

EXPLORATIONS DIVERSITY OF *Dioscorea* spp. VARIETIES FROM PASURUAN, EAST JAVA: INVENTORY AND CHARACTERIZATION

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ABSTRACT

Dioscorea spp. is the edible tubers from *Dioscoreaceae* family. *Dioscorea* is also an important crop which serves as a staple food and medicine. *Dioscoreaceae* exploration collecting mission had been conducted in 10 Districts of Pasuruan, East Java. Forty-four accessions were obtained during the exploration. It comprised of 5 species and 29 varieties i.e. 17 varieties of *Dioscorea alata* L., 8 varieties of *Dioscorea hispida* Dennst., 2 varieties of *Dioscorea esculenta* (Lour.) Burkill., 1 variety of *Dioscorea pentaphylla* L. and 1 variety of *Dioscorea bulbifera* L. The results showed that morphological characteristic features of *Dioscorea* spp. tubers were broadly varied among species and even within varieties at the same species. *Dioscorea* spp. varieties originated from Pasuruan were mostly characterized by its tuber shape, tuber flesh colour, outer and inner skin colour and tubers skin texture. Based on the interviews to local farmers, *D. alata* and *D. hispida* varieties were still widely grown because of its high tuber yields and its most acceptable taste than other *Dioscorea* species.

Keywords: *Dioscorea*; diversity; Pasuruan; varieties

INTRODUCTION

Yam, the edible tubers of various species of the genus *Dioscorea* (*Dioscoreaceae* family), are heterogeneous perennials with many shared morphological, physiological and chemical attributes. *Dioscorea* genus consists of about 600 species comprises of 50-60 species cultivated for food and medicine (Coursey, 1976). Yam tubers are valuable source of carbohydrates, fibers, and low level of fats, which makes them a good dietary source and could be eaten as boiled yam, or fried in oil (Osman, 1990). It has

been suggested to have nutritional superiority when compared to other tropical root crops. They are reported as good sources of dietary essential nutrients (Baquar and Oke, 1976; Bhandari *et al.*, 2003; Maneenoon *et al.*, 2008; Shanthakumari *et al.*, 2008; Arinathan *et al.*, 2009). The energy value of each portion per 100 g yam tubers ranges from 320 to 470 calories and contains of approximately 2.0 g - 2.7 g protein (French, 2006; Fahmi and Antarlina, 2007).

There are some advantages of yam, i.e. (a) its potential production could reach 40 t ha⁻¹, (b) cultivation conditions are very wide from sea level to an altitude of more than 1500 m above sea level, and ranging from moist soil (swamp) to dry land, (c) yams are relatively tolerant of shade, (d) yams are generally resistant to soil borne diseases, (e) tubers can be stored for relative long term period, and (f) yams have antioxidant and medicinal values (French, 2006; Fahmi and Antarlina, 2007).

Yams are common tubers that can be found in Indonesia, but somehow recently it is rather difficult to find in the market. Its total planted areas in Southeast Asia reached almost 19,000 ha with total productions of 249,000 tons. In particular, in Indonesia, the total planted areas were less than 1,000 ha (FAO, 1993). Based on those data, it can be assumed that yam has not got any serious attention yet as a potential agricultural commodity in Indonesia. In the past, traditionally, Yams have been used as supplementary food to rice, especially for people in Java. It has been abandoned even it has great potential as an alternative food source. In East Java, there are about 6 different varieties of edible Yam species i.e. *D. alata*, *D. bulbifera*, *D. esculenta*, *D. hispida*, *D. nummularia* and *D. pentaphylla* (Solikin, 1997).

Yam explorations had been conducted in some areas of Pasuruan, East Java. Conservation

efforts to yam germplasm is needed since its existence becoming rarely to find. Such basic researches are needed to provide scientific information that can be used as the basis for further development of yam. Some yam specimens were collected from the sites to be *ex-situ* conserved in Purwodadi Botanic Garden, Pasuruan. This paper presents the results of diversity inventory and morphological characterization of yam tubers from Pasuruan including its potential utilization by local farmers.

