Curcuma achrae (Zingiberaceae),
A new species from Central Thailand

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Abstract: Curcuma achrae Saensouk & Boonma, a new species of Curcuma subgenus Ecomata (Zingiberaceae) from Nakhon Nayok province, Central Thailand is described and illustrated along with photographs, notes on its distribution and habitat. A revised identification key to 68 species of the genus Curcuma in Thailand is also presented.

Keywords: Curcuma flaviflora, C. xanthella, Nakhon Nayok province, Taxonomy.

Introduction

The genus Curcuma L. is an important natural resource that provides many useful products and is one of the largest genera in the family Zingiberaceae, distributed from India to South China, Southeast Asia, Papua New Guinea and Northern Australia (Larsen & Larsen, 2006). Záveská et al. (2012) recognized three subgenera: Curcuma subgen. Hitceniopsis (Baker) K.Schum. (Schumann, 1904) with an absence of epigynous glands, Curcuma subgen. Ecomata Škornièk. & Šída f. with the presence of epigynous glands, mostly acute anther spur, fertile bracts connate only at the base and lacking a conspicuous coma of sterile bracts, and leaves with well-developed ligules, whereas Curcuma subgen. Curcuma usually has well-developed coma bracts, a closed flower form, bullet-type, and flat anther-spurs, acute, downward-pointed or absent. Subsequently, previously recognized genera, namely Laosanthus K.Larsen & Jenitt., Smithatris W.J.Kress & K.Larsen and Stahlianthus Kuntze, are sunk Curcuma and two species previously recognized in the genus Hitceniopsis Wall., namely H. caulina (J.Graham) Baker and H. glauca Wall., transferred to Curcuma which caused an increase in the number of species in Curcuma (Leong-Škorniková et al., 2015). Recently, five new species of Curcuma subgen. Ecomata were described, namely C. chantaranothaii Boonma & Saensouk, C. rangsimae Boonma & Saensouk, C. aruna Maknoi & Saensouk, C. pitukii Maknoi, Saensouk, Rakarcha & Thammar, and C. siamensis Saensouk & Boonma, bringing the number of species in the subgenus worldwide to 32 (Leong-Škorniková et al., 2020; Tanaka et al., 2020; Maknoi et al., 2021; Saensouk et al., 2021a, b; Saensouk P. et al., 2021).

Thailand is one of the richest diversity hotspots of Curcuma with 70 species of which 26 belong to subgen. Curcuma, 23 to subgen. Hitceniopsis, and 21 to subgen. Ecomata (Larsen & Larsen, 2006; Sirirugsa et al., 2007; Maknoi et al., 2021; Saensouk et al., 2021a, b; Saensouk P. et al., 2021). While investigating the species diversity of Zingiberaceae for the Flora of Thailand by the authors, plants of Curcuma were discovered by the second author (TB) in the Mueang Nakhon Nayok district in the Nakhon Nayok province, Central Thailand. After comparing and examining them with species with

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similar morphological characteristics, we found that these specimen did not match with any existing taxa, hence it is described and illustrated here as new to science. A revised key to the 71 species of *Curcuma* in Thailand is presented, followed by an additional revised key to all species of *Curcuma* subgen. *Ecomata* for facilitating their identification.

**Materials and Methods**

Plant materials were collected and photographs taken in their habitat in the deciduous forest of Mueang Nakhon Nayok district, Nakhon Nayok province, Central Thailand from September 2019 to April 2021. Measurements of the living and preserved specimens were taken with Vernier-caliper, ruler, and morphologically examined under stereo-scope microscope (Stemi 2000-C, ZEISS, Oberkochen, Germany). The protologues of morphologically similar species, *Curcuma flaviflora* S.Q.Tong (Tong, 1986; Maknoi *et al.*, 2005), *Curcuma xanthella* Škornièk. (Leong-Škornièková & Trán, 2013) and their type materials housed in various herbaria (AAU, BK, BKF, C, E, KKU, QBG, SING, VNM), and digital images available online, including all existing published literatures of *Curcuma* especially in subgen. *Ecomata* were compared e.g. Larsen and Larsen (2006), Sirirugsa *et al.* (2007), Leong-Škornièková and Newman (2015), Leong-Škornièková and Trân (2013), Maknoi *et al.* (2021), Saensouk *et al.* (2021a, b), Saensouk P. *et al.* (2021).

