

Germplasm and New Cultivars or Breeds

Musa campestris BECCARI VARIETIES IN NORTHERN BORNEO

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INTRODUCTION

Borneo, the third largest island in the world, comprises three countries: Malaysia (Sarawak and Sabah), Indonesia (Kalimantan) and Brunei Darussalam, which is encompassed by Sarawak. Borneo has a rainy humid equatorial climate. In prehistoric times, it used to be connected to the Asian continent through a landbridge. Near the eastern edge of the island is the so-called "Wallace line", which separates the indigenous flora and fauna into Asian and Australian categories. Due to the wide variety of plant species that developed as a result of its isolation from the continent, Borneo has been considered a center of biodiversity in tropical Asia.

Borneo, being part of the center of banana origin, has a large number of wild bananas. Until the end of the 19th century, the island was covered with dense rain forests. As bananas are pioneer plants and can grow only in the open areas, their growth was confined to rather small isolated populations. This is also the reason for the wide genetic variation in bananas.

Wild *Musa* species are generally grouped into four sections, namely, *Australimusa* (n = 10), *Callimusa* (n = 10), *Musa* (n = 11) and *Rhodochlamys* (n = 11). The latter originated from the Asian continent. This paper focuses on *Musa campestris*, which belongs to the *Callimusa* section (Cheesman 1947). *Campestris* in Latin means "pertaining to plains or flat areas".

HISTORY

Odoardo Beccari, an Italian botanist, was the first to describe *Musa campestris* and three other wild

bananas from Borneo in his classic book "Nelle Foreste di Borneo" (Beccari, 1902, republished in Webbia 1923). Beccari conducted his studies in Sarawak from 1865 to 1868.

His Latin diagnosis of *M. campestris* is as follows:

"*Musa campestris* Becc. sp. n. - Truncus cylindricus, stoloniferus (?); foliorum limbus basi cuneatus et in petiolum longiusculum erectum decurrens. Inflorescentia erecta; bractee flor. (*male*) rubro-vinosae, concavae, ovatae in acumine obtuso regulariter attenuatae; flores masculi in omni bractea circiter 10, biseriati, 3.5 cent. longi, apice 5-dentati, lobis exterioribus duobus, cuspidatis; tepalum liberum (fl. (*male*)) membranaceum, lineari-oblongum, apice rotundatum vel emarginatum perigonio 1/4 brevius; baccae, 1-2 seriatas, distincte 3-4 costatae, sessiles, elongato-oblongae, breviter crasseque rostratae, 8-9 cent. longae, 2-2.5 cent. crassae; semina numerosa, subcylindraceo-oblonga, 6 mill. longa, 2-3 mill. diam.; testa brunnea longitudinaliter rugoso-tuberculata.

Abita nelle piantagioni di riso abbandonate sulle rive dell'alto Sarawak (P. B. n. 2722)".

And his Italian description is as follows:

"PISANG TRINDGIO. Di questo Banano selvatico ho sentito parlare dai Daiacchi di Marop, ma io non l'ho trovato durante il mio soggiorno cola. Esso si dice simile al "Pisang Lenki", ma con frutti piu grossi e piu bianchi. Io credo che sia questo il Pisang da me incontrato assai frequente nelle piantagioni abbandonate dell'alto Sarawak, che e molto simile alla

Musa violascens Ridley, della Penisola malese, ma che nondimeno mi sembra costituisca una quarta forma di *Musa* endemica di Borneo, la quale potrebbe distinguersi col nome di *Musa campestris*”.

After O. Beccari’s explorations in Sarawak, studies of wild bananas in Borneo were neglected until Prof. Mitsuru Hotta of Japan made a series of expeditions in 1963-4, 1968-9 and 1976 mainly in Sabah and Brunei (Hotta 1987). He described several additional species, including a revision of *M. campestris* from Brunei. Both of these botanists studied very small areas and therefore did not observe the entire diversity of the species. To date, only these two studies have been carried out on *M. campestris*. It is noticeable, however, that Hotta’s descriptions are from different areas and are of a different variety from those described by Beccari. Beccari’s research described the variety *M. campestris* var. *sarawakensis* from Sarawak and Hotta’s described the variety *M. campestris* var. *sabahensis* from Sabah (Hotta 1967). Prof. Hotta noticed these differences later on (pers. communication) and proposed to the author to divide the species into two subspecies: *M. campestris* ssp. from Brunei and *M. campestris* ssp. from Sarawak. The author made an illustrated report of a wild *Musa* species during a cartography expedition to Borneo in 2001 (Häkkinen 2002).

