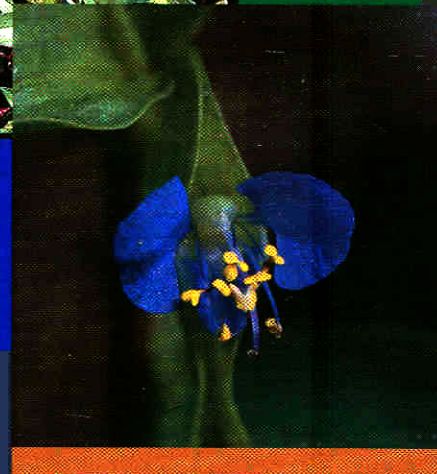


Upland Rice Weeds of South and Southeast Asia



**Marita I. Galinato, Keith Moody,
and Colin M. Piggin**



IRRI

INTERNATIONAL RICE RESEARCH INSTITUTE

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**1999
IRRI**

INTERNATIONAL RICE RESEARCH INSTITUTE

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Commelina diffusa Burm. f. at different stages of growth. From left: seedling, mature plant; top right: seed; bottom right: flower.

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Foreword

Weeds are the major biotic constraint in rice-farming systems. In the developing world, they are mainly controlled by cultivation, hand weeding, crop/fallow rotation, and, in the lowlands, by flooding. Lack of action means little yield. The extent of the problem in the uplands can be illustrated by upland rice farmers in Lao PDR, who may spend 150-200 days per hectare—perhaps half of the overall time spent on cropping—on hand weeding to control weeds. But because land, labor, and water are becoming more limited and expensive, farmers are seeking alternatives to hand weeding for managing weeds in rice. This is reflected in the increasing use of herbicides in rice in Asia.

Weed control will need to become more sophisticated in the future by integrating herbicide use with crop management to develop and refine better integrated weed management (IWM) systems. IWM demands precise identification of weeds. It also requires access to current knowledge on the biology of individual weeds and the ecology of weed communities.

Access to identification guides and literature is limited for researchers in many parts of upland Asia however. This book therefore aims to provide a practical identification guide and information on biology and management for the major weeds of upland rice across Asia. It was produced as an output of the Upland Rice Research Consortium, a collaborative research partnership between IRRI and upland rice research groups in Bangladesh, India, Indonesia, Lao PDR, Myanmar, the Philippines, and Thailand. Many upland weeds are common across these countries, and it was thought that such a book would be useful to help in the struggle to develop better integrated weed management systems.



Ronald P. Cantrell
Director General

Introduction

One hundred fifty million hectares of rice are cultivated in the world, with about 19 million ha grown in the rainfed uplands under a wide range of management practices, varying from shifting cultivation to highly mechanized systems. Upland rice is important in Asia. It constitutes a significant part of the rice area in India, Bangladesh, Indonesia, the Philippines, Thailand, Lao PDR, Vietnam, and Myanmar (Piggin et al 1998).

Yields of upland rice have remained low (about 1 t ha⁻¹), whereas lowland rice yields have improved substantially over the years. Only about 4% of the world's rice comes from the uplands. Low upland yields have been attributed mainly to inadequate and irregular moisture supply, heavy weed infestation, lack of suitable cultivars, nutritional imbalance, inadequate cultural practices, and inefficient control of insect pests and diseases.

The importance of weeds is illustrated from a survey conducted by Arrau deau (1986) in 36 countries representing approximately 90% of the upland rice area in the world; weeds were reported to be the major biological constraint to rice production in 25 countries. Roder et al (1995) reported that farmers in Lao PDR mentioned weeds as the major constraint to upland rice production, with up to 50% of farmer time (140-190 d ha⁻¹) spent on weed control.

Weeds are difficult to control under upland conditions because they emerge at the same time as the crop and, unlike under irrigated conditions, flooding cannot be used to suppress them. Weeds increase the cost of production and lower the quantity and quality of the rice produced. In upland rice, losses caused by uncontrolled weed growth can range from 40% to 100%. To obtain a good yield, a weed-free period of 40 to 60 d from sowing is needed.

Knowing what the weed problem is and how the weed behaves in the field is important in developing good weed management programs and achieving good yields. This book therefore aims to assist with the accurate identification of upland rice weeds and provide information on their biology and control.

Research at the International Rice Research Institute (IRRI) on upland rice-based cropping systems is conducted in Asia and Southeast Asia in collaboration with rice research groups in India, Indonesia, Thailand, the Philippines, Vietnam, Lao PDR, Myanmar, and Bangladesh through the Upland Rice Research Consortium (URRC). This partnership facilitates collaboration and cooperation in research and development on upland rice-based farming systems. It was established with support in Phase 1 (1991-93) from the Asian Development Bank (ADB), in Phase 2 (1994-96) from both Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung/Deutsche Gesellschaft für Technische Zusammenarbeit (BMZ/GTZ) and Japan, and in Phase 3 (1997-99) from BMZ/GTZ.

The consortium undertakes strategic germplasm, agronomy, soil management, and socioeconomic research addressing major constraints in the uplands. It focuses on the themes of drought, weeds, nutrient availability, soil acidity, blast, nematodes, and erosion. Weeds are a problem

across all countries, and there is a comprehensive effort to develop sustainable, integrated weed management systems.

This book was conceived during the second year of implementation of the URRC. Because weeds are of major importance in all countries, and many of the weeds are common, it was thought that better information on weed identification, biology, and management would benefit all countries in their endeavors to control weeds. Species discussed in the book are based on lists of important weeds from URRC site coordinators in the eight partner countries, and the list of upland rice weeds given in Moody (1989). Those selected include the most important weed from each country and those species occurring in six to eight countries.

Using these criteria, 64 weeds were selected as the most important in upland rice in South and Southeast Asia. These occur in 18 families; 37 are broadleaf weeds, 20 are grasses, and 7 are sedges. Twenty-seven of the weeds are primarily annuals, 20 are perennials, and 17 are classified as annual or perennial. The weed species are listed alphabetically by family and by scientific name (genus and species) within each family. Synonyms from floras and taxonomic literature are provided. For easy reference, Appendix 1 also lists scientific names and synonyms. Common names are given in English and the dominant local languages where possible. Botanical descriptions are written with minimal use of taxonomic jargon. Appendix 2 has a glossary for those who are unfamiliar with some of the terms. Color photographs show these weeds at different growth stages, to assist with weed identification. (Four photos accompany each species. From left to right, and top to bottom, they show the seed, seedling, flower, and flowering plant.) Information on distribution, biology, ecology, and weed control is given from published literature, which was extensive for many species but sparse for some less-common weeds.

Appendix 3 gives the common and chemical names of herbicides mentioned in the text. The listing of a herbicide does not mean endorsement by IRRI, and other products may perform equally well. In the text, under chemical control, kg ha^{-1} means kg ai ha^{-1} .

At the end of the book is Appendix 4—"An inventory of spontaneous and cultivated vegetation occurring in upland rice in South and Southeast Asia"—developed over many years from the literature and field observations by one of the authors, Dr. K. Moody.

The authors are grateful to all who helped prepare this book. Special thanks are extended to the following: research collaborators in the URRC for providing lists and local names of upland rice weeds, especially Drs. K. Prasad and G.N. Mishra of the Central Rainfed Upland Rice Research Station, Bihar, India; Dr. Zainal Lamid of the Sukarami Assessment Institute for Agricultural Technology, West Sumatra, Indonesia; Dr. Vichien Petpisit of the Phrae Rice Research Center, Phrae, and Dr. Waree Chaitep and Mr. Thongma Manakul of the Sanpatong Rice Experiment Station, Chiang Mai, Thailand; Somphet Phengchanh, Sulasit Maniphone, Bountjanth Keoboulapha, and Dr. W. Roder of Houay Khot Station, Luang Prabang, Lao PDR; Dr. Philipe Godon of CIRAD and Dr. Vo-Tong Xuan, University of Cantho, Vietnam; Gazi Jashim Uddin Ahmed and Shaikh Tanveer Hossain of the Bangladesh Rice Research Institute, Gazipur, Bangladesh; and Saw Ler Wah of the Myanma Agricultural Service, Yangon, Myanmar. Prof. M. Galinato prepared the species list for the Philippines. We thank Dr. Tho-

mas Le Bourgeois of CIRAD for reviewing the manuscript, for his suggestions on botanical descriptions, and for verifying nomenclature and synonyms according to the Kew Garden and Missouri Botanical Garden Nomenclatures; Blas Hernaes of the University of the Philippines Los Baños for information on *Pennisetum glaucum*; R.T. Lubigan of IRRI for information on *Urena lobata*, the herbarium specimen of *Cyperus halpan*, and for some references and important suggestions; T.R. Migo and J.D. Janiya of IRRI for information and assistance in locating various weeds; Dr. A. Martin Mortimer of IRRI for literature searches; Dr. D. Johnson of the West Africa Rice Development Association, Côte d'Ivoire, for advice and the photos of live *C. halpan*; Dr. B. Courtois of IRRI/CIRAD for translating French descriptions of some weeds; farmers from URRC countries for locating and identifying weeds; scientists and staff from IRRI and the Visayas State College of Agriculture (ViSCA) for assistance; and scientists from AgChem, AgrEvo, Bayer Philippines, DowElanco, and Jardine Agchem for providing current herbicide recommendations for control of weeds in upland rice.

We acknowledge the help of Ms. Bong Graciano of ViSCA for typing drafts, Ms. Cora Bambase of IRRI for formatting and typing the final manuscript, and Dr. Bill Hardy of IRRI's Communication and Publications Services for editing this book.

Special gratitude is also due to Mr. Lingkod Sayo of IRRI for most of the excellent photos of the weeds and for teaching the senior author how to photograph weed seeds. Mr. Jimmy Tan of ViSCA is also thanked for the initial photos of many of the weeds.

We hope readers find the book useful for identifying and controlling weeds in upland rice. Those with additional information on these and other upland rice weeds are encouraged to send it to the Weed Research Group, IRRI, for inclusion in a future revision of this book.

Marita I. Galinato
Keith Moody
Colin M. Piggin

Mollugo pentaphylla L.

(Synonym: *M. stricta* L.)

Common names

Country/language	
English	Bird's-foot mollugo
Indonesia	Daun mutiara
Philippines	
Bisaya	Maribulis, tuway-tuway
Thailand	Phak nok khou
Bangladesh	Khetpakri
Vietnam	Co binh-cu

Botanical characteristics

A slender, much-branched annual herb from 8 to 30 cm high, often reddish. Stem and branches slender, angular, smooth. Leaves opposite or in whorls (3-5), narrow, linear-lanceolate and pointed at the top, up to 5 cm long and 1 cm across, those at the base of the stem often broader and spatulate, the upper ones shortly petioled to sessile. Flowering shoots very slender with many small flowers on very slender stalks, tepals 5, reddish or yellowish, about 0.1 cm long, stamens 3-5. Fruit a globular capsule, about 0.3 cm in diameter, the outer covering thin, splitting from the top, faintly 3-lobed, 2 mm high. Seeds numerous, kidney-shaped, dark brown, less than 1 mm long, granulate, with short stalk.

Distribution

Of Southeast Asian origin. Distributed in the tropics and subtropics of the Old World, Malesia; also in Papua New Guinea, Micronesia, New Caledonia, and Africa; rare in Australia. In upland rice, common in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh.

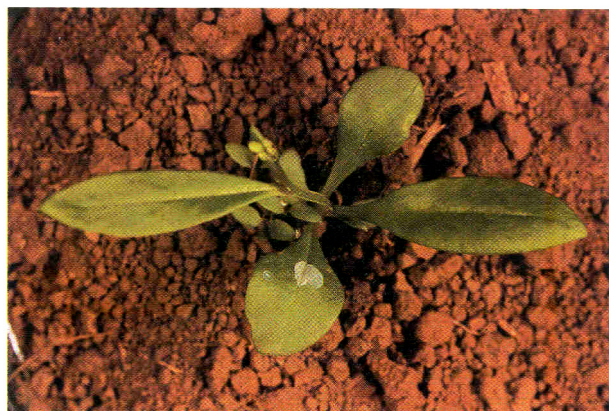
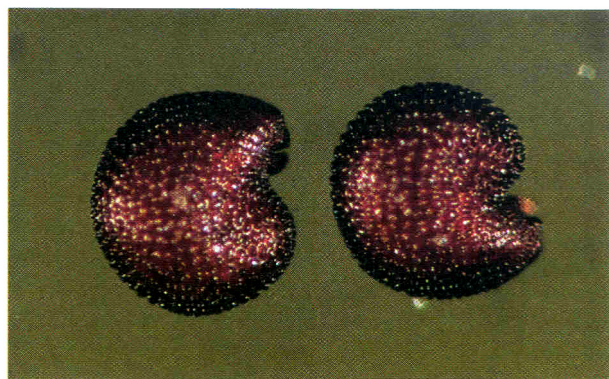
Biology and ecology

M. pentaphylla grows from sea level up to 1,200 m in cultivated fields, gardens, grasslands, railroad banks, roadsides, and plantations such as teak. It can be locally abundant, especially in the wet season, and is favored in sunny or lightly shaded sites and where soils are sandy or stony.

Propagation and dispersal are by seeds. It can produce 5,000 seeds plant⁻¹ and 15,000 seeds g⁻¹. The weight of 1,000 seeds is 0.07 g.

Flavones have been isolated from *M. pentaphylla*. An anti-fungal compound has been isolated from aerial parts. The weed also contains large quantities of nitrate, saponin, carotenes, and vitamin C.

In India, it is grown in pots and eaten as a herb; its leaves or stems are cooked and used as greens.



Weed management

Chemical. MCPA at 0.4 kg ha⁻¹ applied 25-30 d after seeding provided good control.

References

Chopin et al (1982), Hamburger et al (1989), Henderson (1959), Pancho (1964), Soerjani et al (1987).

Trianthema portulacastrum L.

(Synonyms: *T. monogyna* L., *T. obcordata* Roxb.)

Common names

Country/language	
English	
USA	Horse purslane
India	Patharchatta
Indonesia	Subang-subang
Philippines	
Cebuano	Ayam
Ilocano	Kantataba, tabtabukol
Ilongo	Ayam, ulisiman
Tagalog	Toston
Thailand	Phak bia hin
Myanmar	Laik-yin-but
Vietnam	Co-tam-khoi

Botanical characteristics

A fleshy, prostrate annual herb. Stem flat, succulent, 10-40 cm long, much-branched, green or purplish. Leaves opposite, broadly ovate, smooth, with slightly wavy margins with petioles 3-10 mm long expanded at their bases. Flowers white to pale pink or red to purple, solitary, sessile, in the leaf axils. Fruit a capsule, 3-4 mm in diameter, with a single awn at the tip, opening around the middle, containing 6-8 seeds. Seed rough, kidney-shaped, reddish brown to black, about 1.3 mm in diameter.

Distribution

Cosmopolitan, with no known center of origin and widespread in Southeast Asia, tropical America, and Africa. In upland rice, common in India, Indonesia, Philippines, Thailand, and Vietnam and present in Myanmar.

Biology and ecology

T. portulacastrum, a C₄ species, is common from sea level up to 800 m. It occurs in cultivated fields, waste places, roadsides, lawns,



and gardens. Occasionally, it is found in perennial crops and pastures.

T. portulacastrum establishes with the first rains of the wet season and often becomes the dominant early season weed. It prefers rich, moist soils. Seedlings exposed to a very dry period or flooding are easily killed.

More than 40% of the seeds sown on the soil surface can germinate, while 60% germinate at 1.2 cm, 40% at 2.5 cm, 26% at 5 cm, and 10% at 7.5 cm. No seedlings emerge from below 7.5 cm.

Biotypes of *T. portulacastrum* occur in India. Typical descriptions refer to red and green as well as large and small types. Red biotypes form larger plants with roots 0.5 to 1 cm in diameter at the base and the stem has long internodes and is reddish. Green biotypes have roots half as large, shorter internodes, flowers with green bracts and pods, and white sepals. The red biotype is more abundant, but the green one appears earlier in the season. Both red and white biotypes grow best under partial shade and thrive in neutral to alkaline soils that are low in organic matter.

Plants begin flowering 20 to 30 d after emergence. Plants grown under various environmental conditions produce 4 to 15 seeds capsule⁻¹, with an average of 9.4. The fewest seeds per capsule are found in the erect branches, the highest number in prostrate branches, and intermediate numbers in procumbent stems. Total seeds per plant ranged from 126 to 16,300 and averaged 6,940, with a mean weight of 1.2 mg seed⁻¹.

Freshly harvested seeds germinate readily, with germinability increasing up to 9 mo after harvest. Germination can be increased through mechanical or chemical scarification or by washing fresh but not old seeds. Fresh seed had 17% germination. When exposed to dry heat of 90 °C for 1 h, germination increased to 90% and seedlings were normal. But a temperature of 50 °C with high humidity damaged the seed.

Seeds germinate quickly between 25 and 40 °C but not at 20 or 45 °C. Germination is complete within 12 d at optimum

temperatures. Germination is lower in continuous light than in darkness (8% vs 34%) and is even higher (42%) in alternating dark and light conditions.

This weed is a host of *Rhizoctonia solani* and the chilli mosaic virus. The caterpillar *Hymenia recurvalis* has been observed feeding on the weed and the plant can die when the infestation is severe. When infestation is light, the larvae feed only on the chlorophyll of the leaves, but, when infestation is severe, they devour the leaves.

It is sometimes eaten as a vegetable and has been used as a medicine for many years. The leaf sap is used in India to cure wounds. The leaves are sometimes used as a diuretic. Whole-plant extracts have analgesic, antibacterial, and anti-inflammatory effects and can be used to treat fevers, inflammatory diseases, respiratory infection, and pain.

Weed management

Cultural. Can be difficult to control by tillage because of ready regrowth from cut stems.

Chemical. Propanil at 2 kg h⁻¹ applied 2 wk after rice emergence can control the weed.

Biological. *Gibbago trianthemae*, the causal agent of leaf spot on *T. portulacastrum*, was isolated from diseased plants collected in Brazos County, Texas, USA. Plants sprayed with conidia at or above 1 × 10⁵ spores mL⁻¹ were killed within 9 d. In host-range studies, the fungus was pathogenic only to *T. portulacastrum*. This fungus may be a useful agent for the biological control of *T. portulacastrum*.

References

- Auld and Medd (1992), Chandra and Sahai (1979), Datta and Banerjee (1976), Henderson (1959), Holm et al (1977, 1997), Johnson (1997), Kannaiyan and Prasad (1980), Katiyar et al (1977), Mitchell (1988), Moody et al (1984).

AMARANTHACEAE

Amaranthus spinosus L.

Common names

Country/language	
English	
USA	Spiny amaranth
India	Kantili chaulai
Indonesia	Bayam duri
Philippines	
Bicolano	Kulitis
Bisaya	Kulitis
Cebuano	Kulitis
Ilocano	Kalunai, kuanton, kuantung
Ilongo	Kulitis
Pampango	Ayang lalaki, ayantoto
Tagalog	Bayambang, kulitis, oray, uray
Thailand	Phak khom nam
Bangladesh	Katanata, kata notey
Lao PDR	Pak hom nahm
Myanmar	Min-nuo-nwe-su-bauk
Vietnam	Rau den gai

Botanical characteristics

Stout, often reddish, erect, branched annual herb up to 1.5 m high, with slender sharp-pointed spines, usually borne in the axils of the leaves. Leaves alternate, long-petioled, 4-10 cm long, oblong or broader at the base or elliptic-lance-shaped. Tip notched, with a short, straight point. Flowers about 1 mm long, green or greenish white. Bracts have bristles that are as long as or longer than the five sepals. They form as clusters or spikes at leaf axils and as elongated, densely flowered spikes at the stem terminals. Seeds round, shiny, dark reddish, about 0.8 mm long.

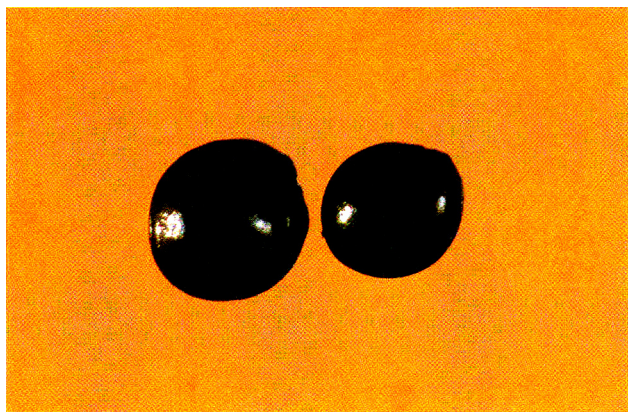
Distribution

Presumed to be of American origin, the plant is now cosmopolitan in the warmer regions of the world and widely naturalized in temperate regions. Common in upland rice at all consortium sites.

Biology and ecology

A. spinosus, a C₄ species, occurs abundantly in disturbed sites, waste places, pastures, gardens, and along roadsides. It prefers rich, moist soils.

This day-neutral plant may flower at daylengths between 8 and 16 h. Optimum growth is obtained at daylengths of 11 to 12 h, when the earliest and the most abundant flowering takes place. Flowering is suppressed under shade or cool temperatures.



The plant can produce 117,000 seeds plant⁻¹. A stand of 140 plants m⁻² produced 2,460 g of seeds. The weight of 1,000 seeds is 0.38 g.

The weed is a host of nematodes, including *Meloidogyne acrita* and *M. incognita*, the insect pest *Spodoptera litura*, and viruses that cause tobacco mosaic and groundnut rosette.

It is used as a wild food plant in Thailand and some other countries. Its leaves are used as spinach and the seeds as grain. The whole plant is used as a medicine to cure wounds. Young shoots are poisonous to livestock due to their high nitrate content.

Weed management

Cultural. *A. spinosus* is controlled readily by hoeing or uprooting. Hand weeding becomes very difficult once its spines have hardened.

Chemical. Postemergence treatments of propanil at 2 kg ha⁻¹ or trifop methyl at 1.5 kg ha⁻¹ and preemergence application of butachlor at 2 kg ha⁻¹ control *A. spinosus*. 2,4-D at 0.5 to 0.8 kg ha⁻¹, or MCPA at 0.4 kg ha⁻¹ applied within 20–30d after emergence, also gives good control.

References

Backer (1949), Bendixen (1986), Dassanayake and Fosberg (1980), Henderson (1959), Holm et al (1977), IRRI (1979), Le Bourgeois and Merlier (1995), Liu and Kao (1976), Misra (1969), Moody et al (1984), Noda et al (1984), Pancho and Obien (1995), Parker (1992), Smartt (1976), Vernon (1983).

***Amaranthus viridis* L.**

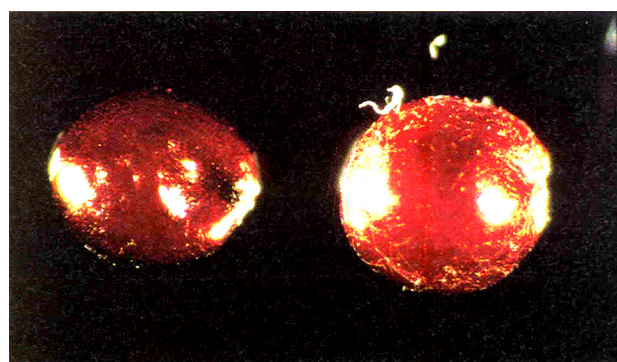
(Synonyms: *A. gracilis* Desf., *Chenopodium caudatum* Jacq., *Euxolus caudatus* Moq.)

Common names

Country/language	
English	
USA	Slender amaranth
India	Jangali chaulai
Indonesia	Bayam
Philippines	
Bicolano	Kilitis, kulitis na babae
Bisaya	Kulitis
Cebuano	Halom
Ilocano	Kalunai, siitan
Ilongo	Alom-alom, kulitis
Pampango	Ayang babae
Tagalog	Kolitis, kulitis, uray babae
Thailand	Phak khom
Bangladesh	Marissag, metha khuirey, notey, shak notey
Lao PDR	Pak hom ban
Myanmar	Taw-hin-nu-nwe
Vietnam	Rau den com

Botanical characteristics

A smooth, much-branched annual broadleaf herb, up to 100 cm high. Stem slender, often reddish. Leaves alternate, long-petioled, 4-10 cm long with a broad base and a narrow, rounded tip with a sharp point. Inflorescence simple or branched at the top of the stem or in the leaf axils, 2.5-12 cm long and 2-5 mm wide; flowers sessile, dense, green; sepals 3, stamens 3. Pistillate flowers more numerous than staminate ones. Fruit subglobose. Seeds brown or black, shiny, slightly compressed, reticulate and with shallow outgrowths on the reticulum.