**Taxonomic Treatment**

*Curcuma achrae* Saensouk & Boonma, sp. nov. Figs. 1–5

Similar to *Curcuma xanthella* Škornièk. but differs. *C. achrae* having pubescent petioles (*vs.* glabrous), green with a reddish tinge (*vs.* green); adaxially sparsely hairy leaves with fine hairs along the midrib (*vs.* glabrous on both surfaces); fertile bracts connate in the lower 1/7 (*vs.* connate in the lower 1/4); apex mucronate (*vs.* narrowly acute); base of labellum white, middle and apical part golden yellow, with embossed two golden yellow median band running along the midrib from tip to base and divided into two Y-shaped patches at base (*vs.* base of labellum white to light yellow, middle and apical part warm yellow, with two yellow-orange swollen bars running across the center); staminodes irregularly ovate, apex acute, golden yellow gradually fades to pale yellow at base, with reddish V-shaped or triangle patch at base of staminodes (*vs.* staminodes irregularly oblong, apex obtuse, bright warm yellow without red patch); anther appear almost straight (*vs.* anther appear as L-shaped), spurs c. 3 mm long (*vs.* spurs c. 6 mm long), crest 3–4 mm long with apex acute to rounded or slightly truncate (*vs.* crest not obvious).

**Type:** THAILAND, Nakhon Nayok province, Mueang Nakhon Nayok district, 60–152 m, 05.04.2021, T. Boonma 24 (holo KKU!; iso QBG!, BKF!, BK!).

Perennial herbs, up to 45 cm tall. Rhizome ovoid, 3.2–3.8 × 1–1.4 cm, brown externally, two layers of pale yellow internally, fragrant; root tubers ellipsoid, 2.5–3 × 1.2–1.4 cm, brown externally, white internally, fragrant, developing some distance from the rhizome. Leafy shoot with 6–8 leaves spread out in a circle parallel to the ground almost the same plane, developing after flowering; pseudostem 18–24 cm long, green with reddish brown tinge, composed of sheathing bracts and leaf sheaths; sheathing bracts 2–3, apex slightly mucronate, reddish when young with green tip and drying out and decaying while growing; leaf sheaths distichous, green with reddish brown tinge, pubescent; ligules up to 6 mm long, bilobed, hyaline, green with a reddish tinge, sparsely hairy; petioles up to 25 cm long (petiole of innermost leaves longest, outermost leaf shortest), canaliculate, green with a reddish brown tinge, pubescent; lamina narrowly ovate to narrowly elliptic, 26–45 × 10–13 cm, base cordate, margins slightly undulate, apex caudate, adaxially green, sparsely hairy, abaxially lighter green, puberulous, midrib green or brownish green, with fine hairs along the midrib, spread out into a circle shape, almost in the same plane parallel to the ground. Inflorescence lateral, peduncle and base of the spike often subterraneean;
Curcuma achrae, a new species from Thailand