HABITAT

During an exhaustive study of Section *Callimusa* plants in Sarawak, Brunei and Sabah in the autumn of 2002, the author also studied *M. campestris* populations in these areas. O. Beccari spent most of

his time in Sarawak during his expedition. M. Hotta, in contrast, focused his studies on Brunei and Western Sabah. *M. campestris* is found at least in five separate areas of Borneo (Fig 1).

The northern population is in the western part of Sabah, where it grows in quite large areas. The next three partially overlapping populations are in northern Sarawak and Brunei. However, those populations are rather homogenous and no further hybridisations could be observed between the varieties. The most isolated population of *M. campestris* is south of Kuching in southern Sarawak from where it has spread in isolated populations to West Kalimantan as well.

A noteworthy phenomenon was observed some 70 km south of Limbang (in Sarawak). A large square area was recently logged. Without secondary forest, the area was filled with thousands of *M. campestris*. In this case, the seeds must have been in the ground for a very long time. This observation is consistent with the fact that *M. campestris* seeds remain viable in the ground for decades or even longer and will germinate rapidly in the open (Simmonds 1959). Natural phenomena such as landslides and fire, and now human influences, cause germination of the seeds.

The varieties do not grow on the large swampy areas because the peat is too acid, pH being 3 to 3.5 for these lowland species. The highest elevation where *M. campestris* varieties were observed growing in their natural habitat was 600 meters in the Crocker Range of Sabah. *M. campestris* grows sympatrically with several species such as *Musa acuminata* of the section



Fig. 1. Location of observed *Musa campestris* varieties and *Musa hirta*.

Musa, *Musa flavida* of the section *Callimusa* and *Musa textilis* of the section *Australimusa*, the wild form of which was most probably the result of its introduction for fiber production in the early 20th century from Sabah.

Aside from *Musa campestris*, another small lowland *Callimusa* species exists in Sarawak: *Musa hirta*. *M. hirta* is unique in having a closed ovary and hairy fruits; the fruit peel splits upon ripening (Fig. 2). The regions where *M. hirta* and where *M. campestris* grow generally do not overlap. In most instances, there is a 100 - 200 km boundary between the areas where these two species grow. There are no obvious topographic boundaries that account for these distinct areas and the climates in these regions are similar. The areas also have a humid equatorial climate and an annual rainfall of 4000 – 7000 mm.

Two exceptions to the tendency of mutually exclusive growth have been recently discovered in the Bau limestone area some 40 km west of Kuching, where two small isolated populations of *M. hirta* were found growing sympatrically with *M. campestris*. The author believes that *M. hirta* and *M. campestris* distributions are usually the result of activities of small mammals such as squirrels and monkeys that disperse the banana seeds as a consequence of feeding. The localized areas of distribution are consistent with the small territories covered by such mammals. Since the fruits do not change color upon ripening, an effect that is usually associated with attracting avifauna, birds are not suspected to be a significant agent of seed distribution. Flying foxes (bats) are not suspected to contribute to seed distribution either because they are quite large, and evidence of partially eaten fruit indicates that it is devoured in small nibbles rather than in large bites.



Fig. 2. *Musa hirta*.

One possible explanation for the unusual sympatric distribution of *M. hirta* is that during the last

few centuries, man has entered the picture, using the young leaves of *M. hirta* as tobacco for hand made cigarettes. As far back as the time of Beccari's expedition, a vernacular name for *M. hirta* has been Pisang roko, which translates to "banana tobacco". The use of *M. hirta* as tobacco continues to this day in the Kapit area.

