A new species of *Illicium* (*Illicium arunachalensis*) from Arunachal Pradesh, India

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**ABSTRACT**

In India, *Illicium griffithii* Hk. f. & Thoms and *Illicium simonsii* Maxim. are the only 2 species reported so far from North East India. Recently during the field exploration in Arunachal Pradesh, the authors came across a new species *Illicium arunachalensis* N.Venugopal & E. J. Marbaniang sp. nov. (*Illiciaceae*) from Yewang village, which is located in Dirang, West Kameng District of Arunachal Pradesh occurs at 1859 -1954m. A small aromatic evergreen tree of 4-6 m tall; flowers solitary, axillary or subterminal; tepals 27-29, arranged in 3 whorls, dark pinkish with creamy white patches; stamens 25-27 arranged in two whorls; carpels 13, conduplicate; ovary creamy white; style and stigma dark pink, erect, appressed; fruits star-shaped; flowering: April; fruiting: May to August. The epithet of the species name *arunachalensis* is derived from the state from where the plant is collected.

**Key words:** Aromatic, Arunachal Pradesh, North East India, *Illicium arunachalensis* N.Venugopal & E. J. Marbaniang.

**INTRODUCTION**

*Illicium* comprises of about 40 species belonging to the family Illiciaceae and majority of the species were restricted to East and South East Asian countries which include Myanmar, China, India, Malaysia, Vietnam, Bhutan, Philippines, etc. and few species in North America, West Indies, Central America, and North-East South America of the New World (Smith, 1947). *Illicium* is generally characterized by the primitive nature of the floral structure which are numerous and spirally arranged around an elongated receptacle, and a regular perianth of unfused segments that do not form distinct sepals and petals [1, 2, 3]. The number of stamens is variable within the genus. The gynoecium consists of a whorl of free carpels that are attached laterally to the elongated receptacle. The number of carpels is also variable and each carpel is differentiated into an enlarged ovary, short style and curved stigmatic crest with numerous papillae and form a conduplicate structure [4]. The variable number of stamens and carpels are taxonomically valuable at the specific level [5].

*Illicium griffithii* Hk. f. & Thoms. and *Illicium simonsii* Maxim. are the only 2 species of *Illicium* recorded particularly from North East India [6]. Recently during the field exploration in Arunachal Pradesh, the authors collected another new species, *Illicium arunachalensis* sp. nov. from Yewang village in Dirang, West Kameng District of Arunachal Pradesh. The plants are found in four forest patches in West Kameng district of Arunachal Pradesh, India.
Key to the species (with respect to the species of group–A):

1. Shrubs 2–3 m tall ................................................................. 2
   — Trees 4–20 m tall ......................................................... 6

2. Tepals greenish yellow to pale yellow; carpels and (fruit) follicles 12
   — Tepals red, pink to purplish red; carpels and (fruit) follicles 7–13 ................. 3

3. Leaves lanceolate to oblanceolate; tepals 12–20 .................................................. I. dunnianum
   — Leaves lanceolate to elliptic; tepals 14–17 ......................................................... 4

4. Stamens 7–10 ................................................................. I. tsangii
   — Stamens 13–23 .................................................................. 5

5. Tepals 9–12 ................................................................. I. pachyphyllum
   — Tepals 15–17 ................................................................. I. difengpi

6. Tepals yellow, pale yellow to creamy white ............................................................... 7
   — Tepals red, pink to purplish red ........................................................................ 8

7. Tepals 11–18; outer tepals greenish yellow; middle and inner tepals creamy white; anthers yellow ................................................................. I. oligandrum
   — Tepals 27–29, a prominent pink colour at the apex, midvein and margin of the tepals leaving a distinct ovate creamy white area in each tepals; stamens 25–27; anthers brownish ................................................................. I. arunachalensis

8. Leaf base cuneate, apex acuminate to caudate ......................................................... 9
   — Leaf base attenuate, apex acute to caudate ......................................................... 16
   — Leaf base attenuate, apex acute to acuminate ................................................... 17