Fig. 1. Curcuma achrae Saensouk & Boonma: a. Plants in natural habitat; b. Pseudostem–top view; c. Pseudostem–side view; d. Distal part of sheathing bract–side view; e. Young inflorescence–side view; f. Anthesis in natural habitat (a–c in September 2019; d in late April 2020; e & f in late March 2020, 2021 respectively; photos by Thawatphong Boonma).
Fig. 2. Curcuma achrae Saensouk & Boonma: a. Flower, (upper row) dorsal corolla lobe and lateral corolla lobes, (lower row) two lateral staminodes, labellum, calyx, cross-section of flower, ovary with epigynous glands, bracteole, flower bud, and bract; b. Reddish V-shaped patch at base of staminode; c. Stamen–side, oblique side, front and back view; d. Inflorescence with rhizome, spike varied in sizes and colours–side view; e. Inflorescence–oblique top view; f. Close up flower–front view (photos by Thawatphong Boonma).
Fig. 3. *Curcuma achrae* Saensouk & Boonma: a. Habit—oblique top view; b. Flower—side view; c. Lateral staminodes; d. Labellum; e. Flower—front view; f. Stamen—side view; g. Dorsal corolla lobe; h. Lateral corolla lobes; i. Floral tube with ovary, calyx, and front view of stamen; j. Bract; k. Bracteole; l. Calyx; m. Ovary with epigynous glands; n. Inflorescence with flowers, rhizome, and tuberous roots (from T. Boonma 24; drawn by Thawatphong Boonma).
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peduncles 3–5 cm long, with up to 6 mm diam., white, pubescent, with up to 6 sheathing bracts (sheathing bracts red or reddish tinge with white at base, apex mucronate, pubescent); spike 4–6.5 cm long, 2–3 cm diam. in the middle, wider apically; coma absent; fertile bracts 10–18, narrowly ovate to lanceolate, smaller and narrowly ovate at the apex, 2.5–5.8 × 1–2.5 cm (larger at the base of the inflorescence), apex mucronate, both sides pubescent, pale green with various degrees of reddish tinge, connate in the lower 1/7; cincinni with 3–4 flowers at the base of the inflorescence, 1–2 flowers at the top; bracteoles one per flower, narrowly triangular, 7–12 × 1–2.7 mm (outer ones larger, inner ones are gradually smaller), pubescent, translucent white. Flowers 5.8–6.4 cm long; calyx tubular, 18–20 mm long, 3-toothed, with unilateral incision up to 8 mm long, pubescent, translucent white; floral tube 30–32 mm long, externally yellowish white with pale pink tinge, pubescent, white internally, with white hairy at throat; dorsal corolla lobe narrowly triangular ovate, 21–26 × 9–11 mm, concave, sparsely hairy, apex mucronate, 3.3–4.8 mm long, sparsely hairy, pale yellowish white at base, yellowish with pale pink tinge towards the apex; lateral corolla lobes narrowly triangular-ovate; 18–24 × 7–9 mm, concave, apex slightly mucronate, sparsely hairy, pale yellowish white at base, yellowish with pale pink tinge towards the apex; labellum obovate, 27–29 × 18–20 mm, apex emarginate, incision to 7 mm, base of labellum white, middle and apical part golden yellow, with embossed two golden yellow swollen bars running along the midrib from tip to base and divided into two patches at base like a Y-shape (forming a median band), fine and short hairy along both sides of median band; lateral staminodes irregularly ovate, 24–26 × 14–17 mm, apex acute, with short fine hairy on the adaxial side, golden yellow gradually fades to pale yellow at base, with reddish V-shaped or forming of triangle patch at base of staminodes. Stamen 12–14 mm long; filament 4–5 mm long, pale yellowish-white, c. 5 mm broad at the base, c. 3 mm broad at the apex (the point of attachment to the connective), covered with short fine hairs; anther 12.5–14 mm long (measured in side-view including spurs and crest), yellowish, spurred, pubescent; connective yellowish-white, covered with short fine hairs; anther spurs c. 3 mm long, conical, pale yellow, covered with transparent jelly on both spurs, pointing outwards; anther crest 3–4 mm long, 2.7–3 mm wide, golden yellow, apex acute to rounded or slightly truncate, rarely retuse, covered with short fine hairs; anther thecae 6.5–7 mm long. Epigynous glands two, 5–7 mm long, 0.7–0.8 mm across, pale yellow, apex acute. Style thin, white, glabrous, placed in the groove in the dorsal side of floral tube; stigma c. 1.7 × 1.8 mm, pale yellow; ostiole ciliate. Ovary c. 3.8 × 3 mm, trilocular, puberulent. Fruits and seeds not seen.

Vernacular name: Khamin Thong.

Flowering & fruiting: Flowering from late March to early May; flowers open in the morning and last a
single day. Leafy shoot emerging in late May and dormancy begins in November. Fruiting was not observed.

**Habitat**: Occurring at elevations of 60–152 m, growing in sandy loam soil at the boundary, close to the watercourse, in semi-open area in a deciduous forest.

**Distribution**: *Curcuma achrae* is known from the southwestern part of the Sankamphaeng mountain range in Mueang Nakhon Nayok district, Nakhon Nayok province, Central Thailand (Fig. 4).

**Etymology**: The specific epithet “achrae” is chosen to honour Assistant Professor Dr. Achra Thammathaworn (botanist of Khonkaen University), who is a specialist in botany and teacher of many Thai botanists.

**Specimens examined**: *Curcuma xanthella* Škornièk.: VIETNAM, Bình Thu-n province, Hâm Thu-n Nam district, Tà Kóu Nature Reserve, 145 m, 11.06.2009, Lý 348 (holo SING; iso E, VNM); Tà Kóu mountain, 30.05.2009, Nguyễn Thiện Tích (under Trần collection number), Lâm Đồng province, Bảo Lộc pass, 22.06.2008, Trần et al. s.n. (collected from cultivation, 06.05.2013), GRC-147 (SING, incl. spirit).

