

Thai Rubiaceae with hooks and thorns

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ABSTRACT. Several woody Thai Rubiaceae (ca. 30 taxa) are distinguished by the presence of thorns or hooks (curved or recurved thorns). Most of these taxa belong to the tribe Gardenieae (*Catunaregam*, *Ceriscoides*, *Dioecrecis*, *Fagerlindia*, *Oxyceros*, *Tamilnadia*), two to the Vanguerieae (*Canthium*, *Meyna*), and one to the Coptosapelteae (*Uncaria*). The climbing hooks of *Uncaria* spp. morphologically represent modified inflorescence stalks, while thorns are vegetative lateral shoots with limited growth in all other taxa. In *Ceriscoides*, thorns are short lateral branches which, in turn, bear very abbreviated leafy and/or flowering shoots. In the monotypic *Tamilnadia*, short lateral branches terminally bear one or two pairs of short thorns. In the monotypic *Dioecrecis*, paired thorns are primarily on lateral shoots which occur in clusters in the lower part of the trunk. In the remaining taxa, thorns are short shoots produced in the leaf axils of long shoots, often together with leafy and/or flowering short shoots (accessory bud/shoot formation; thorns then always above the leafy and/or flowering brachyblasts; one or the other may not be developed). Thorns are either straight or curved (sometimes within a genus, e.g. *Canthium* spp.). The presence of curved thorns or hooks is associated with a climbing or straggling habit (*Uncaria*; Thai *Oxyceros* spp.; amongst the thorny Thai *Canthium* spp., only those with such a habit have curved thorns). Noteworthy is the presence of two different types of hooks (and shoot morphology) within *Oxyceros*. A key to the taxa is provided.

INTRODUCTION

Thorns, either solitary and straight or sometimes branched, occur in a large number of angiosperm families. Their occurrence is not necessarily a generic character but may be confined to a number of species of a genus, often providing a good field character for identifying them. Unfortunately, their presence is sometimes omitted in flora descriptions, which are often based on herbarium specimens, because the thorns are sometimes only found on older, “non-collectable” stem parts. A small selection of examples from the Thai flora include families such as Apocynaceae (*Carissa*; Middleton, 1999: fig. 4A), Euphorbiaceae [*Shirakiopsis indicum* (syn. *Sapium indicum*), with straight thorns on older stems], Flacourtiaceae (*Flacourtia* and *Scolopia* spp.), Guttiferae (*Cratoxylum* spp.), Leguminosae (e.g. in the introduced and cultivated “thorn of Madras”, *Pithecellobium dulce*), or Rutaceae (*Citrus* and *Feroniella* spp.). Hooked thorns (curved or recurved thorns), too, have independently evolved in woody taxa of a number of families and typically occur in climbing or straggling shrubs. Examples from the Thai flora include *Artabotrys* spp. (Annonaceae), *Ancistrocladus tectorius* (Ancistrocladaceae), or *Indorouchera griffithiana* (Hugoniaceae, or Linaceae s.l.).

In the Rubiaceae, nine of the approximately 100 genera occurring in the flora of Thailand area have, in total, ca. 30 woody taxa which develop either straight or curved or recurved or hook-like thorns. The majority of these belong to the tribe Gardenieae (*Catunaregam*, *Ceriscoides*, *Dioecrecis*, *Fagerlindia*, *Oxyceros*, *Tamilnadia*), one of

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the largest in the flora area; the others to the tribes Vanguerieae (*Canthium*, *Meyna*), and Coptosapelteae (*Uncaria*) (see Table 1).

The main aim of this paper is to describe and compare the thorny structures in these taxa, and to provide information on how these thorn-bearing taxa differ from each other. The article is especially intended to aid field botanists in identifying the genera. A key to the thorn-bearing taxa is also provided.

