to the Siem Pang town by minor roads. Along the roadside, we collected the stems of *E. procerus* (C8, Photo 14). There were 30 individuals in the population. The glumes were completely open, and we collected the panicles for obtaining seeds.

Day 7: May 5, 2019  
Site: Stung Treng Province  
Weather: Sunny

There was a major market near the Mekong River, and three colonies of 15 minority shops. A lady (age, ~40 years) informed us that there was black sorghum near their village; however, the bridge on the way was broken. Another lady (age, ~40 years) also had the grains of black sorghum in their garden; however, it was too young. One lady (age, ~50 years) cultivated both white and black sorghum 10 years ago. These three ladies had Khmer and Laos parents.

We left Stung Treng and headed northwest by a major road (Route 214). We found *E. procerus* and collected the stems (C9, Photo 15) along the roadside of the Sam Ang village. There were 10 individuals in the population. We collected the panicles to obtain seeds, but the glumes were almost completely open. Mr. Hou San of the Islamic Khmer tribe informed us that its local name is “Treng.” He thought it was of no use and always slashed and burned the plant to eradicate it.

From the Sam Ang village, we drove north toward the Laos border by unpaved sideroads. We visited Long Preah, a village along the border of the Preah Vihear Province, but the Khmer villagers did not have any sorghum. However, they informed us that there were two different types of sorghum, called “Topov” (black) and “Srakouy” (white) on the Laos side of the border.



Photo 15. *Erianthus* (C9)



Photo 14. *Erianthus* (C8)



Photo 16. *Erianthus* (C10)

Day 8: May 6, 2019

Site: Stung Treng to Kratie, Kratie Province

Weather: Sunny

We visited the Kratie Provincial Department of Agriculture, Forestry, and Fisheries and requested a province official to accompany us on the survey. We headed south via Route 7, which runs north-south for 10-20 km parallelly to the eastern bank of the Mekong River. From the roadside of Route 7, we collected the stems of *E. procerus* (C10, Photo 16). There were 20 individuals in the population. We collected the panicles to obtain seeds, but the glumes were almost lost. We visited villages between Route 7 and the eastern bank of the Mekong River, but 12 villagers provided no sorghum sample.

Day 9: May 7, 2019

Site: Kratie Province

Weather: Sunny

We arrived at a port (N12°26'44.5", E106°01'13.9"; elevation, 15 m) of the Mekong River near the Kratie city and waited 30 minutes for the departure of the next boat. The fee was 3 USD per vehicle. We crossed the Mekong River from the eastern bank and arrived at the western bank in 10 minutes at 10:00 am.

We collected stems from two *E. procerus* (C11 and C12, Photos 17 and 18, respectively). There were over 100 individuals in the C11 population, but only 1-2 in the C12 population. The glumes of both samples were



Photo 17. *Erianthus* (C11)

completely open and almost lost. Therefore, we collected the panicles to obtain seeds. Nearly 1,000 families and 5,000 people lived in the area on the western bank of the Mekong River. We visited villages along the Mekong River, but seven villagers provided no sorghum sample.

Then, we boarded a boat (Photo 19) from a port that was different from the one we used in the morning, crossed the Mekong River, and arrived at the eastern bank (N12°32'24.1", E106°00'2.0"; elevation, 23 m) at 14:37 pm. The fee was 2.5 USD per vehicle.

We visited two families in the Prek Kov village. One did not know sorghum, and the other informed that a visitor sold white sorghum seeds and bought the harvest 4-5 years ago.

Day 10: May 8, 2019

Site: Kratie to Snuol

Weather: Sunny

We visited the Sre Norn village, and Ms. Derk Theal of the Phnong tribe provided us a maize sample (C13, Photos 20-21). She obtained the maize landrace 6 years ago. She also used to cultivate white sorghum until 10 years ago. She informed us that the chemicals in the river killed many fish in the previous year. In the Treab village, Ms. Pin Kon of the Kouy tribe provided us a



Photo 18. *Erianthus* (C12)



Photo 19. Big boat





Photo 20. Maize collection C13



Photo 22. Maize collection C14



Photo 21. Maize (C13)



Photo 23. Maize (C14)

maize sample (C14, Photos 22-23) but not sorghum. We found *E. procerus* (C15, Photo 24) on the roadside and collected the stems. There were three individuals in the population. We collected the panicles to obtain seeds, but the glumes were completely open.

Day 11: May 9, 2019

Site: Snuol to Phnom Penh

Weather: Sunny

The survey team moved toward Phnom Penh from Snuol.

### Discussion

In the present survey, 15 accessions of plant genetic resources were collected, including 3 sorghum (*S. bicolor*) accessions, 2 maize (*Z. mays*) accessions, 10 *Erianthus* (*E. procerus*) accessions.