**Conservation status:** This new species is hitherto known from the type locality in Nakhon Nayok province, Central Thailand (the Southwest part of the Sankamphaeng mountain range). Available information about this species is insufficient for a proper assessment of its conservation status. Thus according to IUCN criteria (IUCN, 2022) it should be listed as Data Deficient (DD). However, we expect this plant to be found distributed elsewhere in the Sankamphaeng mountain range and nearby in the Khao Yai National Park where suitable habitats still seem to exist. Further fieldwork and observations are needed to assess changes in population, distribution, and abundance of this taxon in the future.

**Notes:** *Curcuma achrae* belongs to subgen. *Ecomata* (Záveská *et al.*, 2012) because of the absence of a coma bract, open-form flower, presence of epigynous glands, and conical anther spur. This species has varied size and colour of bracts but produces almost the same size of flowers (Fig. 2d). *Curcuma achrae* is similar to *C. flaviflora* S.Q.Tong, *C. aruna* Maknoi & Saensouk, and *C. xanthella* Škornièk. in having yellow flowers, an inflorescence produced directly from the rhizome before the new leaves, lacking coma bracts, open flowers, and presence of epigynous glands. *Curcuma flaviflora* is a high-elevation species known to occur in pine forests in the mountains of northern Thailand and southern China. *Curcuma aruna* occurs in scrub forests at foothills of limestone mountains and is currently only found in Sukhothai province in northern Thailand, while *C. xanthella* is so far recorded from two places in southern Vietnam and differs from *C. achrae* by many characteristics e.g., shape and surfaces of leaves, and different shapes, colors, sizes, and proportions of various flower parts, especially in having an L-shaped anther whereas in *C. achrae* it is almost straight. The morphological comparison of *C. achrae* with its allied species *C. xanthella* and *C. flaviflora* is provided in table 1. A comparison of anthers in front and side view, and flowers of the newly described species and its similar species are additionally provided in figure 5. A key to the species of *Curcuma* distributed in Thailand and a revised key to species of *Curcuma* subgen. *Ecomata* are provided for facilitating their identification in the field.

**Key to the species of Curcuma in Thailand**

1. Epigynous glands absent (subgen. *Hitkheniopsis*) ................................. 2
2. Epigynous glands present ........................................ 24
3. Bracts not laterally connate, campanulate involucre with two slits ............... 3
4. Bracts laterally connate to each other for about half of their length and forming basal pouches .............................................. 6
5. Bracts purplish-brown ...... *C. macrochlamys*
6. Leaves glabrous adaxially, pubescent abaxially; bracts green with dense stripes from the base to apex or red .................. *C. pedicellata*
7. Leaves glabrous on both surfaces; bracts green ........................................ 5
8. Leaves 2–3, lanceolate; flowers 15–20 ........... ................................. *C. campanulata*
9. Leaves 4–5, oblanceolate-oblong; flowers 6–8 ...................................... *C. involucrata*
10. Inflorescence without coma ............................................. 7
11. Inflorescence with well-developed coma .......... 15
12. Bracts pink with green or purple at the tip, or reddish-brown with green margin .......... 8
13. Bracts pale green to dark green .................. 10
14. Labellum light purple to purple, basally with two bright to dark red thick bands (one on each side), distally pale to bright purple, median band only slightly darker than remainder of labellum .......................... *C. lithophila*
### Table 1. Morphological comparison of Curcuma *achrae*, *C. xanthella* and *C. flaviflora*