9. Tepals 10–15 ......................................................................... 10
   — Tepals 14–21 ......................................................................... 13

10. Stamens 13–14; carpels and (fruit) follicles 7–9 ......................................................... I. henryi
    — Stamens 6–14; carpels and (fruit) follicles 10–14 ................................................. 11

11. Leaves lanceolate, oblanceolate or obovate - elliptic .............................................. I. lanceolatum

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Other species of Illicium used for comparison:

In the present study, 33 species of *Illicium* reported from East and South East Asian countries were used to compare the morphological characters with that of *I. arunachalensis* sp. nov. All these 33 species are categorized into group-A (Table-1) and group-B (Table-2) based on the shape of the tepals and the type of pollen grains. *Illicium* species with obovate, ovate to suborbicular tepals and trisyncolpate pollen grains were categorized under group-A which includes 22 species viz. *I. majus*, *I. henryi*, *I. pachyphyllum*, *I. dunnianum*, *I. brevistylum*, *I. ternstroemioides*, *I. difengpi*, *I. lanceolatum*, *I. tsangii*, *I. arborescens*, *I. leiophyllum*, *I. petelotii*, *I. modestum*, *I. micranthum*, *I. merrillianum*, *I. oligandrum*, *I. tenuifolium*, *I. peninsulare*, *I. stapfii*, *I. sumatranum*, *I. kinabaluense* and *I. ridleyanum*. Most of the species, the colour of the tepals are pink, red or purplish red. Greenish yellow and creamy white colour tepals are encountered with *I. oligandrum*, *I. modestum* and *I. peninsulare*. The number of tepals ranges from 7-25 and stamens range from 6-33 except in *I. oligandrum* (4-7), and *I. arborescens* (39-41). Base on the shape of the tepals and type of pollen grains, *I. arunachalensis* is placed under group-A.

Group-B comprises of 11 species of *Illicium* viz. *I. griffithii*, *I. simonsii*, *I. jiadifengpi*, *I. angustisepalum*, *I. philippinense*, *I. verum*, *I. tashiroi*, *I. tsaii*, *I. burmanicum*, *I. macranthum* and *I. wardii*. *Illicium* species with elliptic, narrowly oblong to tongue-like and having tricolpate pollens are categorized under group-B. The tepals are either whitish or yellowish green, pale yellow to creamy white. The number of tepals ranges from 15-32 except in *I. verum* (7-12) and *I. jiadifengpi* (33-55). The number of stamens ranges from 12-32 with creamy white to yellowish. The number of carpels and fruit follicles ranges from 7-14 except in *I. angustisepalum* (11-16). Species under group-B has more number of tepals and stamens when compared to group-A.
—Leaves oblong - elliptic to narrowly obovate ........................................ 12
12. Stamens 9-14; carpels and (fruit) follicles 4-8 ................................. I. petelotii
—Stamens 22-30; carpels and (fruit) follicles 12-14 .............................. I. ternstroemioides
13. Carpels and (fruit) follicles 7-8 ...................................................... I. majus
—Carpels and (fruit) follicles 11-16 ................................................. I. brevistylum
14. Leaves elliptic to lanceolate; stamens 14-19 ................................. I. merrillianum
—Leaves obovate - elliptic, narrowly oblong - elliptic; stamens 10-12 ...... I. micranthum
15. Stamens 39-41 ................................................................. I. arborescens
—Stamens 12-21 ................................................................. I. major
16. Tepals 9-11; stamens 14-21 ........................................................ I. sumatranum
—Tepals 21-23; stamens 29-30 ....................................................... I. stanfii
17. Carpels and (fruit) follicles 5-10 ................................................ I. paracytic (amphibrachyparacytic) (Fig. C. 13).
—Carpels and (fruit) follicles 8-14 ................................................ I. paracytic
18. Tepals 15-21; stamens 15-19 ...................................................... I. merrillianum
—Tepals 10-18; stamens 12-16 ........................................................ I. merrillianum
—Tepals 9-19; stamens 9-14 ............................................................ I. merrillianum