Distribution

Of East Asian origin. Widespread in tropical and subtropical regions of the world. Reported to occur in 50 crops in more than 80 countries. In upland rice, common in Thailand and present at all other consortium sites.

Biology and ecology

A. viridis, a C_4 species, is found in open waste places and cultivated land, especially in volcanic soil.

It reproduces from seeds. The plant can produce 7,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.34 g with 3,000 seeds g⁻¹. Its chromosome number is $2n = 34$. Seed is dispersed by wind, water, and birds, with manure, with movement of farm machines, and as a contaminant in crop seed.

Germination of *A. viridis* seeds remained constant for 1 yr while buried in the soil at several depths from 2.5 to 25 cm.

The seeds can survive only a few weeks in silage and manure. Seeds fed to lambs, upon excretion, gave good initial germination, but viability decreased as time spent in the digestive tract increased. High survival of *A. viridis* in the digestive tract of chickens was reported. Seedlings were also found growing from horse dung.

In a study of germination at different temperatures and light and dark cycles, seeds of *A. viridis* were not sensitive to light stimulation 4 to 6 d after imbibition. Continuous white light at 25 °C completely inhibited germination. Germination was largely under phytochrome control and light was effective in stimulating germination at suboptimal temperatures. In an Indian study, 55% germination was obtained in complete darkness and 64% in a regime of alternating 24-h periods of light and darkness at 25 °C.

No secondary dormancy has been reported. Cultivation favors emergence of *A. viridis* with about 85-95% of the population emerging within a few days of sowing.

Morphologically distinct forms occur. Erect forms have been found in dry, exposed situations, whereas geniculately ascending

forms have been found in moist, shady situations. Erect plants are much taller and comparatively shallow rooted with a small number of branches. Genuiculately ascending plants are much-branched, deep-rooted, thicker, and with a much larger number of racemes and leaves. Total leaf area per plant is also conspicuously greater in ascending forms than in erect forms.

A. viridis is an alternate host of nematodes, including *Meloidogyne arenaria thamesi*, *M. incognita*, and *M. javanica*.

Young leaves and tops are eaten as a vegetable. This weed is used as a medicine to cure wounds.

Weed management

Cultural. Cultivation favors *A. viridis* emergence, and is a useful means of killing seedlings before sowing rice.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence gives good control of *A. viridis*. Butachlor applied preemergence at 2.0 to 2.5 kg ha⁻¹ also gives excellent control.

Biological. A weevil, *Hypolixus truncatulus*, feeds on *A. viridis*. But its suitability as a biological control agent is hampered by its relatively long life cycle and low reproductive capacity. The caterpillars of *Hymenia recurvalis* in large numbers defoliate the weed and, where infestation is severe, practically every plant is infested. But *H. recurvalis* has a wide host range, is a pest of several vegetable crops, and is unsuitable for biological control of *A. viridis*.

References

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Celosia argentea L.

(Synonym: *C. cristata* L.)

Common names

Country/language	
English	Cock's-comb
India	Chilmili, safed murg
Indonesia	Talas (Broco)
Philippines	
Bisaya	Kudiapa, redtap
Cebuano	Kudiapa
Ilocano	Balunsay, lofoi, pudpudo, sansandok
Ilongo	Kudiapa
Tagalog	Kadayohan, kindayohan, taling-talingan
Thailand	Ngon kai thai, ngornkai dong
Bangladesh	Sheth morogful
Lao PDR	Nya dok hone kai
Myanmar	Kyet-mauk-pyu
Vietnam	Mong-ga

Botanical characteristics

An annual herb, erect, 0.5-2 m high, simple or with many ascending branches. Stem and branches strongly ridged and often grooved with deep furrows, smooth. Leaves lanceolate-oblong to narrowly linear, acute to obtuse, tipped with an abrupt short point where the midrib projects beyond the leaf apex, smooth; blade of the leaves originates from the center of the main stem, 2-15 × 0.1-3 cm, tapering below into an indistinctly demarcated, slender petiole; upper and branch leaves smaller; leaf axils often with small-leaved sterile shoots. Inflorescence a dense, many-flowered spike, silvery to pink, first conical but becoming cylindrical in full flower, terminal on the stem and branches, on a long peduncle. Bracts and bracteoles lance-shaped or the lower ones triangular-shaped, 3-5 mm, transparent or nearly so, more or less awned. Perianth segments 6-10 mm, narrowly elliptic-oblong, acute to rather blunt, tipped with an abrupt short point with midrib projecting beyond the apex of the leaf, having 2-4 lateral nerves ascending more than halfway up each segment, margins hyaline. Filaments very delicate, subequalling or exceeding the staminal sheath, sinuses

rounded with no or very minute intermediate teeth; anthers and filaments creamy to magenta in color. Stigmas 2-3, very short, the filiform style 5-7 mm long; ovary 4-8-ovulate. Capsule 3-4 mm, ovoid to almost globular. Seeds 1-9, 1.3-1.5 mm, lenticular, black, shining, testa very finely reticulate.

Distribution

Originates in Africa. A practically pantropical weed. Present in upland rice at all consortium sites except Myanmar.

Biology and ecology

C. argentea, a C_3 plant, occurs up to 700 m altitude and grows best in clay loam or sandy loam soils with high pH and high nutrient content. It responds well to organic and inorganic fertilizers. It is frequently and locally abundant as a weed of cultivated fields, waste ground, roadsides, dried-up river beds, building sites, and quarries.

Propagation is by seed. The plant can produce 57,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.25 g and there are 4,000 seeds g⁻¹. Germination in countries such as Singapore and Malaysia starts in May when the first rains come and continues until August. New seedlings can come up at any time after field operations such as weeding. Flowering, which takes about 100 d, occurs from August to October, but this phase is extended for plants that germinate late. Seed maturation and dissemination start in October and continue until the beginning of the dry season in November. Dissemination is aided by wind and water. *C. argentea* seed is often an impurity in upland rice seed.

Continuous light or alternating light and dark is necessary for good germination. Both high light intensity and temperature are required for good growth of *C. argentea*. A reduction of up to one-third of full light may not cause a significant reduction in growth, indicating that the plant is quite tolerant of shading.

C. argentea is an alternate host of nematodes, including *Meloidogyne arenaria*, *M. hapla*, *M. incognita*, and *M. javanica*, and of insects *Haplothrips ganglbaueri*, *Nephotettix virescens*, and *Nezara viridula*.

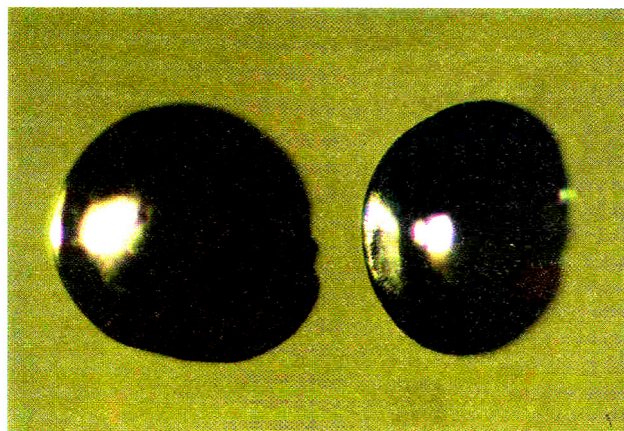
Weed management

Cultural. Control is enhanced by cutting flower heads to prevent seed production.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence gives good control.

References

Alam and Islam (1959), Ananthakrishnan and Thangavelu (1976), Bendixen (1986), Bhatia et al (1984), Corpus (1969), Dassanayake and Fosberg (1980), Hew and Hee (1990), Le Bourgeois and Merlier (1995), Okusanya (1980), Pancho (1964), Quisumbing (1923), Soerjani et al (1987), Townsend (1974), Umamahesh and Pandya (1984).



APIACEAE

Centella asiatica (L.) Urb.

(Synonym: *Hydrocotyle asiatica* L.)

Common names

Country/language	
English	
USA	Pennywort
India	Bramhi
Indonesia	Pigago
Philippines	
Bisaya	Jahong-jahong
Cebuano	Hahanghalo
Ilongo	Yahon-yahon
Pampango	Balubag-dagis
Tagalog	Takip-kohol, takip-suso, taingan-daga
Thailand	Boor bok
Lao PDR	Pak nok
Myanmar	Myin-kwa
Vietnam	Rau-ma

Botanical characteristics

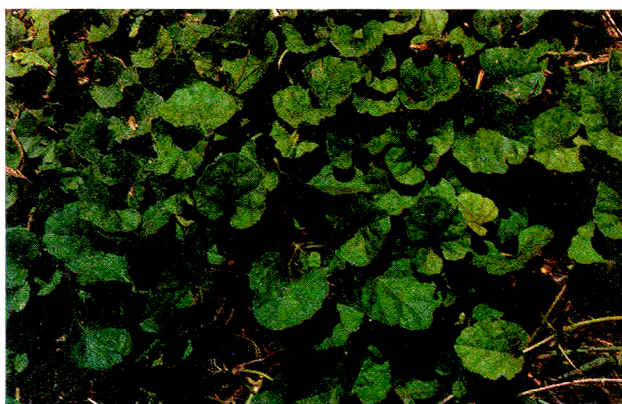
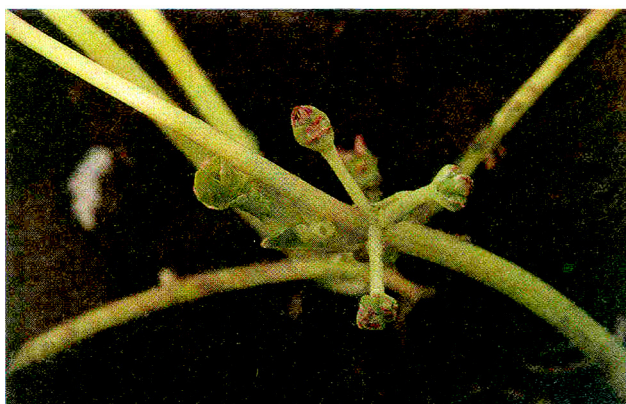
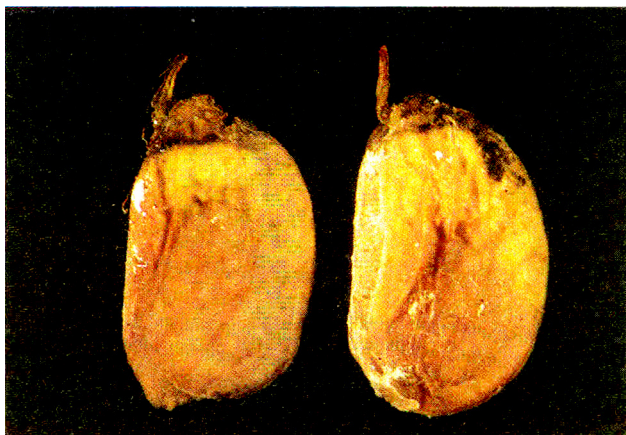
A perennial herb with stem creeping and rooting at the nodes, smooth to finely pubescent. Leaves simple, 2-10 in rosettes, kidney-shaped, long-petioled; upper surface with minute hair clusters; wavy-margined; leaf bases sheathing; petioles covered with soft, loose hairs. Inflorescence becoming smooth with age or having soft, loose hairs; involucre of 2 ovate bracts; umbels 2-4 flowered; flowers white; calyx teeth imperfectly developed; stylopodium flattened, purplish; styles short. Fruit very distinct with broader end downward to circular in outline, 3-4 mm in diameter, flattened and constricted into two parts with one seed in each part. Each mericarp has 7-9 primary ridges, narrow furrows, and reticulate fruit surface.

Distribution

Native to Asia. Pantropical, and distributed widely in tropical America, Africa, India, Pakistan, China, Japan, and the Pacific Islands. Present in upland rice in all consortium countries except Bangladesh.

Biology and ecology

C. asiatica occurs from sea level to 2,500 m and is locally common in plains and foothills, especially in fields, roadsides, earth banks, and ditches.



Chromosome numbers exist in three cytotypes ($2n = 18, 22, \text{ and } 33$) with basic chromosome numbers based on 9 and 11.

A report from India suggests it is a primitive species because it is found in the impenetrable, undisturbed evergreen thick forest environment of Silent Valley. The diploid nature of *C. asiatica* also indicates its primitive state.

The plant propagates and disperses by seeds and runner fragments. It can germinate anytime after rains, and flowering plants can be seen from January to December. Seed production numbers 42 plant^{-1} . The weight of 1,000 seeds is 1.44 g.

C. asiatica is a host to *Rhizoctonia solani*.

The species is used in India in the preparation of hair tonic and as a diuretic, antitumor agent, leprosy treatment, and skin disease medicine.

Weed management

Chemical. MCPA at 0.4 kg ha^{-1} applied 25-30 d after emergence provides effective control.

References

Auld and Medd (1992), Babu et al (1995), Datta and Banerjee (1976), Hamal and Koul (1989), Kannaiyan and Prasad (1980), Moody et al (1984), Nasir (1972), Prasad and Janaki Ammal (1985), Soerjani et al (1987).

Ageratum conyzoides L.

Common names

Country/language	
English	
USA	Tropic ageratum
India	Bhurbhurwa, mahkua
Indonesia	Bandotan
Philippines	
Bicolano	Kulong-kogong babae
Bisaya	Kanding-kanding
Ilocano	Ambabangot, bangbangsit, marakalding, singilan
Ilongo	Kanding-kanding
Tagalog	Bulak-manok, damong mabaho, damong-pallas
Thailand	Saapraeng saapkaa, yaa suap raeng
Bangladesh	Fulkuri, ochunti, shialmuti
Lao PDR	Nya khiu
Myanmar	Kayin-ma-pau-poo, khwe-thay-paw
Vietnam	Co cui heo



Botanical characteristics

An erect, branched, somewhat odorous annual herb up to 60 cm high with rigid and stiff hairs on stem. Leaves opposite, ranging from 5 to 13 cm long, broadened toward base with shallow round-toothed margin and sharp apex. Flowers numerous, white, violet, or very pale blue, clustered in heads, stalks of which are longer in the lower flowers, thereby forming a more or less flat-topped inflorescence at the top of the stem. Bracts green with a sharp tip. Seeds black, 5-angled with 5 awned scales (pappus) often saw-toothed at the base.

Distribution

A native of tropical America, *A. conyzoides* is one of the most common weeds in the warmer regions of the world. It is common at all consortium sites,

Biology and ecology

A. conyzoides grows in a wide range of arable crops and grasslands in many tropical and subtropical countries. It is found in plantations, waste places, and roadsides, in both light and heavy soils, and responds well to increasing soil fertility. It prefers moist conditions with high air humidity and tolerates shading, but also grows well under dry conditions.

It is a short-lived annual weed, tetraploid, exhibiting extreme plasticity and quick flowering. It is very adaptable, and it rapidly colonizes disturbed and cultivated areas. Its life cycle may be completed in less than 2 mo. It can flower when as few as two pairs of leaves have been formed. It grows up to 90 cm tall with hundreds of flower heads in favorable conditions, although when growing in crowded or extremely wet or dry conditions it exists as a tiny plant with a single flower.

The plant appears to have no photoperiodic requirement. It is self-pollinated and can produce up to 40,000 seeds plant⁻¹, half of which germinate shortly after they are shed. Seeds are dispersed by wind and water. Light is needed for germination. These traits help *A. conyzoides* to succeed as an early colonizer.

The weed is often found in stands of maturing rice plants because it continues to germinate following dissipation of herbicides or after the last hand weeding. Such late infestations have little effect on crop yield but interfere with harvesting and also harbor rodents. It is disliked as a fallow species by farmers in Lao PDR because it is generally associated with poor rice yields.

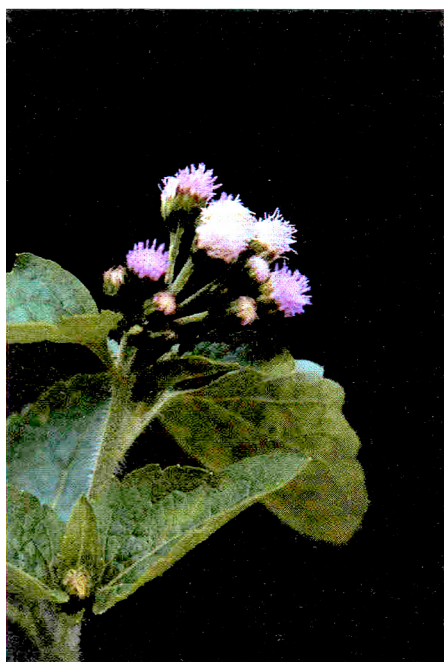
The leaf spot *Ragnhildiana agerati* and its parasite *Hanfordia ugandensis* have been recorded on *A. conyzoides*. It is a host to many nematodes, including *Helicotylenchus dihystra*, *Meloidogyne acrita*, *M. arenaria*, *M. graminicola*, *M. hapla*, *M. incognita*, *M. javanica*, *Pratylenchus* sp., *P. zaeae*, and *Rotylenchus reniformis*. It is a source of the tobacco krupuk virus inoculum. It is also a host to fungi *Puccinia conoclinii*, *Rhizoctonia solani*, and *Sclerotium rolfsii*, the common cutworm *Spodoptera litura*, the wilt bacterium *Pseudomonas solanacearum*, and *Haplothrips ganglbaueri*.

The species is sometimes used as a medicinal plant.

Weed management

Cultural. *A. conyzoides* can be readily controlled when young by hand pulling or hoeing.

Chemical. Application of 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ within 20-30 d after emergence gives good control. Butachlor and oxadiazon at planting are also effective in controlling this weed. Spraying a 20% salt (NaCl) solution mixed with detergent completely eliminates *A. conyzoides* in northern Thailand.



References

Akobundu and Fagade (1978), Ananthakrishnan and Thangavelu (1976), Bansal and Singh (1986), Bendixen (1986), Fenner (1980), Gapasin et al (1996), Henderson (1959), Holm et al (1977), Kardin et al (1977), Le Bourgeois and Merlier (1995), Merrill (1912), Moody et al (1984), Mortimer (1994), Nemoto et al (1983), Pancho and Obien (1995), Parker (1992), Roder et al (1995), Rodriguez and Cepero (1984), Shibayama and Hashem (1995), Swarbrick (1989), Trisusilowati et al (1990), Vaughan and Autrey (1973), Vernon (1983), Waterhouse (1994).



Bidens pilosa L.

(Synonyms: *B. chinensis* Willd., *B. leucantha* Willd., *B. subalternans* DC.)

Common names

Country/language

English

Australia Cobbler's pegs

Indonesia Harenga

Philippines

Bisaya Pisau-pisau

Cebuano Pisau-pisau

Ilocano Puriket, purpurikit

Ilongo Tubak-tubak

Tagalog Panibat, tagab

Thailand Puen nok sai

Lao PDR Pak kwan cham

Myanmar Moat-so-ma-hlan, ne-gya-gale, ta-se-urt

Vietnam Cuc trang, su nha long

Botanical characteristics

Very young plants of *B. pilosa* have strap-shaped cotyledons 25 mm in length and purple-tinged hypocotyls. Plant annual, erect, branched, usually smooth but sometimes more or less hairy herb ranging from 0.2 to 1.5 m high, very variable. Leaves opposite up to 15 cm long, the top one usually much smaller. Blade simple but deeply divided; seems to be compound with 1 or 2 pairs of leaflets arranged along the sides of a common petiole. Segments broad, lance-shaped, tapering to a point, toothed. Heads long-peduncled, about 8 cm long in flower, disk flowers brown or yellowish, rays yellow or nearly white, inner involucre bracts with broad, rough margins. Achenes linear, black, 1 to 1.5 cm long, bearing a few pale stiff hairs on angles in upper part. Pappus bristles gold-colored, 2-4 furnished with downward-pointing barbs.

Distribution

Originates in tropical America but now widespread throughout warmer regions of the world. In upland rice, common in Thailand and present in Indonesia, Lao PDR, Myanmar, Philippines, and Vietnam.



Biology and ecology

B. pilosa is of major to intermediate importance as a weed in crops, roadsides, pastures, wastelands, gardens, and cultivated areas. It crowds out crops. It has developed adaptive mechanisms for dispersal and survival. It has a collection of black, barbed fruits radiating in all directions from a common receptacle. Its adherent fruits give it great mobility.

A single plant yields 3,000 to 6,000 seeds, many of which will germinate at maturity. In Zimbabwe, seed production of 12,000 seeds plant⁻¹ was reported. Light and good aeration favor

germination, but the plant can also germinate in the dark. Under continuous fluorescent light, germination was 80-90%. Germination is also induced by brief exposures (2 min or longer) to blue, green, red, and far-red light. The promotive effect of an irradiation with red light is not reversed by far-red light.

The lower temperature limit for germination is 10-20 °C and the upper limit is 40 °C. Optimum germination temperatures are from 15 to 40 °C. *B. pilosa* seeds can remain viable for years when buried below the soil surface. Those stored from 3 to 5 yr still gave 80% germination. Germination is affected by moisture availability and decreases with decreasing osmotic potential.

The weed has chromosome numbers of $2n = 24, 36, 46, 48, 72$, and ca. 76.

It has a strong taproot and tolerates low humidity, characteristics that allow it to grow in fairly dry places, although it does not do well in sandy soils. It grows mainly where the annual rainfall is > 1,500 mm and it is an indicator of heavy moist soil. It can grow at any time of the year. Propagation is by seed.

The weed is a host for nematodes such as *Meloidogyne hapla*, *M. incognita*, and *M. javanica*, and fungal pathogens such as *Cercospora bidentis*, *C. magalopotamica*, *Entyloma bidentis*, and *Uromyces bidenticola*. It is also a host for the parasitic plant *Cassytha filiformis*.

The leaves are used in Africa to treat inflammation and rheumatism. Two acylated glucosides may be associated with therapeutic effects. The Igorots of Bontoc (Philippines) mix the shrub with grains of rice to make rice wine.



Weed management

Cultural. Hand weeding at 2-3 wk after emergence provides effective control.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence gives effective control.

References

Bendixen (1986), Dassanayake and Fosberg (1980), Henderson (1959), Hoffman and Holz (1988), Holm et al (1977), Le Bourgeois and Merlier (1995), Ohwi (1965), Pancho and Obien (1995), Sauerborn et al (1988), Schwerzel (1967), Swarbrick (1989), Valio et al (1972), Vernon (1983).

Chromolaena odorata (L.) R. M. King & H. Rob.

(Synonyms: *Eupatorium conyzoides* Vahl, *E. inulifolium* H.B.K., *E. odoratum* L.)

Common names

Country/language	
English	Siam weed
Indonesia	Kerinyu
Philippines	
Bisaya	Hagonoy nga badyi
Cebuano	Hagonoy
Ilongo	Hagonoy
Tagalog	Gonoy
Thailand	Saap suea
Lao PDR	Nya khi law
Myanmar	Kone-be-da, ne-da-ban, za-ma-ni
Vietnam	Co hoi, yen bach

Botanical characteristics

A spreading perennial shrub growing from 1 to 7 m high. Taproot deep and massive; stems yellowish, shortly hairy or nearly smooth, round, with fine longitudinal lines, spreading and profusely branched. Herbaceous when young, tough and semiwoody when older. Leaves opposite, broad and triangular in shape and tapering to a point, 6 to 12 cm long, 3 to 5 cm wide; margin toothed with teeth pointing forward. Petiole 1 cm or more long. Capitula, 10 to 35, arranged into flat-topped inflorescences at terminal or axillary peduncles, outer ones opening first. Bracts 0.5 to 1 cm long, 3 mm in diameter, straw to greenish colored in 5-6 closely overlapping rows. Florets all tubulate with a corolla, 5-lobed, with two branched stigmas projecting above. Florets pale mauve, pale blue, or whitish, protruding from capitula. Fruit an achene 5 mm long, narrow, linear-angled, brown or black, with short white stiff hairs on angles, pappus white with rough bristles, about 5 mm long.

The plant is easily distinguished by the many rows of phyllaries that are progressively longer, giving a markedly cylindrical appearance to the head; the three prominent veins on the leaves; and the pungent smell when crushed.

Distribution

Native to Mexico, West Indies, and tropical South America. Mainly a weed of plantation crops and pastures in South and Southeast Asia and West Africa. Spread widely by early navigators. In upland





rice, common in Thailand and Lao PDR and found in the Philippines, Indonesia, Myanmar, and Vietnam.