<table>
<thead>
<tr>
<th>Characters</th>
<th><em>C. achrae</em> Saensouk &amp; Boonma</th>
<th><em>C. xanthella</em> Škornièk.</th>
<th><em>C. flaviflora</em> S.Q.Tong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhizome</td>
<td>Pale yellow inside</td>
<td>Light yellow inside</td>
<td>White inside</td>
</tr>
<tr>
<td>Petiole</td>
<td>Up to 25 cm long, pubescent, green with reddish tinge</td>
<td>Up to 23 cm long, glabrous, green</td>
<td>4–7 cm long, glabrous, green</td>
</tr>
<tr>
<td>Leaves</td>
<td>Narrowly ovate to narrowly elliptic, 26–45 × 10–13 cm, cordate at base, caudate at apex</td>
<td>Elliptic-lanceolate, c. 32 × 9.5 cm, rounded to cordate at base, acuminate at apex</td>
<td>Oblanceolate, 18–30 × 6–8.5 cm, cuneate at base, acuminate at apex</td>
</tr>
<tr>
<td>Leaf surfaces</td>
<td>Sparsely hairy adaxially, puberulous abaxially and fine hairy along the midrib</td>
<td>Glabrous on both surfaces</td>
<td>Glabrous adaxially, puberulent abaxially</td>
</tr>
<tr>
<td>Peduncles</td>
<td>3–5 cm long, narrowly ovate to lanceolate, 2.5–5.8 × 1–2.5 cm, apex mucronate, connate in the lower 1/7</td>
<td>c. 15 cm long, ovate to narrowly ovate, 4.5 × 2.1 cm, apex narrowly acute, connate in the lower 1/4</td>
<td>5–9 cm long lanceolate, 4–4.5 × 2.6–3 cm, apex acuminate, connate in the lower 1/3</td>
</tr>
<tr>
<td>Fertile bracts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bracteoles</td>
<td>One per flower, 7–12 × 1–2.7 mm</td>
<td>One per flower, 2–8 × 1–1.5 mm</td>
<td>Absent</td>
</tr>
<tr>
<td>Calyx</td>
<td>18–20 mm long, unilateral incision up to 8 mm, pubescent</td>
<td>Up to 30 mm long, unilateral incision c. 11 mm, sparsely puberulous</td>
<td>c. 21 mm long, unilateral incision 7 mm, hairy along ridges</td>
</tr>
<tr>
<td>Corolla tube</td>
<td>3–3.2 cm long, yellowish white with pale pink tinge, pubescent</td>
<td>c. 3.5 cm long, white and almost glabrous in the basal part, yellowish and shortly densely hairy in the apical part (2/3)</td>
<td>3.8–4.2 cm long, with white hairs</td>
</tr>
<tr>
<td>Dorsal corolla lobe</td>
<td>21–26 × 9–11 mm, apex mucronate, mucro 3.3–4.8 mm, sparsely hairy</td>
<td>30–34 × 10–12 mm, apex mucronate, mucro 2–3 mm, glabrous, sometimes with a few short hairs</td>
<td>24 × 9 mm, apex acuminate, scattered hairy</td>
</tr>
<tr>
<td>Lateral corolla lobes</td>
<td>18–24 × 7–9 mm, sparsely hairy, apex mucronate, pale yellowish white at base, yellowish with pale pink tinge towards the apex</td>
<td>27–28 × 9–10 mm, glabrous, apex obtuse white at base, yellow towards the apex</td>
<td>c. 18 × 7 mm, sparsely hairy, apex obtuse, yellow</td>
</tr>
<tr>
<td>Labellum</td>
<td>27–29 × 18–20 mm, apex emarginate, incision to 7 mm, base of labellum white, middle and apical part golden yellow, with embossed two golden yellow median band running along the midrib from tip to base and divided into two Y-shaped patches at base, fine and short hairy along both sides of median band</td>
<td>32–35 × 22–25 mm, apex emarginate, incision to 12 mm, base of the labellum white to light yellow, middle and apical part warm yellow, with two yellow-orange swollen bars running across the centre, densely puberulent with glandular hairs</td>
<td>c. 25 × 20 mm, apex deeply bifid, incision to 7 mm, yellow with bright yellow mid-band, rarely with red streaks at sinus, glandular hairy more densely on either side of mid-band</td>
</tr>
</tbody>
</table>
8. Labellum not purple as above ......................... 9
9. Bracts pink with green or purple at tip, apex acute; labellum pale to dark red with bright yellow patches on the bright red swollen band at the base half of the labellum, yellow towards the apex. ......................... C. sparganiifolia
9. Bracts reddish-brown with green margin, apex rounded; labellum white with pink apex and yellowish band in centre. ......................... C. bella
10. Bracts puberulent on both sides ......................... C. papilionacea
10. Bracts glabrous on both sides .......................... 11
11. Labellum with prominently fimbriate margins, fimbriae c. 1.5 mm long, curly .... C. fimбриa
11. Labellum not fimbriate at margins ..................... 12
12. Bracts lanceolate, with upper half, suddenly narrowed to acute apex ................... C. harmandii
12. Bracts almost orbicular or broadly ovate or broadly obovate .......................... 13
13. Flowers slightly exserted from bracts; bracts almost orbicular ......................... C. prasina
13. Flowers exserted from bracts; bracts broadly ovate or broadly obovate ................... 14
14. Labellum with two dark yellow spots at base and a small pale-yellow line at mid lobe from sinus almost to base; bracts broadly ovate; staminodes pale pinkish purple to pale purple with white at base ......................... C. charanii
14. Labellum without two dark yellow spots at base, with short yellow dashes along each side of incision margin about half-length; bracts broadly obovate; staminodes white .......... C. puangpeniae
15. Labellum red ............................................. 16
15. Labellum not red ........................................ 20
16. Staminodes pale purple or violet ................... 17
16. Staminodes yellow or white .......................... 18
17. Anther spurred, L-shaped, connective white to cream, sometimes very pale purple dorsally, covered with short glandular hairs .......... C. rufostriata
17. Anther not spurred ......................... C. rhabdota
18. Labellum yellow with red lines; staminodes pale yellow to yellow with red tinge .......... C. gracillima
18. Labellum white with red; staminodes white with red ........................................ 19
19. Fertile bracts light green with two white circle patches and light pale green or white longitudinal line; coma bracts outer light green with green longitudinal line alternating with light green or white lines, inner white with green edges .................................. C. saraburiensis