MATERIALS AND METHODS

Yam explorations and collecting missions were conducted in July-August 2011 and 2013 with areas covered of some areas in Pasuruan Regencies which consists of 9 Districts i.e. Purwodadi, Tutur, Prigen, Rembang, Purwosari, Kejayan, Pasrepan, Wonorejo and Puspo. Those locations were chosen based on informations from the local and traders in the local markets as the center of yam-producing areas.

Equipments used in this study were common equipments for plant explorations e.g. GPS, pH meter, Thermo-hygrometer, paper label, digital caliper, measuring scale, ruler, field books, stationery, digital cameras, hoes, knife, cutter, old newspaper, sack bag, plastic bag and raffia rope. Materials observed in this study were yam (*Dioscorea* spp.) tubers found on the sites.

Exploratory study was conducted through direct surveys and observations method at the targeted locations. Yam diversity found along the sites were noted, inventarized, characterized and documented. The first step was to identify the species of *Dioscorea* by characterizing the stem, leaves, and absence or presence of aerial tuber based on 'Descriptors for yam (*Disocorea* spp.)' by IPGRI/IITA (1997). Then, the next step was to identify the varieties generally using the tuber shape, skin colour of tuber, and flesh colour of tuber. Documentation of accession was taken by digital camera. Direct interviews to local were carried out to obtain supporting informations regarding its potential utilization and consumption types. Some living specimens in form of tubers or bulbils were collected to be *ex-situ* conserved in Purwodadi Botanic Garden.

RESULTS AND DISCUSSIONS

Inventory of Yam (*Dioscorea* spp.) in Some Areas of Pasuruan, East Java

From this yam exploration collecting missions in 9 Districts of Pasuruan it was obtained 44 accessions of *Dioscorea* spp. It comprised of 5 species and 29 varieties i.e. 17 varieties of *Dioscorea alata* L., 8 varieties of *Dioscorea hispida* Dennst., 2 varieties of *Dioscorea esculenta* (Lour.) Burkill., 1 variety of *Dioscorea pentaphylla* L. and 1 variety of *Dioscorea bulbifera* L. (Table 1).

Yam diversity was most prevalent plant in Purwodadi, Rembang and Prigen Districts, especially from the species of *D. alata* and *D. hispida*. They are widely spread and commonly cultivated by local farmers and used as alternative food source for self consumption and economically valued for local trade. Whereas *D. esculenta*, *D. pentaphylla* and *D. bulbifera* were less spread, unpopular and rarely cultivated by local farmers.

Morphological Characteristics of Yam Tubers (*Dioscorea* spp.)

Morphological characteristic features of yam tubers were broadly vary among species and even within varieties at the same species. The tubers were different in characters including tubers shape, size, inner and outer skin colour, skin surface texture and tuber flesh colour. The morphological characterization results of yam tubers from Pasuruan were shown in Table 2.

Tuber morphological characters of *Dioscorea* were differentiated based on tuber shape characters, tuber flesh colour, outer and inner skin colour, and tuber skin texture. *D. alata* had the most variants compared to other species. Each variety of *D. alata* tubers had diverse morphological characteristics. It shapes was varies from regular-irregular rounded, flattened, oval, oblong to cylindrical shaped. Tubers outer skin colours were generally light brown, redish brown to dark brown, while inner skin colours varies from light brown, brown to dark brown, and light purple to dark purple. Tubers skin textures were also quite varied from smooth to roughed; grooved to un-grooved; absent, with short to long roots. Tuber flesh colours varies from white, off-white, and white with purple blotches (Table 2, Figure 1: A-F).

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D. hispida had high variation in tuber shape after *D. alata* which had round-oval-oblong and irregular shape. The number of the tuber of each varieties were more than 5 tubers, and outer skin colour were light brown to brown, inner skin colour were light brown and tuber flesh colour were dominantly yellowish to yellow. (Table 2, Figure 1: G-L).

D. esculenta tubers had oval to oblong shaped. Tubers outer and inner skin colours were varied light brown to brown. Tubers skin textures were mostly smooth-spininess and speckled with many roots. Tuber flesh colours were white (Table 2, Figure 1: M-N).

D. pentaphylla had the least variants, and it was only found one variety i.e. Uwi Sosohan.

Uwi Sosohan tubers had irregular shape with clustered and branched. Tubers skin outer colours were brown while tubers skin inner colours were light purple. Tuber skin textures were cracks and some were with many roots, while tubers flesh colours is white (Table 2, Figure 1: O).