**Taxonomy** - *Illicium arunachalensis* N. Venugopal & Ester Jones Marbaniang sp. nov. Fig. B (1-7) & Fig. C (8-10)

**Holotype**: Yewang village, Dirang, West Kameng District, Arunachal Pradesh, India, 27°21’35.3˝N to 27°21’41.7˝N and 92°13’36.5˝E to 92°13’41.3˝E at 1859-1954m, 27.04.2013, N. Venugopal & Ester Jones Marbaniang 84487A (ASSAM).

**Diagnosis** - *I. arunachalensis* is similar to *Illicium* species but is readily distinguished from all other described species in having, a prominent pink colour at the apex, midvein and margin of the tepals leaving a distinct ovate creamy white area in each tepal; the number of tepals ranges from 27-29; stamens 25-27 arranged in two whors with trisyncolpate pollen grains; consistently 13 carpels and fruits forming a follicletum of consistently 13 free and star shaped.

**Description** - A small aromatic evergreen tree of 7-12 m tall. Leaves (9.0-12.5 by 2.5-4.5cm), simple, entire, elliptical, glabrous and petiolate (1.0-1.5cm); midvein adaxially impressed, secondary veins 10-12 on each side of midvein and are not prominent on both surfaces of the lamina and perilous when dried; base obtuse, apex acute to acuminate; 4-6 leaves are clustered at the distal nodes; stomata paracytic (amphibrachyparacytic) (Fig. C. 13). Flower buds are light green, round and pendulous; flower solitary, axillary or subterminal, bracteate, pedicel (1.5-2.6cm). Tepals leathery, 27-29, prominent pink colour at the apex, midvein and margin leaving a distinct ovate creamy white area in each tepal (Fig. C. 8), arranged in 3 whors; the outermost tepals are large (15-16 by 10-11mm), obovate, apex obtuse with pinkish tinge; middle are obovate to lanceolate, (12-15 by 4-6mm) with acuminate apex, the inner whorl are lanceolate (5-6 by 3-3.5mm) with acuminate apex. Stamens 25-27, shorter than the carpels, arranged spirally in two whors around the carpels: (outer) stamens 5.0-5.5mm, anthers are 2.4-2.6 by 1.5-2.0 mm and filaments 2.5-3.0 by 1.5-2.1mm; (inner) stamens 6.3-6.5mm, anthers are 2.0-2.5 by 1.5-2.0mm and filaments 3.3-4.0 by 1.2-1.5mm, inner stamens are longer than the outer stamens; anthers brown, adaxially embedded on the flat filament, tetrasporangiate, and dehiscence introrse by longitudinal slits; filaments are creamy white and longer than the anthers. Pollen grains are trisyncolpate, exine reticulate (Fig. C. 12). The carpel consists of 13 numbers (9.5-10.5mm by 3.0 mm), conduplicate, free and uniovulate. Each carpel has a basally expanded and flattened ovary, style and stigma erect and appressed, stigma papillate and dark pinkish (Fig. C. 10). Fruit (13-20 by 7-12 by 3-5mm) forming a follicletum of 13 free, star-shaped, brown, ventrally dehiscing, spreading follicles (Fig. C. 11). At maturity the follicletum is greatly sclerified, dry and woody with an elongate, drooping pedicel of 1.5-5.0 cm long; single-seeded. Seeds are glossy and light brown (7-8 by 6-7 by 3-4mm).
Phenology - Flowering occurs in April and fruiting in May (last week) - August.