MORPHOLOGICAL OBSERVATIONS

Morphological observations based on living plants of *M. campestris* were conducted in the field. All of the varieties were described by completing the entire INIBAP *Musa* Descriptor List (IPGRI-INIBAP/CIRAD 1996). Relevant parts of the specimens were deposited as holotype at the herbaria of the Sarawak Forest Department herbarium (SAR), Semengoh and the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah (BHOR). Isotypes were deposited at the herbarium in University of Helsinki (H) and at Sarawak Biodiversity Centre Herbarium (SBC), Malaysia. Suckers and living specimens were delivered to the Sarawak Agricultural Research Centre, Semengoh and ITBC, Universiti Malaysia Sabah to establish duplicate collections. The complete descriptor list is available at the University of Helsinki, Finland, as well as at the aforementioned centers. The different characteristics of the 5 botanical varieties of *Musa campestris* Beccari are given in Table 1.

Description of the Species

***Musa campestris* Becc.** Perennial herbs vary from small clumps (3 to 4 stems) to big clumps (10 to 12 stems). Plants producing stolons freely, pseudostem slender, 0.8 – 2.0 m high, 6 – 9 cm in diameter at base, color varying from green to ivory and marked with blackish purple blotches, with or without wax. Leaf blades 1.2 – 2.4 m long, 30 – 50 cm wide, with moderate wax or without wax, petioles 50 – 100 cm long, petiole canals erect to incurved with narrow wings that become quickly scarios, petiole bases strongly grooved, slightly expanded into narrow auricles at the basal part.

Inflorescences erect, peduncles and rachis pubescent or glabrous, watery green to rusty-green, sterile bracts usually one, with narrow and short foliage lamina, 30 – 50 cm long, base broadened, lower side green to purple, upper side green to reddish purple, usually persistent at the opening of the male flowers, 3 – 8 basal hands female, upper hands male, female flowers 2 – 10 per bract, in a single row or two rows, the ovary 5.5 – 6.5 cm long, white to cream, the compound tepal 3.5 – 4.0 cm long, the free tepal

Table 1. Characteristics of different *Musa campestris* varieties.

DESCRIPTOR	var. lawasensis	var. limbangensis	var. miriensis	var. sabahensis	var. sarawakensis
Pseudostem color	Purple-brown	Medium-green	Black-purple	Green-red	Ivory with purple-brown stripes
Pseudostem appearance	Shiny (not waxy)	Dull (waxy)	Shiny (not waxy)	Shiny (not waxy)	Shiny (not waxy)
Underlying color of the pseudostem	White-green to green	Light-green	Light-green	Pink-purple	Red-purple
Pigmentation of the underlying pseudostem	Purple	Pink-purple (very little)	Purple	Purple	Purple
Wax on the leaf sheaths	Very little or no visible sign of wax	Very little or no visible sign of wax	Very little or no visible sign of wax	Moderate waxy	Very little or no visible sign of wax
Blotches at the petiole base	Large blotches	Extensive pigmentation	Sparse blotching	Sparse blotching	Without pigmentation
Blotches color	Black-purple	Pink-purple	Black-purple	Black-purple	Black-purple
Petiole canal leaf III	Open with margins spreading	Margins curved inwards	Wide with erect margins	Open with margins spreading	Straight with erect margins
Petiole margin color	Light-green	Rusty-brown	Rusty-brown	Green	Rusty-brown
Edge of petiole margin	Colorless (without a color line along)	With a color line along (purple)	With a color line along (purple)	(Colorless (without a color line along)	With a color line along (purple)
Color of leaf upper surface	Medium-green	Green	Green	Dark-green	Green
Appearance of leaf upper surface	Shiny	Dull	Shiny	Shiny	Dull
Color of leaf lower surface	Medium-green	Light-green	Medium-green	Medium-green	Yellowish-green
Appearance of leaf lower surface	Shiny	Dull	Shiny	Shiny	Dull
Wax on leaves	Very little or no visible sign of wax	Very little or no visible sign of wax	Slightly waxy	Moderately waxy	Very little or no visible sign of wax
Insertion point of leaf blades on petiole	Asymmetric	Asymmetric	Asymmetric	Symmetric	Asymmetric
Shape of leaf blade base	Both sides pointed	Both sides pointed	Both sides rounded	Auriculate	Both sides rounded
Color of midrib dorsal surface	Green-purple	Light-green	Light-green	Medium-green	Light-green
Color of midrib ventral surface	Yellow	Ivory	Purple to blue	Yellowish-green	Medium-green
Peduncle color	Watery green	Light-green	Green-rusty	Watery-green	Light-green
Peduncle hairiness	Hairless	Slightly hairy	Very hairy	Slightly hairy	Very hairy
Bract base shape	Large shoulder	Small shoulder	Large shoulder	Small shoulder	Small shoulder
Bract apex shape	Pointed	Slightly pointed	Slightly pointed	Intermediate	Intermediate
Color of the bract external face	Pink-purple	Pink-purple	Pink-red	Purple	Purple
Color of the bract internal face	Pink-purple	Pale-purple	Pale-pink	Pale-purple	Pale-purple
Color on the bract apex	Not tinted with yellow	Not tinted with yellow	Tinted with yellow	Not tinted with yellow	Not tinted with yellow
Male bract lifting	Lifting one at time	Not lifting from male bud (bracts are persistent)	Lifting one at time	Not lifting from male bud (bracts are persistent)	Not lifting from male bud (bracts are persistent)
Wax on the bract	Moderately waxy	Very little or no visible sign of wax	Very little or no visible sign of wax	Moderately waxy	Moderately waxy
Presence of grooves on the bract	Strongly grooved	Strongly grooved	Strongly grooved	Slightly grooved	Slightly grooved
Male flower behaviour	Falling with the bract	Falling after the bract	Falling after the bract	Falling with the bract	Falling with the bract
Compound tepal basic color	Cream	Yellow-brown	Cream	Orange	Orange
Free tepal shape	Oblong	Oval	Oblong	Oblong	Oblong
Free tepal appearance	Simple folding under apex	Several folds under apex	Several folding under apex	Simple folding under apex	Simple folding under apex
Anther exsertion	Inserted	Inserted	Inserted	Same level	Same level
Stigma color	Bright yellow	Cream	Yellow to white	Cream	Cream
Ovary shape	Arched (small)	Arched	Arched	Arched	Straight
Ovary basic color	Light-green	Light-green	Light-green	White	White

