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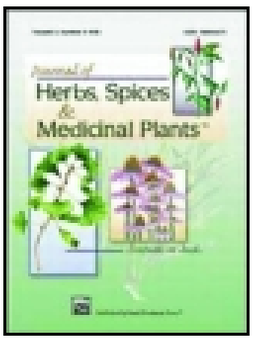


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Journal of Herbs, Spices & Medicinal Plants

ISSN: 1049-6475 (Print) 1540-3580 (Online) Journal homepage: http://www.tandfonline.com/loi/whsm20

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To cite this article: Vijayakumar Dhaarani, Ariyan Sarvalingam & Arumugam Rajendran (2018): Medicinal uses of psammophytic plants in Tranquebar regions of Tamil Nadu, India, Journal of Herbs, Spices & Medicinal Plants, DOI: 10.1080/10496475.2018.1471765

To link to this article: https://doi.org/10.1080/10496475.2018.1471765

Published online: 08 May 2018.

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JOURNAL OF HERBS, SPICES & MEDICINAL PLANTS
https://doi.org/10.1080/10496475.2018.1471765

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Medicinal uses of psammophytic plants in Tranquebar regions of Tamil Nadu, India

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ABSTRACT

The ecological habitats in the Indian sub-continent vary from the humid tropical Western Ghats to the hot deserts of Rajasthan; the ice-capped mountains of the Himalaya to warm coast of Peninsular India. The present study of the Coromandel coast for the use of plants for medicinal purposes documented 100 species belonging to 88 genera in 41 families of which 27 species were administered against 17 ailments by fisherman and rural communities in the Tranquebar coastal regions of Tamil Nadu; 15 species were used in Ayurvedic systems of medicine, 16 species were used in Siddha and Unani systems of medicine, and 12 species are used against other diseases.

ARTICLE HISTORY
Received 13 June 2017

KEYWORDS
Phytomedicine; Coastal plant; Indian medical systems and Fisher folks

Introduction

Global Biodiversity Outlook recognized major threats to biodiversity worldwide including habitat loss/change. The coastal geomorphology of India is divided into offshore features, shore features, coastal features, and littoral geomorphology in relation to human activities and problems (1). India has about 7,500-km long coastline. The Economic Exclusive Zone extends up to 2.02 million km^2 and 14 major rivers, 44 medium-sized rivers, and 162 minor rivers discharge vast quantity of water and sediments to the ocean (2). The major rivers that cut across the coast are the Ganges, Brahmaputra, Krishna, Godavari, and Cauvery on the east coast, and Narmada and Tapti on the North West coast.

The west coast of India is predominantly rocky consisting of silt-covered rocky flats or lime stone rocks, often with overhanging cliffs formed of green-to-black basalt. Sandy areas, rivers, creeks interrupt the rocky coast and black water on the east coast small stretches of rocky formation occur along Tamil Nadu and Andhra Pradesh (3). The dynamics of population and the management of environmental resources are closely related concerns confronting the world. Coastal plains and seas include the most taxonomically rich and productive ecosystems on the earth. Mangroves are over 20 times more

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productive than the average open ocean (4). Coastal ecosystems have their own international importance by possessing Coastal Sand Dunes. The coastal vegetation is subjected to a varied range of ecological stresses, which affects the survival and distribution of the plants. The most important environmental stresses are salt spray, low nutrient, water unavailability, high temperature, substrate instability, and sand blasting (5). The sandy areas possess diverse forms of seasonal herbs. The coastal sand bears xerophytic vegetation, because the sand is physically dry (6). Xerophytic species possess long and rich branched rhizomes (7). They are also known as Psammophytes, thriving in shifting sands, encountered not only in deserts, but along the seas, large lakes, and in sands along rivers.

The psammophytic plants are characterized by their long hairy roots penetrating the sand dunes, an adaptation that helps the plants to absorb water and nutrient from the lower horizons of the soil, and withstand the hazards of the coast. They grow in sand soils with high pH and low nutrients in dry conditions. A number of interesting morpho- functional adaptations such as succulent tissues to store water, pubescent epidermis, and thick cuticle to reduce transpiration, below ground structure to withstand sand burial and annual habit (8). A variety of psammophytic strand vegetation exists on the coastal sand dunes of the Indian subcontinent (9). This study highlights the diversity of psammophytes, their adaptive features and the medicinal uses of some of the plants used by the local people.