19. Fertile bracts pale green to cream without white circle patches and without longitudinal line; coma bracts white .......... C. spathulata

20. Coma bract pink ......................... C. alismatifolia

20. Coma bract green or white ............... 21

21. Fertile bracts green with rich reddish-brown tinge ........................................ C. micrantha

21. Fertile bracts green without reddish-brown tinge ........................................................................ 22

22. Corolla tube longer than bract, flower distinctly protruding from the inflorescence; staminodes white; coma bracts green on both surfaces ......................................... C. purpurata

22. Corolla tube shorter than bract; staminodes purple or violet; coma bracts white or with green ...................................................... 23

23. Labellum deeply bilobed; coma bracts pure white ................................................................. C. thorelii

23. Labellum with fringed edge; coma bracts white with green at apex ..................... C. parviflora

24. Inflorescences lacking a conspicuous coma of sterile bracts, fertile bracts connate only at the base, open flower form; anther spurs filamentous or conical, forward-pointed (subgen. Ecomata) ........................................ 25

24. Inflorescences usually with a coma bract, closed flower form, bullet-type; anther spurs, flat, acute, downward-pointed or absent (subgen. Curcuma) .................................................. 46

25. Corolla tube longer than bracts, narrow; petioles very distinct from leaf blade ......................... C. supraneeana

25. Corolla tube shorter than bracts, broad; leaf-blade tapering into petioles ......................... 26

26. Anther spurs filamentous, 0.5–1.5 mm long . ........................................................................... 27

26. Anther spurs conical or cylindrical, > 2 mm long .......................................................... 31

27. Staminodes white with dark purple tips ........ ............................................................. C. pierreana

27. Staminodes white or white with yellowish patch in centre and apex ....................... 28

28. Leaves puberulous on both surfaces ................................................................. C. chantarananothaii

28. Leaves adaxially glabrous ......................... 29

29. Rhizomes creeping; leaf base attenuate .......... ................................................... C. cochinchinensis