Table 1. Continued. . .

DESCRIPTOR	var. lawasensis	var. limbangensis	var. miriensis	var. sabahensis	var. sarawakensis
Dominant color of male flower	Red-purple	Orange	Cream	Red-purple	Red-purple
Fruit shape (longitudinal)	Straight (or slightly curved)	Straight in the distal part	Curved (sharp curve)	Straight (or slightly curved)	Straight (or slightly curved)
Transverse section of the fruit	Slightly ridged	Pronounced ridge	Slightly ridged	Pronounced ridge	Slightly ridged
Remains of flower relicts at fruit apex	Persistent style	Persistent style	Persistent style	Without any floral relicts	Without any floral relicts
Pedicel surface	Hairless	Hairless	Hairless	Hairless	Hairy
Fusion of pedicels	No visible sign of fusion	No visible sign of fusion	No visible sign of fusion	Very partially or no visible sign of fusion	Totally fused
Mature fruit peel color	Cream-yellow with grey spots	White-green and heavily blotched with red-purple	Cream-yellow	White-green and heavily blotched with dark-purple	Very light yellow (a bit greenish)
Adherence of the fruit peel	Fruits peels easily	Fruits peels easily	Fruits peels easily	Fruits peels easily	Fruit does not peel easily
Pulp color at maturity	Cream-white	Cream	Cream-white	Cream	Cream-white
Fruits fall from hands	Deciduous	Persistent	Deciduous	Persistent	Persistent

obovate, 3.0 – 3.5 cm long, male bud, in advanced stage of blooming, narrowly ovoid, acute, the bracts imbricate, bract pink-purple to purple, the outer surface shining without shade of glaucousness, lanceolate-oblong or ovate, the lowest ones about 10 – 20 cm long, 4 – 12 cm wide, deflexed but not rolled back, very soon deciduous, male flowers 3 -10 per bract in one row or partly in two rows, the compound tepal 3.2 – 4.0 cm long, orange in the upper part and nearly white at the base, the free tepal 3.0 – 4.0 cm long, oblanceolate, rotundate and entire or with a few irregular serrations, the stamens longer than the free tepal.