Biology and ecology

C. odorata is found on cultivated lands, abandoned or neglected fields, waste places, forest trails, fencerows, roadsides, and banks. It is mainly a weed in plantations of perennial crops such as oil palm, coconut, rubber, and fruit trees, and in fallows and pastures. It can be an aggressive weed due to rapid regrowth after cutting, profuse branching, and prolific seed production. It has a chromosome number of $2n = \text{ca. } 64$.

The plant can grow on many soil types but seems to prefer well-drained sites. Reproduction of *C. odorata* is by achenes (seeds), which are produced in large numbers (90,000 seeds mature plant⁻¹ or 400,000 seeds m⁻² in 3-yr-old fallow) and are wind-borne. These traits help the weed to succeed as an early colonizer.

Germination is favored by alternating temperatures (15/30 °C). Treatment with various white and red light exposure periods promoted germination. A dark imbibition period (greater than 24 h) prior to light treatment also significantly promoted germination.

The seeds will not germinate in areas of scanty rainfall and where temperature is below 15 °C, but germinate well after fire. Seedlings are not capable of survival under deep shade vegetation in undisturbed forests. No persistent seed bank has been reported because seed longevity in the soil is little more than 3 wk. Growth is initially slow at the seedling stage and increases progressively to a maximum between 40 to 60 and 130 to 150 d after emergence. At maximum growth, an increase of 1-2 cm in

length per day is normal. At the early stage, the plant maintains a monopodial growth for approximately 2 mo. Within this period, a corresponding increase in height occurs. After 4 mo, however, shoot growth decreases and profuse lateral branching occurs.

Flowering can occur over a wide range of daylengths (10-14 h) but is greatly enhanced by shorter daylengths. All plants tend to flower together.

The plant supports a large insect fauna. Oligophagous insects associated with *C. odorata*, especially host-specific forms, have been studied. The arctiid, *Ammalo arravaca*, has been shown to complete larval development on *C. odorata*. It is reported in Thailand to be an alternate host of *Cercospora* leaf spot.

In the Philippines, farmers claim that ingestion of *C. odorata* causes diarrhea and consequent death among cattle. The decline in cattle population and abandonment of grazing lands in some areas have been attributed to this weed.

Weed management

Mechanical/cultural. *C. odorata* is controlled in many countries mechanically, although regrowth can be rapid after clearing. The species often grows as a fallow volunteer, with argument over whether it is a useful plant or a weed, and is cleared in slash-and-burn preparation of cropping areas. Mulch and cover crops such as *Centrosema pubescens*, *Calopogonium mucunoides*, and *Desmodium ovalifolium* have been used to reduce the incidence of the weed, especially in plantations. Hand hoeing, usually done twice, can keep the weed under control during the cropping season.

Chemical. MCPA at 0.4 kg ha⁻¹ applied 25-30 d after emergence gives reasonable control.

Biological. Biological control has been investigated using larvae and adults of the insect *Pareuchaetes pseudoinsulata* and fungal pathogens *Ciononthrix praelonga* and *Septoria ekmaniana*. They may prove to be useful either as classical biocontrol agents or as mycoherbicides.

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Crassocephalum crepidioides (Benth.)

S. Moore

(Synonyms: *C. diversifolium* Hiern, *Gynura crepidioides* Benth., *Senecio diversifolius* A. Rich.)

Common names

Country/language	
English	
USA	Thick head
Indonesia	Jaringan ketul
Philippines	
Bisaya	Tugalpo
Tagalog	Bulak-manok
Thailand	Phak phet maeo
Lao PDR	Nya hua bin
Myanmar	lyar-ma-ni-paung
Vietnam	Kim-that

Botanical characteristics

An erect, sparsely hairy annual herb up to 1m high. Stem branched, with soft hairs or nearly smooth, prominently ribbed. Leaves dark green, soft, alternate, elliptical, sharply toothed with at least 2 lobes near the base, the lower leaves with long stalks. Inflorescence in heads pinkish to reddish brown tipped, 0.8-1.3 cm long, enclosed by green bracts, drooping on slender branched peduncles 0.4-6.5 cm long in open clusters. Flowers all tubular, 9-11 mm long, bisexual. Fruit a brown achene, narrow, with 10 ribs, 2 mm long; pappus white, up to 10 mm long, fine and silky.

Distribution

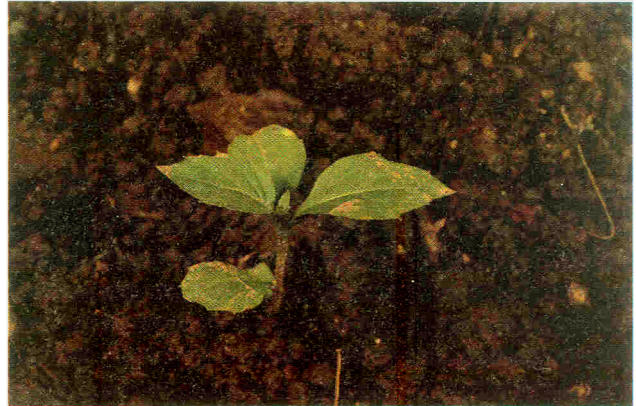
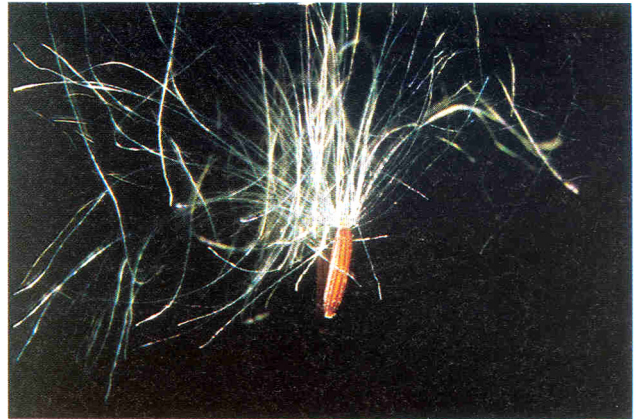
A native of tropical Africa and now widely distributed in the tropics of Asia. In upland rice, common in India, Indonesia, Lao PDR, Philippines, and Thailand and present in Myanmar and Vietnam.

Biology and ecology

C. crepidioides occurs from 250 to 2,500 m, especially in wet localities on arable land, waste areas, river banks, and roadsides. It is a weed of disturbed habitats, crops and pastures, abandoned cultivation areas, and plantations, reaching a density of 70 plants m⁻². Although a crop weed, it is readily eaten by livestock, and is reportedly a useful fodder for poultry.

Optimum temperatures for germination are between 20 and 35 °C. The lowest temperatures at which germination occurred were 10-20 °C, while germination did not occur above 40 °C. The low-temperature limit for germination explains its common incidence at high altitudes. Seed germination is sensitive to moisture availability and was reduced by an osmotic potential of -1 bar.

After storage for a year in dry conditions, seeds of *C. crepidioides* germinated only when exposed to light. After 20 mo, seeds also germinated in the dark.



The plant is daylength-neutral, and can flower year-round with a high reproductive capacity. It is able to produce about 30 flowers with approximately 4,400 seeds plant⁻¹. The seeds have a 10-mm pappus and are easily blown by the wind after detachment from the mature inflorescence. The plant is widely wind-dispersed. *C. crepidioides* is a host for nematodes such as *Meloidogyne incognita*.

Weed management

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20–30 d after emergence provides good control.

References

Auld and Medd (1992), Bendixen (1986), Henderson (1959), Lubigan and Moody (1987), Moody et al (1984), Pancho (1986), Pancho and Obien (1995), Sauerborn (1985), Sauerborn and Koch (1988), Soerjani et al (1987).

Eclipta prostrata (L.) L.

(Synonyms: *Cotula alba* L., *E. alba* (L.) Hassk., *E. erecta* L., *Verbesina alba* L., *V. prostrata* L., *V. pseudo-acmella* L.)

Common names

Country/language	
English	
Great Britain	American false daisy
India	Bhangra, bhringraj
Indonesia	Urang aring
Philippines	
Bisaya	Kahoy-kahoy
Ilocano	Karimbuwaya, tinta-tinta, tultulisan
Tagalog	Higis-manok
Thailand	Kra meng
Bangladesh	Keshuti
Lao PDR	Nya hom keo
Myanmar	Kyeit-hman
Vietnam	Co-muc

Botanical characteristics

A subherbaceous annual or perennial plant with reddish stems, 5–45 cm long, often rooting at the nodes, stiffly appressed, hairy. Leaves opposite, simple, elliptic to lance-shaped, 0.8–5.5 cm × 1.5–15 cm, narrowing gradually and subpetiolate at the base, narrowly acute at the apex, margin entire or faintly toothed with

sharp, appressed, straight, and basally swollen hairs on both surfaces, quite strongly trinerved at the base. Inflorescence a globose head, 0.5–1 cm in diameter, axillary or terminal, involucre bracts in two rows. Ray flowers numerous, white, basal tubes 0.5 mm long; minutely hairy at the apex; ligules 1.5–2.5 mm long. Disc flowers 10–15, white, corollas 1.5–1.8 mm long. Paleae bristle-like, 3–3.5 mm long. Peduncles 0.5–4 cm long, involucre 3–5 mm in diameter; phyllaries oblong-ovate, acute, 4–6 mm long, 1.5–3 mm broad, covered with stiff appressed hairs. Fruit (achene) brown or black, 3–3.5 mm long, 1.5 mm broad, sparsely and minutely hairy or downy at the top; pappus absent.

Distribution

Native of Asia. Now distributed worldwide in subtropical, tropical, and warm temperate regions. Common in upland rice at all consortium sites.

Biology and ecology

E. prostrata, a C₃ plant, is adaptable to changing environmental conditions, occurring in poorly drained wet areas along streams and ditches, marshes, paddy fields, and margins of tanks and pools, especially in sunny places. It thrives from the seacoast, where conditions can be saline, up to 2,000 m. It can impede water flow in small drainage and irrigation channels.

Studies conducted in the Philippines in the 1987 wet and dry seasons to evaluate season-long competition between upland rice and 40 *E. prostrata* plants m⁻² at different fertilizer levels showed that yield reduction due to *E. prostrata* competition was





approximately the same (0.7 t ha^{-1}) irrespective of nitrogen level. Percentage yield loss decreased from 40% to 20% in the dry season and 63% to 32% in the wet season as the amount of nitrogen applied increased from 0 to 90 kg ha^{-1} . Thus, addition of nitrogen partly overcame the competitive effect of the weed. The amount of nitrogen lost because of weed competition ranged from 28 to 34 kg ha^{-1} in the dry season and from 34 to 44 kg ha^{-1} in the wet season.

Several studies have shown that germination of *E. prostrata* is affected by temperature, light, moisture availability, and pH.

Light is required, with germination possible at light intensities ranging from 6% to 100% of full light. No germination occurred in the dark or with exposure to green, blue, or far-red light. Germination under red and yellow light was as good as that under white light. Emergence is reduced by increased depth of planting and flooding and this may be partly a light effect. In an upland soil, 74% of the achenes planted on the soil surface germinated, 18.5% emerged from 0.2 cm, and no emergence was observed from depths of 0.5 cm or greater.

Seeds germinate even at a temperature range from 10 to 35°C , and alternating temperatures significantly improve germination. At a constant temperature of 35°C , 78% of the achenes germinated, whereas at alternating temperatures of $35/20^\circ\text{C}$ with a 12-h thermoperiod germination was 96.5%. Germination is also influenced by the duration of illumination after absorption of water. Ten hours of illumination was needed for maximum germination and 2 h for 50% germination. Exposure to light for 30 min or less gave no germination.

Eclipta seeds germinated in water potentials ranging from 0 to -0.8 MPa , but germination dropped from about 80% above -0.2 MPa to only 30% at -0.8 MPa . Seeds failed to germinate when the moisture content of the medium was at or lower than 30% saturation. As the moisture content increased, there was a corresponding increase in germination. Germination was 50% to 90% over a buffered solution with pH ranges of 5 to 8, but no germination occurred at pH 4, 9, or 10.

Flowering can commence as soon as 5 wk after emergence and mature achenes are produced from the sixth week. Usually, 10–14 d are required for the achenes to mature. About 200 inflorescences and 14,000 achenes are produced per plant.

The basic chromosome number is eleven ($x = 11$). Both regular and irregular meioses are observed in the species. Different populations show differences in the nature of chromosomal association and chiasmata. Plasticity can be altered by environmental influences.

The weed is a host of rice sheath blight (caused by *Rhizoctonia solani*), sclerotinia blight (caused by *Sclerotinia minor*) of groundnut, dry root rot (*Macrophomina phaseolina*) of chickpea, and tobacco necrosis virus. It is an alternate host of root-knot nematodes (*Meloidogyne graminicola*, *M. incognita*, and *M. javanica*), ring nematodes (*Cricanemella onoensis* and *Tylenchorhynchus claytoni*), rice root nematode (*Hirschmanniella oryzae*), and corn cyst nematode (*Heterodera zaeae*). The weed is also a host of *Amsacta moorei*, which also feeds on newly emerged sorghum and castor bean, and the girdle beetle, *Oberea brevis*.

The weed is a source of coumestan-type compounds used in phytopharmaceutical formulations of medicines prescribed for treatment of cirrhosis of the liver and infectious hepatitis. It is also used as a wild food plant in Thailand. The leaves are used for dyeing the hair black and as a hair tonic.

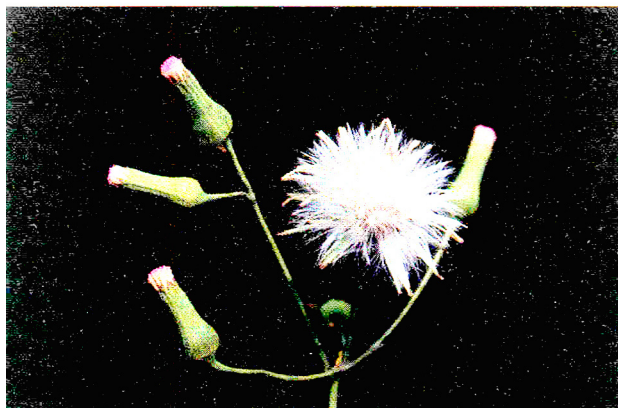
Weed management

Cultural. Early control is necessary to prevent competition from this rapidly growing weed. It is easily controlled by hand pulling and cultivation.

Chemical. Good control is achieved using 2,4-D at 0.5 to 0.8 kg ha^{-1} or MCPA at 0.4 kg ha^{-1} applied within 20–30 d after emergence. It is also controlled by oxadiazon at 0.75 to 1.0 kg ha^{-1} applied after sowing rice seeds.

References

- Agarwal et al (1989), Altom and Murray (1996), Auld and Medd (1992), Bendixen (1986), Correll and Correll (1972b), Dassanayake and Fosberg (1980), Franca et al (1995), Holm et al (1977), Kannaiyan and Prasad (1980), Kardin et al (1977), Lee and Moody (1988a,b; 1989), Mathur and Prasad (1973), Melouk et al (1992), Nahata and Kusaba (1979), Parihar et al (1991), Rao et al (1970), Satyanarayana Prasad et al (1980), Shrivastava et al (1989), Singh et al (1990), Soerjani et al (1987), Trivedi and Rajesh (1984).



***Emilia sonchifolia* (L.) DC.**

(Synonyms: *Cacalia sonchifolia* L., *Senecio sonchifolius* Moench)

Common names

Country/language	
Indonesia	Patah kemudi
Philippines	
Bicolano	Kipot-kipot, libun
Bisaya	Kampisao
Ilocano	Lamlampaka
Ilongo	Ketim, libun
Pampango	Tagulinaw
Tagalog	Tagulinaw
Thailand	Hu pra chon
Bangladesh	Bon tushi
Vietnam	Co chua-le

Botanical characteristics

Annual herb, somewhat smooth to evenly hairy, covered with a fine waxy powder that rubs off. Leaves alternate, deeply and irregularly pinnately lobed, terminal segments triangular, rarely broadly heart-shaped in shaded plants and shallowly and bluntly toothed, petioles of lower leaves narrowly winged, those joining a stem broad, furnished with auricles. Inflorescence about twice the length of leaves, or longer, with 1 to 2 ovate-lanceolate bracts, heart-shaped clasping at base, nearly flat-topped, with 3-6 heads. Involucres narrowly cylindric, 7-9 x 2.5-3 mm, with 12-16 linear bracts; flowers 30-60, all tubulate, protruding no more than about 1-1.5 mm, pale mauve, corolla lobes 5, 1 mm long. Fruit a dry indehiscent achene, about 2.5 mm long, 5-ribbed, ribs grooved, grooves covered with fine and short or almost imperceptible hairs. Outer achenes reddish brown, inner ones off-white; achene overtopped by a white setose pappus, 6 mm long, falling down rapidly.

Distribution

Native to the Old World tropics. Present in upland rice in Bangladesh, Indonesia, Philippines, Thailand, and Vietnam.

Biology and ecology

E. sonchifolia is found from sea level to 3,000 m. It prefers moist, sunny, or slightly shaded localities that are not too dry. It grows in roadsides and ditches, earth banks, gardens, lawns, shifting-cultivation fields, and tea, rubber, and other plantations. It is locally abundant but always scattered.

One thousand seeds weigh about 0.7 g. The outer circle of florets have only female parts and form achenes that differ in seed coat color from those of the perfect inner florets. The outer achenes are reddish brown, whereas the inner ones are off-white.

Germination studies have shown little difference between inner and outer achenes but a strong response to light. In one study, at 27 °C, all outer achenes germinated and 90% of inner ones did. Germination of both types was only 25% at 30 °C and nil at 35 °C. In another study, at a constant temperature of

25 °C, 80% of seeds germinated in the light but only 60% germinated in the dark. Under continuous white light, which maintains 70% of Pfr (far-red phytochrome), germination of *E. sonchifolia* is fast.

In the field, one study showed that the total buried seed population of the weed species was small, but its germinable fraction was invariably great. Forty percent of the viable (germinable + dormant) seed population occurred in the upper soil layer (0-5 cm).

Flowering plants occur throughout the dry season and individual plants complete their life cycle in about 90 d. Propagation is entirely by seed.

E. sonchifolia is a host of thrips (*Thrips tabaci*) and nematodes (*Meloidogyne acrita*, *M. incognita*, *M. javanica*, and *Rotylenchus reniformis*).

The species is used in medicine. The leaf is pounded and applied on wounds. Plants are used in India to treat fever, asthma,

and diarrhea. In China, leaf tea is used for dysentery and whole plants for abscesses, boils, colds, influenza, burns, and snake bites. The young leaves are eaten with rice and soup in Java, as edible leaves in Puerto Rico, and as salads and for home remedies in Brazil. Leaves are edible as a vegetable and have 22% protein, 11% fiber, 2.2% Ca, and 0.6% P.

Weed management

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence gives good control.

References

Bendixen (1986), Blanco Brito et al (1982), Correa and Takaki (1995), Dassanayake and Fosberg (1980), Holm et al (1997), Misra et al (1995), Moody et al (1984), Pancho and Obien (1995), Soerjani et al (1987).

Synedrella nodiflora (L.) Gaertn.

(Synonyms: *Verbesina nodiflora* L., *Ximenesia encelioides* auct. non Cav.)

Common names

Country/language	
English	
USA	Synedrella
Indonesia	Babadotan lalaki
Philippines	
Bisaya	Bukarkag nga kahoy, kilum
Ilocano	Fantakuen
Tagalog	Kalintuhod, tuhod-manok
Thailand	Phak khraet
Lao PDR	Nya katai
Myanmar	Shar-htone
Vietnam	Co tho

Botanical characteristics

An erect, dichotomously branched, smooth or sparingly hairy annual herb, 1.5 m high or less. Leaves opposite, petioled, ovate-lance-shaped to elliptic-ovate, acute, finely toothed, base prolonged on the stem beneath insertion, 3-nerved, 7-13 cm long. Flower heads subsessile or shortly pedunculate up to 4 cm, axillary and terminal, nearly 1 cm long, cylindric, few, yellow; involucre bracts ovate in 2 or 3 rows. Ray florets 3-8, ligulate, female. Disc florets 8-20, tubular, hermaphrodite. Achenes of two distinct shapes. Outer, ray achenes winged, inner, disc achenes more or less triangular and topped with 2 or 3 short bristles. Achenes arising from outer florets reddish brown, inner ones off-white.





Distribution

Probably a native of tropical America, now introduced into most tropical countries. Common in upland rice in Indonesia, Lao PDR, and Philippines and present in Myanmar, Thailand, and Vietnam.

Biology and ecology

S. nodiflora is favored in disturbed situations where moisture, nutrients, and lack of competition favor germination, establishment, and later growth. It will also grow vigorously in uncompetitive pastures and crops. The plant can become a major weed in gardens and an intermediate weed in dryland crops, plantations, and waste places. It occurs from 0 to 1,200 m altitude. It is polymorphic with chromosome numbers $2n = 18, 32, 36, 38, 40$. It can produce 6,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.71 g.

Seeds germinate in both light and dark. In light, germination is similar under a range of temperatures (27, 30, and 35 °C). In the dark, however, germination occurred only at 27 and 30 °C and was less than germination in the light. Disc achenes have significantly better germination than ray achenes at both temperatures. Seeds buried at 15 cm survived for 1 yr in the Philippines.

The weed flowers throughout the year in Indonesia. In Nigeria, it was reported to flower 6 wk from germination.

An intraspecific competition trial was conducted in Nigeria, in which populations of 5, 10, 15, 20, and 25 plants were grown for 7 wk in pots containing 1 kg of soil. There was a large drop in root and shoot dry weight per plant from 5 to 10 plants pot⁻¹ and then a gradual decrease in weights at higher densities.

This weed is an alternate host of nematodes such as *Helicotylenchus dihystra*, *Meloidogyne acrita*, *M. incognita*, *M. javanica*, *Pratylenchus* sp., *Rotylenchus* sp., and *Xiphenema americanum*. It is an ovipositional host of the planthopper *Nisia carolinensis*.

Young leaves of this plant are sometimes used as lalab, a side dish with rice, in Java and for medicinal purposes in Colombia.

Weed management

Cultural. The weed can be effectively controlled by hand weeding every 4 wk for the first 8-12 wk. After this, emerging weed seedlings are not competitive against the rice crop.

Chemical. The weed can be effectively controlled with 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence.

References

Bendixen (1986), Bischof (1978), Catindig et al (1995b), Dassanayake and Fosberg (1980), Gapasin et al (1996), Henderson (1959), Holm et al (1997), Marks and Akosim (1984), Merrill (1912), Moody et al (1984), Ohwi (1965), Pancho (1964), Pancho and Obien (1995), Swarbrick (1989), Unamma and Melifonwu (1988), Wagner et al (1990a).

Tridax procumbens L.

Common names

Country/language	
India	Fulani
Indonesia	Gletang
Malaysia	Coat buttons
Philippines	
Bisaya	Butsao dagko
Tagalog	Bulak-manok
Thailand	Teen tukkae
Lao PDR	Nya pa mo
Myanmar	Ta-bin-shwe-htee
Vietnam	Cuc-mui, thu-thao

Botanical characteristics

An annual or perennial plant with stiff, beard-like hairs. Stems trailing on the ground 15-45 cm long. Leaves opposite, ovate or lanceolate, petiolate, petioles up to 3 cm long; laminae 1.5-7 × 0.84 cm, acute or tapering to a point, wedge-shaped at the base; margins cut into sharp teeth with coarsely deep and irregularly cut teeth pointing outward, somewhat rough with stiff, beard-like hairs on both surfaces. Capitula solitary on erect, bent backward or downward, bearded, and few glandular peduncles 10-20 cm long. Involucre 7-10 mm in diameter, outer phyllaries ovate, 3.5-6 mm long, 2-3.5 mm broad, herbaceous, tapering to a point, sides incurved, thick with beard-like hairs, inner phyllaries mem-

branous, oblong, 5-8 mm long, 1.5-2 mm broad. Ray flowers 5-6, basal tubes 3-3.5 mm long, with soft hairs, ligules obovate-oblong, creamy white, 4-5 mm long, deeply 2-3-lobed at the apex. Disc corollas 5.5-6.5 mm long, with soft hairs. Paleae linear-lanceolate, 8-9 mm long. Achenes look like an inverted cone, narrow, blackish, less silky, 2-2.5 mm long, as if cut off at the apex. Pappus bristles about 20, 4.5-6.5 mm long, unequal in length, alternately longer and shorter, plumose.