D. bulbifera also had the least variants, only one variety i.e. Uwi Gantung (Kentang Gedubug). Uwi Gantung tubers had one tuber, with round to irregular shape. Tubers skin outer colours were brown while tubers skin inner colours were greyish. Tuber skin textures were cracks and few wrinkles with many roots, while tubers flesh colours is yellow (Table 2, Figure 1: P).

Table 1. Inventory of yam (*Dioscorea* spp.) found in some areas of Pasuruan

No.	Origin Area (District)	Species and Varieties
1	Purwodadi	- <i>Dioscorea alata</i> : Uwi Kelopo (DA-1), Uwi Putih (DA-2), Uwi Bangkulit (DA-3), Uwi Jaran (DA-4), Uwi Ungu (DA-5), Uwi Ulo/ Jero (DA-6), Uwi Perti (DA-7), Uwi Gedek (DA-8) dan Uwi Ratu (DA-9) - <i>Dioscorea hispida</i> : Gadung (DH-1), Gadung Jahe (DH-2), Gadung Ketan (DH-3) - <i>Dioscorea esculenta</i> : Gembolo (DE-1)
2	Tutur	- <i>Dioscorea hispida</i> : Gadung Kuning (DH-4)
3	Rembang	- <i>Dioscorea alata</i> : Uwi Kelopo (DA-10), Uwi Jaran Ungu (DA-11), Uwi Elos (DA-12), Uwi Soso'an (DA-13) - <i>Dioscorea hispida</i> : Gadung Lumut (DH-5)
4	Prigen	- <i>Dioscorea alata</i> : Uwi Ulo (DA-14), Uwi Perti (DA-15), Uwi Alang-alang (DA-16) - <i>Dioscorea hispida</i> : Gadung Kripik (DH-6), Gadung Jahe (DH-7), Gadung Kripik (DH-13) - <i>Dioscorea pentaphylla</i> : Uwi Sosohan (DP-1)
5	Purwosari	- <i>Dioscorea alata</i> : Uwi Cemeng (DA-17), Uwi Putih (DA-18) - <i>Dioscorea hispida</i> : Gadung Kebo (DH-8)
6	Wonosari	- <i>Dioscorea alata</i> : Uwi Talas (DA-19), Uwi Jaran (DA-20) - <i>Dioscorea hispida</i> : Gadung Kuning (DH-9), Gadung Jahe (DH-10), Gadung Kuning (DH-14)
7	Kejayan	- <i>Dioscorea alata</i> : Uwi Ulo (DA-21), Uwi Ireng (DA-22) - <i>Dioscorea hispida</i> : Gadung Mentega (DH-11) - <i>Dioscorea esculenta</i> : Gembili (DA-2) - <i>Dioscorea bulbifera</i> : Uwi Gantung (DB-1)
8	Pasrepan	- <i>Dioscorea alata</i> : Obi/ Uwi Ratu (DA-23) - <i>Dioscorea hispida</i> : Gadung (DH-12), Gadung (DH-15)
9	Puspo	- <i>Dioscorea alata</i> : Uwi Tanduk Rusa (DA-24), Uwi Ulo (DA-25)