Materials and methods

Study area

Tranquebar- "The land of singing waves" rests on the Coromandel Coast in the Nagapattinam District, about 15-km south of Poompuhar on Southern Tamil Nadu coast. The district lies on the shores of the Bay of Bengal between latitude 10.7906° N and longitude 79.8428°E. Tranquebar lies in 11°1′45 N and 79°50′58 E longitude. Geologically, the coast is aligned almost north–south without any prominent bays and hills and is covered with recent alluvial soils. Many small rivers named Nandalar, Uppanar, Virasolanar, Kadalaliyar, and Vadiyar join the Bay of Bengal near Tranquebar region. The study area experiences Tropical Maritime Climate, average temperature of the region ranges from 25°C to 31°C.

Methodology

The present study was carried out during 2014–2016. Field trips were conducted covering different parts of the study area in all seasons and to collect the entire flowering and fruiting specimens for almost all the species. The

collected plant specimens were identified with the help of regional floras and related research articles (10–15) and other available floras, revisions, and monographs. The identity of herbarium specimens were then confirmed by further study with the help of authentic specimens deposited in the Madras Herbarium, of Botanical Survey of India, Southern Circle, Coimbatore. Vegetation types and plants were photographed; important observations and other relevant field data were noted in the field. The plants were made into standard herbarium (16) and the voucher specimens were deposited in the Bharati Herbarium, Department of Botany, Bharathiar University, Coimbatore for future verification.

Results

A total 154 species belonging to 108 genera and 41 families were reported in Indian Coastal Sand Dune (17). A study on the coastal sand dune plants of Thoothukudi resulted in 42 species of plants belonging to 38 genera representing 26 families (18). One hundred taxa were collected and identified during the field investigation, belonging to 88 genera in 41 families in the present study area (Table 1).

Temperate sand dunes are mainly comprised of poaceae, where as tropics are dominant with the members of Asteraceae, Cyperaceae, Fabaceae, and Poaceae (19). The Euphorbiaceae had more dominance with nine species belonging to seven genera. Asteraceae and Fabaceae were the second dominant families of the present study with six species each under genera 6 and 5, followed by Amaranthaceae, Convolvulaceae, and Lamiaceae with five species each, respectively; other families were represented with < four species. Euphorbiaceae, Asteraceae, Fabaceae, and Poaceae were particularly abundant in the coastal study area (20). The analyses also showed that out of 88 genera represented, *Ipomoea* was the dominant genus with four species followed by *Suaeda* and *Solanum* with three species each and the other genus were represented by one or two species.

A total of 100 species enumerated from the present study area, represented four distinct types *viz*., Trees (9%), Climbers (17%), Shrubs (10%), and herbs (64%) as also reported earlier in coastal areas (21,22). As several authors have pointed out in various parts of the world, many dune ecosystems support high plant richness and diversity values (23–26) as also noted in this study area.

Discussion

India has rich wealth of medicinal plants widely used by all section of people either directly as folk remedies or indigenous system of medicine or indirectly in the pharmaceutical preparations of modern medicines (27). In India about 8,000 species are known to be medicinally important, around 2,500

