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An account of the Plantaginaceae of Thailand

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ABSTRACT. One genus, with a single native species, is recognised in the Plantaginaceae following revision of Thai and associated materials. *Plantago* comprises the widespread *P. major* which is taken to include *P. asiatica* (lectotypified here) and *P. erosa* (lectotypified here). Investigation of stomatal density, stomatal length, seed size, seed number, leaf-lobing, pseudo-pedicel presence, inter-flower spacing and corolla-lobe length revealed that only the latter showed significant difference between material usually assigned to *P. asiatica* and *P. major*; with the latter the larger. The detected difference is both small and the reverse of that expected from previous studies. Though field experience suggests that *P. major* is fairly frequent throughout Thailand the number of collections housed in herbaria is very few and the distributional data given are, necessarily, incomplete.

Plantaginaceae comprises three genera and 250–260 species worldwide: *Brougiera* and *Littorella* contain three and one species respectively, the rest are all in *Plantago*. The family is cosmopolitan, being absent only from the Arctic and Antarctic. It is closely allied to the Scrophulariaceae and in recent years, on the basis of rather limited molecular, anatomical and more substantial chemical evidence, the two families have been considered as one (Judd et al., 1999). However, the most recent molecular evidence suggests that there is only weak support for the formation of this new clade (Soltis et al., 2000). Most recently, on the basis of DNA sequence data from the plastid genes *rbcL*, *ndhF* and *rps2*, Olmstead et al. (2001) propose the submergence of the Plantaginaceae within a weakly defined clade which they have called the Veronicaceae. As Olmstead et al. (2001) indicate the name Plantaginaceae postdates the name Veronicaceae but has priority as it is conserved: therefore, the correct name for this clade at family level is Plantaginaceae. At one point in their paper, Olmstead et al. (2001) accept but later they implicitly reject the concept that this clade (Veronicaeae) should be recognised at family level. It seems that Olmstead et al. (2001) prefer to retain the Plantaginaceae as a family, in the narrow conventional sense. Certainly, their analysis shows that the branch lengths linking *Plantago* and *Veronica* are very long (209 and 108 respectively) (Olmstead et al., 2001). Therefore, the fact that these genera cluster together may be a false indication of a close relationship due to the Felsenstein effect or long-branch attraction (Felsenstein, 1978, Judd et al., 1999). In these circumstances, it would appear sensible to retain the family Plantaginaceae as a separate entity until more data from more taxa becomes available. This is congruent with the opinions of Pilger (1937) & Rahn (1996) who clearly indicate that they consider the family monophyletic with the latter suggesting that the consistent presence of hairs in the leaf axils is an important autapomorphy.

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A survey of herbarium material in A, AAU, ABD, BK, BKF, C, E, K and TCD yielded only 59 collections from Thailand, 55 of which are of *P. major* s.l. Though many collections were duplicated in more than one herbarium, the family is clearly severely under-collected. Therefore, the distributional data given herein are even more than usually tentative. Species descriptions are based on original observations, largely of herbarium material. As measurements have been taken from dried specimens they may differ slightly from fresh material.

It is known that a number of species, particularly *Plantago indica* L., *Plantago arenaria* Waldst. & Kit., *Plantago afra* L. (listed as *Plantago psillium* L.) and *Plantago ovata* Forsk. are grown for pharmaceutical use as bulk laxatives (Leung, 1980) and that the mucilage from the husk is used as a thickener in some food products (Chua *et al*., 1994). *P. afra* and *P. arenaria* have escaped from cultivation, being found as weeds amongst a crop of cumin and *P. ovata* is cultivated in Thailand: therefore, all these species are included in this account and appear in the key. Surprisingly, *Plantago lanceolata* L. has not yet been recorded from Thailand nor any of the immediate surrounding countries and, therefore, is currently excluded.

PLANTAGINACEAE

Juss., Gen. Pl. 89. 1789 (‘Plantagines’); Decne. in A.DC., Prod. 13: 693–737. 1852; Pilger in Engl. & Diels, Pflanzenr. 4. 269: 1937.

Upright to spreading annual or perennial herbs with short stems; Thai material never subshrubby. *Leaves* simple, spirally arranged, with ± parallel venation, margin entire or lobed to toothed. *Petiole* forming a sheath at the base; stipules absent, hairs always present in leaf axils. *Bracts* small, persistent. *Flowers* (3–)4(–5)-merous, in long or short spikes on long peduncles, usually hermaphrodite. *Sepals* fused, lobed. *Corolla* largely fused, scarious; lobes triangular, spreading and usually reflexed at maturity. *Stamens* usually 4 (solitary in *Bougeria*), equal, with long filaments, alternating with corolla-lobes, anthers 2-celled, exserted, versatile, opening by longitudinal slits; connective prominent. *Ovary* superior of 2 carpels; ovules 1-many on an axile placenta. *Style* 1, long, stigma bifid, exserted. *Fruit* in all Thai species always a circumscissile capsule, the top segment falling off as a lid.