Ecology - *Illicium arunachalensis* grows in a mixed and wet forest, the type of soil is sandy, clay and loam, dark brownish in colour, acidic (pH: 5). *I. arunachalensis* grows in association with *Glychenia japonica* Sprg., *Corylopsis himalayana* Griff., *Eleagnus pyriformis* Hk. f., *Quercus griffithii* Hk. f. ex. DC., *Alnus nepalensis* Don. along the hill slopes of Dirang reserve forest, (Yewang village), West Kameng District of Arunachal Pradesh. The angle of the slope ranges from 50 – 55°. The size of four populations of *I. arunachalensis* was recorded in terms of the proportion of adult individuals (Table – 3).

Etymology - The specific epithet “arunachalensis” is named after the state from where the plant has been collected.

Vernacular Name: Lissi

Common Name: Star Anise

Remarks – In India particularly from Northeast region, *I. griffithii* and *I. simonsii* are the only two species of *Illicium* reported so far. But *I. arunachalensis* can be easily distinguished from the two species in having obovate, ovate to suborbicular tepals with a prominent pink colour at the apex, midvein and margin leaving a distinct ovate creamy white area. This is one of the morphological character which is entirely different from the other two species where all the tepals are elliptic, narrowly oblong to tongue-like, entirely creamy white and pale yellow in *I. griffithii* and *I. simonsii* respectively; stamens are creamy white in *I. griffithii* and *I. simonsii* at maturity but on the other hand anther lobes are brown in *I. arunachalensis*; style and stigma are erect, dark pinkish and appressed in *I. arunachalensis* but in *I. griffithii* and *I. simonsii* the stigma is free, creamy white and recurved; stomata are mostly amphibrachyparacytic or sometimes brachyparacytic in *I. arunachalensis* but in *I. griffithii*, stomata are mostly brachyparacytic (personal observation) and in *I. simonsii* the stomata are mostly brachyparacytic and sometimes incomplete stephanocytic bicyclic [7]; in *I. arunachalensis*, pollen grains are trisyncolpate but tricolpate in *I. simonsii* and *I. griffithii* [6, 8].

CONCLUSIONS

It is an interesting observation to find a new species of *Illicium* from Arunachal Pradesh as the state itself is considered to be luxuriant in floral diversity and is recognized as the 25th biodiversity hotspot in the world [9] and among the 200 globally important ecoregions[10]. The state of Arunachal Pradesh harbours the world’s northernmost tropical rainforests in which and it is the richest terrestrial biodiversity of the country and estimated to contain about 50% of India’s flowering plants [11]. It is also a home for numerous endemic, primitive, medicinal and endangered plant species which are of great significance. North-East region of India is unique due to presence of ancestral flowering plants, high floristic richness and endemism [12].

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REFERENCES


ANNEXURE

FIGURE-A
CAPTIONS TO FIGURES

Fig.A. *Illicium arunachalensis* - Map showing the location of the state Arunachal Pradesh in India and the study sites of *I. arunachalensis* sp.nov.

Figure B. *Illicium arunachalensis* (Line Drawing) – 1: A twig showing the matured fruit consisting of 13 carpels, collected during the month of August (note the venation pattern in the leaves); 2: A single flower showing the spiral arrangement of tepals and distinct creamy white patches in the inner and middle whorls of the tepals; 3: Young fruits after pollination showing the appressed nature of carpels, stigma and style; 4, 5 & 6: Inner, middle and outer tepals respectively; 7: Structure of a seed.

Figure C. *Illicium arunachalensis* -8: An enlarged view of a flower showing the prominent pink colour at the apex, midvein and margin of the tepals, leaving a distinct ovate creamy white area (bar = 1cm); 9: A branch of a tree showing the pendulous nature of flowers (bar = 20cm); 10: Young fruits after pollination showing the dark pinkish colour, erect and appressed nature of style and stigma (bar = 0.5cm); 11: An enlarged view of fruit with 13 follicles (bar =1.5cm); 12: SEM photograph of trisyncolpate pollen grain with finely reticulate exine; 13: Stomatal peeling of the ventral surface of the leaf showing the amphibrachyparacytic stomata (bar = 10μm).