Table 1. Details of the Psammophytic Species Studied

S. NO.	BOTANICAL NAME	FAMILY	HABIT
1.	*Abrus precatorius*	Fabaceae	Climber
2.	*Abutilon indicum*	Malvaceae	Herb
3.	*Acalypha indica*	Euphorbiaceae	Herb
4.	*Achyranthes aspera*	Amaranthaceae	Herb
5.	*Aerva lanata*	Amaranthaceae	Herb
6.	*Aleuropus lagopoides*	Poaceae	Herb
7.	*Alternanthera sessilis*	Amaranthaceae	Herb
8.	*Alysicarpus monilifer*	Fabaceae	Herb
9.	*Andrographis enchioides*	Acanthaceae	Herb
10.	*Anisomeles malabarica*	Lamiaceae	Shrub
11.	*Antigonon leptopus*	Polygonaceae	Climber
12.	*Argemone Mexicana*	Papaveraceae	Herb
13.	*Aristolochia bracteata*	Aristolochiaceae	Herb
14.	*Azadirachta indica*	Meliaceae	Tree
15.	*Blepharis repens*	Acanthaceae	Herb
16.	*Blumea sonchifolia*	Asteraceae	Herb
17.	*Boerhaevia diffusa*	Nyctaginaceae	Herb
18.	*Borassus flabellifer*	Arecaceae	Tree
19.	*Bulbosystis barbata* .	Cyperaceae	Herb
20.	*Calotropis gigantean*	Asclepiadaceae	Shrub
21.	*Canavalia rosea*	Fabaceae	Climber
22.	*Canthium coromandelicum*	Rubiaceae	Shrub
23.	*Cardiospermum halicacabum*	Sapindaceae	Climber
24.	*Cassia siamea*	Cesalpiniaceae	Tree
25.	*Catharanthus roseus*	Apocynaceae	Herb
26.	*Citrullus colocynthis*	Cucurbitaceae	Herb
27.	*Cleome viscosa*	Capparaceae	Herb
28.	*Clerodendrum inerme*	Lamiaceae	Shrub
29.	*Coccinia indica*	Cucurbitaceae	Herb
30.	*Commelina bengalensis*	Commelinaceae	Herb
31.	*Corchorus trilocularis*	Tiliaceae	Herb
32.	*Cressa cretica*	Chenopodiaceae	Herb
33.	*Crotolaria pallida* var.*obovata*	Fabaceae	Climber
34.	*Crotolaria verrucosa*	Fabaceae	Herb
35.	*Croton bonplandianus*	Euphorbiaceae	Herb
36.	*Cyanotis cristata*	Commelinaceae	Herb
37.	*Cyperus brevifolia*	Cyperaceae	Herb
38.	*Dactyloctenium aegypticum*	Poaceae	Herb
39.	*Datura metal*	Solanaceae	Shrub
40.	*Emilia sonchifolia*	Asteraceae	Herb
41.	*Euphorbia corrigioloides*	Euphorbiaceae	Herb
42.	*Euphorbia hirta*	Euphorbiaceae	Herb
43.	*Euphorbia prostrata*	Euphorbiaceae	Herb
44.	*Evolvulus alsiniodes*	Convolvulaceae	Herb
45.	*Glinus oppositifolius*	Aizoaceae	Herb
46.	*Gmelina asiatica*	Lamiaceae	Shrub
47.	*Gomphrena celesioides*	Amaranthaceae	Herb
48.	*Gomphrena serrata*	Amaranthaceae	Herb
49.	*Heliotropium curassavicum*.	Boraginaceae	Herb
50.	*Hyptis suaveolens*.	Lamiaceae	Herb
51.	*Ipomaea cairica*	Convolvulaceae	Climber
52.	*Ipomaea carnea*	Convolvulaceae	Climber
53.	*Ipomoea pes-caprae*	Convolvulaceae	Climber
54.	*Ipomoea pes-tigridis*	Convolvulaceaea	Climber
55.	*Jatropa gossipifolia*	Euphorbiaceae	Shrub

(*Continued*)

Table 1. (Continued).