Three genera (only *Plantago* in Thailand) and ca. 250–260 species. Cosmopolitan.

PLANTAGO

L., Sp. Pl. 112. 1753; Decne. in A.DC., Prod. 13: 694. 1852.

Inflorescences 3–7, spicate or, in some introduced species, capitate. *Leaves* mainly radicle, usually hairy, entire or lobed. (All native Thai material has a distinct blade and petiole, the latter is sometimes as long as the blade; introduced species may have linear

to narrowly ensiform leaves with the petiole not distinguishable from the blade.) *Bracts* triangular to ovate or obovate; glabrous or hairy, membranous to herbaceous, keeled, sometimes winged, usually green or brown. *Flowers* hermaphrodite. *Corolla lobes* reflexed at maturity, inconspicuous. *Stamens* 4, exserted; anthers often cauducuous. *Fruit* enclosed in the remnants of the perianth segments at maturity. *Seeds* angular, peltate.

One native species in Thailand; three species potentially cultivated.

1. Inflorescence a spike, leaves with a distinct, broad blade and obvious petiole **1. P. major**
1. Inflorescence capitate, leaves lacking a distinct broad blade and obvious petiole 2
2. Involucral bracts with long, silky, ciliate hairs **2. P. ovata**
2. Involucral bracts lacking long, silky, ciliate hairs, though often with a long acumen 3
3. Inflorescence branches sparsely hirsute and minutely, but evidently, papillose, (*i.e.* long and very short hairs evident). Bracts of two types, the basal suddenly narrowing to a long acumen 3–4x as long as the base of the bract, the upper lacking a long acumen **3. P. arenaria**
3. Inflorescence branches hirsute and not evidently papillose (*i.e.* hairs apparently ± the same length). Bracts ovate to lanceolate, all similar, the base never suddenly narrowing to a long acumen **4. P. afra**

1. Plantago major L., Sp. Pl. ed. 1. 1:112. 1753; Decne. in A.DC., Prod. 13: 694. 1852; Hook.f., Fl. Brit. India 4: 705. 1885; Gagnep. in Lecomte, Fl. Indo-Chine 4: 1047. 1936; Pilger in Engl. & Diels, Pflanzenr. 4. 269. 41–56: 1937; Matthew & Rani in Matthew, Flora of Tamilnadu Carnatic 2: 1285. 1983; Hô, Câyco Viêtnam 2: 1109. 1993; Type: Herb. Linn. 144.1 (lectotype LINN!).— *P. asiatica* L., Sp. Pl. ed. 1 1: 113. 1753; Pilger in Engl. & Diels, Pflanzenr. 4. 269: 56–59: 1937; Ridl., Fl. Mal Pen. 2: 225. 1923; Alston in Trimen, Hand. Fl. Ceylon 6: 237. 1931; Hô, Câyco Viêtnam 2: 1109. 1993. Type: Herb Linn. 144.4 (lectotype LINN!, selected here).— *P. major* var. *asiatica* (L.) Decne. in A.DC., Prod. 13: 694. 1852; *Plantago major* var. *asiatica* (L.) Trimen, Hand. Fl. Ceylon 3: 389. 1895.— *P. erosa* Wall. in Roxb., Fl. Ind. Ed. 1 (ed. Carey) 423. 1820, Decne. in A.DC., Prod. 13: 695. 1852; Pilger in Engl. & Diels, Pflanzenr. 4. 269. 60–61: 1937; Dassan. in Dassan. & Clayton, Rev. Hndbk. Fl. Ceylon 10: 328–330. 1996; Springate, in Grierson & Long, Flora of Bhutan 2: 1342. 2002. Type: *Wallich* 6412A, lower specimen (lectotype K-W!, selected here).

Perennial herb, 5–20 cm tall, with a single basal rosette of leaves, rosette present on flowering. *Bracts* ± ovate to triangular, much smaller than the flowers, sometimes largely green other times mostly membranous with a green midrib. *Flowers* in long spikes 5–15(–20) cm long, the lower often well separated from each other the upper usually congested. *Calyx* 2–2.5 mm long, oval, obtuse or acute, scarious, keeled, keel green when fresh, brown when dry. *Corolla-lobes* spreading, 1–1.2 mm, recurved; lilac to whitish. *Stamens* exserted, with caducous, cream-coloured anthers and fragile white filaments, connective 0.1–0.2 mm long, apiculate, prominent. *Stigma* ca. 2 mm long, white. *Capsule* 3–4 mm, the top 50–60% forming a circumscissile capsule. *Seeds* black, somewhat angular (Fig. 1).