#### *S. bicolor*

During this survey, three sorghum accessions (C3, C6, and C7) were collected. Members of the Phnong tribe provided the grains of white sorghum (C3), called “Boboke” in the Mondulkiri Province. Members of the Tom Poun tribe also provided the grains of white sorghum (C6), called “Katav” in the Ratanak Kiri Province. Plant height was 2.5 and 3.0 m, and panicle



Photo 24. *Erianthus* (C15)

length was 32 and 18 cm, respectively. Both tribes consume white sorghum as popped grains. Members of the Khmer tribe provided the grains of black sorghum, called “Om Pov” in the Stung Treng Province. The plant

height was 2 m, and panicle length was 19 cm. The tribe extracts sweet juice from the stem.

#### *Z. mays*

Maize (C13 and C14) is called “Pout” by the Phnong tribe and “Pout Phnong” by the Kouy tribe in the Kratie Province. The plant height of both samples (C13 and C14) was 1.5 m, and the panicle length was 14 and 15 cm, respectively. Both plants were cultivated in May and harvested in August. Maize is cooked with rice or eaten as sweet corn.

#### *E. procerus*

Ten erianthus samples were collected from four provinces (Mondulkiri, Ratanak Kiri, Stung Treng, and Kratie). It was locally called “Treng” by three Khmer persons (C4, C9, and C11). Plant height was 2.4 to 5.0 (mean, 3.5) m, and panicle length was 0.3 to 1.0 (mean, 0.7) m. The panicles of C12 were relatively short among the samples collected from the four provinces. Erianthus is considered a weed and often eradicated in Stung Treng and northwestern Cambodia.

#### *Sorghum information that was not available*

During the present survey, we contacted 59 people to find sorghum landraces and successfully obtained accessions from three people (5 %). However, 18 people (31 %) had stopped growing sorghum and 38 people (64 %) did not know or have sorghum. Moreover, 18 people had lost sorghum 1-20 (mean, 5.7) years ago, and of these, 11 people (61 %) had sorghum for the previous 5 years, whereas 7 people (39 %) had lost it more than 5 years ago.

Some who have lost sorghum now cultivate improved corn varieties. In the village where no sorghum was found, various improved vegetable varieties were sold in a small shop (stall).

Based on these results, sorghum landraces seem to have rapidly disappeared in recent years, and improved agricultural crop varieties have simultaneously become widespread in the local areas of the studied provinces.

Nonetheless, we could indeed collect sorghum samples during this survey, which reflects the villagers’ maintenance of traditional lifestyle, agricultural practices, and crop landraces.

#### *Possibility of surveying the western bank of the Mekong River*

To collect information for future surveys, we visited the western bank of the Mekong River. The possible difficulties in surveying the western bank of the Mekong

River were as follows.

#### *Availability of few bridges:*

The Mekong River runs from north to south for about 250 km in the Stung Treng and Kratie provinces; however, there is only one bridge in the Stung Treng city.

#### *Poor roads on the western bank of the Mekong river:*

The survey on the western bank of the Mekong River was very short, even after crossing the bridge, because of the poor roads in this region.

As mentioned above, the studied provinces are divided into east and west over 250 km by the Mekong River. There are many small ports (Photos 25-26), and boats are available at a low cost. Unfortunately, the development of villages on the western bank of the Mekong River is slow, and this, however, means that the traditional landraces may remain in these areas.

In the present survey, we crossed the Mekong River by boat twice. We hired a small boat (Photo 12) for three people to visit an island near the Laos border of the Stung Treng Province and obtained a sorghum landrace. In Kratie, we crossed the Mekong River in a big boat (Photo 19) along with our vehicle. Although



Photo 25. Small port of the Mekong River



Photo 26. Large port of the Mekong River

the population in this part of the western bank was relatively large, no sorghum landrace was found. In this region, large-scale cultivation of improved sorghum was attempted 4-5 years ago but never continued. This may be because sorghum is not commonly used in this part of the river bank. We also visited a small shop (stall) and found improved varieties of various vegetables.

Based on our experience, sorghum landraces may still be found in villages without a port for big boats. Another possible target is the villages of ethnic minorities, which are remote from the river bank in the western hilly area.

The genetic resources collected during this survey will be subjected to further characterization and evaluation at CARDI and the Genetic Resources Center, NARO.