Distribution

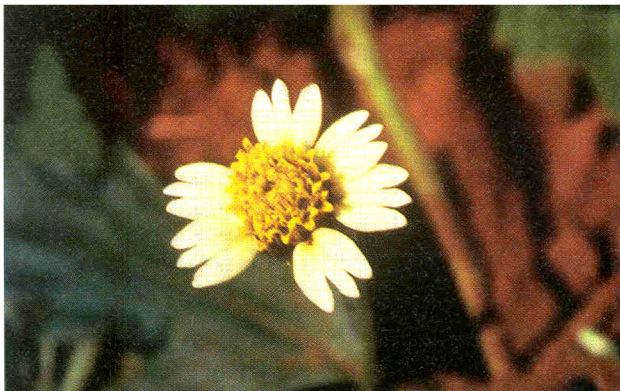
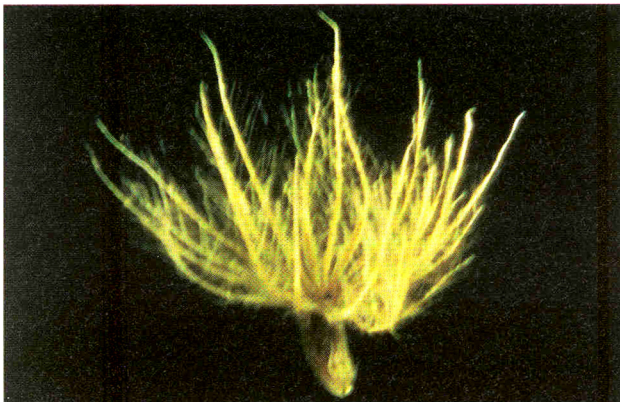
Native of tropical America, now widespread throughout tropical and subtropical regions of the world. Present in upland rice in India, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Vietnam.

Biology and ecology

T. procumbens, a C_3 species, is a common weed of lawns and cultivated grounds. It is found along roadsides, wasteground, dikes, railroads, riverbanks, meadows, and dunes. The species thrives especially in drier areas and where it is sunny or lightly shaded. It occurs at elevations ranging from 0 to 1,500 m. Its chromosome number is $2n = 36$.

The seeds of *T. procumbens* have a high degree of dormancy. They gave low germination (3%) when tested in full light and dark treatments. Drying and re-wetting the seeds increased germination by 45%.

Germination in many tropical countries in the northern hemisphere normally starts with the onset of rains in April or May. Flowering occurs quickly, with the first flowers appearing 2



to 3 wk after emergence. Flowers are in full bloom in June. Fruiting and achene dissemination start in late June and end in November, with the plants desiccating at the end of the rainy season. Flowering and seed production, however, can take place at any time during the year if moisture is available. The weed produces 2,500 seeds plant⁻¹ and the weight of 1,000 seeds is 0.77 g.

Intraspecific competition studies in Nigeria and in India found that plant density greatly affects *T. procumbens* growth. Plants attained maximum height and biomass at 12 wk. Root and shoot weight, plant height, and the number of leaves per plant dropped as the plant population increased. When 2, 6, 18, and 54 seeds were planted in pots 25 cm in diameter and placed outdoors, counts showed that 95% of the seeds emerged at all densities. But the establishment percentage dropped from 95% at 2 seeds pot⁻¹ to 82% with 18 or 54 seeds pot⁻¹. Fewer inflorescences were formed at the high populations, whereas the number of seeds per inflorescence remained constant. The overall production of seeds per pot rose from 450 to 800 as densities increased from 2 to 54 plants pot⁻¹.

In India, some allelopathic effects of *T. procumbens* on rice have been reported. Vapors emitted from leaves did not affect rice seed germination but reduced root and coleoptile length 30%, coleoptile dry weight 31%, and root dry weight 15%. When exposed to *T. procumbens* leaves, rice roots exhibited a proliferation of secondary root growth.

T. procumbens is often found in maturing rice plants because it can continue to germinate following weed control with herbicides or hand weeding. Such late infestations have little effect on crop yield but interfere with harvesting, add to the weed seed bank, and harbor rodents.

T. procumbens is a host to the root-knot nematode, the insect *Phalanta phalanta*, a virus, and the red spider mite, *Tetranychus telarius*. It is also an alternate host to *Orobanche*.

The plant is sometimes used as green feed for poultry in Nigeria and to stop bleeding in India.

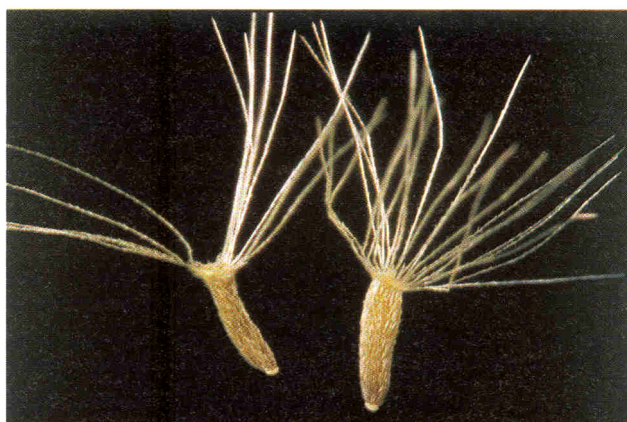
Weed management

Cultural. Plants are easily hand-pulled or mechanically weeded, but their stems often break readily and plants regrow from the lower nodes.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20–30d after emergence gives successful control of the weed.

References

Adinarayana and Gopala Rao (1989), Akobundu and Fagade (1978), Dassanayake and Fosberg (1980), Fenner (1980), Holm et al (1979, 1997), Le Bourgeois and Merlier (1995), Pancho (1964), Pancho and Obien (1995), Soerjani et al (1987).



Vernonia cinerea (L.) Less.

(Synonyms: *Conyza cinerea* L., *V. abbreviata* DC., *V. albicans* auct. non DC., *V. laxiflora* Less., *V. linifolia* Bl.)

Common names

Country/language	
English	
USA	Little ironweed
India	Sahdei
Indonesia	Buyung-buyung
Philippines	
Bisaya	Waras-waras
Ilocano	Agas-moro
Ilongo	Kolong-kugon
Pampango	Magmansi
Tagalog	Tagulinau
Thailand	Suea saam khaa
Bangladesh	Kukaim
Lao PDR	Nya phaen din yen
Myanmar	Byaing-chay-pin
Vietnam	Bach dau ong

Botanical characteristics

An erect, slender, rarely branched, somewhat pubescent annual herb 15-30 cm tall, occasionally up to 1.5 m tall. Stem ribbed, finely pilose, glandular. Leaves alternate, lower ones petioled, upper ones reduced and sessile, oval, or broadest about or above the middle, tapering to each end, shallowly toothed, 2-6 cm long, more or less densely and finely hairy. Heads small, peduncled, in open, loose corymbs, about 7 mm long, 2.5 mm in diameter. Flowers all tubular, rather bright purple, pink, or white, about 20 in each head, twice as long as the involucre bracts. Pappus bristles whitish, dentate, 3-5 mm long. Achenes rounded, nearly ribless, about 1.5 mm long.

Distribution

Native to tropical Asia. Widespread in Caribbean countries, tropical Africa, and Asia through Malaya to Australia, and New Zealand. Common in upland rice in Indonesia, Lao PDR, and Philippines and present in Bangladesh, India, Myanmar, Thailand, and Vietnam.

Biology and ecology

V. cinerea thrives in sunny or lightly shaded, dry, grassy sites along roadsides, open waste places, rubber and tea plantations, dunes, and upland rice fields, often in mixtures with other species. It occurs from 0 to 1,400 m altitude. It is a reported weed of 27 crops in 47 countries.

The plant reproduces by seeds and flowers throughout the year. Hybridization is very common in the genus, with chromosome numbers of $2n = 18$ up to about 32-36. One study showed that single anthers form 76 pollen grains, or 380 per flower.

Seeds germinate with or without the pappus when in contact with the soil. Light enhances germination (82% in light vs 62% in darkness) and seeds can germinate over a 30-d period at 25 °C. Germination percentage decreases from 58% on the soil surface to 36%, 19%, 12%, and 9% at 0.5, 1, 2, and 4 cm, respectively. But seedlings establish/emerge only from shallow depth (0-1 cm). If seeds start to germinate and then receive no moisture for up to 72 h, many will still complete germination, although the process is greatly delayed.

The weed is an alternate host of nematodes such as *Meloidogyne incognita*, *M. javanica*, *Pratylenchus* sp., and *Rotylenchus reniformis*. It is an ovipositional host of the planthopper *Nisia carolinensis* and a host of powdery mildew.

Medicinal uses of *V. cinerea* in India include treatment of conjunctivitis, dropsy, and urinary disorders. In the Philippines, an infusion of this plant is used for coughs and skin diseases and to dress wounds. A poultice from leaves reduces headaches, while a root decoction relieves stomachache and diarrhea.



Weed management

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied within 20-30 d after emergence provides good control.

References

Bendixen (1986), Catindig et al (1995b), Gapasin et al (1996), Gonzales and Soto (1984), Henderson (1959), Holm et al (1997), Ohwi (1965), Pancho and Obien (1983, 1999, Soerjani et al (1987), Wagner et al (1990a).

BORAGINACEAE

Heliotropium indicum L.

(Synonyms: *Heliophyllum indicum* DC., *H. cordifolium* Moench, *H. foetidum* Salisb., *Tiaridium indicum* (L.) Lehm.)

Common names

Country/language	
English	Scorpion weed
Indonesia	Tusuk konde
Philippines	
Bicolano	Buntot-leon
Bisaya	Elepante sa basak
Cebuano	Kambra-kambra
Ilocano	Ar-aritos, pengnga-pengnga
Ilongo	Ikog-ikog sang kuti, kabra-kabra, trompa elepante
Tagalog	Buntot-leon, higad-higaran, hinlalayon, kuting-kutingan
Thailand	Yaa nguang chaang
Bangladesh	Hatisur
Lao PDR	Nya nguang sang
Myanmar	Da-yin-gauk-pin, sin-hnar-maung-gyi, sin-let-maung-gyi
Vietnam	Voi-voi

Botanical characteristics

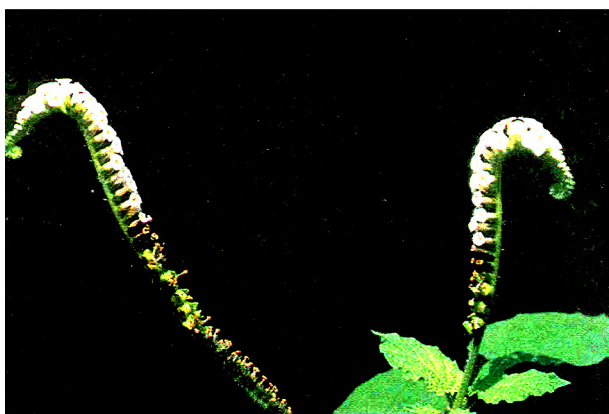
An erect, robust, coarse, succulent annual herb up to 100 cm high. Stem hairy, not much branched but with branches alternate. Leaves opposite or alternate, usually oval in outline, 4-12 cm long, 2-4 cm wide, tip pointed, base broad, with the blade running down the leaf stalk in a narrow wing, margin more or less undulate. Inflorescence of terminal, narrow spikes, curled over at their tips, 15-20 cm long, numerous small white, lavender, or purple flowers on the upper side in two closely packed rows; individual flowers tubular, up to 4 mm long. Fruit conical, composed of 2 nutlets inserted in the persistent calyx. Seed 1 per nutlet or often only 1 per pair of nutlets.

Distribution

A native of the Old World tropics, has spread to become a weed in the Caribbean, East and West Africa, and South and Southeast Asia. Present in upland rice in Bangladesh, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Vietnam.

Biology and ecology

H. indicum, a C₄ species, is found on sunny, periodically moist or marshy, and desiccating sites. It is a common weed in waste places, ditch borders, dried-up pools and ditches, and roadsides. It occurs in many crops, competing mostly for moisture and nutrients. Its adaptation to periodically wet or partially flooded situa-



tions enables it to grow and compete in crops such as rice, where weeds that are sensitive to excess water are not favored.

An annual, *H. indicum* reproduces by seeds, which are produced prolifically on long, curled, one-sided spikes. The flowering season is extended, and basal flowers of the spike mature and fall to the ground while new flower buds are still developing at the apex. The plant flowers year-round in the Philippines. It produces 2,500 seeds plant⁻¹ and 1,000 seeds weigh 2.34 g.

This weed is a host of rice sheath blight (caused by *Rhizoctonia solani*), parasitic nematodes (*Criconemella onoensis*, *Hoplolaimus indicus*, *Pratylenchus indicus*, *Tylenchorhynchus claytoni*), root-knot nematodes (*Meloidogyne* spp.), and fungi (*Botrytis cinerea*, *Cercospora heliotropii*, *Puccinia aristidas*, and *Verticillium albo-atrum*).

The plant is used as a traditional medicine in India, where the leaf juice is applied to scorpion stings and a fruit decoction is used against asthma and leprosy.

Weed management

Cultural. *H. indicum* is often controlled manually using hand tools.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ applied within 20–25 d after emergence provides good control. The weed is moderately susceptible to MCPA.

References

Catalfamo et al (1982), Henderson (1959), Ivens (1967), Kannaiyan and Prasad (1980), Moody et al (1984), Pancho (1964), Satyanarayana Prasad et al (1980), Soerjani et al (1987).

COMMELINACEAE

Commelina benghalensis L.

Common names

Country/language	
English	
USA	Tropical spiderwort
India	Kankaua
Indonesia	Brambangan
Philippines	
Bisaya	Kabilao dagko
Cebuano	Kabilau, sabilau, sambilau
Ilocano	Kulkulasi
Ilongo	Kabilao, sabilau
Pampango	Bias-bias
Tagalog	Alikbangon, likbangan, ulikbangon
Thailand	Phak plaap
Bangladesh	Dholpata, kanaibashi, kanai bashi, kanchira
Lao PDR	Nya kabpi hyai
Myanmar	Wet-kyut
Vietnam	Dau-rieu, trai an

Botanical characteristics

Annual or perennial, low creeping plant, or ascending to 30 cm tall, hairy or smooth. Leaves elliptic-ovate, hairy, 2.5-7.5 cm long,

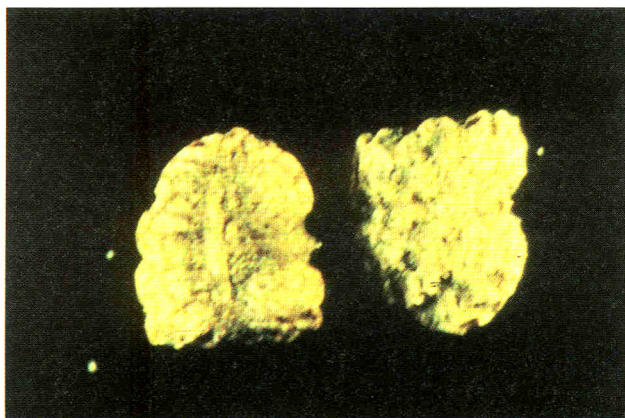
1.25-2.5 cm wide with parallel veins, the base narrowed into a petiole; petioles 0.6 cm long, fringed with short and long red hairs. Spathe 1 to 3, funnel-shaped, 1.25 cm long, shortly pedunculate. Spathe closed down the upper side to the point of attachment to the stalk. Flowers 2 or 4 per spathe, the first one long-peduncled, the others sessile. Petals 3, round, much narrowed at the base, violet-blue. Pale reduced flowers often produced on underground stems. Fruit a 3-locular capsule, 5-seeded. Seed black with a wrinkled surface, sometimes appearing sugar-coated, 2 mm long.

Distribution

Native in India and Southeast Asia. Occurs widely in the tropics and subtropics, growing mainly as a perennial in tropical Africa, India, and Southeast Asia. Can also grow as an annual in some temperate countries. Widespread and has been reported as a weed of 25 crops in 28 countries. Present in upland rice in all consortium countries.

Biology and ecology

C. benghalensis occurs from sea level to 1,000 m, and grows best under conditions of high soil moisture and fertility, in sunny or lightly shaded places. It is persistent in loamy, sandy, or rocky soils. It is a weed in crops, grasslands, roadsides, and waste places. In ditches, it can grow in water and form enormous root-bundles. In pastures, it can become dominant.



The species is prevalent in the wettest part of the season. It has a straggling habit and adventitious roots can be produced at the nodes. These two features, together with the high degree of branching that occurs in favorable conditions, enable a single plant to spread over a large area.

The plant exhibits floral dimorphism and seed polymorphism. On the stems are aerial chasmogamous flowers that normally produce one large and four small seeds. The plant has white burrowing rhizomes that can produce underground cleistogamous flowers that normally form one large and two small seeds. Both flower types are bisexual and self-pollinated.

Germination of freshly harvested seeds differs for different flower types. It was 0-3% for small aerial seeds, 20-35% for large aerial seeds, 33% for small underground seeds, and 90% for large underground seeds. Innate dormancy of all seed types was completely overcome by clipping off the seed coat. Exposure to dry heat to crack the seed coat also increased germination, the most effective treatment being 90 °C for 2 h.

Optimum temperature for germination differed among seed types. All germinated over a similar range (15-18 to 36 °C), but small aerial seeds had a narrower range of optimum temperatures.

Exposure to light improved germination but was not necessary and underground seeds responded more to light than aerial seeds. Sowing depth for optimum emergence for the four seed types was from 0 to 50 mm. There was a positive correlation between maximum depth from which emergence was possible and seed weight.

Seedlings emerged after 10-12 d in the field. They took 35 d to reach the reproductive stage. Plants grown from aerial seeds were smaller, developed aerial flowers earlier, and produced more aerial fruits than those from underground seeds. Rhizomes and underground flowers developed 6 wk after emergence on plants from all seed types, before the development of aerial flowers.

Total seed production in the field was 8,000 m⁻² for plants grown from underground seeds and 12,000 m⁻² for those from aerial seeds.

C. benghalensis is an alternate host of nematodes (*Meloidogyne incognita*, *Criconemella onoensis*, *Helicotylenchus dihystra*, *Hemicriconemoides cocophillus*, *Hoplolaimus indicus*, and *Pratylenchus indicus*), groundnut rosette virus, leaf blotch (*Corticium sasakii*) of rice, and insect pests (*Cnaphalocrosis medinalis*, *Cretonotus gangis*, and *Marasmia patnalis*).

Although a weed in crops, *C. benghalensis* is a useful forage plant in Indonesia and the Philippines. Leaves are used as human food, as medicine for infected wounds, for treating sterility, and as a mucilage for treating burns, sore eyes, and sore throats.

Weed management

Cultural. *C. benghalensis* is particularly difficult to control by cultivation, partly because broken pieces of above- and below-ground stems readily take root. With hand weeding, it is necessary to uproot all of the plant from the soil to ensure effectiveness.

Chemical. Butachlor has been reported to provide good preemergence control of *C. benghalensis*. For postemergence control, propanil at 2 kg ha⁻¹ at 10 d after emergence or 2,4-D at 0.5-0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ at 20-30 d is effective. Mixing thiobencarb at 1-3 kg ha⁻¹ or 2,4-D with propanil can increase effectiveness.

References

Auld and Medd (1992), Catindig et al (1991), De Datta and Llagas (1984), Holm et al (1977), Ivens (1967), Kim et al (1990), Le Bourgeois and Merlier (1995), Menck (1983), Pancho and Obien (1995), Satyanarayana Prasad (1980), Smartt (1961), Soerjani et al (1987), Terry (1983), Walker and Evenson (1985a,b), Watt and Breyer Brandwijk (1962).

Commelina diffusa Burm. f.

(Synonyms: *C. agraria* Kunth, *C. aquatica* J.K. Morton, *C. communis* Benth. non L., *C. nudiflora* sensu Merr. non L.)

Common names

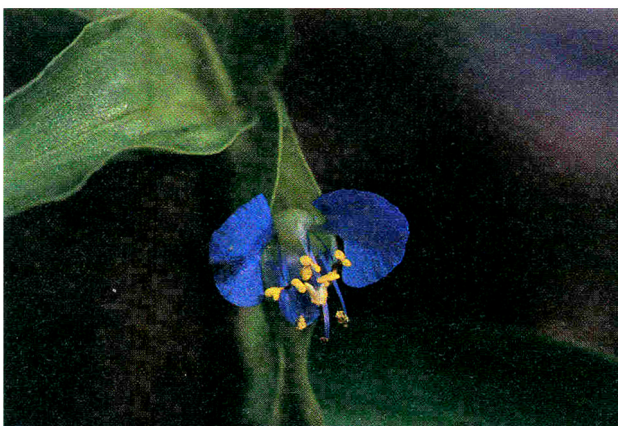
Country/language	
English	
USA	Spreading dayflower
India	Kankaua
Indonesia	Brambangan
Philippines	
Bisaya	Kabilao
Ilocano	Kulasi, kulkulasi
Ilongo	Sabilau
Tagalog	Tari-tari
Thailand	Phak plaap
Bangladesh	Kanainala, manaina
Lao PDR	Nya kabpi noy
Myanmar	Myit-cho, wet-kyut
Vietnam	Rau-trai

Botanical characteristics

Annual or perennial with a fibrous root system. Stem at first erect, later reclining on the ground because of profuse branching and layering, rarely more than 7 mm in diameter, the larger internodes to 10 cm long. Leaves broadly lanceolate, smooth beneath, smooth to slightly rough above, 3.5-11 cm long, 9-22 mm wide, parallel-veined; the base of the blade attenuated as a petiole; leaf sheaths 5-10 mm long, the throat usually lined with long white hairs or sometimes with only short hairs. Spathe stalk 1-2 cm long; spathe smooth, open across top, tapering to a slightly narrowed tip at the lower end and open down the upper side to the point of attachment to the stalk. Flowers 2 to 3, pedicelled, petals blue, 3, two larger and one smaller. Capsule 3-celled, the upper with 1 seed, the two lower each with 2 seeds. Seeds 2-2.5 mm long, angular, finely reticulate and ridged on one side.

Distribution

Native of the Old World tropics, originating in Asia. Now a pantropical weed, extending somewhat into temperate zones. Widely distributed and has been reported as a weed in 17 crops



in 26 countries. Common in upland rice in India, Indonesia, Lao PDR, Philippines, and Thailand and present in Bangladesh, Myanmar, and Vietnam.

Biology and ecology

C. diffusa is more common than *C. benghalensis*, thriving in humic or clayey soils that are continuously damp for at least part of the year. It can also persist in sandy or rocky soils, even under fairly dry conditions, and will grow rapidly with the onset of rains. The plant occurs in cultivated lands, field borders, wet pastures, gardens, roadsides, and waste places.

It is favored in shady situations, and does not grow vigorously under bright, full sunlight, where it has been observed to roll up its leaves. Because it is well adapted to moist environments, it competes strongly with crop plants, making rapid, vigorous growth. In upland pastures, *C. diffusa* grows rapidly over desirable grasses and legumes, competing with them for light and nutrients.

The plant reproduces vegetatively and from seed. It roots readily at the nodes of creeping stems, especially if cut or broken. It can produce approximately 1,000 seeds plant⁻¹. The weight of 1,000 seeds is 6.22 g.

In Japan, seeds that were buried in autumn in the soil and removed after different periods showed cyclic changes in dormancy. The innate dormancy in fresh seeds was overcome during the winter and was minimal in the field from early May, when most seedlings emerge. In late July, the seedlings cease to emerge and dormancy was induced in the remaining viable seeds until late November. Induced dormancy was caused by the high soil temperatures in the summer period and decreased with depth of burial. Any seeds emerging after July failed to set seed. Another study found that the plant began to emerge at 10 °C and reached a peak of emergence above 10 °C up to 15 °C.

C. diffusa is an alternate host of several rust fungi (*Uromyces commelinae*, *Phakopsora tecta*, and *Physopella tecta*), rice sheath blight (caused by *Rhizoctonia solani*), and insect pests (*Cretonotus gangis* and *Mythimna separata*).

Although a weed of crops, it has been used as a cover crop in coffee plantations in Nicaragua. It is reportedly used in medicine.

Weed management

Chemical. As for *C. benghalensis*.

References

Bradshaw and Lanini (1995), Catindig et al (1990, 1994c), Datta and Banerjee (1976), De Datta and Llagas (1984), Gardner (1981), Holm et al (1977), Ivens (1967), Kannaiyan and Prasad (1979), Nakayama (1977), Pancho and Obien (1995), Soerjani et al (1987), Watanabe and Hirokawa (1975), Wilson (1981).