29. Rhizomes ovoid; leaf base cuneate to rounded, or sub-cordate .......................... 30

30. Calyx white, glabrous; filament 2 mm long; anther 8–9 mm long .................. C. eburnea

30. Calyx pale purple, puberulent; filament 5–8 mm long; anther 2.5–4 mm long .... C. pitukii

31. Inflorescence terminal ........................................... 32

31. Inflorescence lateral ........................................... 40

32. Leaves adaxially glabrous ......................... 33

32. Leaves adaxially hairy along the veins or pubescent ................................................ 37

33. Staminodes without red spots at the base ... 34

33. Staminodes with dark red or dark purple spots at the base .............................................. 35

34. Midrib adaxially green ....................... C. rangsimae

34. Midrib adaxially red ....................... C. siamensis

35. Leaves abaxially glabrous; labellum yellow with inside half orange .................... C. rhomba

35. Leaves abaxially pubescent; labellum not as above ............................................... 36

36. Labellum sub-orbicular, white with an orange median band and deep purple lines at the base; staminodes white with orange tip .... C. woodii
| 36. | Labellum diamond-shaped, white with a yellow median band and red spots at the base; staminodes white without orange tip | C. peramoena |
| 37. | Corolla lobes whitish-green to pale green; leaf base cuneate to attenuate | C. putii |
| 38. | Staminodes dark red in the lower half, upper half orange-yellow | C. bicolor |
| 39. | Staminodes pale yellow to yellow | C. ecomata |
| 40. | Labellum yellow | C. cinnabarina |
| 41. | Labellum white with yellow median band | C. stenochila |
| 42. | Anther almost straight in sideview; staminodes with reddish V-shaped or triangular patch at the base | C. achrae |
| 43. | Anther L-shaped in sideview; staminodes without red patch as above | C. flaviflora |
| 44. | Staminodes ovate to elliptic; leaf base cuneate | C. aruna |
| 45. | Staminodes obovate; leaf base rounded | C. candida |
| 46. | Leaves adaxially with red patch along the midrib | C. singularis |
| 47. | Leaves adaxially with green midrib | C. roscoeana |
| 48. | Inflorescence lateral and terminal | C. angustifolia |
| 49. | Inflorescence terminal | C. plicata |
| 50. | Sheaths glabrous; leaf abaxially glabrous | C. attenuata |
| 51. | Sheaths pubescent; leaf abaxially hairy or glabrous at least at the apex | C. cinnabarina |
| 52. | Inflorescence terminal | C. rubrobracteata |
| 53. | Inflorescence usually lateral | C. ecomata |
| 54. | Rhizome creeping | C. antinaia |
| 55. | Rhizome with branches non-creeping | C. sattayasaiorum |
| 56. | Inflorescence terminal | C. phrayawan |
| 57. | Inflorescence lateral and terminal | C. petiolata |
| 58. | Sheaths glabrous; leaf abaxially glabrous | C. wanenlueanga |
| 59. | Sheaths pubescent; leaf abaxially hairy or glabrous at least at the apex | C. amada |
| 60. | Sheaths pubescent; leaf abaxially hairy or glabrous at least at the apex | C. longa |
42 Curcuma achrae, a new species from Thailand

60. Leaves abaxially pubescent ......................... 61
60. Leaves abaxially glabrous ........................... 65
61. Leaves adaxially green with green midrib .......... 62
61. Leaves adaxially green with red or reddish-purple patch along the midrib ................... 63
62. Rhizome yellow; lamina broadly lanceolate ....... ................................. C. aromatica
62. Rhizome pale yellow; lamina oblong ............ ................................. C. elata
63. Bracts glabrous .......................... C. zedoaroides
63. Bracts pubescent ........................................ C. rubescens
64. Inflorescence cylindrical, >10 cm long; bracts green, short hairy on both surfaces .................. C. latifolia
64. Inflorescence almost globular, <10 cm long; bracts bright green to brownish green with pale green venation, adaxially puberulent, abaxially glabrous ............. C. globulifera
65. Petioles and leaf-sheaths reddish brown ......... ........................................ C. rubescens
65. Petioles and leaf-sheaths green ....................... 66
66. Leaves adaxially green with red or reddish-purple patch along the midrib ............... 67
66. Leaves adaxially green with green midrib .... 69
67. Rhizome aeruginous green ........ C. aeruginosa
67. Rhizome yellow or orange .......................... 68
68. Corolla lobes whitish or with very slight pinkish shade; rhizome pale straw coloured to yellowish white .................................................. C. picta
68. Corolla lobes conspicuously pink to reddish; rhizome deep bright orange to yellow-orange .................................................. C. zanthorrhiza
69. Fertile bracts pale pink; rhizome pale ochraceous .................................. C. comosa
69. Fertile bracts green; rhizome white to pale yellow ........................................ 70
70. Bracts glabrous .................. C. leucorrhiza
70. Bracts minutely puberulous on both sides ...... ........................................... C. mangga