Table 1. Survey of Thai Rubiaceae with thorns and hooks. Column “Tribe”: GAR. – Gardenieae; VAN. – Vanguerieae; COP. – Coptosapelteae

Taxa	Tribe	straight thorns	curved or recurved thorns, hooks
<i>Catunaregam</i> (all 4 Thai taxa)	GAR.	X	
<i>Ceriscoides</i> (all 3 Thai taxa)	GAR.	X	
<i>Dioecrecis erythroclada</i> (monotypic genus)	GAR.	X	
<i>Fagerlindia</i> (all Thai taxa)	GAR.	X	
<i>Oxyceros</i> (all 5 Thai taxa)	GAR.		X
<i>Tamilnadia uliginosa</i> (monotypic genus)	GAR.	X	
<i>Canthium</i> (ca. 10 taxa; the remaining without thorns)	VAN.	X	X
<i>Meyna</i> (all 3 Thai taxa)	VAN.	X	
<i>Uncaria</i> (all Thai taxa)	COP.		X

A note on terminology

In botanical literature, the terms “thorn” and “spine” are often used interchangeably, not taking account the origin of the organs in question. In the present context, the following definition, based on traditional morphology, is applied:

Thorns (either straight or hooked, solitary or branched) are modifications of shoots, typically abbreviated shoots with limited growth. Being shoots, they have a “normal” shoot structure, i.e. have phloem and xylem (this definition largely corresponds to that in “Tropical Woody Rubiaceae”, the standard work describing Rubiaceae character states, cf. Robbrecht, 1988: 41).

Spines, in contrast, are sharp-pointed outgrowths of primarily epidermal and subepidermal tissues, without contributions from the woody body. Examples of the latter are the vicious spines on the leaves of the palm *Elaiodora*, or the sharp-tipped outgrowths on the stems of *Bombax* spp. (Bombacaceae).

OBSERVATIONS

In Thai Rubiaceae, thorns are either straight, curved or recurved (sometimes within a genus, e.g. *Canthium* spp.). The presence of curved thorns or hooks is associated with a climbing or straggling habit (*Uncaria*; Thai *Oxyceros* spp.; amongst the thorny Thai *Canthium* spp., only those with such a habit have curved thorns; see below). Noteworthy is the presence of two different types of hooks (and shoot morphology) in *Oxyceros* (see below).

Uncaria Schreb. Recurved or climbing hooks occur in all species of the genus. They are normally only found on the paired lateral branches of the woody lianas (i.e. not on the main axes), and the hooks themselves are typically paired at the nodes (cf. fig 1A). Morphologically, they represent modified fertile shoots, i.e. they are modified inflorescence stalks.

Observations on living plants sometimes reveal that the production of stalked, axillary, head-like inflorescences eventually stops and that the stalks are transformed into hooks (cf. fig. 1B, arrow). A relevant ontogenetic study confirming this has been published for a Madagascan species of the genus (Guillaumin, 1931). The modification of inflorescence stalks and axes into climbing hooks also occurs in several other plant families. A well known example is the Annonaceae genus *Artabotrys*. As opposed to the axillary hooks of *Uncaria*, the “inflorescence hook” is terminal in *Artabotrys*, and growth continues via a lateral shoot (sympodial-monochasial growth).

In view of the ontogenetic evidence and documentation provided here, Ridsdale’s (1998) description of “vegetative lateral branches modified into hooks” cannot be upheld.

In all other thorny rubiaceous taxa, thorns are lateral shoots with limited growth. As thorn morphology, and the arrangement and number of thorns are not uniform, genera or groups of genera can be distinguished quite easily:

Ceriscoides (Hook.f.) Tirveng. All species of this genus of small trees produce thorns (cf. Reza 2001). Thorns tend to be of equal length and regularly arrangement (i.e. in decussate pairs) on younger branches, but older stems often have a very “untidy” appearance because some lateral shoots ending in a thorn have become relatively long (to ca. 10 cm) while other thorns remain short (only to ca. 3–4 cm).

Characteristic of this genus is that thorns or thorn-tipped lateral branches, in turn, bear leafy or fertile short shoots. Fig. 1D illustrates this for *C. sessiliflora*, where a lateral branch ending in a thorn is seen which bears an abbreviated shoot with an inflorescence of which only one flower is left. Fruits often appear to sit on the thorny branches, but a closer examination reveals that they are produced on very short and much abbreviated lateral shoots.