Thailand.— NORTHERN: Mae Hong Son (Kieo Lom), Chiang Mai (Mae Rim-Samoeng, Mae Chaem, Chiang Mai, Doi Chiang Dao, Doi Inthanon, Doi Khun Huai Pong, Doi Pa Hom Pok, Doi Suthep, Doi Pui, Khun Yam, Om Koi), Chiang Rai (Doi

Tung, Mae Chan), Nan (Muang District, Phu Kha), Lamphun (Ban Muang Nga, Doi Khun Tan), Lampang (Jae Son, Mae Mo), Phrae (Ban Nam Klai, Mae Krae), Phitsanulok (Phu Hin Rong Kla, Phu Miang); SOUTH–WESTERN: Kanchanaburi (Sai Yok); PENINSULAR: Yala (Bannang Sata).

Distribution.— Cosmopolitan.

Ecology.— Roadsides, open and disturbed habitats; largely recorded from elevations above 500 m and from damp or wet habitats.

Vernacular.— Ya en yuet (หญ้าเอ็นยืด), En yuet (เอ็นยืด) (Northern).

Uses.— Whole plant is powdered and applied to cuts to stop bleeding and infection and to treat strains. In Peninsular Malaysia a decoction of the plant is used to alleviate coughs.

Notes.— *P. erosa* Wall. in Roxb., *P asiatica* L. and *P. major* L. have all been reported from Southeast Asia. Rahn (1996) indicated that *P. erosa* was most likely to be a subspecies of *P. asiatica* and that *P. asiatica* and *P. major* differed in their chromosome number (2n=12 and 2n=24 respectively). Linneaus (1753) & Barnéoud (1845) distinguished the latter two taxa on the basis that the scape of *P. major* was rounded and the flowers ± imbricate whilst the scape of *P. asiatica* was angled and the flowers were separated from each other along the scape. Taiken et al. (1993) suggested that these taxa differed in various features shown in Table 1.

Table 1. Putative differences between *P. asiatica* and *P. major* (Taiken et al., 1993).

	P. asiatica	*P. major*
Stomatal number per mm^2	(125–)165(–200)	(225–)285(–375)
Stomatal index	(20.1–)27.2(–36.4)	(20.5–)26(–30)
Seed length (mm)	≥2	≤2

Rahn (pers. comm.) also indicated that he believed these species differed as follows:

P. major: flowers sessile. Corolla lobes ≤1 mm. Seeds 6–34 per capsule. 2n=12.

P. asiatica: flowers borne on a short pedicel-like extension of the calyx. Corolla lobes >1.2 mm. Seeds 5–9 per capsule. 2n=24.

Examination of all available Thai material and material from surrounding regions and elsewhere has, with a solitary exception, not confirmed the existence of the putative differences between these species suggested by Linneaus (op. cit.) or Taiken (op. cit.) or Rahn (op. cit.) (Table 2).

Table 2. Characteristics of measured material of *P. asiatica* and *P. major*; (n=100).

	P. asiatica (Thailand) Mean ± Standard Error	*P. major s.s.* (all non-Thai material) ± Standard Error	F-value; p
Corolla-lobe length	0.81 ± 0.02	0.9 ± 0.03	4.25; 0.04
Stomatal number per mm^2	143 ± 8.74	154 ± 8.7	0.81; 0.38
Stomatal length (mm)	0.256 ± 0.007	0.247 ± 0.006	0.84; 0.36

Seed length (mm)	1.23 ± 0.05	1.20 ± 0.05	0.29; 0.59
Seed number / Capsule	8.81 ± 0.82	8.56 ± 0.74	0.13; 0.71