S. NO.	BOTANICAL NAME	FAMILY	HABIT
56.	*Justicia tranquebariensis*	Acanthaceae	Herb
57.	*Lantana camara*	Verbenaceae	Herb
58.	*Launaea sarmentosa*	Asteraceae	Herb
59.	*Leucas aspera*	Lamiaceae	Herb
60.	*Melia azedarach*	Meliaceae	Tree
61.	*Micrococca merculiaris*	Euphorbiaceae	Herb
62.	*Mollugo pentaphylla*	Aizoaceae	Herb
63.	*Mukia madrasapatana* .	Cucurbitaceae	Climber
64.	*Murdannia striatipetala*	Commelinaceae	Herb
65.	*Opuntia dillenii* .	Cactaceae	Shrub
66.	*Pandanus odorattismus*	Pandanaceae	Shrub
67.	*Passiflora foetida*	Passifloraeceae	Climber
68.	*Pedalium murex*	Pedaliaceae	Herb
69.	*Pentatropis microphylla*	Asclepiadaceae	Climber
70.	*Pergularia daemia*	Asclepiadaceae	Climber
71.	*Phoenix slyvestris*	Arecaceae	Tree
72.	*Prosopis juliflora*	Mimosaceae	Tree
73.	*Ricinus communis*	Euphorbiaceae	Shrub
74.	*Salicornia brachiata*	Salicorniaceae	Herb
75.	*Sauropus bacciformis*	Euphorbiaceae	Herb
76.	*Scoparia dulcis*	Plantaginaceae	Herb
77.	*Sesamum prostratum*	Pedaliaceae	Climber
78.	*Sesuvium portulacastrum*	Aizoaceae	Herb
79.	*Sida acuta*	Malvaceae	Herb
80.	*Sida cordata*	Malvaceae	Herb
81.	*Solanum nigrum*	Solanaceae	Herb
82.	*Solanum suratens*	Solanaceae	Herb
83.	*Solanum torvum*	Solanaceae	Herb
84.	*Spaeranthus indicus*.	Asteraceae	Herb
85.	*Spinifex littoreus*	Poaceae	Herb
86.	*Suaeda fruiticosa*	Chenopodiaceae	Herb
87.	*Suaeda maritima*	Chenopodiaceae	Herb
88.	*Suaeda nudiflora*	Chenopodiaceae	Herb
89.	*Tephrosia purpurea*	Fabaceae	Herb
90.	*Thespesia populnea*	Malvaceae	Tree
91.	*Tinospora smilecinea*	Menispermaceae	Climber
92.	*Trianthema triquetra*	Aizoaceae	Herb
93.	*Tribulus terrestris*	Zygophyllaceae	Herb
94.	*Tridax procumbens*	Asteraceae	Herb
95.	Typha *angustifolia*	Typhaceae	Herb
96.	*Vernonia cinerea*	Asteraceae	Herb
97.	*Vitex negundo*.	Verbenaceae	Tree
98.	*Wattakaka volubilis*	Asclepiadaceae	Climber
99.	*Ziziphus mauritiana*	Rhamnaceae	Tree
100.	*Ziziphus oenophlilia*	Rhamnaceae	Climber

plant species are used in the Ayurveda, Unani, Siddha, and Homoeopathy (28). In India about 90% of plant materials are collected from wild sources; many of the plants have become rare, threatened, endangered, or vulnerable due to the destructive harvesting. About 8,000 plant species are used by many tribal communities for traditional medicinal preparation (29).

Out of 100 species, 27 species were collected and recorded which are administered against 17 ailments including dermatological disorders, jaundice,

kidney stone, common cold, cancer, anaemia, arthirits, blood clot, and rheumatism (Table 2). Some frequently used medicinal plants *viz. Andrographis enchioides, Abutilon indicum, Sphaeranthus indicus, Pandanus odorattismus*, and *Sauropus bacciformis* were also used in Ayurvedha, Unani, and Siddha systems of medicine. The medicinal formulations, which are made from these plants, were either taken internally or applied externally.

Present study also indicated that various parts of the plants such as leaf, flower, fruit, bark, stem, seed, root, and latex were used as raw drugs, and were major ingredients for the preparation of medicinal formulations. The mode of usage includes mono-herbal and polyhedral and the mode of preparation differed with the disease and the plant used. The parts of the plant used include leaf (77%), latex (7%), stem (7%), root (3%), fruit (3%), and whole plant (3%). Most of the herbal preparations used leaves.

The study revealed that the usage of fresh juice (28%) was more dominant among the people in the study region. They consider this to be an effective first-aid before going for some other treatments, followed by paste (24%), food (16%), decoction (12%), direct usage (12%), powder (4%), and fomentation (4%). According to (30), the dominant mode of preparations includes the usage of fresh juice 52% followed by paste 28%. The inhabitants of the Palk Strait region use coastal plants for treating about 50 diseases.

The present study focused on inter-cultural analysis (Folklore of Western, Eastern and Coastal regions) and intra-cultural analysis of the frequently used 20 medicinal plants collected from the study area (Table 3). A number of informants reported the same use and a number of patients reported useful application (31).