Dioecrescis Tirveng. In this monotypic tree genus (*D. erythroclada*; cf. Tirvengadam, 1983), paired, straight thorns are normally found on most lateral branches of young individuals (Fig. 1E, small tree on the right). On older trees, thorns are typically seen on clustered lateral branches (presumably having arisen due to serial bud/shoot formation)

which come from the basal parts of the main trunk. Often, several tiers of such thorn-bearing branch clusters can be observed (Fig. 1E, arrows). The life-span of these branches is limited, so that very old individuals may lack thorns altogether. The presence of these thorn-bearing branches along the lower part of the trunks could be interpreted as a protection against browsing animals.

Thorn-bearing branches normally have a “regular” appearance as all thorns are of roughly the same length (often ca. 2 cm), paired and arranged in a decussate fashion.

Tamilnadia Tirveng. & Sastre. Branches of this monotypic tree genus (*T. uliginosa*; cf. Tirvengaum & Sastre, 1979) bear decussately arranged, short lateral shoots, each of which terminally produces one or two pairs of short thorns (Fig. 1C). Leaves and flowers and fruits are typically produced on very abbreviated shoots immediately below the thorns. Fig. 1C, inset, shows these knob-like brachyblasts, from which the fruit depicted below was removed.

Fagerlindia Tirveng. and **Oxyceros** Lour. These two genera are closely allied and, as noted by Ridsdale (1985), the architecture of the two is basically very similar. *Fagerlindia* typically has erect main axes (trunks), while in *Oxyceros* the main axes bend over (straggling or $\pm$ climbing habit). In both, the main shoots bear regularly arranged, decussate lateral branches which, in turn, bear thorns (no thorns on the main trunks!). *Fagerlindia* invariably has straight thorns, while the Thai species of *Oxyceros* always have curved or recurved thorns (*Oxyceros* species with straight thorns are known from Indochina and Southwest China, species with no thorns from Vietnam and Sri Lanka; cf. Tirvengadum, 1982; Ridsdale, 1985, 1998).

Fagerlindia shows accessory bud/shoot formation, which is defined as follows: two, buds, rather than one, are produced in the axil of a long shoot leaf, the two being arranged on top of each other (serial bud/shoot formation, as opposed to collateral accessory buds, such as in the banana, *Musa* spp.). The upper develops into the short-shoot thorn, the lower (i.e., the one immediately above the leaf axil) into a very abbreviated leaf- and/or flower-bearing short shoot. The association between these two kinds of shoots is visible in Fig. 1G (although the leaves in whose axils they have developed have already fallen off).

This feature is absent in *Oxyceros*. Only one bud - the one developing into hooked thorn-is developed in the axil of a foliage leaf (cf. Fig. 1H).

Moreover, the Thai species of *Oxyceros*, show a dimorphic pattern. Whilst in three of the species, the hooked thorns are regularly arranged, i.e. found in pairs at each node of a lateral branch, and are of uniform size (cf. Fig. 1H), this is not so in *O. bispinosus* and *O. scandens*. In these two species, the hooks at the first (i.e. basal) node of a lateral axis are recurved and fang-like (see illustration on the right), and both the basal lateral branch internode and this thorn pair are thick and massive (Fig. 1I). The next one or two nodes of the lateral branch usually bear the “normal”, much smaller, thinner hooked thorns, and the following nodes are always hook less. This undoubtedly is a much more sophisticated climbing aid than in the other taxa. Strictly, the fang-like hooks face downward, but as the plant’s habit is scandent, shoots with these hook-bearing branches hang downward, as depicted in Fig. 1I.

Like *Fagerlindia* (above), all remaining taxa (*Catunaregam*, *Canthium*, *Meyna*) show accessory bud/shoot formation, i.e. thorns and abbreviated leafy and/or flowering shoots are in immediate vicinity to each other.

Catunaregam Wolf. A genus of shrubs or small trees with thorns on erect and plagiotropic shoots. Thorns are typically arranged in decussate pairs, but in species such as *C. spinosa*, where leaf arrangement is variable (decussate and in whorls of three on one plant), they may be both paired and in threes. In the mentioned species, erect shoots often show ternate leaf and thorn arrangements, while plagiotropic shoots bear decussate leaves and thorns.