There appears to be no consistent or statistically significant difference between *P. major s.s.* and material normally assigned to *P. asiatica* in respect of stomatal density, stomatal length, seed length or seed number / capsule (all $p>0.05$; Table 2). Corolla lobe length is statistically different between the two species with the lobes of *P. major* 0.1 mm longer than *P. asiatica* on average ($F=4.25$; $p\leq0.5$); this finding appears to contradict the suggestion of Rahn (op. cit.) that the corolla-lobes of *P. asiatica* are longer. Examination of Southeast Asian material attributed to *P. asiatica*, also revealed that the pedicel-like extension (pseudo-pedicel) of the calyx is not consistently present in duplicate collections of material. Also, whilst some specimens have flowers well separated along the base of the scape, others have the flowers congested and all intermediate conditions may be found. Leaf lobing is similarly inconsistently present and the angularity of the scape variable. Comparison of Southeast Asian material with undoubted material of *P. major* from Europe and elsewhere showed that material assigned to *P. major* subsp. *intermedia* (Gilib.) Lange has identical leaf-lobing to material of *P. asiatica* with leaf-lobes. Furthermore, material labelled as *P. erosa* by Rahn (e.g. *Sorensen, Larsen & Hansen* 1777 (C)) tends to have high stomatal densities ($\geq$ 250 per mm^2), often has lobed leaves and the basal flowers in the inflorescence well separated out from the rest. However, as stated before all intermediate conditions between this form and typical *P. major* exist. On the basis of the available evidence, I do not believe that *P. asiatica* warrants recognition at the species level: indeed at present, in my view, even subspecific rank appears difficult to justify - at best, varietal rank might be warranted for this taxon. If varietal rank is accepted the correct name for such material is *P. major* var. *asiatica* (L.) Decne. This conclusion is in concord with those of Hooker (1885), Gagnepain (1936), Backer & Bakhuizen van der Brink (1965) & Chua et al. (1994). Though Trimen (1895) was inclined to recognise this taxon at specific level, he did not do so, preferring varietal status. As I do not recognise *P. asiatica* as a separate species I also cannot follow Rahn's suggestion that *P. erosa* be treated as a subspecies of *P. asiatica*. My view of the pattern of variation *P. major* is well summarized by Backer & Bakhuizen van der Brink Jr (1965) who state that 'the extreme forms differ so much that they might be taken for different species, were it not that they are connected by a series of intergrades'.

The type of *P. asiatica* has not been chosen. There are two relevant specimens of *P. asiatica* (144.4 & 144.3) in LINN and one of *P. major* (144.1). Of these, 144.4 is the more complete, with many mature and younger flowers - it shows all the features Linnaeus thought distinctive and I therefore have typified by reference to that specimen. 144.1 clearly corresponds to Linnaeus's description of *P. major* and matches current thinking on this species. It has been already selected as the type.

The type of *P. erosa* is indicated as *Wallich* 6412 by Dassanayake in Dassanayake & Clayton (1996). However, no formal lectotypification has been made and 6412 is not an unique reference. The sheet bearing the label 6412A in K-W is labelled *P. erosa* and consists of two specimens. The upper has only one mature leaf and is somewhat small and immature.

The lower is well preserved, mature and with the features of *P. erosa* that Wallich thought distinctive. Presumably it should be designated as 6412B (there is, apparently, no sheet so

labelled in K-W). Therefore I have nominated this specimen as the lectotype. All the material (four specimens) on sheet 6412C, D also corresponds to the concept of *P. erosa* of Wallich. However, 6412E and 6412Suppl. correspond to *P. major* L.

2. Plantago ovata Forsk., Fl. Aegypt. Arab. 31. 1775; Decne. in A.DC., Prod. 13: 706. 1852. Type: Egypt, *Forsskal* 249, partly (syntype C, not seen), 250 (syntype C, not seen) & 253 (syntype C, not seen).

Annual or biennial, erect herb 4–15 cm tall with a rosette of leaves which are upward-pointing when flowering. *Leaves* linear, narrow, almost ensiform, very densely hirsute, sometimes woolly, about as long as flower heads. *Flowers* in ovate to oblong heads of knobbly appearance. *Bracts* with long, silky, ciliate hairs which are normally numerous.

Thailand.— Cultivated.

Distribution.— Europe to the Middle East and India.

Ecology.— N/A.

Uses.— Used in the pharmaceutical industry and widely cultivated.

Notes.— Used as a source of laxatives and as a source of food thickeners; it may be sold as ‘Psyllium husk’.

3. Plantago arenaria Waldst. & Kit., Pl. Rari. Hung. 1: t. 51. 1801; Decne. in A.DC., Prod. 8: 735. 1852; Rahn, Bot. J. Linn. Soc. 120: 184. 1996. Type: not located.— *P. indica* L., Sys. Nat. ed. 10. 896. 1759. nom illegit.; Pilger in Engl. & Diels, Pflanzenr. 4. 269. 419. 1937.— *Plantago psyllium* L., Sp. Pl. ed. 1. 1: 115. 1753, nom ambig.

Annual, usually erect herb, 30(–50) cm tall, lacking a basal rosette of leaves when flowering. *Upper parts* minutely papillose and sparsely and shortly hirsute. *Leaves* linear, opposite, with fascicles in the axils and appearing as a whorl of ± equally sized leaves or as a whorl of leaves with two members of the whorl a little larger than the rest, shortly hirsute. *Flowers* in numerous ovate to oblong heads of smooth appearance, with the flowers closely packed. *Bracts* winged, of two types; the basal with a very long acumen 3–4 x longer than the rest of the bract; the upper bracts lacking a long acumen.