Medicinal plants used in different Indian systems

The credibility on the basis of similar medicinal use of a plant among different ethnic group living in neighboring, but separate geographical regions, cross-cultural, and multilocational application of indigenous knowledge has been inferred (32,33). Others recorded ~43 Psammophytes and associated plants belonging to 41 genera with special reference to Indian system of medicine (34). Among 27 species, 15 species are used in Ayurvedhic systems of medicine such as *Cardiospermum halicacabum (*Glandular swelling, piles), *Catharanthus roseus* (Blood pressure and diabetics), *Euphorbia hirta* (sterility, worm infestation), and *Vitex negundo* (arthritis, abdominal diseases and cold). Sixteen (33) species were used in Siddha medicine viz. *Abutilon indicum* (Piles and leprosy), *Achyranthes aspera* (Diarrhoea, anemia, and ear diseases), *Aerva lanata* (Urinary calculi), *Boerhavia diffusa* (Nasal disorders and constipation); in Unani system of medicine, 12 species were used against various diseases *Calotropis gigiantia* (Antiphyretic and antispasmodic), *Lecus aspera* (Vermicidal and brain tonic),

Table 2. Ethnomedicinal Uses Plant Species in the Study Area

S. NO.	BOTANICAL NAME	FAMILY	PARTS USED	USES	MODES OF PREPARATION
1.	*Abutilon indicum*	Malvaceae	leaves	Used in the treatment of piles	Leaves dried powdered and taken alon with water
2.	*Achyranthes aspera*	Amaranthaceae	Leaves	Respiratory ailments	Boiled in water and consumed
3.	*Aerva lanata*	Amaranthaceae	Stem	To treat kidney stone	Made into decoction and orally administered
4.	*Andrographis enchioides*	Acanthaceae	Leaves	Used to treat poison bites	Leaf juice orally administered
5.	*Aristolochia bracteolata*	Aristolochiaceae	Leaves	To treat poisonous bites and skin diseases	Leaf juice applied over the affected area
6.	*Azadirachta indica*	Meliaceae	Leaves	Cures mums and measles	Made into paste with turmeric and applied over the wounds
7.	*Boerhaevia diffusa* .	Nyctaginaceae	Leaves	Gas trouble	Boiled and consumed as food
8.	*Calotropis gigantea*	Asclepiadaceae	Latex	Heals wound	Applied directly over the wound
9.	*Cardiospermum halicacabum*	Sapindaceae	Leaves	Gas trouble	Made in paste and consumed
10.	*Catharanthus roseus*	Apocynaceae	Leaves	Cures cancer	Leaf juice administered orally
11.	*Euphorbia hirta*	Euphorbiaceae	Latex and leaves	Cures skin disease	Cooked and taken as food
12.	*Heliotropium curassavicum*	Boraginaceae	Leaves and stem	Used for insect bite	Leaves made into paste and applied on parts affected
13.	*Ipomoea pes-caprae*	Convolvulaceae	Leaves	Used to relieve joint pain	Leaves made into paste and applied over the joins to get relieved from pain
14.	*Justicia tranquebariensis*	Acanthaceae	Leaves	Used to treat skin diseases	Leaf juice is applied on the affected area
15.	*Lantana camara*	Verbenaceae	Leaves	Heals wound	Leaf juice directly applied
16.	*Leucas aspera*	Lamiaceae	Leaves	Controls migraine	Leaf boiled in water and the decoction is consumed
17.	*Melia azedarach*	Meliaceae	Leaves	Antihelminthic	Leaf juice along with piper beetle and ginger is given to children
18.	*Mukia madraspatana*	Cucurbitaceae	Leaves	Used to treat cold	Leaf juice is given orally
19.	*Pandanus odorattissmus*	Pandanaceae	Roots	Used to treat Jaundice	Used alone with tender coconut water
20.	*Pergularia daemia*	Asclepiadaceae	Leaves	Used to treat blood clot	Leaves made into paste and applied
21.	*Sauropus bacciformis*	Euphorbiaceae	Leaves	To treat skin diseases and gastric problems	Leaf juice is given orally
22.	*Solanum nigrum*	Solanaceae	Leaves and fruit	Cures mouth ulcer	Cooked with ghee and consumed
23.	*Solanum suratens*	Solanaceae	Leaves	Cures respiratory ailments	Made into decoction
24.	*Solanum torvum*	Solanaceae	Leaves	Antihelminthic	Fruits cooked and taken as food
25.	*Spaeranthus indicus*	Asteraceae	Whole plant	Used to treat skin diseases	Whole plant made into paste and applied over affected parts

(*Continued*)

Table 2. (Continued).