Table 2. Morphological characteristics of Yam tubers from Pasuruan

No	Species, Varieties	Underground tubers				
		Shape	Colour	Outer skin colour	Inner skin colour	Skin texture
<i>Dioscorea alata</i> L.						
1	Uwi Kelopo	Several tubers (>5 tubers) rounded until flattened shape	White-offwhite	Brown	Light purple-offwhite	Many root, rough
2	Uwi Putih	Oval oblong-flattened, cylindrical shape, several tubers	White-offwhite	Brown	Light brown	Many wrinkles, cracks, few roots entire tuber
3	Uwi Bangkulit	Several tubers, irregular shape-flattened	White	Redish brown	Light purple	Few roots in entire tubers, cracks, many wrinkles
4	Uwi Jaran	Consists of few tubers with oval-oblong shape	Offwhite	Brown-dark brown	Light brown	Few roots entire tubers, few wrinkles, no cracks
5	Uwi Ungu	One tuber with flattened-irregular shape	White with purple blotches	Brown	Light purple	Few roots in upper of tubers, Many wrinkles and present of cracks
6	Uwi Ulo/ Jero	Few tuber (2-5), oval-cylindrical/elongated	White, Offwhite	Brown	Light purple-dark purple, Light brown	Few roots, many wrinkles
7	Uwi Perti	One tuber, cylindrical shape	White	Brown	Light brown	Few roots in upper tuber, smooth skin
8	Uwi Gedek	One tuber, oval-oblong shape	Offwhite	Light brown	Light brown with purple	Few roots entire tuber, many wrinkles
9	Uwi Ratu	Few tubers, cylindrical shape	Offwhite, White with purple	Brown	Light brown with purple, purple	Few roots entire tubers, many wrinkles and Cracks
10	Uwi Jaran Ungu	Few tubers with oval-oblong to irregular shape	White with purple	Dark brown	Dark purple	Few roots entire tubers, many cracks and wrinkleless
11	Uwi Elos	Few tuber with irregular-flattened shape	Offwhite	Dark brown	Light brown	Few roots in upper of tuber, many wrinkles
12	Uwi Soso'an	One tuber with elongated shape	Offwhite	Brown	Light brown	Roots in entire tuber, few wrinkle and cracks
13	Uwi Cemeng	Few tubers, oval-oblong to irregular shape	Offwhite with purple blotches	Brown	Light purple	Few roots in entire tubers, few wrinkles and cracks
14	Uwi Talas	Few tubers with irregular shape	Offwhite	Brown	Light brown	Few roots entire tuber, Many wrinkleless, prickly and cracks

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No	Species, Varieties	Underground tubers				
		Shape	Colour	Outer skin colour	Inner skin colour	Skin texture
16	Uwi Tanduk Rusa	One tuber, irregular shape	White with purple blotches	Brown	Dark purple	Few roots entire tubers, many wrinkles, cracks,
17	Uwi Alang-alang	Few tubers, cylindrical/elongated shape	Offwhite	Brown	Light brown	Few roots entire tuber, few wrinkles and cracks
<i>Dioscorea hispida</i> Densst.						
1	Gadung	Several ntubers >5 tubers, round until oval-oblong	Yellowish	Light brown	Light brown	Many roots entire tubers, few wrinkles and cracks
2	Gadung Jahe	Several tubers (>5), Oval-oblong shape and irregular shape (Rhizome look like)	Yellowish - yellow	Light brown	Light brown	Many roots entire tubers, few wrinkles and cracks
3	Gadung Ketan	Several tubers (>5), rounded to oval	Yellowish	Light brown	Light brown	Smooth and speckled, many roots
4	Gadung Kuning	Several tubers (>5), Round until oval- oblong shape	Yellowish- yellow	brown	Light brown	Many roots entire tubers, absent of wrinkles and cracks
5	Gadung Kripik	Several tubers (>5), oval-oblong until irregular in shape	Yellow	Light brown	Light brown	Many roots in entire tuber, non-prickly, non-wrinkless, no cracks
6	Gadung Lumut	Several tubers (>5), oval-oblong	Yellowish	Brown	Light brown	Smooth and speckled, many roots
7	Gadung Kebo	Several tubers (>5), round until oval-oblong shape	Yellow	Brown	Light brown	Roots entire tubers, few wrinkleless
8	Gadung Mentega	Several tubers (>5), oval oblong	Yellow	brown	Light brown	Many root entire tubers, few wrinkles and cracks
<i>Dioscorea esculenta</i> (Lour.) Burkill						
1	Gembolo	2-5 tuber with oval to oblong shape	White	Light brown	Brown	Smooth and speckled, many roots
2	Gembili	>5 tuber, oval to oblong	White	Light brown	Light brown	Spiness root
<i>Dioscorea pentaphylla</i> L.						
1	Uwi Sosohan	One tuber, irregular shape	White	Brown	Light purple	Many roots entire tuber, cracks
<i>Dioscorea bulbifera</i> L.						
1.	Uwi Gantung/ Kentang Gedubug	One tuber, round to irregular shape	Yellow	Brown	Greyish	Few wrinkles and cracks



Figure 1. Morphological Variation of Yam tubers from Pasuruan e.g. *D. alata* variants: (A) Uwi Kelapa, (B) Uwi Putih, (C) Uwi Tanduk Rusa, (D) Uwi Ulo, (E) Uwi Jaran Ungu and (F) Uwi Ireng; *D. hispida* variants: (G) Gadung Keripik, (H) Gadung Ketan, (I) Gadung Lumut, (J) Gadung Jahe, (K) Gadung Mentega and (L) Gadung Kebo; *D. esculenta* variants (M) Gembili and (N) Gembolo; *D. pentaphylla* variant: (O) Uwi Sosohan; *D. bulbifera* variant: (P) Uwi Gantung/Kentang Gedubug.