Thailand.— Cultivated.

Distribution.— Europe to the Middle East and India.

Ecology.— N/A.

Uses.— Used in the pharmaceutical industry and cultivated. An escape from cultivation in Chiang Mai (Fang).

Notes.— Used as a source of bulk laxatives and of food thickeners.

The nomenclature of this species is confused and probably worth rehearsing as the incorrect name continues to be applied in herbaria in the region and elsewhere despite Rahn (1996), whose work on the phylogeny of the group remains the most up-to-date summary. Panigrahi (1975) showed that the name *P. indica* was coined by Linneaus in 1759 as a new name for a species he had already described in 1753 as *P. psillium*: *P. indica* is therefore a superfluous and invalid new name. Unfortunately, Verdcourt (1969, 1971) has also shown that the name *P. psillium* is a *nomen ambiguum* and therefore cannot be used: a view also ascribed to by Rahn (1996). The first available, valid epithet is therefore that coined by Waldstein & Kitaibel. Under the current ICBN rules formal application should, probably, be made to reject *P. psillium*, as until this is done it remains the correct name for this taxon. However, 'psillium' is certainly a taxonomically confusing epithet irrespective of its nomenclatural priority. The epithet 'psillium' is widely applied to *Plantago* material used in Asian pharmaceutical preparations. Its usage in these preparations adds to the confusion as manufacturers report that the material is *P. ovata*.

4. Plantago afra L. Sp. Pl. ed. 2. 168. 1762.; Rahn, Bot. J. Linn. Soc. 120: 184. 1996. Type: not located.— *P. psyllium* L. Sp. Pl. ed. 2. 1: 167. 1762 et auct. mult. non L., Sp. Pl. ed. 1. 1: 115. 1753, Decne. in A.DC., Prod. 13: 734. 1852; Hook.f., Fl. Brit. India 4: 707. 1885; Pilger in Engl. & Diels, Pflanzenr. 4. 269. 424. 1937.

Annual herb lacking a basal rosette of leaves when flowering, 8–20(–40) cm tall. *Upper parts* covered in short hairs and sparsely or densely glandular. *Leaves* linear, opposite, with small fascicles in the leaf-axils and so appearing as a whorl of leaves with two members of the whorl larger than the rest or a whorl of ± equally sized leaves. *Flowers* in ovoid spikes; of somewhat knobbly, somewhat loose appearance. *Bracts* oval to lanceolate, hairy, all similar and lacking a long acumen.

Thailand.— Cultivated.

Distribution.— Europe to the Middle East and India.

Ecology.— N/A.

Uses.— Used in the pharmaceutical industry and cultivated.

Notes.— Used as a source of bulk laxatives and as a source of food thickeners.

The nomenclature of this species is complex, ties in with that of the previous species, and is probably worth restating as the incorrect name continues to be applied in herbaria in the region and elsewhere. Verdcourt (1969, 1971) showed that Linnaeus used the name *P. psillium* in two different senses. Unfortunately, the name which is widely used is based on the later concept of Linnaeus which appeared in the second (1762) edition of Species Plantarum. The name *P. psillium* as used in the first edition of 1753 is, in fact, an earlier name for what has

been called *P. indica* (see above). Verdcourt (op. cit.) therefore rejected *P. psillium* as a *nomen ambiguum*. This leaves *P. afra* as the first available, valid name (Verdcourt, 1969, 1971).

This species is often confused with *P. arenaria*.