S. NO.	BOTANICAL NAME	FAMILY	PARTS USED	USES	MODES OF PREPARATION
26.	*Tribulus terrestris*	Zygophyllaceae	Leaves	Source for blood	Cooked as food
27.	*Tridax procumbens*	Asteraceae	Leaves	Heals wound	Leaf juice directly applied
28.	*Vitex negundo*	Verbenaceae	Leaves	Used to treat cold	Fomented on forehead

Table 3. A Comparative Analysis of Medicinal Plants Used in Three Regions

S. NO.	BOTANICAL NAME	USE IN SPECIFIC DISEASE		
		WESTERN GHATS	EASTERN GHATS	COASTAL REGIONS
1.	*Achyranthes aspera*	Ringworm infection, Dog bite, Snake bite, Skin disease, Asthma, Wounds	Snake bite, Paralysis, Scorpion bite.	Respiratory ailments
2.	*Aerva lanata* Juss.	Kidney disorders asthma	Snake bite	Treat kidney stone
3.	*Andrographis enchioides*	Fever, wounds and Hair tonic	Fever	Treat poison bites
4.	*Aristolochia bracteolate*	Snake bites, Dandruff	Dandruff	Treat poisonous bites and skin diseases
5.	*Azadirachta indica*	Skin disease, Tooth ache, Stomach worms, Wounds, Fever.	Skin disease, Ulcer, Antiseptic, Diabetes	Mums and Measles
6.	*Boerhaevia diffusa*	Cuts and Wounds ease delivery	Ease deliver, Jaundice	**Gas trouble**
7.	*Calotropis gigantean*	Wounds, Skin disease,	Tooth ache, Insect bite,	Wound
8.	*Cardiospermum halicacabum*	Earache, Relieves gas trouble, joint pain, Rheumatism	Dysentry, Paralysis, Fever, Nervous disorder, Blood purifier	Gas trouble
9.	*Catharanthus roseus*	Diabetes, Abortification	Antivancer	Cures cancer
10.	*Euphorbia hirta*	Ringworm infection, Dysentery, Leucorrhoea, Stomachache and Vomiting	Applied on warts	Skin disease
11.	*Lantana camera*	Cuts and WOUNDS	Diabetes	Wound
12.	*Leucas aspera*	Scabies, Head ache, Bronchitis, Purgative.	Toothache	Controls migraine
13.	*Melia azedarach*	Stomach pain	Measles pain	Anthelminthic
14.	*Pergularia daemia*	Skin disease, Asthma, Rheumatism, Gas trouble	Rheumatism	Treat blood clot
15.	*Solanum nigrum*	Stomach ulcer, Fever, eye disease	Stomach ulcer	Mouth ulcer
16.	*Solanum surattense*	Dyspepsia, Tooth ache	Toothache	Respiratory ailments
17.	*Solanum torvum*	Digestion, Boils	Infusion of enlargement.	Anthelminthic
18.	*Tribulus terrestris*	Urinary complaints, Menstrual disorders	Fertility	Source for blood
19.	*Tridax procumbens*	Cuts and Wounds	Cuts and Wounds	Heals wound
20.	*Vitex negundo*	Headache, Wounds, Asthma and Body pain	Body pain	Treat cold

Sphaeranthus indicus (Jaundice weakness of hart), *Solanum nigram* (Anti-inflammatory, ulcer), *Azadiracta indica* (Antiseptic and blood purifier), and *Melia azedarach* (sterility in female and splenomegaly).

Common use of plant in such distant region and by local people of so diverse ethnic background provides great credibility to their potential for wider usage (35).

Acknowledgments

We are grateful to the fishermen and rural communities of Tranquebar for the cooperation and sharing information during the field trips and Scientist & Head of the Office, Botanical Survey of India, Southern Regional, Coimbatore, Tamil Nadu, India for helping the plant identification and confirmations of my research work.

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