Genetic diversity of Uwi and Gadung in Pasuruan were high enough. Genetic diversities related to genetic source were very useful for plant breeding program. Substantial morphological variation within and between the various accessions may be attributed to cross-pollination and sexual recombination, and perhaps mutation followed by intensive selection by isolated human communities in diverse environments (Martin, 1976). In fact, Uwi in Pasuruan was flowering rarely, and when it was found there was male flower only, so the new type of Uwi produced from cross pollination was rarely found, same as Gadung. Morphological variations among species we-

re affected mostly by its genotypes than environmental factors. Whilst morphological variations within varieties at the same species were dominantly affected by the environmental factors than its genotypes e.g. altitude, latitude, temperature, humidity, soil conditions, etc. Adaptations process of one particular plant species to such local environmental conditions then will arise many varied varieties (Suranto, 2001).

Consumption Type by Local Farmers and Organoleptic Test

Table 3 presents the data of soil depth when the tubers were harvested, texture and

flavour of steamed yam tubers and interviews results of its consumption type by local farmers in Pasuruan.

D. alata is the most favorite and popular yam in Pasuruan. The interviews results to local farmers noted that *D. alata* type was still widely grown because of its high tuber yields and its taste which were are the most acceptable than other *Dioscorea* species, with smooth and grainy textures and medium sweet and savory tastes (Table 3). Uwi Kelapa variety can be a safe food for diabetics because it has carbohydrates with low glucose levels. Tubers of Uwi Kelapa were generally self-consumed by boiling, steaming or frying. But it can also be diversified into a variety of food products processed which is firstly made into flours. Processing into flours can be made traditionally without any complicated techniques. Tubers were shredded and then soaked in lime water to clean up the gums, then sun dried and grounded into flours. The flours taste plain, so it can be easily processed into varied products such as cakes, noodles, etc. While its gums can be used as environmentally friendly natural pesticides (Arifin, 2008).

D. hispida tubers were harvested in shallow soil depth (5 to 25 cm). Its tastes and textures were not observed since the tubers contains of anti-nutrition or poison compounds that may cause nausea and dizziness if tubers were not well-processed. Antinutrition compounds that exist in *D. hispida* were alkaloid compounds such as Dioscorine, Dihydrodioscorine and Hydrogen Cyanide in free or bound forms, and if they were in bound form known as Cyanogenic Glucosides, moreover when they were hydrolyzed they would release Hydrogen Cyanide (Webster *et al.*, 1984). Type of *D. hispida* was high in economic values; they were widely grown by local farmers to be processed into chips for local trade. So there were still many local farmers who were interested to cultivate these types of yam even though the processing techniques were complicated. Local *D. hispida* varieties were common to be made into chips i.e. Gadung Kripik, Gadung Ketan and Gadung Kuning while Gadung Lumut and Gadung Jahe were not commonly used to be made into chips because of its small sized ± 2 to 4 cm in diameters. Due to high carbohydrates content of *D. hispida*, it considerably had high potential to be processed into varies food products beside of chips. Apart of as a food source, *D. hispida* tubers

could be used as medicinal plants to reduce obesity, diabetes and other related diseases (Aprianita *et al.*, 2009). In addition, as carbohydrate source, Gadung tubers did not contain any gluten, which made Gadung tubers became an important substance in the reduction of incidence of celiac disease (CD) or other allergic reactions (Rekha and Padmaja, 2002). With these benefits in mind, efforts on Gadung processing into edible food materials were need to undertake.