Key to all species of Curcuma subgenus Ecomata

1. Corolla tube longer than bracts; petiole very distinct from leaf blade .................. C. supraneeana
1. Corolla tube shorter than bracts; leaf-blade tapering into the petiole ............... 2
2. Anther spurs filamentous or <2 mm long .... 3
2. Anther spurs conical or cylindrical or >2 mm long ........................................ 10
3. Staminodes with purple colour ....................... 4
3. Staminodes without purple colour ............... 5
4. Inflorescence terminal; staminodes white with dark purple at apex ................ C. pierreana
4. Inflorescence lateral; staminodes light yellow to white with a dark purple patch at base ..... .......................................................... C. pambrosima
5. Leaves puberulous on both surfaces ......... ........................................... C. chantaranothai
5. Leaves adaxially glabrous or glabrous on both surfaces ........................................ 6
6. Staminodes yellow-orange with light yellow at base ........................................ C. vitellina
6. Staminodes white, or with yellow in the centre or at the apex ............................. 7
7. Rhizome crawling; leaf base attenuate ......... ........................................... C. cochinchenensis
7. Rhizome ovoid; leaf base oblique, rounded to sub-cordate ................................ 8
8. Calyx pale purple, puberulent; filament >5 mm long ........................................ C. pitkii
8. Calyx white, glabrous; filament <5 mm long .............................................. 9
9. Anther crest pure white, apex rounded, 1.5–2 mm long ........................................ C. eburnea
9. Anther crest yellow, apex obtuse, 1.0–1.5 mm long .......................................... C. arida
10. Inflorescence terminal .................................................. 11
10. Inflorescence lateral ............................................... 22
11. Leaves adaxially glabrous ......................................... 12
11. Leaves adaxially with hairy along the veins or pubescent ........................................ 17
12. Staminodes yellow or light orange; leaves abaxially glabrous ................................... 13
12. Staminodes white; leaves abaxially pubescent ........................................ 16
13. Leaf adaxially usually green with red patch along the midrib .................................. 14
13. Leaf adaxially green without red patch along the midrib ........................................ 15
14. Flowers opened-form; peduncle <10 cm long .................................................. C. siamensis
14. Flowers closed-form; peduncle >10 cm long .................................................. C. stolonifera
15. Staminodes rhomboid, with dark red dot at the base ........................................... C. rhomba
15. Staminodes asymmetrical trullate to ovate, without red dot at the base .......... C. rangsimae
16. Labellum diamond-shaped, white with a yellow patch in centre and red spots at the base, white with dark purple spots at base ........................................ C. peramoena
16. Labellum suborbicular, white with two deep orange bands at the centre with deep purple lines at the base ........................................ C. woodii
17. Corolla lobes whitish-green to pale green; leaf base cuneate to attenuate .......... C. putii
17. Corolla lobes pink, red or purple; leaf base oblique, rounded or cordate .......... 18
18. Staminodes lower half red to dark red, upper half orange-yellow .......... 19
18. Staminodes pale yellow to yellow .......... 20
19. Inflorescence almost sessile with peduncles c. 1.5 cm long; bracts light green with more or less reddish tinge and prominent veins; Labellum yellowish orange with reddish to purple margins ............................................ C. bicolor
19. Inflorescence with longer peduncles to 13 cm long; bracts white, pink to dark red; labellum bright orange with various degrees of red ornamentation ........................................ C. flammea
20. Spike >8 cm long; staminodes pale yellow; corolla lobes white to pale yellow .......... ................................................ C. cinnabarina
20. Spike <8 cm long; staminodes yellow; corolla lobes red ........................................ 21
21. Anther spurs c. 2 mm long; bracts pubescent on both surfaces ......................... C. stenochila
21. Anther spurs c. 5 mm long; bracts glabrous on both surfaces ................................ C. kayahensis
22. Staminodes purple or with purple at base .. 23
22. Staminodes white or yellow or orange ...... 25
23. Leaf base cuneate; labellum pale pink to dark purple with yellow median band .. C. ecomata
23. Leaf base cordate or rounded; labellum white with yellow or light orange .......... 24
24. Labellum apex strongly recurved with horn-like lobes, light orange with the deep orange line up; staminodes bright orange with dark purple tinge at base ........................................ C. corniculata
24. Labellum apex curved inward, white with yellow margins, and golden yellow line up; staminodes lower half white, upper half golden yellow, and a purple patch at base .... C. glans
25. Labellum yellow or orange ......................... 26
25. Labellum white or cream white with a yellow median band ........................................ 30
26. Anther almost straight in the side view; staminodes golden yellow, gradually fades to pale yellow at base, with reddish V-shaped or triangular patch at base ................ C. achrae
26. Anther L-shape; staminodes without reddish patch at base as above .................. 27
27. Leaves base cuneate; sheath and petiole pubescent ........................................... C. flaviflora
27. Leaves base obtuse or rounded to cordate; sheath and petiole glabrous......................... 28
28. Epigynous glands c. 15 mm long; anther thecae 3–4 mm long .............................. C. xanthella
28. Epigynous glands 4–6 mm long; anther thecae 6–7 mm long ............................................... 29
29. Anther crest apex emarginate; long peduncle; bract with various degree of red tinge .......... .................................................... C. saluythensis
29. Anther crest apex obtuse to rounded; short peduncle; bract green...................... C. aruna
30. Leaves adaxially green with red patch along the midrib .............................................. 31
30. Leaves adaxially green without red patch along the midrib ........................................ 32
31. Anther almost straight in side view ................. .......................................................... C. candida
31. Anther L-shaped (obtuse angle) in side view .......... .......................................................... C. newmanii
32. Bract green; labellum white, with yellow median band ........................................... C. singularis
32. Bracts cream white at the base with increasing red tinge towards apex and margins; labellum cream white, sometimes pale pinkish basally, with deep purple-red or dark red bands placed next to the yellow median band ........ C. tongii

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