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# カンボジアにおける植物遺伝資源の探索・収集, 2019年4月および5月

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## 和文摘要

本研究は、ジーンバンク事業の研究の一環として、カンボジアにおける植物遺伝資源の探索・収集に関して2019年4月から5月に行われた。本探索では、カンボジア東部の村を対象に、雑穀等遺伝資源の探索・収集および情報収集を行った。その結果、ソルガム3点、トウモロコシ2点、エリアンサス10点の合計15点の遺伝資源を収集した。収集した遺伝資源は、カンボジア農業開発研究所および農研機構遺伝資源センターで特性評価を行う予定である。

Table 3. Passport data of collected materials

No.	Coll. No.	JP No.	Coll. Date	Species name	English common name	Type of Sample	Local name	Status	Locality (Province, Village)	Latitude	Longitude	Altitude (m)	Topography-Site-Drainage	Remarks (H: plant height, D: stem diameter, L: length)	Photo No.
1	2019-04-C1	273505	April 30	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Mondul Kiri, roadside	N12-08-23.1	E106-55-31.1	130	Hilly - Slope - Good	H 4.4 m, D 2 cm, panicle L 0.6 m	Photo 1
2	2019-04-C2	273506	April 30	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Mondul Kiri, roadside	N12-10-56.6	E106-59-13.6	276	Hilly - Slope - Good	H 4.2 m, D 2 cm, panicle L 0.6 m	Photo 2-3
3	2019-04-C3	273507	April 30	<i>Sorghum bicolor</i> (L.) Moench ssp. <i>bicolor</i>	sorghum	Seed	Boboke	Landrace	Mondul Kiri, Pu Hem	N12-20-13.6	E107-08-50.0	728	Hilly - Slope - Good	H 2.5 - 3 m, panicle L 32 cm, Mr. Nhos Kam, Phnong Tribe	Photo 4-5
4	2019-04-C4	273508	May 1	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	Treng	Wild	Mondul Kiri, roadside	N13-35-34.7	E106-57-04.6	114	Plain level - Slope - Good	H 3.7 m, D 2 cm, panicle L 0.6 m	Photo 8-9
5	2019-04-C5	273509	May 1	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Ratanak Kiri, roadside	N14-00-02.9	E107-05-13.8	123	Plain level - Level - Poor	H 5.0 m, D 3 cm, panicle L 0.8 m	Photo 10
6	2019-04-C6	273510	May 3	<i>Sorghum bicolor</i> (L.) Moench ssp. <i>bicolor</i>	sorghum	Seed	Katav	Landrace	Ratanak Kiri, Lake Yeak Laom	N13-43-07.6	E107-00-15.5	278	Hilly - Slope - Moderate	H 2.5 m, panicle L 18 cm, Mr. Lon Charp, Tom poun tribe	Photo 11
7	2019-04-C7	273511	May 4	<i>Sorghum bicolor</i> (L.) Moench ssp. <i>bicolor</i>	sorghum	Seed	Om Pov	Landrace	Stung Treng, Koh Cheorteal Thom island	N13-55-03.6	E105-59-27.9	63	Flood plain - Level - Poor	H 2 m, panicle L 19cm, grow in the island, Ms. Pi, Khmer tribe	Photo 13
8	2019-04-C8	273512	May 4	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Stung Treng, roadside	N13-56-10.7	E106-09-03.4	91	Flood plain - Slope - Good	H 2.6 m, D 1.5cm, panicle L 1.0 m	Photo 14
9	2019-04-C9	273513	May 5	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	Treng	Wild	Stung Treng, roadside	N13-39-19.2	E105-53-57.2	77	Plain level - Slope - Good	H 3.6 m, D 2 cm, panicle L 0.9 m	Photo 15
10	2019-04-C10	273514	May 6	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Stung Treng, roadside	N13-22-25.4	E106-05-07.6	112	Plain level - Summit - Good	H 2.5 m, D 1 cm, panicle L 0.7 m	Photo 16
11	2019-04-C11	273515	May 7	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	Treng	Wild	Kratie, roadside	N12-33-55.8	E105-57-54.4	28	Flood plain - Slope - Good	H 3.4 m, D 2 cm, panicle L 0.8 m	Photo 17
12	2019-04-C12	273516	May 7	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Kratie, roadside	N12-33-19.8	E105-58-40.5	22	Flood plain - Summit - Good	H 2.8 m, D 0.5 cm, panicle L 0.3 m	Photo 18
13	2019-04-C13	273517	May 8	<i>Zea mays</i> L.	maize	Seed	Pout	Landrace	Kratie, Sre Norn	N12-23-35.1	E106-15-48.7	34	Plain level - Level - Good	H 1.5 m, Ear L 14 cm, Ms. Derk Theal, Phnong tribe	Photo 20-21
14	2019-04-C14	273518	May 8	<i>Zea mays</i> L.	maize	Seed	Pout Phnong	Landrace	Kratie, Sre Norn	N12-33-19.2	E106-17-58.2	67	Plain level - Level - Moderate	H 1.5 m, Ear L 15 cm, Ms. Dim Kon, Kouy tribe	Photo 22-23
15	2019-04-C15	273519	May 8	<i>Erianthus procerus</i> (Roxb.) Raizada	erianthus	Vegetative and Seed	N/A	Wild	Kratie, roadside	N12-21-17.2	E106-23-57.1	53	Plain level - Slope - Good	H 2.4 m, D 1cm, panicle L 0.7 m	Photo 24