D. esculenta found in Pasuruan comprised of two varieties with local names; Gembili and Gembolo, which were currently rare. The tubers of Gembili were harvested in shallow soil depth (5 to 25 cm), while Gembolo were harvested in medium soil depth (26 to 45 cm). Steamed Gembili tubers textures were grainy, while steamed Gembolo tubers textures were much smoother. Steamed Gembili and Gembolo tubers tend to have savory tastes with medium sweet. Local farmers cultivated Gembili for both self-consumption and trade, whereas Gembolo were cultivated only for personal consumption. Tubers of Gembolo and Gembili were covered by thorns that make the harvesting process become difficult. They made farmers unwilling to cultivate them, although they had sweet and good tuber quality. They mostly grow wild in the backyards and intercropped with bamboo plants. *D. esculenta* had low economic values, so that these types was rarely cultivated by farmers, in addition, it was also due to the lack of information about its nutrition contents.

D. pentaphylla tubers were harvested in shallow soil depth (5 to 25 cm). Its steamed tubers had smooth, sticky texture and sweet taste though the tubers were in small size. It had no economic values, and it was rarely for trade, only for self consumption, and many people were not familiar with this type.

D. bulbifera, well known as Uwi Gantung or Kentang Gedubug was harvested on 5-25 cm soil depth. Their steamed tubers were not grainy and flavorless. Now, they were not cultivated or used. *D. bulbifera* had higher levels of carbohydrate and energy with appreciable levels of minerals that made them nutritious and could be used as reliable food and energy security crops (Polycarp *et al.*, 2012). Continuous experiment was needed to determine nutritional content and identify the benefit of *D. bulbifera*.

Table 3. Soil depth at harvest, organoleptic test results and utilization by local farmers in Pasuruan

No.	Species	Variety	Origin	Soil depth at harvest (cm)	Texture and Flavour of steamed tuber	Utilization
1	<i>D. alata</i>	Uwi Kelapa	Purwodadi	5 – 25	- Smooth - Savory, medium sweet	Self consumed and locally traded
2	<i>D. alata</i>	Uwi Kelapa	Rembang	5 – 25	- Smooth and sticky - Savory	Self consumed
3	<i>D. alata</i>	Uwi Putih	Purwodadi	5 – 25	- Smooth and sticky - Savory, medium sweet	Self consumed and locally traded
4	<i>D. alata</i>	Uwi Putih	Purwosari	26 – 45	- Grainy - Flavourless	Self consumed
5	<i>D. alata</i>	Uwi Bangkulit	Purwodadi	5 – 25	- Grainy - Savory	Self consumed
6	<i>D. alata</i>	Uwi Jaran	Purwodadi	5 – 25	- Grainy - Savory	Self consumed
7	<i>D. alata</i>	Uwi Jaran	Wonosari	5 – 25	- Not grainy - Flavourless	Self consumed
8	<i>D. alata</i>	Uwi Jaran Ungu	Rembang	5 – 25	- Grainy - Flavourless	Rarely consumed
9	<i>D. alata</i>	Uwi Ungu	Purwodadi	5 – 25	- Grainy - Savory	Self consumed
10	<i>D. alata</i>	Uwi Cemeng	Purwosari	26 - 45	- Grainy - Savory	Self consumed
11	<i>D. alata</i>	Uwi Ireng	Kejayan	26 - 45	- Not grainy - Flavourless	Self consumed
12	<i>D. alata</i>	Uwi Ulo/Jero	Purwodadi	> 45	- Grainy - Savory	Self consumed
13	<i>D. alata</i>	Uwi Ulo	Prigen	> 45	- Medium smooth and sticky - Flavourless	Not used for consumption
14	<i>D. alata</i>	Uwi Ulo	Kejayan	> 45	- Not grainy - Flavourless	Self consumed
15	<i>D. alata</i>	Uwi Ulo	Puspo	> 45	- Grainy - Medium savory	Not used for consumption,
16	<i>D. alata</i>	Uwi Perti	Purwodadi	5 – 25	- Smooth and sticky - Savory	Self consumed
17	<i>D. alata</i>	Uwi Perti	Prigen	5 – 25	- Smooth and sticky - Savory	Self consumed and locally traded
18	<i>D. alata</i>	Uwi Elos	Rembang	26 – 45	- Smooth and sticky - Savory	Self consumed
19	<i>D. alata</i>	Uwi Ratu	Purwodadi	26 - 45	- Grainy - Medium savory	Self consumed
20	<i>D. alata</i>	Uwi Ratu	Pasrepan	> 45	- Grainy - Medium savory	Self consumed and locally traded
21	<i>D. alata</i>	Uwi Gedek	Purwodadi	26 – 45	- Grainy - Medium savory	Self consumed