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THAI SPECIMENS EXAMINED

***Plantago afra* L.**
Sutheesoen, S., 3354 (BK); *Umpai*, 566 (BK).

***Plantago arenaria* L.**
Umpai, 569 (BK).

***Plantago major* L.**
Anderson, E.F. 5281 (BKF); *Barnid, s.n.* (TCD) Java; *Bragg, K.* 16 (A,L); *Brun, Bjornland, Schumacher,* 122 (C), 440 (C); *CC. & CH.* 353 (BKF); *Chermsirivathana, C.*, 375 (BK); *Chantaranothai, P., Parnell, J., Simpson, D. & Pooma, R.* 1014 (TCD); *Hansen, B. & Smitinand, T.* 12761 (C), 12841 (C), 12891 (AAU, BKF, E, K, L); *Iwatsuki, K., Fukuoka, N. & Chintayungkun, A.* T-9569 (BKF, L); *Kermode, C.W.D.* 16656 (K); *Kerr, A.F.G.* 2912 (E, TCD); *Khantchai*, 370 (BKF); *Koyama, H., Nagamusu, H.* T-40140 (A, BKF); *Koyama, H., Terao, H. & Wongprasert, T.* T-32590 (BKF); *Larsen, K., Larsen, S.S., Nielsen, I. & Santisuk, T.* 41843 (AAU); *Larsen, K., Larsen, S.S., Norgaard, C.T., Pharsen, K., Puudjaa, P. & Ueachirakan, W.* 44378 (AAU), 44720 (AAU); *Larsen, K., Santisuk, T. & Warncke, E.* 1873 (AAU, BKF, E), 2931 (AAU, BKF, E); *Larsen, K., Smitinand, T. & Warncke, E.* 1020 (AAU, BKF, C); *Maxwell, J.F.* 87-1477 (L), 94-680 (A, BKF), 96-1245 (A, BKF), 96-1277 (A, BKF); *Murata, G., Iwatsuki, K., Phengklai, C. & Charamphol, C.* T-15371 (BKF); *Niyomdham, C.* 75 (AAU, BKF, C, L); *Paisooksantivatana*, y-1695-85, y-1720-86, y-2304-89 (BK); *Phengkhlai, C.* T-49886 (BKF), T-49891 (BKF); *Samrong, S.P.N.S.* 17 (BKF); *Shimizu, T., Toyokuni, H., Koyama, H., Yahara, T. & Santisuk, T.* 19175 (L); *Smitinand, T.* 2646 (BKF); *Sorensen, T., Larsen, K. & Hansen, B.* 1777 (C), 2859 (A, C), 4837 (C); *Suvarnakoses, P.* 1702 (BKF); *Suvatoa, L.A.*, 39 (BK); *Tagawa, M., Iwatsuki, K., Koyama, H., Fukuoka, N., Nalampoon, A. & Chinayungkun, A.* T-9292 (BKF); *Takahasi, H.* T-32590 (BKF), T-62552 (A, BKF), T-61863 (A, AAU, BKF); *Tsugaru, S.* T-61863 (BKF); *Umpai*, 463 (BK); *Vacharee*, 478 (BK); *van Beusekom, C.F., Geesink, R., Phengklai, C. & Wongwan, B.* 4721 (BKF, C, K, L); *Winit, K.*, 1808 (A), 1873 (BK); s.n. (BK35192) (BK).

***Plantago ovata* L.**
Umpai, 508 (BK)

REPRESENTATIVE, NON-THAI SPECIMENS EXAMINED

Plantago afra L.
Adomovic, s.n. (K) Greece; *Al Ani, H.A.*, 9823 (K) Iraq; *Ash, J.*, 2041 (K) Ethiopia; *Asplund, E.*, 447 (K) Canary Islands; *Ball, J.* s.n. (TCD) Algeria; *Balls, E.K. & Gowerlay, W.B.*, B713 (K) Turkey; *Bally, P.R. & Melville, R.*, 157671 (K) Somalia; *Bang, A.M.*, 1965 Bolivia; *Bourgeau, E.*, 526 (K) Canary Islands; *Bove*, s.n. (TCD) Algeria; *Bramwell, D.* 787 (TCD) Canary Islands; *Bramwell, D., Richardson, I.B.K. & Murray, B.G.*, 186 (K) Morocco; *Casey, E.C.*, 243 (K) Cyprus; Chevallier, *L.* 474 (TCD) Algeria; *Davis, P.F.*, 41426 (K) Turkey; *Deane, H.*, s.n. (K) India; *Ellman, E. & Hubbard, C.*, 398 (K) Spain; *Evans, I.*, 44 (K) Ethiopia; *Gaillardot*, 2176 (TCD) Syria; *Gillett, J.B.*, 15257 (K) Jordan; *Gregor, A.G.*, s.n. (K) U.K.; *Houck, D.F.* 363 (BKF) U.S.A.; Joad, *G.C.*, s.n., s.n., s.n., s.n. (K) France; *Kotschy, T.* 50 (TCD) Iran; *Lehmann, F.C.*, 6317 (K) Ecuador; *Mandon, G.*, s.n. (K) Madeira; *Mosseray, R.*, s.n. (K) France; *Metcalf, s.n.* (K) Italy; *Mooney, H.F.*, 2836 (K) Ethiopia; *Morton, L.*, 3699 (K) Iran; *Muschler, R.*, s.n. (K) Egypt; *Newbould, J.B.*, 5687 (K) Kenya; *Qazilbash, N.A.*, 2418 (K) India; *Sine nom*. s.n. (K) Britain; *Trethewy, A.W.*, 186 (K) Algeria; *Whiting, M.H. & Richmond, K.*, 56 (K) Morocco; *Wright, E.P.* s.n. (TCD) Algeria; *Yip, H.G*. 186 (BKF) China.