Fruit bunch rather lax, hands spirally arranged, the fingers inflexed to stand almost parallel to the rachis or slightly curved, individual fruit 8 – 14 cm long, 2 – 2.5 cm in diameter, cylindrical with 3 angles, pedicel short and obscure, apical part bottle-neck-shaped with truncate apex, the pericarp 1 – 2 mm, watery to light green and usually some varieties blotched reddish purple. Seeds many, 60 – 120 per fruit, cylindrical, obpyriform and wrinkled, tuberculate, 4 – 5 mm long, 2.5 – 3.0 mm in diameter.

Distribution

Borneo: Sarawak, Brunei, Western Sabah and northern part of West Kalimantan.

Description of Botanical Varieties of *M. campestris*

1. *Musa campestris* Becc. var. *lawasensis* Häkkinen, var. nov. (Fig. 3)

A *Musa campestris* Becc. var. *typica* floribus masculinis 2-3 uniseriatis per bracteam, cum tepalis

liberis et perigonio fere subaequali, bracteis late auriculatis ad basin, baccis strictis pauca costulatis, praecipue differt. Pericarpium maturum tenue flavum, brunneis maculis praeditum.

Holotypus: MALAYSIA. Sarawak. Lawas, Trusan, Kg. Air, on roadside, alt. 190 feet, latitude 04° 50,420' N., longitude 115° 21,815' E., *M. Häkkinen, H. Doyok & P. Padan, SBC 8002* [Sarawak Forest Department herbarium (SAR)]. Isotypus at Sarawak Biodiversity Centre Herbarium (SBC), Malaysia.

Big clump up to 5 stems, pseudostem short, slender, less than 1 m high, shiny, with purple-brown blotching on a light green background. Leaf-blade 160 cm long, 30 cm wide, lamina shiny at both faces, lamina bases asymmetric and rounded but not auriculate. Petiole 70 cm long, canals open with margins erect, petiole bases winged clasping the pseudostem with heavily wrinkled auricles. Inflorescence erect, peduncle hairless and watery green, sterile bract usually 1, with narrow and short foliage lamina, 35 cm long, base broadened, reddish purple, usually persistent at the opening of the female flowers. Female flowers 2-3 per bract, in a single row, the ovary 6.5 cm long, white, the compound tepal 4.0 cm long, the free tepal obovate, 3.5 cm long, the style 3.5 cm long with a globose white stigma 6 mm in diameter. Male bud, ovoid, acute, the bracts imbricate, bract pink-purple with discolored stripes on the external face, the internal face pink-purple, the lowest bract about 8 cm long, 4 cm wide, moderately waxy, deflexed but not rolled back and quickly deciduous. Male flowers 2-3 per bract in a single row, the compound tepal 4 cm long, orange in the upper part and watery green at the base, ribbed at the dorsal



Fig. 3. *Musa campestris* Becc. var. *lawasensis* Häkkinen, var. nov.

angles, with 5-toothed apex, the outer lobes ovate, cuspidate, inner three lobes rotundate, central one larger than the laterals, the free tepal 3.8 cm long, translucent white, oblong, rotundate and simple folding under apex, the stamens the same length as the free tepal, filaments 1.8 cm long, anthers 2 cm long. Fruit bunch rather lax, with 4 hands and 2-3 fruits per hand on average, the fingers inflexed to stand almost parallel to the rachis, individual fruit 11 cm long, about 2 cm in diameter, slightly ridged with 3 angles,

pedicel short and obscure, apical part bottle-neck-shaped with truncate apex, the pericarp thin, immature fruit peel light green, becoming cream yellow with brown spots at maturity, pulp white becoming cream-white at maturity. Seeds cylindrical obpyriform, wrinkled, tuberculate, 4-5 mm long, 2.5-3.0 mm in diameter, 60-70 per fruit.

Vernacular name: Pisang nglaran, Pisang rotai, Pisang tajak

2. *Musa campestris* Becc. var. *limbangensis* Häkkinen, var. nov. (Fig. 4)

A *Musa campestre* Becc. var. *typica* floribus masculinis 6 biseriatis per bracteam, cum tepalis liberis ovatis flavobrunneis, floribus feminis 4 per bracteam, vestigiis ad baccae apicem persistentibus praecipue differt. Pericarpium maturum latis rubropurpureis maculis praeditum.