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No.	Species	Variety	Origin	Soil depth at harvest (cm)	Texture and Flavour of steamed tuber	Utilization
22	<i>D. alata</i>	Uwi Soso'an	Rembang	5 – 25	- Smooth and sticky - Sweet	Self consumed
23	<i>D. alata</i>	Uwi Alang-alang	Prigen	> 45	- Grainy - Savory	Self consumed
24	<i>D. alata</i>	Uwi Talas	Wonosari	26 - 45	- Grainy - Medium savory	Self consumed
25	<i>D. alata</i>	Uwi Tanduk Rusa	Puspo	> 45	- Not grainy - Flavourless	Not utilized
26	<i>D. hispida</i>	Gadung	Purwodadi	5 – 25	- Not observed	High economic value, traded as chips
27	<i>D. hispida</i>	Gadung	Pasrepan	5 – 25	- Not observed	Traded as chips
28	<i>D. hispida</i>	Gadung	Pasrepan	5 – 25	- Not observed	Traded as chips
29	<i>D. hispida</i>	Gadung Jahe	Purwodadi	5 – 25	- Not observed	Not used for consumption
30	<i>D. hispida</i>	Gadung Jahe	Prigen	5 – 25	- Not observed	Rarely consumed
31	<i>D. hispida</i>	Gadung Jahe	Wonosari	5 – 25	- Not observed	Rarely consumed
32	<i>D. hispida</i>	Gadung Ketan	Purwodadi	5 – 25	- Not observed	Self consumed and locally traded
33	<i>D. hispida</i>	Gadung Kuning	Tutur	5 – 25	- Not observed	High economic value, traded as chips
34	<i>D. hispida</i>	Gadung Kuning	Wonosari	5 – 25	- Not observed	Self consumed
35	<i>D. hispida</i>	Gadung Kuning	Wonosari	5 – 25	- Not observed	Self consumed
36	<i>D. hispida</i>	Gadung Kripik	Prigen	5 – 25	- Not observed	High economic value, traded as chips
37	<i>D. hispida</i>	Gadung Kripik	Prigen	5 – 25	- Not observed	High economic value, traded as chips
38	<i>D. hispida</i>	Gadung Lumut	Rembang	5 – 25	- Not observed	Rarely consumed
39	<i>D. hispida</i>	Gadung Kebo	Purwosari	26 – 45	- Not observed	Traded as tuber
40	<i>D. hispida</i>	Gadung Mentega	Kejayan	5 – 25	- Not observed	Self consumed, sometimes for traded
41	<i>D. esculenta</i>	Gembolo	Purwodadi	26 – 45	- Smooth - Savory	Self consumed
42	<i>D. esculenta</i>	Gembili	Kejayan	5 - 25	- Grainy - Medium sweet	Not utilized
43	<i>D. pentaphylla</i>	Uwi Sosohan	Prigen	5 – 25	- Grainy - Medium sweet	Self consumed
44	<i>D. bulbifera</i>	Uwi Gantung	Kejayan	5 - 25	- Not grainy - Flavourless	Not utilized

CONCLUSIONS

About 44 accessions of *Dioscorea* spp. were obtained during yam explorations and collecting missions in 9 Districts of Pasuruan. They comprised of 5 species and 29 varieties i.e. 17 varieties of *Dioscorea alata* L., 8 varieties of *Dioscorea hispida* Dennst., 2 varieties of *Dioscorea esculenta* (Lour.) Burkill., 1 variety of *Dioscorea pentaphylla* L. and 1 variety of *Dioscorea bulbifera* L. Morphological characteristic features of yam tubers were broadly vary among species and even within varieties at the same species. *D. alata* and *D. hispida* were widely spread and commonly cultivated by local farmers and used as an alternative food source for self-consumption and economically valued for local trade. Furthermore, *D. esculenta*, *D. pentaphylla* and *D. bulbifera* were less spread, unpopular and rarely cultivated by local farmers.

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