***Murdannia nudiflora* (L.) Brenan**

(Synonyms: *Aneilema malabaricum* (L.) Merr., *A. nudiflorum* (L.) Wall, *Commelina nudiflora* L.)

Common names

Country/language

English	Spreading dayflower
India	Choti kankaua
Indonesia	Tapak burung
Philippines	
Bisaya	Kabilao
Ilocano	Kolasi, kulkulasi
Tagalog	Alikbangon
Thailand	Kinkung noi
Bangladesh	Kundali
Vietnam	Loa-trai hoa-tran

Botanical characteristics

A slender, nearly smooth, creeping annual or perennial herb. Stem simple to branched, 15-30 (-45) cm long, reclining on the ground, rooting at the nodes. Roots fibrous. Leaves rather thick, linear to linear-oblong, alternate, narrowed into a basal sheath, entire, acute, tapering to a point, sides incurved, 3-10 cm long, 4-10 mm wide; sheath 5-10 mm long, with fine and soft hairs in front. Inflorescence terminal or axillary, peduncles 3-7 cm long, sometimes with a single bract; flowers numerous, about 5 mm across, blue or pink-purple, racemously clustered near the ends of the few branches; pedicels 3-4 mm long, slightly recurved; bracts about 3 mm long, boat-shaped, falling off very early; sepals 3, 1.5-2.5 mm long, oblong, hairy, obtuse; petals 3. Capsules nearly spherical, three-angled, 4 mm long, about 2 mm broad, membranous, tipped with an abrupt short point, 3-loculed with 2 seeds in each locule. Seeds about 1 mm long, subtriangular, tubercled, dark brown.

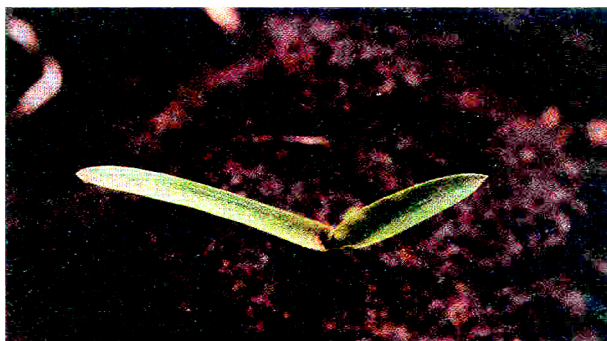
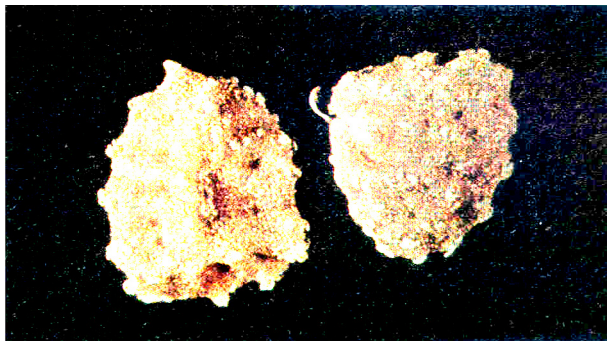
Distribution

Native to Asia. Occurs in both tropical and subtropical regions of Asia, Africa, and Latin America. Present in upland rice in Bangladesh, India, Indonesia, Philippines, Thailand, and Vietnam.

Biology and ecology

M. nudiflora occurs from sea level to 1,800 m and grows in sunny to rather deeply shaded sites that are not too dry. In many places, it is subaquatic. It occurs, often commonly, in teak, tea, oil palm, chinchona, cotton, and coffee plantations, arable land and gardens, edges of water, and ruderal sites.

Vegetative reproduction in *M. nudiflora* involves rooting at the nodes of the creeping stems. Sexual reproduction is by seed. Flowers open only for a few hours, then wilt. It produces 500 to 2,200 seeds plant⁻¹ and there are 1,000 seeds g⁻¹.





M. nudiflora is an alternate host of the nematodes *Pratylenchus pratensis* and *Meloidogyne arenaria*, the fungus *Pythium arrhenomanes*, and viruses that cause cucumber mosaic and southern celery mosaic. *M. nudiflora* is an ovipositional host of a planthopper, *Nisia carolinensis*, that is common in rice field habitats. It is also a host to rice sheath blight caused by *Rhizoctonia solani*.

Weed management

Chemical. Good control can be achieved using 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied at 20-30 d after emergence.

References

Backer and van den Brink (1968), Catindig et al (1995b), Holm et al (1977), Kannaiyan and Prasad (1980), Kardin et al (1977), Menck (1983), Pancho (1964), Qaiser and Jafri (1975), Soerjani et al (1987), Wilson (1981).

CYPERACEAE

Cyperus brevifolius (Rottb.) Hassk.

(Synonyms: *Kyllinga brevifolia* Rottb., *K. cruciformis* Schrad.)

Common names

Country/language	
Malaysia	Short-leaved kyllinga
India	Motha
Indonesia	Jukut pendul
Philippines	
Bisaya	Busikad
Cebuano	Pugo-pugo
Thailand	Kok cok khaew
Myanmar	Myet-mon-hnyin-ywet-toe
Vietnam	Bac-dau la-ngan



Botanical characteristics

Perennial, with slender reddish brown rhizomes up to 20 cm long and 1-2 mm thick, mat-forming. Flowering stems rising from the rhizomes 3-10 mm apart, trigonous, 4-20 (-38) cm long, 1-3 mm thick. Leaves with sheaths 5-30 mm long and membranous; flaccid blades 1-3 (-10) cm long, 1-3 mm broad, mostly much shorter than the stems except when stems are dwarfed, 3 or 4 involucral leaves at the base of the inflorescence. Inflorescence a single, roundish, seemingly simple congested head 4-6 mm long and broad, with 38-100 spikelets. Spikelets falling off as a unit, 2-3 mm long, 0.8-1.1 mm broad, about 0.3 mm thick, muddy or light to moderate yellow-whitish or very pale brownish, with 2 scales, the lower one enclosing a fertile floret, the upper empty, persistent. Achene a double-convex lens shape with the upper surface against the internode and the lower one at the keel of the lower scale, obovate or oblong-obovate, shortly apiculate, 1-1.2 mm long, 0.7-0.8 mm broad, ripening to a rich brown.

Distribution

Native of Australia. Pantropical and also grows in subtropical regions; widely distributed in Southeast Asia. Present in upland rice in India, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Vietnam.

Biology and ecology

C. brevifolius, a C_4 species, occurs from sea level to 1,500 m (sometimes to 3,000 m) and commonly thrives in sunny or partly shaded wetlands, roadsides, grasslands, damp forest clearings, riverbanks, and plantations. It is a weed of 17 crops in 43 countries.

Studies in Indonesia showed that freshly harvested seeds (1 or 2 wk after harvest) are immature and not viable. Seeds older than 2 wk can germinate well and 5-wk-old seeds tend to germinate fastest. Maximum germination percentages (90%) of mature



seeds occurred after 4 wk. Mature seeds do not require an after-ripening period for successful germination. But seeds tended to have lower germination (74%) and germinated faster if they had been stored for 8 wk.

C. brevifolius attained a height of 60 cm at 16 wk after germination. The mean number of tillers was low (0.1) at 7 wk, then

increased steadily to 51 by the 20th week. The first flower head was observed at the 11th week. The plant formed 3–5 heads wk^{-1} and the number of seeds per flower head ranged from 260 to 500.

The underground parts of *C. brevifolius*, including rhizomes and roots that are very extensive but do not form bulbs, contain allelopathic essential oils, which may contribute to the weed's aggressive spread in grasslands and lawns.

C. brevifolius is an alternate host of the nematode *Meloidogyne incognita*. It is an ovipositional host of the planthopper *Nisia carolinensis* and rice insect pests *Creatonotus gangis* and *Mythimna separata*. It is a host of rice tungro-associated viruses.

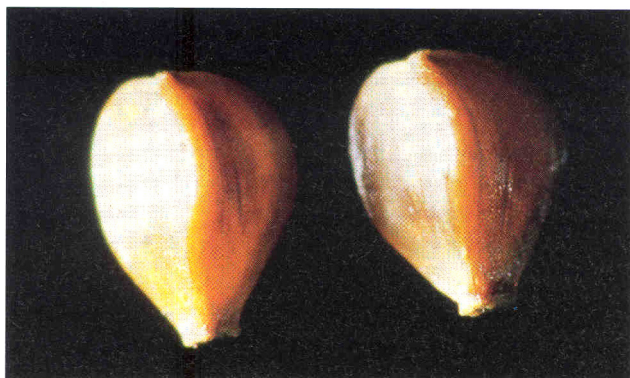
In some countries, the underground parts are used as a perfume and herbal medicine.

Weed management

Chemical. The weed can be controlled with 2,4-D at 0.5 to 0.8 kg ha^{-1} or MCPA at 0.4 kg ha^{-1} applied at 20–30 d after emergence.

References

Auld and Medd (1992), Backer and van den Brink (1968), Bendixen (1986), Catindig et al (1993, 1994c, 1995b), Holm et al (1997), Kern (1974), Komai and Tang (1989), Murata et al (1989), Pancho and Obien (1995), Soerjani et al (1987), Sumaryono (1986).



Cyperus compressus L.

(Synonyms: *Chlorocyperus compressus* (L.) Palla, *C. brachiatus* Poir., *C. pectinatus* Roxb.)

Common names

Country/language	
English	Hedgehog cyperus
India	Motha
Indonesia	Teki
Philippines	
Bisaya	Langsahan way onod
Tagalog	Gisai-kalabaw, tuhog-dalag
Thailand	Kok dok ban
Bangladesh	Satidhara
Lao PDR	Nya sam liam
Myanmar	Myet-mon-hnyin-a-pyar
Vietnam	Lac dep

Botanical characteristics

A smooth, green densely tufted annual plant up to 50 cm high. Stem and sheath of leaves 3-angled. Leaves often nearly as long as the stems, sometimes much shorter, 1–4 mm wide. Rays of inflorescence very unequal, up to 15 cm long, spreading, bracts often long, leaf-like; spikes crowded, with 3–10 spikelets, usually greenish, 1–3 cm long, up to 40-flowered. Glumes papery, prominently tapering to a point, sides incurved, densely overlapping. Stamens 3; stigmas 3. Nut obovoid, sharply 3-angled, concave on the faces, 1.5 mm long, 1 mm wide, dark brown, shiny.

Distribution

Of Asian origin. Cosmopolitan; tropical, subtropical, and temperate regions of the world. Common in upland rice in the Philippines and present in Bangladesh, Indonesia, India, Lao PDR, Myanmar, Thailand, and Vietnam.

Biology and ecology

C. compressus is a common weed of crops, grasslands, waste places, roadsides, and home gardens. It can occur from low to high altitudes and is a common weed in both irrigated and upland rice. It is propagated by seeds. One plant produces 1,000 seeds. The weight of 1,000 seeds is 0.53 g and there are 2,000 seeds g⁻¹.

The plant appears to be homogeneous. An analysis of several populations by cytomorphological examination showed no marked phenotypic or genotypic differences.

The weed is an alternate host of nematodes such as *Meloidogyne graminicola* and blast. Experiments inoculating rice with *Pyricularia oryzae* isolated from *C. compressus* produced blast symptoms.

Weed management

Cultural. In the Philippines, the weed is eradicated using hand tools at 40 d after sowing.

Chemical. In upland rice areas of North Sumatra and the Philippines, propanil at 4.2 kg ha⁻¹ applied 12 d after emergence, 2,4-D at 0.5 to 1.4 kg ha⁻¹ applied at 20-22 d, and MCPA at 0.4 to 1 kg ha⁻¹ applied at 20-30 d give good control.

References

Bendixen (1986), Bir et al (1992), Chakraborti (1983), Dassanayake and Fosberg (1985), Kern (1974), Mangoensoekardjo and Kadnan (1971), Moody et al (1984), Pancho (1964), Singh and Singh (1988), Soerjani et al (1987).

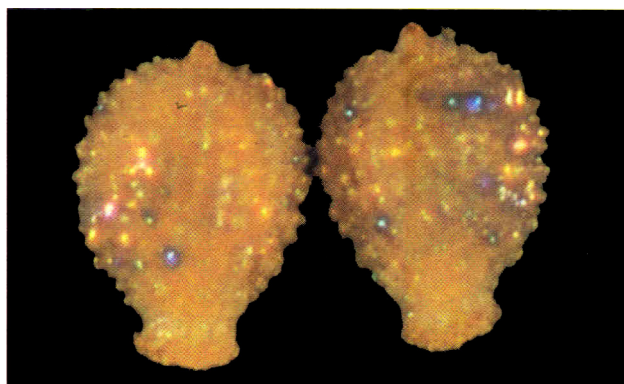


Cyperus halpan L.

(Synonyms: *C. aphyllus* Vahl, *C. autumnalis* Vahl, *C. haspan* L., *C. juncooides* Vahl)

Common names

Country/language	
Malaysia	Sheathed cyperus
India	Motha
Indonesia	Umbot-umbot
Philippines	
Bisaya	Tugbaki
Tagalog	Balabalangutan, manikmanikan, misaikalabaw
Thailand	Kok na
Vietnam	Cu com



Botanical characteristics

Short-lived tufted perennial, flowering in the first year. Stems 10-75 cm tall, erect, 2-5 mm thick at the base, sharply trigonous, soft and easily pressed flat. Leaves basal, the lowest ones bladeless,



some of the upper ones consisting of sheaths with oblique openings or even with soft blades 1-10 cm long. Inflorescence 4-12 cm long, of 10-15 extremely unequal primary peduncles, the shorter one bears a lax glomerule; bracts usually 2, one of them 0.3 to 1 (to 2) times as long as the inflorescence, the other much shorter and inconspicuous; spikelets 4-10 mm long, about 1 mm broad, linear, compressed, brown, with 8-30 flowers, the axis persistent as a unit after the scales have fallen; scales 3-nerved, 1.2-1.6 mm long, 0.8-1 mm broad, reddish or yellowish; stamens 3; achene white, circular in outline, the base tapering in an enlarged portion, the tip minutely apiculated, obscurely 3-angled, 0.4-0.7 mm long, 0.4-0.5 mm thick, roughened with a granular-like structure at the center.

Distribution

Of unknown origin. Widely distributed around the world in the tropics and subtropics. A common rice weed in Chile and Sri Lanka. Present in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam.

Biology and ecology

C. halpan occurs from sea level to 2,000 m and mainly inhabits open, very wet places, although it also grows well in dry places. It is a common weed of rice paddies and hydromorphic soils. It is a weed of 12 crops in 39 countries.

Propagation is by seed and division of rootstocks. Plants of *C. halpan* collected in a rice field in India contained 52,000 seeds each, with a 1,000-seed weight of 0.014 g. In the Philippines, one plant produces 19,000 seeds. Its seeds are harvested with rice and it can be dispersed with the crop seed.

It is an alternate host to rice sheath blight (caused by *Rhizoctonia solani*) and parasitic nematodes (*Cricodemella onoensis* and *Pratylenchus indicus*).

Weed management

Cultural. The weed is often controlled manually using small hand tools.

Chemical. The plant is effectively controlled using 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied at 25-30 d after emergence.

References

Akobundu and Agyakwa (1987), Correll and Correll (1972a), Datta and Banerjee (1976), Datta and Maiti (1963), Hollis (1972), Holm et al (1997), Kardin et al (1977), Kim et al (1981b), Pancho (1964), Prasad and Rao (1986), Ramirez et al (1991), Soerjani et al (1987), Weerakoon and Gunewardena (1983).

Cyperus iria L.

(Synonyms: *Chlorocyperus diaphaniria* Steud., *C. iria* Rikli, *C. panicoides* Lam., *C. santonici* Rottb.)

Common names

Country/language	
English	
USA	Rice flatsedge, umbrella sedge
India	Motha
Indonesia	Teki air
Philippines	
Bicolano	Alinang, paiung-paiung, sudsud, taga-tag
Bisaya	Busikad
Ilocano	Ballayang, sirau-sirau
Ilongo	Payong-payong
Tagalog	Payung-payung, taga-tag
Thailand	Yaa rangkaa khao
Bangladesh	Barachucha
Lao PDR	Nya khompao
Myanmar	Myet-mon-hnyin-a-wa
Vietnam	Lac ran

Botanical characteristics

An annual or rarely perennial herbaceous sedge. Roots yellowish red, fibrous; culms tufted, 3-angled, ranging from 8 to 60 cm high. Leaves linear-lanceolate, usually all shorter than the culm, 3-6 mm wide, margins somewhat rough on the upper part. Sheaths membranous, enveloping the culm at the base. Inflorescence simple or compound umbel, usually open, up to 20 cm long, surrounded by 3-5 bracts, the lowest one longer than the inflorescence; spikes elongate and rather dense. Spikelets erect-spreading, with 6-24 crowded flowers, 5-15 mm long, 1.5-2 mm wide, yellow, three stigmas, floral coverings broad at base, 1-1.5 mm long. Fruits small achenes, slightly shorter than glume. Terminal half broader than base, brown, triangular in cross-section, 1.0-1.5 mm long.

Distribution

Of Asian origin. Widespread in tropical and subtropical Asia, extending northward to Iran, Afghanistan, China, and Japan, southward to Australia, and eastward to the southeastern United States and the West Indies; common throughout Southeast Asia. Common in upland rice in India and present at all consortium sites.

Biology and ecology

C. iria, a C_4 species, inhabits open wet places, crops, pastures, roadsides, and riverbanks. It thrives at low altitudes up to 700 m, but becomes less common as altitude rises to 1,200 m.

It is a principal weed in paddy fields throughout the world and is also common in upland fields in many countries. It reproduces from seed. Its chromosome numbers are $n = 56, 64$. Studies have shown wide variation in genotype and phenotype within the species.

The prodigious rate of multiplication of *C. iria* is due partly to the profusion of seeds and partly to its short life cycle. A





single plant produces around 3,000 seeds although one large plant can produce 5,000 seeds. The weight of 1,000 seeds is 0.14 g and there are 7,000 seeds g^{-1} . The seedlings appear soon after rice is sown, flower in about 1 mo, shed their seed, and establish a second generation in the same season.

In laboratory studies, fresh seeds gave 40% germination while dormant ones germinated best at alternating temperatures of 20/30 °C in the light after being stored for 1 mo. With constant temperatures between 15 and 35 °C, higher temperatures gave higher germination. At 40 °C, germination decreased and at 45 °C it was zero.

Seeds buried in upland soil at a depth of 20 cm showed high germination. Unburied seeds of *C. iria* germinated as well as buried seeds both at constant temperature of 27.5 °C and at alternating temperatures of 20/35 °C when incubated in the light. In the dark, the seeds did not germinate at constant temperature. At alternating temperature, however, the longer the burial period, the greater the number of seeds that germinated.

Concentrated leachates from the root, shoot, and inflorescence of *C. iria* adversely affect germination and root and shoot growth of rice seedlings.

C. iria is an ovipositional host of insect pests (*Nisia carolinensis*, *Creatonotus gangis*, *leptocorisa acuta*, *Marasmia exigua*, *Mythimna separata*, *Nilaparvata lugens*, *Pseudococcus saccharicola*, *Recilia dorsalis*, *Spodoptera mauritia acronyctoides*, *Stenchaetothrips biformis*, and *Aphelenchoides besseyi*) and a host of diseases (*Pyricularia oryzae*, *Rhizoctonia solani*, and *Sarocladium oryzae*) and nematodes (*Criconemella onoensis*, *Hirschmanniella oryzae*, and *Pratylenchus indicus*).

In Malaysia, *C. iria* is used for matting and cattle forage. In India, the juice is used as a tonic and to treat stomachaches.

Weed management

Chemical. *C. iria* is controlled by butachlor and is moderately susceptible to oxadiazon at 0.75-1.0 kg ha^{-1} applied after harrowing and sowing of rice. It is also controlled by early postemergence commercial mixtures of butachlor and propanil, or 2,4-D at 0.5 to 0.8 kg ha^{-1} , MCPA at 0.4 kg ha^{-1} , or propanil at 2 kg ha^{-1} applied 20-30 d after emergence.

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Cyperus rotundus L.

(Synonyms: *Chlorocyperus rotundus* Palla, *C. odoratus* Osbeck., *C. tetrastachyos* Desf., *C. tuberosus* Rottb., *Schoenus tuberosus* Burm. f.)

Common names

Country/language	
English	
USA	Nutgrass, nutsedge, purple nutsedge
India	Motha
Indonesia	Teki berumbi
Philippines	
Bicolano	Boto-botones, kamokamotihan, tarugug
Bisaya	Onod-onod
Cebuano	Taki
Ilocano	Balinsaga, baringasa, barsanga
Ilongo	Sudsud, sudsuron
Pampango	Maluapolid, sursur
Tagalog	Mutha
Thailand	Yaa hao muu
Bangladesh	Badhail, bedalle, dila, motha, mootha, mutha, nagarmuta, sadakufi
Lao PDR	Nya heomu
Myanmar	Myet-mon-hnyin-oo-net
Vietnam	Co cu

Botanical characteristics

A slender, erect, smooth perennial up to 50 cm high, with wiry rhizomes, bearing black, hard, egg-shaped fibrous tubers about 1 cm in diameter, with tubers chained by thin rhizomes. Above-ground stems usually single, erect, and 3-angled. Leaves 5-20 cm long, or sometimes as long as the stems, 3 mm wide or less. Have peppery odor when the base of the leaves is crushed. Involucral leaves 3, at base of inflorescence. Inflorescence umbrella-like, simple or compound, 2-6 cm long; rays may be long or short, spikes dense or rather loose, with 3-8 spikelets. Spikelets reddish brown, slender, erect-spreading, 8-28 (rarely to 40)-flowered; glumes 2.5-3.0 mm long, ovate, 5-7-nerved. Stigmas 3. Achene trigonous, 1.2-1.5 mm long, shortly apiculate, finely punctuate, brown.

Distribution

Widely distributed in warmer parts of the world and reported in 52 crops in 92 countries. Very common throughout Southeast Asia. In the United States, extends north to Tennessee; in Europe, restricted to the Mediterranean region. Common in upland rice in Indonesia, India, Thailand, and Myanmar and present in the Philippines, Bangladesh, Lao PDR, and Vietnam.

Biology and ecology

C. rotundus, a C_4 species, is found on all soil types and from sea level to high-mountain altitudes. It grows in wet and dry soils or climates. In cool areas, or in waterlogged soils, it grows slowly and produces few flowers and tubers. It is sensitive to shading,





which markedly reduces tuber production, leaf area index, and dry matter production. It prefers sunny or lightly shaded localities in crops, lawns, roadsides, and waste places at low and medium altitudes up to 1,000 m. The plant is often a serious pest in cultivated lands, industrial sites, gardens, and nurseries.

The plant propagates from tubers that can be left in the soil during cultivation as they readily break off from the connecting rhizomes. The sprouting tuber produces a rhizome that terminates as a green aerial shoot. In the process of emerging from the soil, a basal bulb appears on the rhizome. Bulb removal shortly after the plant has become established results in decreased growth of the aerial shoot. Roots formed on the basal bulb and rhizome grow for a distance of 1 to 30 cm horizontally before the tip turns up to produce a new aerial shoot with another basal bulb. The period from emergence to flowering varies from 3 to 8 wk. There are some indications that short daylengths stimulate tuber formation. *C. rotundus* may produce up to 40 t of subterranean plant material ha⁻¹. Propagation by seed is insignificant and seed production is low, reported at 40 seeds plant⁻¹ in Zimbabwe.

The weed is an alternate host of diseases (*Pyricularia oryzae*, *Rhizoctonia solani*, *Thanatephorus cucumeris*, and *Xanthomonas campestris* pv. *oryzae*), insect pests (*Cicadulina bipunctata*, *Cretonotus gangis*, *Euscyrtus concinnus*, *Haplothrips ganglbaueri*, *Leptocorisa acuta*, *Mythimna separata*, *Nephotettix virescens*, *Nisia*

carolinensis, *Nymphula depunctalis*, *Recilia dorsalis*, *Scirpophaga incertulas*, and *S. innotata*), and nematodes (*Criconebella onoensis*, *Hirschmanniella oryzae*, *Hoplolaimus indicus*, *Meloidogyne acrita*, *M. graminicola*, *M. incognita*, *M. javanica*, and *Pratylenchus indicus*).

C. rotundus tubers are eaten after boiling or toasting during famine. Its oil is used in perfumes. The stem and tubers are used in medicine as a stimulant or vermifuge in the treatment of bowel and stomach disorders such as dysentery, and for poulticing sores and ulcers in Java and India. When applied externally to breasts, stems and tubers stimulate milk secretion. This weed is commonly used as a feed for water buffaloes in the Philippines.