Holotypus: MALAYSIA. Sarawak. Limbang, on roadside, 78 feet alt., latitude 04° 37,457' N., longitude 114° 53,319' E., *M. Häkkinen & J. Jadol, SBC 8001* [Sarawak Forest Department herbarium (SAR)]. Isotypus at Sarawak Biodiversity Centre Herbarium (SBC), Malaysia.

Big clump up to 12 stems, pseudostem 1 m high, slender, waxy, with few pink-purple blotching on a light-green background. Leaf-blade 180 cm long, 45 cm wide, lamina dull at both faces, lamina bases asymmetric and rounded but not auriculate. Petiole 90 cm long, canal margins with a green line, curved inwards, petiole bases winged clasping the pseudostem with heavily wrinkled auricles. Inflorescence erect, peduncle slightly pubescent and light-green, sterile bract usually 1, with narrow and short foliage lamina, 35 cm long, base broadened, purple, usually persistent at the opening of the female flowers. Female flowers 5-6 per bract, in two rows, the ovary 5 cm long, white, the compound tepal 3.8 cm long, the free tepal obovate, 3.6 cm long, the style 4 cm long with a globose white stigma 5 mm in diameter. Male bud,



Fig. 4. *Musa campestris* Becc. var. *limbangensis* Häkkinen, var. nov

ovoid, acute, the bracts imbricate, bract pale-purple with discolored stripes on the external face, the internal face purple, the lowest bract about 9 cm long, 4 cm wide, waxless, deflexed but not rolled back and quickly deciduous. Male flowers 6 per bract in 2 rows, the compound tepal 3.6 cm long, yellowish brownish in the upper part and cream at the base, ribbed at the dorsal angles, with 5-toothed apex, the outer lobes ovate, cuspidate, inner three lobes rotundate, central one larger than the laterals, the free tepal 3 cm long, translucent white, oblong, rotundate and simple folding under apex, the stamens the same length as the free tepal, filaments 1.4 cm long, anthers 1.6 cm long. Fruit bunch rather lax, with 6-7 hands and 5-6 fruits per hand on average, the fingers inflexed to stand almost parallel to the rachis, individual fruit 14 cm long, about 3 cm in diameter, slightly ridged with 3 angles, pedicel short and obscure, apical part bottle-neck with truncate apex, flower relicts remain at fruit apex, the pericarp 2 mm, immature fruit peel white-green with large red-purplish blotches, becoming more red-purplish at maturity, pulp white becoming cream at maturity. Seeds cylindrical, obpyriform, wrinkled, tuberculate, 4-5 mm long, 2.5-3.0 mm in diameter, 90-100 per fruit.

Vernacular name: Pisang hutan, Pisang kera

3. *Musa campestris* Becc. var. *miriensis* Häkkinen, var. nov. (Fig. 5)

A *Musa campestre* Becc. var. *typica* floribus masculinis 2-3 uniseriatis per bracteam, cum tepalis liberis et perigonio subaequali, bracteis apice flavis, baccis paucis costulatis, praecipue differt. Pericarpium maturum tenue flavocrementeum.

Holotypus: MALAYSIA. Sarawak. Miri, on roadside, alt. 157 feet, latitude 04° 11,361' N., longitude 114° 02,170' E., *M. Häkkinen*, *SBC 8004* [Sarawak Forest Department herbarium (SAR)]. Isotypus at Sarawak Biodiversity Centre Herbarium (SBC), Malaysia.

Small clump up to 4 stems, pseudostem 1.5 m high, slender, shiny, with black-purple blotching on a light-green background. Leaf-blade 180 cm long, 40 cm wide, lamina shiny at both faces, lamina bases asymmetric, rounded and auriculate. Petiole 100 cm long, canals rather open with margins erect, petiole bases winged clasping the pseudostem with heavily wrinkled auricles. Inflorescence erect, peduncle very hairy and green-rusty color, sterile bract usually 1, with narrow and short foliage lamina, 40 cm long, base broadened, pink-purple with green tip, usually persistent at the opening of the female flowers. Female flowers 2-3 per bract, in a single row, the ovary 6.5 cm