Plantago arenaria Waldst. & Kit.
Ball, J. s.n. (TCD) Italy; *Bemrose, C.J.V.*, 32 (K) Britain; *Bleak, A.A.*, s.n. (K); *Black, A.A.* s.n. (K) Channel Islands; *Blom, C.*, s.n. (K) Sweden; *Bogdan, V.*, 4169 (K) Russia; *Boros, A.*, 100 (K) Hungary; *Cadet, T.*, 4545 (K) Reunion; *de Wilde, W.J.J.O. & de Wilde-Duyfjes, B.E.E.*, 9080 (K) Ethiopia; *Favrat, L. & Barbey, W.*, s.n. (K) Switzerland; *Fishwick, R.W.*, 18 (K) Iran; *Gogina, E.E.* 178 (TCD) Russia; Gregor, *A.G.*, s.n. (K) Britain; *Heginbotham, C.*, s.n. (K) Britain; *Horwood, E.K.* 61/42 (TCD) France; *Hukseaeb, A.*, s.n. (K) Russia; *Johnston, T.S.*, s.n. (K) Britain; *Lambert, V.*, 1926 (K) Belgium; Mácel, L., s.n. (K) Slovakia; *Melvill,e R.*, s.n. (K) Cult.; *Mennell, H.*, s.n. (K) Channel Islands; *Milne-Redhead, G. & Shaw, H.K.A.* 1832 (K) Britain; *Pickler*, s.n. (K) Austria; *Porta*, s.n. (K) Italy; *Scheppig, C.*, s.n. (K) Germany; *Schwarz, Z.*, 472 (K) Poland; *Sennen, F.*, 3483 (K) Spain; *Shaw, H.K.A.*, 1832 (K); *Sine nom.* s.n. (K) Cult.; *Tauscher, J.A.* s.n. (TCD) Hungary; *Tomassini, M.* s.n. (TCD) Italy; *Turrill, W.B.*, K557 (K) Bulgaria; *Ussher, C.A.*, s.n. (K) Ireland; *Verdcourt, B.*, 4498 (K) France; *Wilkinson, J.W.*, H2229 (K) Britain; *Wisniewski, T.*, s.n. (K) Romania.

Plantago major L.
Akeroyd, J.R. & Doogue, D., 7709 (TCD) Ireland; *Akeroyd, J.R. & Preston, C.D.*, 881 (TCD) Greece; *Averyanov, L, Ban, N.T., Binh, N.Q., Budantzev, A., Budantzev, L., Hiep, N.T., Loe, P.K., Tam, N.X. & Yakovlev, G.*, VH411 (AAU) Vietnam; *Ball, P.W. & Chater, A.O.*, 108 (TCD) Serbia; *Bonnet*, s.n. (TCD); *Bor, N.L.*, 229 (TCD) Ireland; *Boufford, D.E., Bartholomew, B., Li, G. & Zhu, G.H.*, 24481 (AAU) China; *Chao, J.M & Kao, M.T.*, 6233 (AAU) China; *Chater, A.O. & Moore, D.M.*, 439 (TCD) Spain; *Chow, K.S.*, 35 (AAU)

China, 70 (TCD) China, 727 (AAU) China; *Cirtu, D. & Cirtu, M.*, 724 (TCD) Romania; *Coulter, T.C.*, 571 (TCD) U.S.A.; *Dessanayake, M.D.*, 590 (TCD) Ceylon; *Dixon, H.H.*, s.n. (TCD) Ireland; *D.N.F.C.*, s.n. (TCD) Ireland; *Florence, J.*, 10788 (TCD) Pitcairn;

Gage, A.T., 63 (ABD) India; *Ghosh, S.K.*, s.n. (AAU) India; *Gupta, N.C.*, 36 (TCD) India; *Inamasu, Y.*, 423 (AAU) Japan; *Jeppesen, S. & Løjtant, B.*, 706 (TCD) Denmark; *Johnson, E.*, s.n. (TCD) India; *Kermode, C.W.D.*, 16656 (K) Burma; *Kerr, A.F.G.*, 20968 (K) Laos; *King's Collector* 155 (ABD) India; *Larsen, K.*, s.n. (AAU) Ceylon; *Lau, Y.E.*, 210 (AAU) China; *Loc, P.K., Hoang, P.H. & Averyanov, L.*, CBL1325 (AAU) Vietnam, 1597 (AAU) Vietnam; *Ling, P.P. & Yao, K.*, 39 (AAU) China; *Løjtnant, B. Nielsen, I. & Esbensen, W.*, 145 (TCD) Denmark; *McKee, H.S.*, 6141 (K) Burma; *M'Ken, M.J.*, 110 (TCD) South Africa; *Matthew, K.M.*, 40550 (AAU) India; *Maxwell, J.F.*, 78-202 (AAU) Malaysia; 78-236 (TDC) Singapore; *Moore, A.G.*, s.n. (TCD) Ireland; *Nakano, T.*, s.n. (AAU) China; *Olney, S.T.*, s.n. (TCD) U.S.A.; *Pearson, C.*, s.n. (TCD) Ireland; *Pakuism, C.E.*, 1161 (K) Burma; *Proskuriakova, G.M.*, 179 (TCD) Russia; *Rahl, A.*, s.n. (ABD) Burma; *Ravenel, H.W.*, s.n. (TCD) U.S.A.; *Reporter on Economic Products*, 10355 (TCD) India; Robinson, *C.B.*, 1360 (K) Cambodia; *Santisuk, T.*, s.n., (BKF) U.S.A.; 383 (BKF) China.; *Strachey, R. & Winterbottom, J.E.*, s.n. (TCD) India; *Thomson, T.*, s.n., s.n. (TCD) India; *Thwaites, G.H.K.*, 2246 (TCD) Sri Lanka; *Watts, W.A.*, s.n. (TCD) Ireland; *Yao, K.*, 10441 (AAU) China; *Yip, H.G.*, 186 (AAU, BKF) China.