Weed management

Cultural and mechanical. *C. rotundus* is sensitive to shading. It can be controlled by narrow row spacing and high plant density of crops to provide rapid shading of the soil surface.

In lowland areas, flooding suppresses tuber sprouting but does not kill tubers. Planting permanent pastures usually suppresses infestations until the field is again tilled. Use of tillage machines over a 3–5-wk period to prepare the seedbed helps control. Repeated soil disturbance early in the season is effective because tubers in the upper soil layers are vulnerable to desiccation. It may take 14 d of 40 °C temperature to kill tubers on the surface when relative humidity is high and 21 d if tubers are buried at 5–8 cm. Tillage is always most effective when soil is dry. After crop emergence, cultivation or hand hoeing must be undertaken before *C. rotundus* is well established to prevent the formation of new seeds and tubers. Two to four weeding are usually sufficient to get the crop ahead of this weed.

In traditional rice-growing areas in India, *C. rotundus* is controlled using pigs. Usually, the pigs are fed with vegetable waste and allowed to forage for tubers in wastelands. Because the tubers are succulent and sweet, pigs are fond of them. They can easily remove the tubers even if the soil is hard. Usually, the field is soaked with water and puddled well and then the pigs are introduced. An animal can collect 2–4 kg of tubers in 1 d and 60–75 animals can remove the tubers from 1 ha in 1 d.

Chemical. *C. rotundus* is difficult to eradicate, but control is most effective when herbicide use is integrated with mechanical weeding. The tuber population can be reduced by repeated application of 2,4-D and cultivation. Five 2,4-D applications at 30-d intervals followed by soil disturbance reduced tuber population by 86%. This can only be done successfully in fallows.

In rice crops, almost complete control can be achieved using herbicide combinations such as preplant application of 2 kg of glyphosate, followed by 2,4-D at 1 kg ha⁻¹ at 20 d after sowing.

Biological. The tortricid *Bactra verutana* has been evaluated for efficacy as a biological control agent for *C. rotundus*. Regardless of the stage of the moth upon release, the degree of control depended on the age and condition of the plant. Rates of infestation were high only when a majority of the shoots were 10–21 d old and growing vigorously. Other agents, such as *Athesapecta cyperi* and *Bactra venosana*, were released in Hawaii and have established readily; control has been minimal due to parasitism by native parasitoids. *Nisia atrovirens* also has potential as a biocontrol agent. It has a limited host range, being reared successfully on *C. rotundus*, and is not a rice pest.

References

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Sen (1981), Kannaiyan and Prasad (1979), Kardin et al (1977), Kuntohatono et al (1988), Le Bourgeois and Merlier (1995), Mercado (1979), Moody et al (1984), Netscher and Erlan (1993), Pauling (1983), Prasad and Rao (1986), Salim et al (1994), Satyanarayana Prasad et al (1980), Schwerzel (1967), Shetty et al (1982), Shibayama and Hashem (1995), Singh and Singh (1988), Sivaprakasam et al (1992), Tirumalarao et al (1956), Vernon (1983), Viraktamath et al (1974), Watson (1993).

Fimbristylis dichotoma (L.) Vahl

(Synonyms: *F. annua* (All.) Rohm. & Schult., *F. baldwiniana* (Schultes) Torr., *F. communis* Kunth, *F. diphylla* (Retz.) Vahl, *F. lara* Vahl)

Common names

Country/language	
English	
USA	Two-leaf fimbristylis
Indonesia	Bulu mata
Philippines	
Bisaya	Tikog-tikog
Thailand	Yaa niu nuu
Bangladesh	Joina chaise
Lao PDR	Nya nuet meo
Myanmar	Myet-kun-thee-gyi
Vietnam	Maothung luong-phan

Botanical characteristics

An annual or perennial sedge, 10-75 cm tall, with fibrous root system. Stems angular, smooth, compressed below the inflorescence. Blades 15 cm long, 0.5-2 mm wide; sheaths with fine soft hairs on the inner or lower side, 2-5 bracts at the base of the inflorescence, shorter than or equal to the peduncle. Inflorescence loose or dense, simple or compound, with few to numerous spikelets up to 20 cm long, some spikelets borne on a short stalk, others sessile. Spikelets many, 3-15 mm long, 2-2.5 mm wide, ovoid to oblong-ovoid, brown. Scales bright, 2-3 mm long, tipped with an abrupt short point or short awn. Nutlets longitudinally ribbed, transversely lined, with small knobby protuberance, having the shape of a double-convex lens, 1.2-1.5 mm long, 1-1.2 mm wide.

Distribution

Originates in Southeast Asia. Now widely distributed and common in the warmer parts of the world and reported as a serious weed in many places, such as Fiji, Hawaii, Nigeria, Japan, Taiwan, and Malaysia. In consortium countries, common in upland rice in Indonesia, Lao PDR, Philippines, and Vietnam and present in Bangladesh, Myanmar, and Thailand.





Biology and ecology

F. dichotoma, a C_4 species, occurs from sea level to 1,500 m (sometimes up to 2,500 m) and thrives in open wet places, ditches, meadows, tea plantations, teak forests, and, rarely, in swamps. It

is a weed in paddy crops, cultivated fields, old rice fields, lawns, open wetland pastures, and forest margins.

It is more adapted to upland conditions although it also grows well in poorly aerated soils with high moisture. The plant reproduces by seed, producing many that fall to the ground when mature and germinate quickly to produce seedlings any time after rains. The plant flowers year-round in the Philippines. Seed production is approximately 6,500 plant⁻¹. The weight of 1,000 seeds is 0.05 g and there are 22,000 seeds g⁻¹. In Malaysia, where fallow rice fields are grazed, undigested seeds may be moved by cattle to new locations.

This weed is used to make mats in the Philippines.

Weed management

Chemical. The plant can be controlled by 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence.

References

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Fimbristylis miliacea (L.) Vahl

(Synonym: *F. littoralis* Gaud.)

Common names

Country/language	
English	Grasslike fimbristylis, hoorahgrass
Indonesia	
Javanese	Adas-adasan
Sundanese	Bawagan, bebawangan
Philippines	
Bicolano	Sirisibuyas
Ilocano	Sirau-sirau, siraw-siraw
Ilongo	Bungut-bungot
Tagalog	Gumi, taulat, ubod-ubod
Thailand	Agor, yah nuad maew, yah nuad pladouk, yaa rat khiat
Bangladesh	Bara javani, bara pukker, chatki ghash, joina
Lao PDR	Nya khai khiad
Myanmar	Myet-kun-thee-lay, monhnyin
Vietnam	Co chac

Botanical characteristics

A smooth, strongly tillering, erect sedge that may grow as an annual or perennial. Fibrous root system. Stems slender, 1-2 mm in diameter, 40-60 cm tall, 4-5-angled and somewhat flattened, smooth; basal sheath sharply keeled, laterally compressed, having a gradually diminishing point, up to 15 cm long. Leaves 1.5-2.5 mm wide, up to 40 cm long, stiff, two-ranked, linear, much shorter than to about as long as the stem, strongly flattened, gradually tapering into an acute apex, marked with fine longitudinal paral-



lel lines, without prominent midrib; margin thin, 1.5-2.5 mm wide, slightly rough to the touch, grooved on the inner margin; ligule absent. One bracteal leaf at the base of the inflorescence, shorter than the peduncle. Inflorescence terminal up to 10 cm long, decompound, irregular, loose, umbel-like with 6-50 spikelets. Spikelet solitary, round or acute at apex, rusty brown to reddish, 2-6 × 1.5-2 mm; rachilla persistent, wingless. Glumes ovate, brown, about 1 mm long, spirally arranged, membranous, obtuse, the green midvein or keel broad. Stigmas 3-branched; anthers yellow. Nutlet 0.3-0.5 mm long, whitish to yellowish, 3-angled, broadest above the middle, warty, minutely transversely lined by oblong-linear epidermal cells.

Distribution

Native of tropical America. Now distributed around Asia and the Pacific Islands wherever rice is grown. A troublesome weed in 21 countries and one of the three most serious weeds in rice.

Although occurs mainly in rice fields, also found in bananas (Taiwan), abaca (Philippines), taro (Hawaii), sugarcane and maize (Indonesia), and sorghum (Malaysia). Present in upland rice at all consortium sites.

Biology and ecology

F. miliacea, a C_4 species, occurs from 0 to 1,000 m in damp open fields and waste places. It may not establish well in submerged conditions but competes heavily following germination during dry periods or during low water conditions.

Propagation is by seeds within nutlets. The seeds seem to have no dormancy period and have about 70% germination for the first 2 mo after harvest, but lose their viability within 6 mo of harvest. Light is required for germination.

The plant is a prolific seed producer. In the Philippines, it flowers year-round and can produce 10,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.07 g. There are 14,000 seeds g⁻¹. *F. miliacea* produces its first flowers when the dry weight is less than 10% of its maximum dry weight.

The prodigious rate of multiplication of *F. miliacea* is due partly to the profusion of seeds and partly to its short life cycle. The seedlings appear soon after rice is sown, flower in about 1 mo, shed their seed, and establish a second generation in the same season.

Studies on seedling emergence in relation to time of rice planting showed that the greatest number of seedlings emerged with early plantings of rice. In plantings made at the normal time, emergence was about 20% of that from early plantings. Late plantings produced still fewer seedlings. With all plantings, the species had the ability to keep emerging throughout the cropping period.

According to studies in India, the growth of *F. miliacea* root systems in rice fields is much more rapid than that of rice. Its roots extend vigorously in all directions, growing between rice roots, eventually surrounding them and competing seriously for nutrients. In some cases, the weed roots penetrate and enter the rice roots.

F. miliacea can be spread by livestock. Seed is eaten by cattle, passing through the digestive tract mostly undigested, and germinates near droppings.

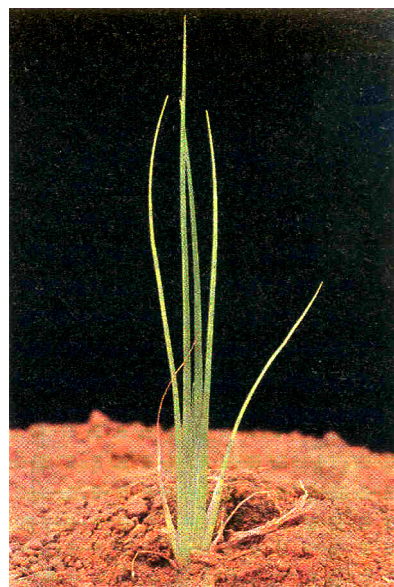
This weed is an alternate host of diseases (caused by *Rhizoctonia solani*, *Thanatephorus cucumeris*, and *Xanthomonas campestris* pv. *oryzae*), insects (*Cretonotus gangis*, *Leptocorisa acuta*, and *Mythimna separata*), and nematodes (*Hirschmanniella oryzae*, *Meloidogyne javanica*, *M. oryzae*, and *Pratylenchus indicus*).

It is considered to be a poor green manure crop and serves as a raw material for making mats. The Malays sometimes use the leaves for poulticing during fever.

Weed management

Cultural. *F. miliacea* is one of the common contaminants in farmers' seed. To prevent infestation, it is important to use weed-free seed.

Chemical. The plant can be controlled using early postsowing applications of butachlor or commercial butachlor and propanil mixtures, or MCPA at 0.4 kg ha⁻¹ at 20-30 d after emergence.



References

- Anon. (n.d.), Anon. (1952), Bandara and Nadaraja (1979), Burkill (1935), Catindig et al (1991, 1993, 1994a), Gokulapalan and Nair (1983), Holm et al (1977), Kardin et al (1977), Kim and Moody (1989a,b), Kim et al (1981a,b), Malla (1979), Pancho (1964), Satyanarayana Prasad et al (1980), Segeren-v.d. Oever and Sanchit-Bekker (1985), Shibayama and Hashem (1995), Soerjani et al (1987), Srivastava and Saxena (1967), Venkitesan and Satyakumar Charles (1979), Yin and Li (1984).

EUPHORBIACEAE

Euphorbia hirta L.

(Synonyms: *Chamaesyce hirta* (L.) Millsp., *E. capitata* Lam., *E. opthalmica* Pers., *E. pilulifera* L., *E. procumbens* DC.)

Common names

Country/language	
English	Asthma plant
India	Badi dudhi, dudh ghas
Indonesia	Dadih-dadih
Philippines	
Bicolano	Pansi-pansi, soro-soro
Bisaya	Tawa-tawa
Ilocano	Maragatas
Ilongo	Tawa-tawa
Pampanga	Bolobotonis, magatas, malis-malis
Tagalog	Botobotonis, gatas-gatas, luha ng birhen
Thailand	Nam nom raatchasee
Bangladesh	Dudhia
Lao PDR	Nya yang en
Myanmar	Kwe-kyaung-min-se
Vietnam	Sua long

Botanical characteristics

A succulent herb having white latex and bristle-like or fine and soft hairs. Usually branching from the base, with branches ascending or spreading up to 40 cm long, simple or in two or three dimensions, reddish or purplish. Leaves opposite, 1-1.5 cm long, oval or oblong to oblong-lance-shaped, base of the leaves nonsymmetrical, slanting, the margin with fine teeth pointing forward, usually with purple patch in the middle. Flowers arranged in clusters or crowded cymes, 1-2 cm in diameter, more or less pedunculate at leaf axil, greenish or purplish, small, 1 mm long, assembled into cupules. Cupule with 4 white glands on the margin and a 3-locular ovary hanging outside. Fruit a capsule, broadly ovoid, 1.5 mm long, 3-angled, hairy. Seed very small, oblong, 0.6-

0.7 mm long, reddish brown, initially smooth, later slightly transversely wrinkled.

Distribution

A native of tropical America and now a widespread weed of the tropics and subtropics. Common in upland rice in Thailand and Vietnam and present in Bangladesh, India, Indonesia, Lao PDR, Myanmar, and Philippines.

Biology and ecology

E. hirta, a C₄ species, is the most common and ubiquitous of the Euphorbiaceae. It is found in both moist and dry environments and prefers sunny to lightly shaded dry conditions. It is an early colonizer of bare ground. It is a weed of cultivated fields, perennial crops, poor or degenerate grasslands and pastures, lawns, gardens, waste areas, roadsides, fallow lands, and ditch banks. Its prostrate habit enables it to tolerate mowing, explaining its importance in lawns or turf.

Seeds of *E. hirta* show hardly any dormancy and have a high percentage germination immediately after fruit dehiscence. The lower temperature limit required for germination is 10-20 °C, whereas the maximum is 40 °C. Optimum germination temperature is 30 °C. Light is needed for germination. Germination decreases with decreasing osmotic potential, and is prevented at -10 bar.

The plant flowers year-round in most areas. When the capsules of *E. hirta* mature, they explode, throwing the seeds some distance from the plant. It produced seeds abundantly, as many as 3,000 plant⁻¹. The weight of 1,000 seeds is 0.06 g and there are 17,000 seeds g⁻¹. Propagation is entirely by seed.

The weed is an alternate host of the root-knot nematodes *Meloidogyne incognita*, *M. graminicola*, and *M. javanica*, *Hoplolaimus indicus*, *Tylenchorhynchus claytoni*, the reniform nematode *Rotylenchus reniformis*, and the root-lesion nematode *Pratylenchus indicus*. It is also one of the ovipositional hosts of the planthopper *Nisia carolinensis*, and a host of sheath blight disease caused by *Rhizoctonia solani*.



The plant may have slightly poisonous properties and is useless for livestock feed. Its leaves and/or latex are used as a traditional medicine against intestinal diseases, ulcers, bronchitis, and conjunctivitis.

Weed management

Cultural. *E. hirta* is easily controlled by hand or hoe and by cultivation.

Chemical. *E. hirta* is susceptible to oxadiazon at 0.75-1.0 kg ha⁻¹ applied after harrowing and sowing of rice. It can also be controlled with 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence.

References

Bailey (1949), Catindig et al (1995b), Henderson (1959), Holm et al (1977), Kardin et al (1977), Kranz et al (1977), Le Bourgeois and Merlier (1995), Merrill (1981), Moody et al (1984), Pancho (1964), Parker (1992), Pope (1968), Prasad and Rao (1986), Rao et al (1970), Satyanarayana Prasad et al (1980), Sauerborn et al (1988), Singh and Singh (1983), Soerjani et al (1987), Terry (1983).



Phyllanthus fraternus Webster

(Synonyms: *P. amarus* Schum. & Thonn., *P. niruri* L.)

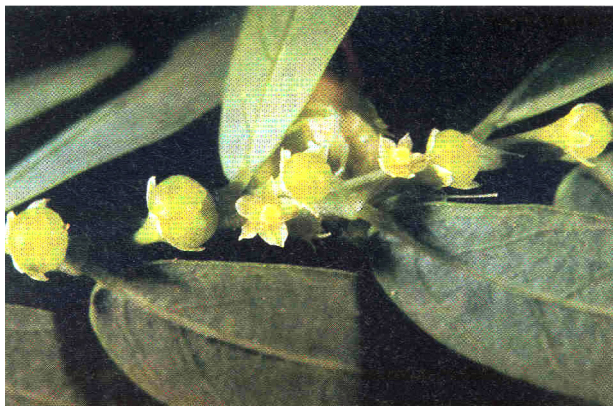
Common names

Country/language	
Jamaica	Seed underleaf
India	Hazardana
Indonesia	Muniran
Philippines	
Bicolano	Karukalunggai, surusampalok, turutalokod
Bisaya	Talikod
Ilocano	Talikod, taltalikod
Ilongo	San Pedro
Pampango	Sampasampalukan
Tagalog	Sampasampalukan
Thailand	Luuk tai bai
Myanmar	Sar-gale-zee, taug-zee-pyu
Vietnam	Co-cho-de

Botanical characteristics

A slender, erect annual up to 30 cm high. Stem with many branches spreading and closely set, smooth, woody at the base. Leaves numerous, small so they look like pinnate leaves, simple, alternate, narrowly oblong or oval with the ends regularly rounded, 5-10 mm long, 3-4 mm wide, tip blunt or broadly pointed, base round and unequal, leafstalk hardly any. Stipules 2, small, at the base of the petiole. Inflorescence very small, greenish or white flowers on downward-pointing stalks 2-3 mm long, axillary, 1 male and 1 female flower from each leaf axil; female flower 1.5





mm in diameter with 5 green sepals with white margins; male flower smaller. Fruit a brown capsule, round, about 1.5 mm in diameter, smooth. Seed light brown, wedge-shaped with two flat sides and a convex one, longitudinally ribbed on the back.

Distribution

Originates in tropical Asia. Now widespread in tropical regions of Africa and Asia. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Myanmar.

Biology and ecology

P. fraternus is a weed of sunny or somewhat shaded areas on moist, preferably fertile soils in gardens, fields, roadsides, and grasslands. It grows commonly from 0 to 2,000 m on well-structured soils where clay content varies from 10% to 40%. It is rare where clay content is more than 40%. It is also absent on very degraded and sandy soils. It is frequently found in plots that have been cultivated continually for more than 10 yr, notably in intensive cropping systems with high levels of inputs. The plant is commonly associated with the floral community of *C. benghalensis*. It is an indicator of good soil fertility.

P. fraternus propagates only by seed. It produces 3,000 seeds plant⁻¹ and there are 6,000 seeds g⁻¹. Weight per 1,000 seeds is 0.2 g. It is present throughout the crop cycle in tropical Africa. Seed germination starts around the first week of May, after first rains, and continues for 2-3 wk. New germination occurs after each cultural operation such as plowing, weeding, and ridging, until September. Flowering and maturation occur 3-4 wk after seedling emergence. The short growth cycle allows the plant to reproduce between two mechanical weedings. Plants mature and dry off in October or November.

P. fraternus is an alternate host of the nematode *Meloidogyne incognita*.

In India, it is used as a diuretic and to treat jaundice, dropsy, gonorrhea, urinary tract infections, and asthma. Brazilians use it as a diuretic, to treat diabetics and to remove kidney stones.

Weed management

Mechanical. *P. fraternus* is easily controlled by hand weeding.

Chemical. *P. fraternus* is moderately susceptible to oxadiazon at 0.75-1.0 kg ha⁻¹ applied preemergence after harrowing and sowing of rice. Effective postemergence control can be obtained by propanil at 2 kg ha⁻¹ applied 2 wk after emergence, 2,4-D at 0.5-0.8 kg ha⁻¹, or MCPA at 0.4 kg ha⁻¹ at 20-30 d after emergence.

References

Bendixen (1986), Henderson (1959), Holm et al (1997), Le Bourgeois and Merlier (1995), Pancho (1964), Soerjani et al (1987), Terry (1983).

FABACEAE

Calopogonium mucunoides Desv.

(Synonyms: *C. orthocarpum* Urb., *Stenolobium brachycarpum* Benth.)

Common names

Country/language

English

Australia Calopo

Indonesia

Indonesian Kalopo, kalopogonium

Javanese Kacang asu

Philippines

Bisaya Iping-iping, nipay-nipay

Ilongo Kalopogonium, mungo-mungo

Tagalog Balatong-aso

Thailand Tua kloom calopo

Lao PDR Ka sam peek

Vietnam Co lam dau

Botanical characteristics

Vigorous creeping perennial herb, rooting and forming a dense mat of foliage over the soil. Stems have a strong twining tendency, ascending in a left-hand direction, but dying back in the dry season. Stems up to 3 m long, succulent with brown, rough hairs. Leaves alternate, trifoliate, with leaflets 3-13 cm long, hairy on both sides, oval, with round or wedge-shaped nonsymmetric base and round apex with a small nerve point. Stipules linear, about 3 mm long, tiny linear stipelles at base of leaflets. Flowers in raceme, few, covered with brown hairs, small and pale blue. Fruit flattened, thick pod, 2-4 cm long, impressed between seeds, covered with rough hairs, splits open when ripe. Seeds 3-8, compressed, squarish, 2-3 mm long, yellowish or reddish brown.

Distribution

Native of tropical America and West Indies. Introduced into tropical Africa and Asia in early 1900s. Common in upland rice in the Philippines and present in Indonesia, Lao PDR, Thailand, and Vietnam.

Biology and ecology

C. mucunoides is suited to the hot humid tropics with an annual rainfall exceeding 1,250 mm. It grows from sea level to 2,000 m but is more suited to altitudes from 300 to 1,500 m. It is moderately drought tolerant but may die out if the dry season is prolonged. It grows vigorously on soils of all textures, even with low pH of 4.5 to 5. As a result of its free-seeding nature and twining growth habit, it is well adapted to a range of ecological conditions. Its chromosome number is $2n = 36$.

The plant grows rapidly, able to form a dense loose sward in 4-5 mo after germination, but is short-lived and may only persist for 1-2 yr. Flowering is initiated by short days. The plant is self-pollinated and seeds freely, producing about 600 seeds plant⁻¹. There are 60 seeds g⁻¹ and the weight of 1,000 seeds is 17 g. Propagation is normally only by seed.



C. mucunoides is a common plant in moist thickets, bushy, rocky areas, and light forests. It is considered a weed in crops but is a useful forage in pastures. In some plantations, it is used for green manuring, where it is cultivated before it reaches flowering to provide nitrogen to the soil.

It is poorly adapted to shade, with top growth, root growth, and nodulation declining with decreasing light intensities. This may be due to nonplasticity of leaves under shade compared with other shade-tolerant plants. Under low light intensities (20%), its leaves are reduced in size by 70% compared with leaves in full sunlight.

It is an alternate host of nematodes (*Meloidogyne acrita*, *M. arenaria*, *Pratylenchus* sp., and *Rotylenchus* sp.) and insect pests (*Nisia carolinensis* and *Nezara viridula*).

Centrosema pubescens Benth.

(Synonyms: *Bradburya pubescens* (Benth.) Kuntze, *C. ferrugineum* A. Rich., *C. intermedium* A. Rich.)

Common names

Country/language	
English	Centro, centro pea, butterfly pea
Indonesia	Sentro
Philippines	
Bisaya	Bagon-bagon
Tagalog	Dilang-butiki
Thailand	Thua-lai, thua-sentro, tua luei
Vietnam	Dau ma

Botanical characteristics

A climbing and trailing perennial plant with slender and hairy stems. Leaves alternate, trifoliate, leaflets ovate to oblong, shortly tapering to a point, 1.5-7 cm long, 0.6-4.5 cm wide, with fine or soft hairs on the lower side, seldom smooth. Stipules present at base of petiole and stipelles present at base of leaflet. Flowers



Weed management

Chemical. Butachlor at 2.0 to 2.5 kg ha⁻¹ applied preemergence has given excellent control of *C. mucunoides*. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence also provides good control.