long, white, the compound tepal 3.4 cm long, the free tepal obovate, 2.0 cm long, the style 3.3 cm long with a globose white stigma 5 mm in diameter. Male bud ovoid, acute, the bracts imbricate, bract pink-red with discoloured stripes on the external face, the internal face pale-pink, the lowest bract about 13 cm long, 7 cm wide, shiny, deflexed but not rolled back and quickly deciduous. Male flowers 2-3 per bract in a single row, the compound tepal 3.8 cm long, orange in the upper part and green yellow at the base, ribbed at the dorsal angles, with 5-toothed apex, the outer lobes ovate, cuspidate, inner three lobes rotundate, central one larger than the laterals, the free tepal 3.4 cm long, translucent white, oblong, rotundate and simple folding under apex, the stamens same length as the free tepal, filaments 1.6 cm long, anthers 1.8 cm long. Fruit bunch rather lax, with 8 hands and 3-4 fruits per hand on average, the fingers inflexed to stand almost parallel to the rachis, individual fruit 10 cm long, about 2 cm in diameter, slightly ridged with 3 angles, pedicel short and obscure, apical part bottleneck-shaped with truncate apex, flower relicts remain at fruit apex, the pericarp thin, immature fruit peel light green, becoming cream yellow at maturity, pulp white becoming cream white at maturity. Seeds cylindrical, wrinkled, obpyriform, tuberculate, 4-5 mm long, 2.5-3.0 mm in diameter, 70-80 per fruit.

Vernacular name: Pisang tajak

4. *Musa campestris* Becc. var. *sabahensis* Häkkinen, var. nov. (Fig. 6)

A *Musa campestre* Becc. var. *typica* floribus masculinis 6 biseriatis per bracteam, cum tepalis liberis oblongis non linearibus et perigonio subaequali, praecipue differt. Pericarpium maturum atropurpureis maculis praeditum.

Holotypus: MALAYSIA. Sabah. Crocker Range, Ulu Kimanis, Kg. Wolit, on roadside, alt. 1958 feet, latitude 05° 30,253' N. Longitude 116° 00,780' E. *M. Häkkinen*, *M. Suleiman*, *J. Gisil* & *S. Magupin CRP 1* (BORH). Isotypus at University of Helsinki (H), Finland.

Big clump up to 8 stems, pseudostem 1.5 m high, slender, shiny, with purple blotching on a pink-purple background. Leaf blade 170 cm long, 50 cm wide, lamina moderately waxy at both faces, lamina bases symmetric, rounded auriculate. Petiole 120 cm long, canal open with margins spreading, petiole bases winged clasping the pseudostem with heavily wrinkled auricles. Inflorescence erect, peduncle nearly hairless and watery green, sterile bract usually 1, with narrow



Fig. 5. *Musa campestris* Becc. var. *miriensis* Häkkinen, var. nov.

and short foliage lamina, 50 cm long, base broadened, reddish purple, usually persistent at the opening of the female flowers. Female flowers 2-3 per bract, in a single row, the ovary 6.0 cm long, white, the compound tepal 5.3 cm long, the free tepal obovate, 4.3 cm long, the style 4.8 cm long with a globose creamish stigma 8 mm in diameter. Male bud, ovoid, acute, the bracts imbricate, bract purple with discolored stripes on the external face, the internal face pale purple, the lowest bract about 13 cm long, 7 cm wide, moderately waxy, deflexed but not rolled back and quickly deciduous. Male flowers 6 per bract in two rows, the compound tepal 3.5 cm long, orange in the upper part and watery green at the base, ribbed at the dorsal angles, with 5-toothed apex, the outer lobes ovate, cuspidate, inner three lobes rotundate, central one larger than the laterals, the free tepal 3.5 cm long,

translucent white, oblong, rotundate and simple folding under apex, the stamens same length as the free tepal, filaments 1.5 cm long, anthers 1.7 cm long. Fruit bunch rather lax, with 4-5 hands and 2-3 fruits per hand on average, the fingers inflexed to stand almost parallel to the rachis, individual fruit 10 cm long, about 3 cm in diameter, ridged with 3 angles, pedicel short and obscure, apical part bottle-neck-shaped with truncate apex, the pericarp 2 mm, immature fruit peel white-green with large black-purplish blotches, remaining the same at maturity, pulp white becoming cream white at maturity. Seeds cylindrical, obpyriform, wrinkled, tuberculate, 4-5 mm long, 2.5-3.0 mm in diameter, 110 – 120 per fruit.