Plantago ovata L.
Bornmüller, J., 589, 590 (K) Iran; *Bourgeau, E.*, 1662 (K) Spain; *Dinsmore, J.E.*, 18456 (K) Syria; *Epling, E., Ellison, L. & Anderson, H.*, s.n. (K) U.S.A.; *Hoover, R.F.*, 4289 (K) U.S.A.; *Hudson, R.*, 2936 (K) Kenya; *Kotschy, T.* 836, 30.61 (TCD) Iran; *Nelson, A. & Nelson, R.A.*, 1235 (K) U.S.A.; *Nuttall, L.W.*, 600 (K) U.S.A.; *Purpus, C.A.*, 120 (K) Mexico; *Schweinfurth, G.*, 331 (K) Egypt; *Sine nom.* s.n., (K) Spain; *Syngrasside, O.*, 313 (K) Cyprus; *Townsend, C.C.*, 65/140a (K) Jordan; *Tribe, A.R.*, T27 (K) Somalia; *Wiggins, I.L. & Wiggins, D.B.*, 15792 (K) Mexico.

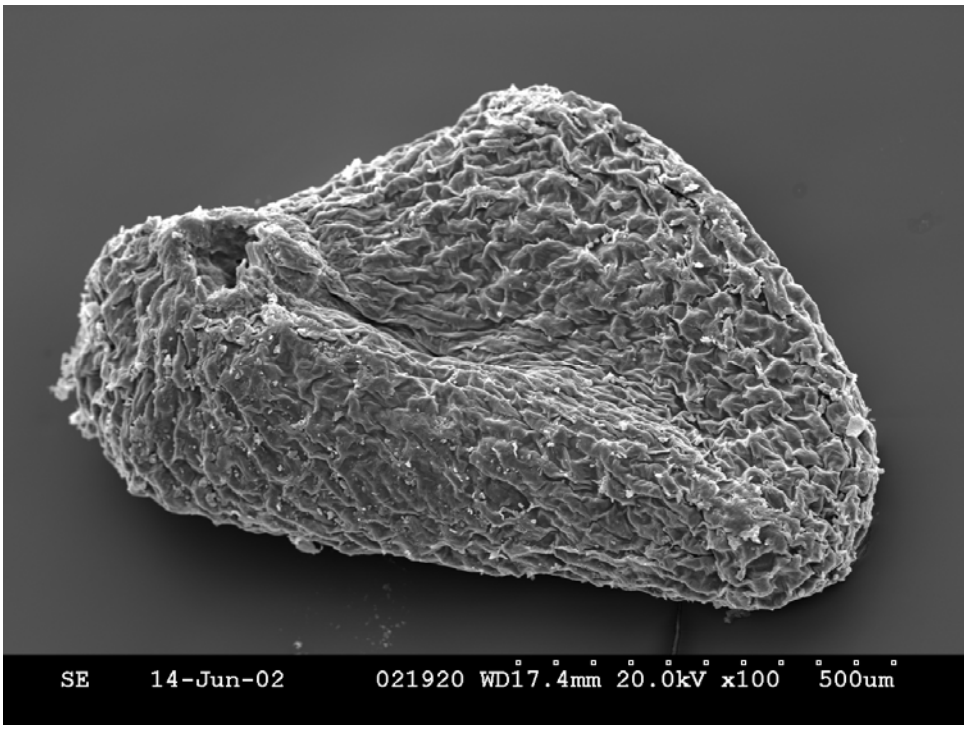

Figure 1. Seed of *Plantago major* L. (*Chantaranothai, P., Parnell, J., Simpson, D. & Pooma, R.* 1014 (TCD)).