References

Bendixen (1986), Catindig et al (1995b), Corpus (1969), Gapasin et al (1996), Garcia et al (1975), Mannetje and Jones (1992), Moody et al (1984), Nakao (1967), Pancho (1964), Pancho and Obien (1983), Saiki et al (1967), Sankaran and De Datta (1985), Skerman et al (1988).

2.5 cm long, 3-4 in cluster, with 1-flowered pedicels arranged along the sides of a common peduncle up to 6 cm long; standard whitish, mauve, purple or yellow, outer surface densely clothed with matted wooly hairs. Fruit a linear pod, 4-17 cm long, 6-7 mm wide, with ridges along both sutures and a narrow straight beak at the apex containing up to 15 seeds. Seed red-brown, streaked with black, 4-5 mm long, 3 mm wide, 2 mm thick.

Distribution

Native to tropical South America. Introduced and widely grown in tropics. Common in upland rice in the Philippines and Indonesia and present in Thailand and Vietnam.

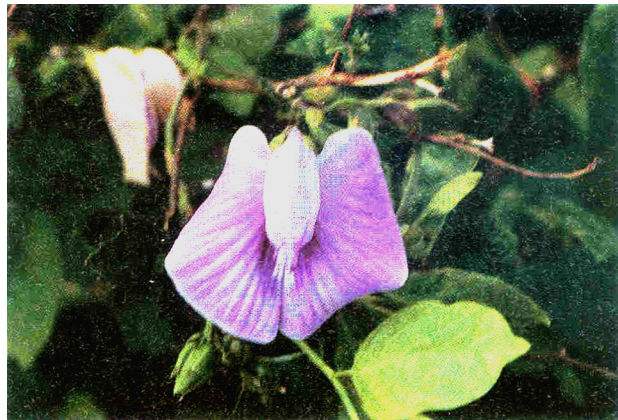
Biology and ecology

C. pubescens is widely grown as a forage legume. It is considered useful as a soil-binder, green manure, and forage, but does not withstand trampling. It is also cultivated as ground cover on teak, rubber, coconut, and palm oil plantations because of its low twining habit, dense green cover, shade tolerance, and drought tolerance. It has a prolific seeding ability and persists as a sole crop or in mixtures. It is harvested and fed to ruminants alone or in mixtures, but is considered a weed in cultivated fields.

C. pubescens is propagated by seeds. It produces approximately 350 seeds plant⁻¹. The weight of 1,000 seeds is about 30 g and there are 35 seeds g⁻¹. Up to 60% of its seeds may be hard, requiring scarification before germination. Its chromosome number is 2n = 22. It establishes slowly but can form a dense, compact cover 35-45 cm deep after 4-8 mo. It produces 12 t ha⁻¹ of dry matter and 200 kg ha⁻¹ of seed in pastures.

It prefers an annual rainfall of 1,500 mm or more but can persist in areas receiving 800 mm. It is intolerant of low temperatures, growing poorly when the temperature falls below 15 °C, but is shade-tolerant and can persist under 80% shade.

C. pubescens is an alternate host of the nematodes *Meloidogyne acrita* and *M. incognita* and sheath blight disease caused by *Rhizoctonia solani*.



Weed management

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence gives good control of *C. pubescens*.

References

Allen and Allen (1981), Asis (1971), Bendixen (1986), Kardin et al (1977), Mannetje and Jones (1992), Pancho (1964), Pancho and Obien (1995), Skerman et al (1988).

Mimosa invisa Mart. ex Colla

(Synonyms: *M. diplotricha* C. Wright ex Sauvalle, *Morongia pilosa* Standl., *Schrankia brachycarpa* Benth.)

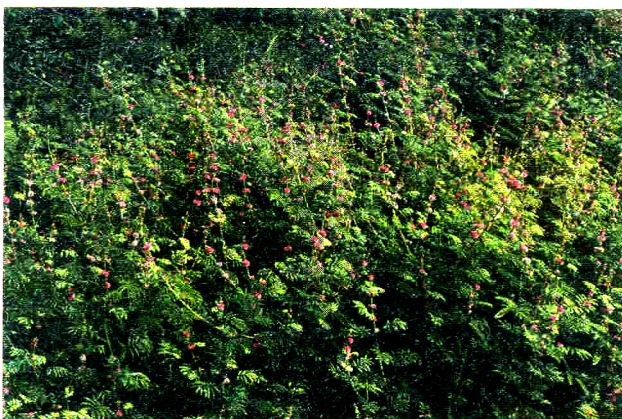
Common names

Country/language	
English	
USA	Giant sensitive plant
India	Lajauni
Indonesia	Putri malu
Philippines	
Bisaya	Hibi-hibi
Tagalog	Aroma, kamit-kabag, makahiya, makahiyang lalaki
Thailand	Maiyaraap luei
Lao PDR	Nya nahm
Myanmar	Tee-ka-yone-gyi
Vietnam	Trinh nu gia

Botanical characteristics

A herbaceous, slightly woody, prostrate perennial shrub, 1-3 m long, branches angular with abundant prickles bent outward or backward, clothed with slender hairs when young. First true leaf deeply divided with several pairs of opposite leaflets, subsequent leaves all bipinnate. Pinnae 4-8 pairs; leaflets oblong-linear, 3-4





mm long, many pairs, smooth on both sides, fringed with hairs. Moderately sensitive and recoils from touch. Flowers in dense round heads; 1-3-peduncled arising from the axil of young leaves; calyx and corolla smooth; stamens twice as many as petals, purplish. Pod linear-oblong, 1-2 cm long, covered with bristles on the valves and margins, often hairy, 4-seeded. Seeds compressed, 3-5 mm long, brown.

Distribution

Native of Brazil and tropical America. Widely distributed in most tropical and subtropical regions of the world. Common in upland rice in Thailand and present in India, Indonesia, Lao PDR, Myanmar, Philippines, and Vietnam.

Biology and ecology

M. invisa was introduced into some countries (e.g., the Philippines) as a cover crop, but has since become a serious noxious weed. It is a weed of waste places, but is becoming increasingly troublesome in plantation crops, pastures, and arable crops. The plant can flower year-round in the Philippines. It reproduces entirely from seed. The seeds can germinate at any time of the year provided moisture and temperature requirements are satisfied, with seeds produced about 50 d after flowering giving maximum germination. Some seeds may remain dormant in the soil for years, with one report of more than 50 yr before germinating. The seeds have a hard, impermeable seed coat. Burning promotes the germination of *M. invisa* seeds by cracking the seed coat and allowing imbibition.

Growth is rapid. The plant often covers an area of 2-3 m² and attains a basal stem diameter of 5 cm in the first growing season. Plants mature quickly, sometimes forming flowers and setting seeds within a few weeks of germination. Seed production is approximately 800 seeds plant⁻¹. The weight of 1,000 seeds is 6.6 g and there are 150 seeds g⁻¹.

In Thailand, the weed is classified as an annual. Seeds germinate from the beginning of the rainy season (late May to early June) and require at least 1 mo to complete vegetative growth. Flowering occurs from October to December, with maximum flowering in November. The pods ripen and dry during December and January each year.

This weed is an alternate host of nematodes such as *Meloidogyne acrita* and *M. javanica*.

M. invisa is used for green manure and as a cover plant in Indonesia and some other countries of Southeast Asia.

Weed management

Cultural. In general, neither cultivation nor cutting and burning are effective methods of control because regrowth from the crown and seedling establishment quickly replace the aerial growth removed. Hand weeding is possible in small areas, but the thorns make weeding difficult and unpleasant.

Chemical. MCPA at 0.4 kg ha⁻¹ applied 25-30 d after seeding is effective in controlling the weed in upland rice.

Biological. Programs have been undertaken in Australia to control *M. invisa* biologically. A sucking psyllid, *Heteropsylla* sp., has produced a dramatic reduction in vigor because it causes severe stunting and deformation; a coreid bug, *Scamurius* sp., which feeds on the shoots and can prevent growth and flowering, has been tested but is not as effective; and a moth, *Psigida walkeri*, the larvae of which can cause spectacular damage by voracious feeding on different plant parts, has also been studied and can provide useful control. But these programs have yet to provide practical levels of control.

References

Bailey (1949), Bendixen (1986), Eussen and Wirjahardja (1973), Holm et al (1977), Moody (1991), Noda et al (1984), Pancho (1964, 1983), Parsons and Cuthbertson (1992), Sakunnarak and Doungsa-ard (1985), Waterhouse and Norris (1987), White (1944), Whyte et al (1953).

Mimosa pudica L.

(Synonyms: *M. hirsuta* HBK, *M. hispidula* Kunth, *M. pudibunda* Willd.)

Common names

Country/language	
English	Common sensitive plant
India	Lajauni
Indonesia	
Indonesian	Putri malu, sikejut
Javanese	Kucingan, piskucing
Philippines	
Bicolano	Torog-torog
Bisaya	Hibi-hibi
Cebuano	Hibi-hibi
Ilocano	Babain, bain-bain, dilgansusu
Ilongo	Huya-huya
Pampango	Malamarine
Tagalog	Makahiya, makahiyang babae
Thailand	Yaa pan yot
Bangladesh	Kajjabati
Lao PDR	Nya nyoub
Myanmar	Tee-ka-yone
Vietnam	Trinh nu thai

Botanical characteristics

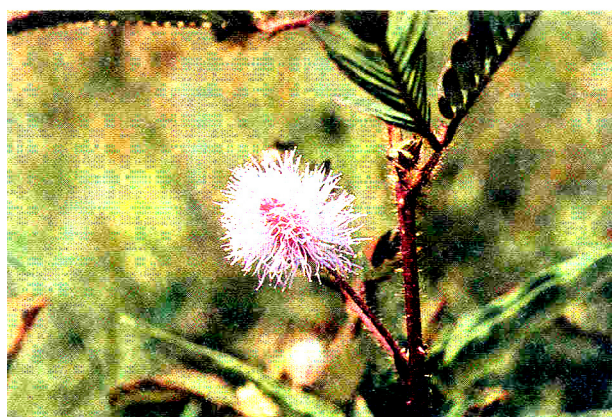
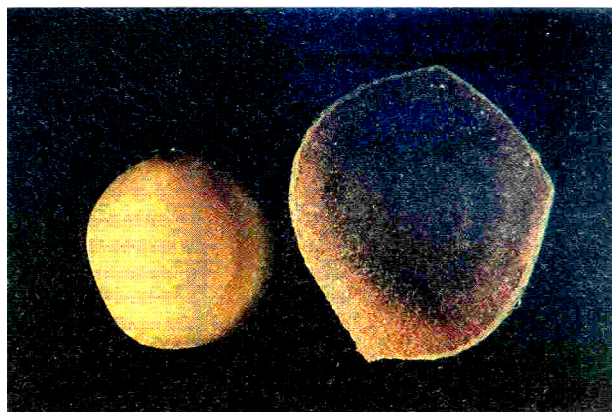
Diffusely spreading, slightly shrubby or woody annual or perennial herb. Stems branched, up to 1 m high, sparingly prickly and with numerous bristle hairs bent downward. Leaves alternate and bipinnate, very sensitive, both the pinnae and leaflets falling when touched. Pinnae usually 4, subdigitate at apex of bristly petiole. Two lance-shaped stipules at base of petiole. Leaflets narrowly oblong, sharply pointed, sides straight, 1-1.5 cm long, sessile, covered with fine bristles. Flowers numerous arranged in heads nearly 1 cm in diameter, long peduncled, solitary or 2 or 3 in each axil. Flowers pink, stamens 4. Pods flat, slightly curved outward or backward, numerous, 1-2 cm long, made up of 3- to 5-seeded joints that open at maturity and fall away from the persistent armed sutures with hairs numerous, weak, spreading, yellow-white bristles. Seeds obovate, 2 × 1.5 mm, brown. Seedlings emerge as a single stem bearing cotyledons and the once-pinnate first true leaf; subsequent leaves bipinnate.

Distribution

Native of tropical America, now found in all tropical countries; widespread throughout Southeast Asia. Common in upland rice in India, Philippines, Indonesia, Myanmar, Lao PDR, and Vietnam and present in Bangladesh and Thailand.

Biology and ecology

M. pudica is found in open waste places, lawns, roadsides, and crop fields on a wide variety of soils and from low to medium elevations. Because it can withstand considerable shading, it is an important vegetative cover under coconuts.



The plant reproduces only by seed. Freshly harvested seeds germinate within 2 wk in moist soil. In one laboratory test, 80% germination was obtained at alternating temperatures of 20/30 °C. Seeds remain viable for long periods. In one test, seeds stored in the laboratory for 19 yr still gave 2% germination.

Growth is rapid and the stem branches profusely as it develops. Flowering starts about 3 mo after germination and is then continuous in warm, moist regions. One plant can produce as many as 675 seeds. The weight of 1,000 seeds is 6.3 g and there are 158 seeds g⁻¹. The bristled pods can be dispersed on the fur of animals and the clothing of humans.

The plant is bothersome to hand weeders because the thorns lacerate the hands, causing painful wounds. It can become a pest in tropical pastures where its high plant populations and thorny stems make grazing difficult.

The plant is a host to nematodes *Meloidogyne* sp., *M. incognita*, *Rotylenchus reniformis*, and *Xiphinema americanum* and to the para-

sitic flowering plants *Cassytha filiformis* and *Cuscuta sandwichiana*.

The species is used as a medicine in various ways.

Weed management

Cultural. Although the thorns make hand pulling unpleasant, the plant can be controlled by hoeing. Cultivation can also help keep the plant under control.

Chemical. Chemical control is more effective than cultivation, and MCPA at 0.4 kg ha⁻¹ applied 25-30 d after emergence is effective in controlling *M. pudica*.

References

Ali (1973), Bendixen (1986), Dassanayake and Fosberg (1980), Holm et al (1977), Mannetje and Jones (1992), Moody et al (1984), Pancho (1964, 1983), Pancho and Obien (1995), Parker (1992), Skerman et al (1988).

MALVACEAE

Sida acuta Burm. f.

(Synonyms: *S. frutescens* Cav., *S. ulmifolio* Mill. non Stahl)

Common names

Country/language	
English	
Australia	Spinyhead sida
India	Bariara
Indonesia	Sidaguri
Philippines	
Bicolano	Surusighid, surusilhig
Bisaya	Eskuba udto-udto
Cebuano	Eskuba, silhigon
Ilocano	Basbasot, herbara, takkimbaka
Ilongo	Escuba, ualis-ualisan
Pampango	Higot balato, mamalis
Tagalog	Eskubilla, pamalis, taking-baka, walis-walisan
Thailand	Yaa khat bai yaao
Bangladesh	Gazai
Myanmar	Shwe-da-daing, ta-byet-si-pin
Vietnam	Bai-nhon, choi due

Botanical characteristics

A perennial undershrub 30-150 cm high. Stems slender, erect or spreading, fibrous to almost woody with a tough stringy bark, covered with small stellate hairs. Leaves alternate on short hairy stalks, with a pair of unequal stipules at the base; blades narrowly lance-shaped and tapering toward both ends, 2-9 cm long, 5-40 mm wide, margins toothed, prominent veins; upper face smooth, lower face with few stellate hairs. Flowers yellow, 1-2 cm in diameter, solitary or occasionally in crowded heads in the leaf axils; sepals 5, 6 mm long, petals 5, gathered at the base, 9 mm long. Fruit a hard, dark brown capsule, 3-5 mm in diameter, rough, breaking into 5-8 segments or seeds. Seeds reddish brown to black, wedge-shaped, deeply indented on both sides, rounded on the back, 1.5-2 mm long, tapering upward into 2 sharp awns or beaks 1-1.5 mm long; produced in considerable quantities in capsules with 5-12 cells.

Distribution

Native of Central America. Mainly a weed of the tropics and subtropics. Has spread to tropical Africa, South Asia, and Oceania. Reported as an equatorial species in Brazil and present in Mexico. Common in upland rice in Indonesia, Lao PDR, Myanmar, Philippines, Thailand, and Vietnam and present in Bangladesh and India.

Biology and ecology

S. acuta grows well in many soils, including heavy clays, and can tolerate dry and wet conditions. It is frequently found in pastures, wastelands, cultivated lands, roadsides, lawns, and planted forests. Once it is established, it is very competitive, holding and



denying sites to other nearby plants. It appears to do best in disturbed habitats. It is widely distributed, reported as a weed of 20 crops in 30 countries.

S. acuta propagates by seed. One plant can produce about 6,000 seeds. The weight of 1,000 seeds is 4.1 g. Seeds begin to germinate during the first 2 mo of the wet season, and continue to germinate intermittently throughout the summer if conditions remain suitable. Plants establish rapidly in the absence of competition, flower in mid-to-late summer, and produce seed in the autumn. Each flower is open for only 1 d, opening in the early morning and wilting in the afternoon. As the soil dries out in the dry season, stems also dry. New growth develops from the rootstock at the beginning of the following wet season. Where there is no marked dry season, *S. acuta* may continue to flower for most of the year.

Most seeds are dormant when shed, providing a long-term seed pool that gives rise to seedlings over many years. Dormancy is due to the hard impermeable seed coat that can be broken by scarification. In the field, dormancy is broken when soil acids, bacterial action, and contraction and expansion of the seed coat due to extremes of temperature at the soil surface eventually crack the seed coat and admit moisture. The seed also requires high alternating temperature to enhance germination. Seedlings are susceptible to shading and competition from other plants.

The awns cling to fur or stick to mud that is carried on the feet or coats of animals and are thereby spread to other areas. When the capsules do not break apart, whole capsules may be disseminated by these means. The seeds are also spread as impurities in agricultural produce such as hay and pasture seed or when seed ingested by livestock is excreted in a viable condition.

The deep taproot of *S. oculta* can withstand drought, mowing, or shallow infrequent tillage while its tough woody stems also aid in persistence. These adaptive mechanisms extend the life of the plant beyond that of many associated species.

S. acuta is reportedly a host of nematodes, but the species has not been identified.

The fibers are used for making medium-strength but hand-some rope, the stems for brooms and baskets. The leaves and roots are used in various ways in medicine.

Weed management

Cultural. Single plants or small patches can be grubbed before flowering, taking care to cut the root well below the crown to minimize regrowth. In larger areas, satisfactory control is obtained by cultivation and sowing improved pastures.

Spread can be minimized by slashing or mowing established plants just before flowering to reduce the number of seeds set.

Chemical. 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20–30 d after emergence provides efficient control.

Biological. Biological control of *S. acuta* has been investigated in Australia. A leaf-feeding chrysomelid beetle, *Calligrapha pantherina*, from Mexico was released in 1989. A population increase since the release of this insect has resulted in some local defoliation and control. Several other insects, including the beetles *C. folina* and *Acanthoscelides brevipes*, are being studied as possible control agents.

References

Bendixen (1986), Datta and Banerjee (1976), Holm et al (1977), Julien (1992), Moody et al (1984), Pancho and Obien (1995), Parsons and Cuthbertson (1992).

Sida rhombifolia L.

(Synonyms: *S. alba* Cav. non L., *S. retusa* L.)

Common names

Country/language	
Australia	Common sida
Indonesia	Sidaguri
Philippines	
Bisaya	Eskuba langusig
Ilocano	Basbasot, nangnang-isit, singitan, takkim-baka
Ilongo	Baseng-baseng
Pampango	Eskobang-haba
Tagalog	Eskobang-haba, walis-walisan
Thailand	Yaa khut mon
Myanmar	Ta-byet-si-pin
Vietnam	Co bai

Botanical characteristics

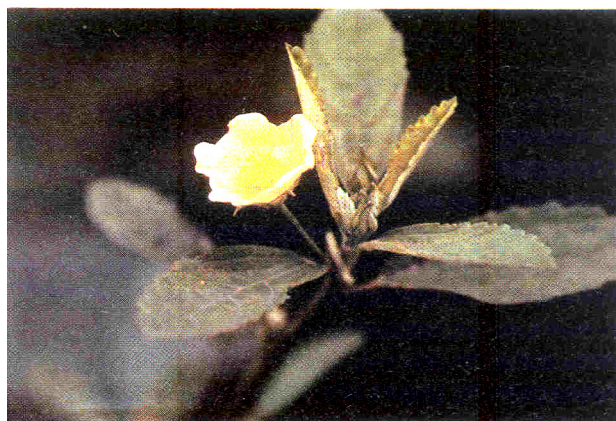
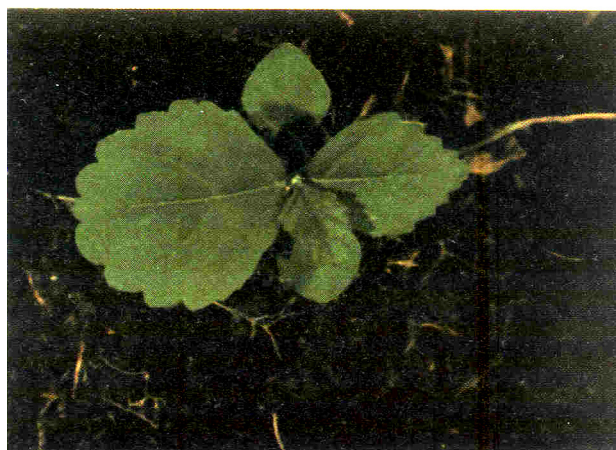
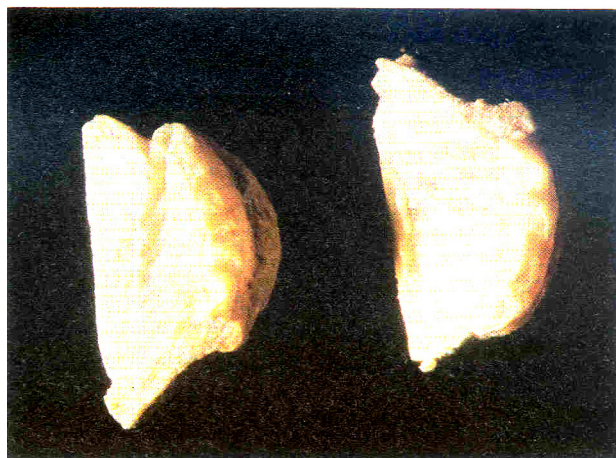
Small, erect, much-branched perennial shrub or herb ranging from 30 to 100 cm in height with a strong taproot. Stem and branches flattened at the extremes, fibrous, almost woody at times. Small stellate hairs on stem. Leaves alternate, slender, variable in shape and size, rhomboid or diamond shape; 1.2-9 cm long, 0.5-4 cm wide, sharply pointed, sides straight, not incurved, margins toothed, lower surface smooth or with sparse, short, branched, starlike (stellate) hairs, with fairly prominent veins. Petiole 3-6 mm long, hairy with a pair of stipules; at least one stipule lanceolate-linear, 1-2 mm broad, 3-6-nerved, often curved, finely hairy, the other stipule narrower, 1-4-nerved. Flowers 1-2 cm in diameter, solitary or in densely crowded axillary heads; pedicels 3-8 mm, slender, jointed near the middle; calyx 5, lobed; sepals pale green, gathered at base, triangular, acute at top, about 6 mm long. Corolla, 5 petals, obovate, light yellow or pale orange, with a shadow notch at apex; ovary 8-celled, 1 ovulate; stamens of many filaments arising from a tube; style divided into 6 branches. Fruit a capsule, 3-4.5 mm in diameter, rough, consisting of 5-8 (rarely more) carpels that break at maturity into equal, 1-seeded segments (mericarp), each of which has 2 glabrous awns or beaks, 1-1.5 mm long, or in some cases no awn. Seed small, roughly triangular, 1.5 mm long with a deep depression on each of the sides, reddish brown or black.

Distribution

Probably originated in South America. Now common throughout the tropics and subtropics and well established in many Pacific islands. Present in upland rice in Indonesia, Myanmar, Thailand, Philippines, and Vietnam.

Biology and ecology

S. rhombifolia, a C_3 species, grows from sea level to 2,000 m in many soil types and from fertile to degraded conditions. Plants grow best in nondisturbed sites but are also found in cultivated



land. When reduced- and no-tillage systems are adopted, this species becomes more common in cropland. Even though *S. rhombifolia* is widely distributed in Africa, it is most frequently reported as a weed in Central and South America and Asia. It is a reported weed of 34 crops in 75 countries, occurring frequently in pastures, sugarcane, and maize. It is a polymorphic weed with chromosome numbers of $2n = 14, 16, 18, 28, 36$.