The thorn pairs develop before the leafy and/or fertile brachyblast pairs, so that on younger shoots only thorn pairs are visible. As the buds from which the thorns develop are some distance away from the subtending foliage leaf, thorns are in a somewhat supra-axillary position. The ontogenetically younger leafy or fertile brachyblast does not always develop.

While thorns and brachyblasts are typically produced in pairs, development of either one thorn or one brachyblast of a pair may be suppressed, fail or be disturbed by external influences. The result is a rather irregular appearance, with solitary thorns intermingled with paired thorns along a long shoot. This seems to happen quite frequently in species of *Catunaregam*. Figure 1F, showing four nodes of a branch of *C. tomentosa*, illustrates this: at the node on the left side, only one thorn is developed but a pair of leafy brachyblasts (although not equally well developed) is present; at the node on the right side, thorns are not developed at all; on the second node from the right, the thorn pair is developed, but one of the short shoots of a brachyblast pair has failed to develop.

Canthium Lam. With regard to Thai *Canthium*, there are two major problems: (1) the generic limits are not resolved, and (2) there is no recent species-level revision (see also Chamchumroon & Puff, 2003 for further comment). Data given here are preliminary. Of the numerous “*Canthium*” species listed in Craib (1932: 135–145), only ca. 10 are species with thorns, whereas the remainder are unarmed species.

At least in some of the thorny taxa, paired, rather massive thorns are present on orthotropic shoots and smaller thorns on lateral branches; in other species thorns are confined to lateral branches.

In the group of taxa with thorns on lateral branches, there are species with straight thorns (plants characterized by an erect habit), and species with recurved, hook-like thorns, all of which have a straggling, scrambling or climbing habit.

Straight thorns on lateral branches are often short to very short (less than 1 cm long) to hardly discernible. The usually paired thorns are, as in, for example, *Fagerlindia* and *Catunaregam*, produced immediately above the leaf and/or fertile much contracted short shoots.

Meyna Link. A small Afro-Asiatic genus of ca. 10 poorly delimited species of shrubs and small trees. All (including the three ill-defined species occurring in Thailand) possess paired or, less commonly, ternately arranged thorns.

The genus is reputed to be very close to *Canthium* s. str. (Verdcourt & Bridson 1991: 859), and shoot structure is very similar. Paired thorns are borne immediately above leafy and/or fertile short shoots on long shoots (lateral branches), but development of the leafy/fertile brachyblasts may occasionally be suppressed (as seen in Fig. 1K). Thorns are also found on old, erect shoots (e.g. *M. velutina*, Fig. 1J), and these are normally very long and massive.

At least in *M. velutina*, leaf arrangement within a plant can be variable, i.e. decussate on some shoots and in whorls of three on others (also cf. *Catunaregam*, above). Consequently, thorn arrangement, too, varies (cf. Fig. 1K, compare with Fig. 1J, both from the same individual).

Dichotomous key to Thai Rubiaceae with hooks and thorns

It is important to note that this key is valid only for taxa occurring in Thailand. Character states for taxa outside the Flora area may deviate. An example is *Oxyceros*, which in Thailand consists only of species with curved thorns but elsewhere contains some species with straight thorns.