Vernacular name: Pisang hutan



Fig. 6. *Musa campestris* Becc. var. *sabahensis* Häkkinen, var. nov.

5. *Musa campestris* Becc. var. *sarawakensis* Häkkinen, var. nov. (Fig. 7)

A *Musa campestris* Becc. var. *typica* tepalis liberis et perigonio aequali in floribus masculinis, floribus feminis 5-7 per bracteam, baccis reduncis pauce costulatis, petioli basi depicta, praecipue differt. Pericarpium maturum flavum pallidum, difficulter detractum.

Holotypus: MALAYSIA. Sarawak. Kuching, Penrissen, Kg. Jambu, on roadside, alt. 138 feet, latitude 01° 16,155' N., longitude 110° 20,322' E., *M. Häkkinen & B.H. Voon, SBC 8003* [Sarawak Forest Department herbarium (SAR)]. Isotypus at Sarawak Biodiversity Centre Herbarium (SBC) Malaysia.

Big clump up to 8 stems, pseudostem 1.2 m long, slender, shiny, with purple-brown stripes on a yellow red-purple background. Leaf blade 240 cm long, 50 cm wide, lamina dull at both faces, lamina bases asymmetric and rounded but not auriculate. Petiole 95 cm long canal open, margins erect with purple line,

petiole bases winged clasping the pseudostem with heavily wrinkled auricles. Inflorescence erect, peduncle very hairy, short hairs similar to velvet touch and ivory, sterile bract usually 1, with narrow and short foliage lamina, 40 cm long, base broadened, reddish purple, usually persistent at the opening of the female flowers. Female flowers 5 – 7 per bract, in two rows, the ovary 6 cm long, white, the compound tepal 4 cm long, the free tepal obovate, 3 cm long, the style 3.5 cm long with a globose white stigma 4 mm in diameter. Male bud, ovoid, acute, the bracts imbricate; bract purple with discoloured stripes on the external face, the internal face pale-purple, the lowest bract about 18 cm long, 6.5 cm wide, moderately waxy, deflexed but not rolled back and quickly deciduous. Male flowers 10 per bract in two rows, the compound tepal 3.8 cm long, orange in the upper part and watery green at the base, ribbed at the dorsal angles, with 5-toothed apex, the outer lobes ovate, cuspidate, inner three lobes rotundate, central one larger than the laterals, the free tepal 3.8 cm long, translucent white, oblong, rotundate and simple folding under apex, the stamens same length as the free tepal, filaments 1.8 cm long, anthers 2.0 cm long. Fruit bunch rather compact,



Fig. 7. *Musa campestris* Becc. var. *sarawakensis* Häkkinen, var. nov.

with 9-10 hands and 5-7 fruits per hand on average, the fingers straight or slightly curved, individual fruit 11 cm long, about 3 cm in diameter, slightly ridged with 3 angles, pedicel short, obscure and hairy, apical part bottleneck-shaped with truncate apex, the pericarp 2 mm, immature fruit peel light green, becoming very light yellow at maturity, pulp white becoming cream-white at maturity. Seeds cylindrical, obpyriform, wrinkled, tuberculate, 4-5 mm long, 2.5-3.0 mm in diameter, 80-90 per fruit.

Vernacular name: Pisang lengki

SUMMARY AND CONCLUSION

M. campestris is a lowland species, which has evolved into several different varieties depending on the growing conditions. Five distinct varieties of *M. campestris* have been identified: *lawasensis*, *limbangensis*, *miriensis*, *sabahensis* and *sarawakensis*. The distinguishing characteristics of each variety have been described and holotype and isotype materials for each variety have been distributed to herbaria. The absence of *M. campestris* is noticeable in most parts of the lowland areas of northern Borneo, where it is replaced by another small *Callimusa* species, *M. hirta*. The subtle reason for the mutually exclusive regions of growth of *M. hirta* and *M. campestris*, as well as the reason for the interposing region where neither species grows, are subjects meriting further research. The



recently discovered exceptions are likely sources of valuable clues as to why *M. hirta* and *M. campestris* generally do not exhibit sympatric growth.

Eventually, it is expected that all these varieties of *M. campestris* will hybridize into one homogenous population due to their fast expansion. The genetic variations that have developed since prehistoric times will be lost forever, unless they are stored in a gene bank.

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