1. Thorns or hooks curved; plants straggling or climbing, never erect trees or shrubs (2)
2. Inflorescences many-flowered, globose, pedunculate; stipules typically bifid at apex **Uncaria**
2. Inflorescences not as above; stipules never bifid (3)
3. Branches (long shoots) with abbreviated leafy and/or flowering shoots and thorns immediately above them (arising at the same node; accessory bud/shoot formation); flowers relatively small, always less than 1 cm in diam., mostly greenish, greenish-white or greenish-yellowish, in fascicles on very abbreviated shoots; fruits drupaceous **Canthium pro parte**
3. Branches (long shoots) with paired hooked thorns (leafy and/or flowering brachyblasts not present in the vicinity of thorns); inflorescences terminal, flowers relatively large, usually > 1 cm in diam., white; fruits berry-like (4)
4. All hooked thorns on a branch of the same kind (Fig. 1H) **Oxyceros pro parte**
4. Thorn pairs basal on lateral branches fang-like; larger and more robust than hooked thorns at the following nodes (cf. Fig. 1I) **Oxyceros pro parte**
1. Thorns straight; plants with erect main stems (5)
5. Trees with branches bearing short lateral shoots which terminally produce one or two pairs of short, straight thorns **Tamilnadia**
5. Arrangement of thorns not as above (6)
6. Thorns or thorn-tipped short lateral branches bearing very abbreviated leafy and/or flowering shoots (cf. Fig. 1D) **Ceriscoides**
6. Thorns neither with leafy nor with flowering abbreviated shoots (7)
7. Numerous pairs of thorns on often ± fascicled branches found in the lower part of trunk; branches of the crown mostly thorn-less; trunk and older branches typically rusty- to red-brown; flowers relatively large (to ca. 2 cm in diam.), green, unisexual **Dioecrescis**
7. Not as above; branches (long shoots) with abbreviated leafy and/or flowering shoots and thorns immediately above them (arising at the same node; accessory bud/shoot formation); flowers either considerably smaller than above or, if relatively large, not green and not unisexual (8)
8. Flowers relatively large, typically more than 1 cm in diam., mostly white (but turning yellow to orange with age in *Catunaregam*), in ± many- to few-flowered terminal inflorescences, or solitary flowers terminal on abbreviated shoots; fruits berry-like, without stones (9)
9. Thorns often long, to 4 cm; flowers 5–10-merous, large (2 cm or more in diam.), solitary (or in groups of few), older corollas turning yellow to orange; fruits large, at least 2 cm long or in diam. **Catunaregam**
9. Thorns smaller, usually not more than 1 cm long; flowers 5-merous, smaller, usually in ± many- to few-flowered inflorescences, old flowers not turning conspicuously yellowish or orange; fruits small, often less than 1 cm in diam. **Fagerlindia**

8. Flowers relatively small, always less than 1 cm in diam., mostly greenish, greenish-white or greenish-yellowish, in fascicles on very abbreviated shoots; fruits drupaceous (10)
10. Thorns often long, to over 5 cm, sometimes both in whorls of 3 or opposite on the same individual; ovary 5-carpellate, drupes typically with 5 stones (sometimes fewer due to abortion) relatively large (to ca. 3 cm in diam.) **Meyna**
10. Thorns typically much shorter (sometimes thin and inconspicuous and less than 1 cm long), opposite only; ovary 2(–3)-carpellate, drupes with 2(–3) stones (or, due to abortion, a solitary stone), normally smaller, mostly not more than 1 cm in diam. **Canthium pro parte**

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Figure 1. A–B, *Uncaria* spp.: A. shoot with three pairs of axillary climbing hooks; B. shoot with paired axillary pedunculate inflorescences, the arrow points to a developing inflorescence with clearly hook-like peduncle; C. *Tamilnadia uliginosa*, branch with short lateral branches terminally bearing one to two pairs of thorns (inset: detail of short lateral branch showing two terminal pairs of thorns and very contracted short shoots immediately below with fruits); D. *Ceriscoides sessiliflora*, thorn-tipped lateral branch bearing short shoot with inflorescence; E. *Dioecrescis erythroclada*, small tree with thorn-bearing lateral branches on the right; trunk of old tree with clustered thorn-bearing branches (arrows) on the left; F–G. *Catunaregam tomentosa* (F) and *Fagerlindia* sp., branches with thorns and associated leafy and fruit-bearing short shoots; H–I. *Oxyceros* spp.; H. *O. horridus*, branch with paired, axillary hooked thorns; I. *O. bispinosus*, branch with two pairs of lateral branches, each with fang-like hooks near their base; J–K. *Meyna velutina*, pictures from the same tree, J. old stems with large, paired thorns; K. younger branches with thorns in whorls of 3. Further explanations in the text (Photographed by C. Puff).