In the field in Australia, seeds of *S. rhombifolia* begin to germinate after the first late spring/summer rains and, under favorable conditions, seedlings continue to emerge throughout the summer. Young plants establish quickly, flowering and setting seeds between December and April. New growth also appears on perennial rootstocks with the first rains and flowering starts almost immediately. One plant produces about 12,000 seeds. The weight of 1,000 seeds is 1.5 g and there are 670 seeds g^{-1} . Propagation is by seed.

In the laboratory, maximum germination occurs at 35 °C. Germination also occurred at 20 and 25 °C but not at 40 °C. Less than 50% of seed was viable after 21 d at 45 °C. The plant can germinate well (>75%) over a pH range of 5 to 8. Light does not influence germination. Emergence is similar at planting depths of 0.5-2.0 cm, with declining emergence below 2.0 cm.

Flowers open only once and all flower parts except the calyx and ovary are ejected the next day. Cold weather delays flower opening. On warm days, flowers remain open 2-5 h. Petals usually open simultaneously but close in sequence.

The awns on many fruits and high stem fiber content cause *S. rhombifolia* to be highly undesirable in pastures. The awned mericarps that contaminate grain crops can also injure livestock when used in the feed ration and young leaves may be poisonous.

The weed is an alternate host of nematodes such as *Meloidogyne acrita*, *M. incognita*, and *M. javanica*. It is also a host for the white fly, a vector of several *Sida* rice viruses.

Its stems are used to make rough cordage and broom heads. Leaves are eaten as green vegetables in Central America and sometimes used as tea. Stems have a high-quality fiber and were the source of one of the "hemp" sent to Europe from India. The species was introduced into the United States from Australia in the late 1800s as a promising fiber crop.

The plant is used in various ways in medicine. Roots have up to 0.05% alkaloids and are chewed with betel nut in New Guinea to cure diarrhea. The shoots and leaves can calm upset stomachs and the root has a sedative effect. In China, roots are used to relieve constipation, cramps, fever, rheumatism, and toothache. Shoots are used to cure chicken pox, measles, and swelling. The plant is sold in liquid, powder, and oil formulations in India to treat tuberculosis, ulcers, itches, and snake bites.

Weed management

Mechanical. Mechanical control is effective only when plants are cut below the reproductive crown; shallow cutting merely causes intense regrowth.

Chemical. *S. rhombifolia* is susceptible to oxadiazon applied at 0.75-1.0 kg ha^{-1} after harrowing and sowing of rice. MCPA at 0.4 kg ha^{-1} applied 25-30 d after seeding also gives effective control. The species is moderately resistant to 2,4-D.

Biological. Several insects, such as the beetles *Calligrapha felina*, *C. pantherina*, and *Acanthoscelides brevipes*, have been considered as possible biocontrol agents against all *Sida* spp. But they have not yet provided useful control in farming situations.

References

Bendixen (1986), Henderson (1959), Holm et al (1997), Merrill (1912), Moody et al (1984), Pancho (1964), Pancho and Obien (1995), Parsons and Cuthbertson (1992), Smith et al (1992), Terry (1983), Wagner et al (1990b), Waterhouse and Norris (1987).

Urena lobata L.

(Synonym: *U. heterophylla* Presl)

Common names

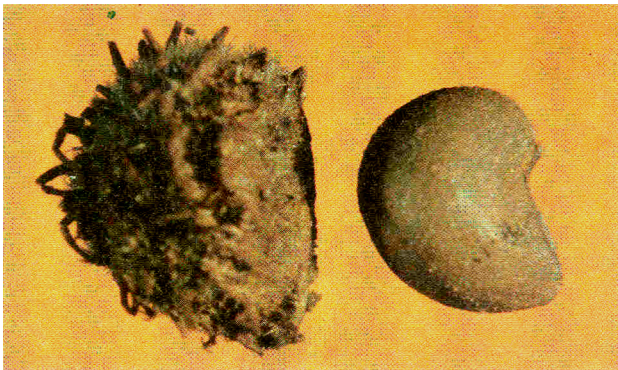
Country/language	
English	
USA	Bur-fruited urena, Caesar weed
India	Bachata, vilaiti san
Indonesia	Ambung-ambung
Philippines	
Ilocano	Kollokollot, kullukullut
Tagalog	Dalupang, kulot-kulitan, malopolo, mangkit, palisin
Thailand	Khee krok
Bangladesh	Ghamira
Myanmar	Kut-si-ne
Vietnam	Ke-khuyet

Botanical characteristics

A rather woody undershrub up to about 120 cm high, more or less hairy. Leaves very variable in shape and size, covered with branched hairs, sometimes gray-woolly, broadest near base; margin shallowly or deeply lobed, reaching 7.6 cm long and wide but usually smaller, with 3 ribs radiating from base; leafstalks from less than 1.3 cm to 6.4 cm long. Flowers axillary, pink to purple, about 2.5 cm across, lasting for only a short time, a few together or solitary on short stalks in the leaf axils. Calyx, 5 sepals alternate with epicalyx bracts. Corolla, 5 petals, obovate, 2 cm long. Stamen 10, gathered in a tube. Fruit a capsule, consists of 5 one-seeded segments (mericarp), flattened, nearly spherical, covered with hooked spines, about 7 mm in diameter. Back side with numerous linear expansions retrorsely hairy.

Distribution

Distributed widely in tropics. A major weed in the Pacific Islands and Melanesia. Common in upland rice in Indonesia, Myanmar, Philippines, Thailand, and Vietnam and present in Bangladesh and India.



Biology and ecology

U. lobata is a very common weed in lowlands, waste ground, open areas, cultivated areas, and roadsides. In upland areas, it grows in cultivated fields and in plantation crops such as coconut. Its chromosome number is $2n = 28$.

The seed is dormant due to the impermeability of the testa to water, which can be overcome by scarification. Scarification results in a large increase in seedling emergence, indicating the importance of dormancy in controlling germination. Seed viability declines rapidly during storage.

Flowering for the whole plant occurs over a prolonged period and the sequence is such that one node may bear simultaneously all stages from flower buds to ripe, mature fruit. Its pollen has spirals of long, stout, pointed spines alternating in uniform rows with operculate apertures. It has a basal cushion on its primary spine.

Two forms of the weed from Sierra Leone, called Ex-Mokwa and Indigenous, were studied for seed production, particularly the effect of harvest date on yield. Both were sown on the same date (7 May) at the start of the rainy season. Ex-Mokwa flowered after 3 mo and 21 d and Indigenous in 6 mo. Mature fruit was produced over 14 wk by Ex-Mokwa and 12 wk by Indigenous, but the bulk of fruit production was confined to a 6- to 8-wk period commencing 6-8 wk after the onset of flowering. Seeds maturing early or late had low viability and significant viable seed production occurred over a period of only 4-6 wk. The greatest

fruit yields with single harvests were recorded at the end of 6 wk. With later harvests, lower yields were obtained because of fruit shedding.

In Sierra Leone, adult and immature *Dysdercus* spp. feed primarily on developing *U. lobata* fruit. Buds and open flowers did not appear to be attacked. Leaf-eating insects, *Podagrica sjostedtii* and *P. uniforma*, were observed visiting the plant frequently. The plant is a host to nematodes such as *Meloidogyne acrita*, *M. arenaria*, *M. incognita*, and *M. javanica*.

Although a weed in crops, *U. lobata* is cultivated in some areas. The fibers are used in South America and tropical Africa for making carpets and ropes. The leaves and roots are reportedly used in medicine.

Weed management

Chemical. *U. lobata* is susceptible to oxadiazon applied at 0.75-1.0 kg ha⁻¹ after harrowing and sowing of rice. MCPA at 0.4 kg ha⁻¹ or 2,4-D applied 25-30 d after seeding also provides good control.

References

Auld and Medd (1992), Brackhanes and Vandervegt (1991), Figueiredo and Popinigis (1979), Harris (1981), Harris and Bindi (1983, 1985), Henderson (1959), Pancho and Obien (1995), Pushparajan et al (1989), Seth and Dabral (1961), Taylor (1970).

OXALIDACEAE

Oxalis corniculata L.

(Synonyms: *O. javanica* Bl., *O. micrantha* Boj., *O. repens* Thunb., *Xanthoxalis corniculata* (L.) Small)

Common names

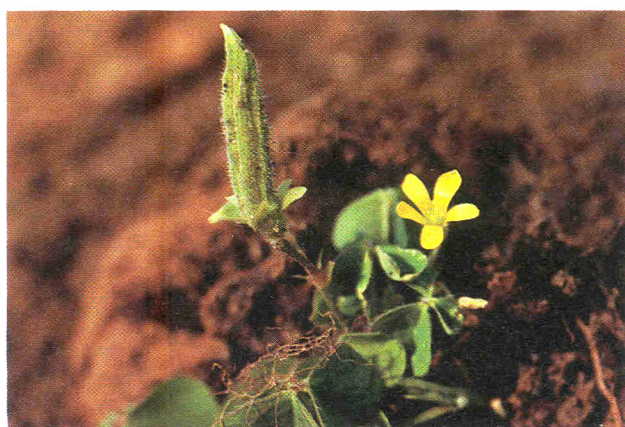
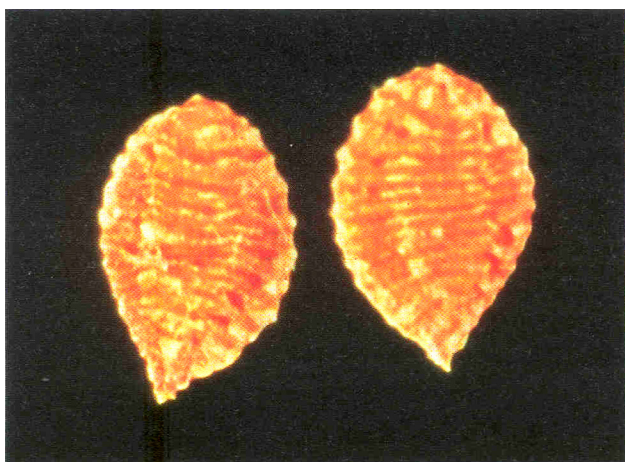
Country/language	
English	
USA	Creeping wood sorrel
India	Khati mithi ghas
Indonesia	Daun asem kecil
Philippines	
Bicolano	Daraisig
Bisaya	Gumao
Ilocano	Marasiksik
Pampango	layo, kungi
Tagalog	Taingang-daga
Thailand	Somkop
Bangladesh	Amboli, amrul, amrulshak, chukatripati, fingraphuli, tripatrishak
Lao PDR	Nya som sen ka
Myanmar	Hmo-chin
Vietnam	Me-dat nho

Botanical characteristics

Perennial or sometimes annual herb with stoloniferous stems, up to 50 cm long. Stem lying flat on the ground or semierect, hairy, rooting at the nodes. Leaves alternate, long petiolate with 3 leaflets at the top. Leaflets 4-15 mm long, 8-32 mm broad, inversely heart-shaped, the notch apical, clothed with soft slender to woolly hairs. Flowers solitary or in 2-5 flowered axillary umbels at the top of a peduncle 3-9 cm long; pedicel 5-15 mm long, bent downward in fruit; bracts 3-5, linear; sepals 5, linear-lanceolate, hairy; petals 5, oblong, yellow, 4-8 mm long, 15 mm across; filaments smooth; carpels 5, hairy; styles longer than the shorter filaments. Fruit an erect, green, hairy, oblong, beaked capsule 1-2 cm long. Seeds many, ovoid, 1.5 mm long, reddish brown, flattened, transversely ribbed. Dehiscence of seed capsules is through loculicidal slits on the abaxial sides of the carpels. Ejected seeds can be violently scattered up to 2 m from the parent plant.

Distribution

Believed to have originated in tropical Asia, Malaysia, Australasia, or the western Pacific. Probably indigenous to the Americas, and has been introduced into temperate regions throughout the world. A common weed of 12 crops in 44 countries. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh, Lao PDR, and Myanmar.



Biology and ecology

O. corniculata occurs in cultivated fields, roadsides, and waste places, especially on gravelly or sandy soils. It is troublesome in lawns, where its creeping habit enables it to escape mowing, and in container-grown horticultural plants. A major factor contributing to its weediness is prolific reproduction, by rooting at the nodes of stolons and by seeds that are dispersed forcefully from capsules some distance from the parent plant. Spread has also been reportedly encouraged by rodents.

Seed germination in the greenhouse is determined by seasonal temperature and daylength effects. Seeds produced in the winter months had the narrowest temperature range for germination (1 to 25 °C) and the lowest germination at the optimum temperature of 15 °C (44% after 2 wk) compared with those produced in other seasons. Seeds produced in summer had the widest temperature range (10 to 30 °C) and highest germination percentage at 15 °C (93% after 2 wk), whereas those produced in spring and autumn were intermediate in temperature responses, germinating within the range of 10 to 25 °C. Incubation temperatures above 30 °C and below 9 °C completely inhibited germination of fresh seeds.

Fresh *O. corniculata* seed requires only low levels of light for germination. At 0.25% of full sunlight, germination was 60% after 2 wk and nearly 100% after 4 wk. As light level decreased, germination also decreased. No germination occurred in the dark.

Regardless of season of production, seed possesses low levels (10% or less) of primary dormancy when freshly matured. This low incidence of primary dormancy may reflect ecotypic adaptation to local environments, or may be indicative of a more widespread trend among perennial weeds in which vegetative reproduction is common and seeds are not the only means of survival. Seed stored under laboratory conditions for 1 yr retains nearly 75% of its original germination capacity.

Seed germination is inhibited by heat treatments of 0.5 h above 48 °C, 1 h above 46 °C, and 2 h above 43 °C. The detri-

mental effect of high temperatures may be due to temporary thermo-inhibition, induced secondary dormancy (thermodormancy), or thermal injury and death. In commercial greenhouses, a 5-min heat treatment at 60 °C stimulated germination of buried *O. corniculata* seeds.

Plants may start flowering within 4 wk of germination and set seed quickly. In the tropics, *O. corniculata* flowers year-round.

A range of insects occur on *O. corniculata*. The aphid *Ovatus reticulatus* spends its entire life cycle on the leaves, while the female of *Argynnis hyperbius inconstans* lays eggs on the underside of leaves. The butterfly *Zizeeria kynsna* feeds on the plant. The plant is a host to nematodes (*Meloidogyne camelliae*, *M. incognita*, and *M. javanica*), rusts (*Puccinia sorghi*, *P. purpurea*, and *P. polysora*), and fungus (*Fusarium oxysporum* f. sp. *cepae*).

Apart from being a competitive weed in crops and pastures, *O. corniculata* can also be toxic to livestock. The leaves contain oxalic acid and consumption may accumulate lethal concentrations of soluble oxalates. Its extracts have demonstrated antibacterial action. The species is used in various medicinal preparations.

Weed management

Cultural. During early growth, seedlings are readily hand-weeded, especially in gravel. After that time, rooting stolons make complete removal of plants difficult. The weed can be readily controlled by hoeing.

Chemical. *O. corniculata* can be controlled by 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after sowing.

References

- Abawi and Lorbeer (1972), Auld and Medd (1992), Bendixen (1986), Egley and Duke (1985), Holt (1987), Ivens (1967), Karssen (1982), Lovett Doust et al (1985), Nasir (1972), Pancho and Obien (1995), Sawhney et al (1984), Soerjani et al (1987), Valdez (1968), Warcup (1980).

PASSIFLORACEAE

Passiflora foetida L.

(Synonyms: *P. hirsuta* Lodd., *P. variegata* Mill., *P. vesicaria* L.)

Common names

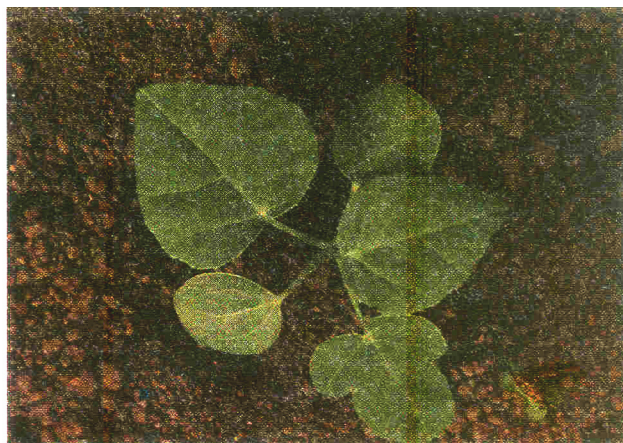
Country/language	
English	
Jamaica	Love-in-a-mist
Malaysia	Wild watermelon
Indonesia	Kambut-kambut
Philippines	
Bicolano	Kurunggut, masafloa
Bisaya	Belon-belon
Cebuano	Taungan
Ilocano	Masaplora
Ilongo	Lupok-lupok
Tagalog	Melon-melonan, pasionariang mabaho, prutas
Thailand	Ka thok rok
Lao PDR	Nya ham ho
Myanmar	Chin-gya-thee-pin, su-ka
Vietnam	Chum-bao, nhan-long

Botanical characteristics

Herbaceous annual climber with an unpleasant odor. Stem slender, green, hairy, long, and round; climbing by axillary unbranched tendrils. Leaves with petiole, alternate, hairy, thin, shining green, with 3 blunt or pointed lobes, base heart-shaped, very variable in size, from 2 × 2.5 cm to about 10 cm long and wide. Flowers solitary from leaf axils on a stalk about 4 cm long, each flower with 3 pale green, moss-like leaves (involucre) close under the calyx, deeply lacinate, base of calyx tube ring-shaped, green; sepals white, tinged green on the back, with a needle-like point, 1.5 cm long; corolla 2–5 cm in diameter, petals 5, white, corona of 2 rows of purple filaments with white tips spreading out flat and nearly as long as the petals. Stamens 5, with strong filaments, anthers dorsifix. Stigmas 3, above the stamens. Fruit globular, orange, about 2 cm in diameter, surrounded by the involucre, inflated. Seeds numerous, wedge-shaped to ovate with a coarse network pattern centrally on each side.

Distribution

Native of tropical America. Spread widely to Asia and Africa and now pantropical. Common in upland rice in Indonesia, Lao PDR, Myanmar, Philippines, and Vietnam and present in Thailand.



Biology and ecology

P. foetida occurs in wet or dry areas and is a weed of crops, hedges, scrub, waste places, roadsides, and plantation margins. It thrives on many soil types, including peat.

The plant reproduces and disperses by seeds. It flowers year-round, with the flowers opening in the morning and closing before noon, after which they soon wilt. The seeds are eaten by birds and may be carried long distances.

An active flavonoid, ermanin (7,4'-di-o-methylkaempferol), has been isolated from the resin and leaves of *P. foetida*. This compound showed deterrent activity against *Dione juno*, an insect pest that eats unsprayed leaves of *Passiflora mollissima* and *P. quadrangularis*, plants that produce edible fruits of great economic importance in Colombia.

P. foetida is susceptible to *Fusarium oxysporum*. It is also an alternate host of the nematode *Meloidogyne arenaria*.

Although mostly considered a weed, *P. foetida* is sometimes cultivated for soil cover to control *Imperata cylindrica* and erosion. Its young leaves are a good vegetable and the seed is tasty and edible, being marketed in West Java, Indonesia. The young fruits contain cyanic acid and are suspected to cause poisoning.

Weed management

Chemical. *P. foetida* can be controlled by 2,4-D at 0.5 to 0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence.

References

Auld and Medd (1992), Bendixen (1986), Echeverri et al (1991), Gardner (1981), Henderson (1959), Soerjani et al (1987).

Brachiaria distachya (L.) Stapf

(Synonyms: *Digitaria distachya* (L.) Pers., *Panicum distachyon* L., *Urochloa distachya* (L.) Nguyen)

Common names

Country/language	
English	
USA	Lesser brachiaria
India	Bansghas
Indonesia	
Indonesian	Suket reketek
Javanese	Blabakan, bleblem, kadalán
Philippines	
Bisaya	Gome-gome, tanageb
Tagalog	Giling kalat
Thailand	Yaa khon lek
Lao PDR	Nya khao nok
Vietnam	Co mat



Botanical characteristics

A widely spreading and slender annual grass with culms lying flat on the ground, branched, rooting at the nodes, 1-2 m in length. Flowering branches erect or ascending, 20-40 cm high. Leaves narrowly lanceolate and tapering to a point, 8-20 cm long, 5-10 mm wide, smooth with rounded base. Ligule represented by a line of hairs. Inflorescence consists of 2-4 protruding spike-like racemes arranged along the sides of a common main axis. Spikelets oblong, sharply pointed, 4 mm long, arranged in 2 rows, sessile or nearly so, green.

Distribution

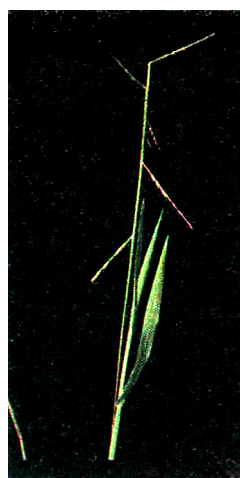
Originates in and occurs throughout South Asia, Southeast Asia, Australia, and the Pacific Islands. Introduced in Africa. Present in upland rice in the Philippines, Indonesia, Thailand, India, and Lao PDR.

Biology and ecology

B. distachya is found in open waste places, cultivated fields, and pastures, especially at low altitudes. Although sometimes considered a weed in upland rice, *B. distachya* is widely used as a forage. It is adapted to humid tropical lowlands and can grow under mild shady conditions such as in old coconut plantations or orchards. In coastal sand dunes, it acts as a soil-binder. It does not tolerate water-logging but is well adapted to sandy loam soils.

The plant commences flowering early in the growing season and flowers continuously throughout the year, but little seed is set. Its chromosome number is $2n = 36$. Like other *Brachiaria* species (e.g., *B. mutica* (Forsk.) Stapf) that also rarely set seeds, it is usually propagated by stolon cuttings that sprout and take root readily, sending out long creeping stolons that root readily at the nodes.

The plant is harvested and used as forage in Indonesia. It is considered good fodder when young and highly suitable for hay in India.



B. distachya is an alternate host of rice bacterial sheath blight (caused by *Rhizoctonia solani*), insect pests (*Chaetocnemo basal*, *Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Cretonotus gangis*, *Marasmia exigua*, *Mythimna separata*, *Pseudococcus saccharicola*, and *Spodoptera mauritia acronyctoides*), parasitic nematodes (*Criconemella onoensis*, *Hoplolaimus indicus*, and *Pratylenchus indicus*), rice blast fungus (*Pyricularia oryzae*), and rice tungro virus.

Weed management

Cultural. In the Philippines and Indonesia, it is controlled by hand weeding.

Chemical. *B. distachya* can be controlled at the 1–3leaf stage by early postemergence application of fenoxaprop-P-ethyl (34 g ha⁻¹). Beyond the 3-leaf stage, higher rates of 45 g ha⁻¹ at the 4-leaf/1-tiller stage and 56 g ha⁻¹ at the 2-4-tiller stage are recommended.

References

Barrion and Litsinger (1986), Catindig et al (1991, 1993, 1994a,b,c), Cope (1982), Kardin et al (1977), Kim et al (1981a), Mannetje and Jones (1992), Pancho and Obien (1983,1995), Satyanarayana Prasad et al (1980).

Chloris barbata (L.) Sw.

(Synonyms: *Andropogon barbatus* L., *C. inflata* Link, *C. longiflora* Steud., *C. paraguayensis* Steud.)

Common names

Country/language	
English	
Australia	Purple top chloris
USA	Swollen fingergrass
Indonesia	Rumput tombak
Philippines	
Bisaya	Bila-bila
Ilocano	Banuko, magsaysay
Tagalog	Koros-korosan
Thailand	Yaa rangnok
Myanmar	Myet-ka-ya
Vietnam	Luc long

Botanical characteristics

A tufted erect annual grass, 0.5 to 1 m high. Stem erect or sometimes bent at base, smooth, usually flattened at base, rooting at lower nodes. Sheath smooth or with long hairs; ligule membranous with short and ciliate hairs at top. Leaves linear-lanceolate, thin, up to 20 cm long, 1–2 mm wide, rough on margins, often with long hairs near base on upper side. Flowering heads open from a central point, terminal, consisting of 2-11 finger-like spikes, 3–8 cm long; spikelets purplish, broad, with 3 slender bristles. Fruit a caryopsis, pale brown, tapering at both ends, 1–1.5 mm long, enclosed within persistent lemma and palea.

Distribution

Native of tropical America, now widespread at low altitudes throughout the tropics. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam.

Biology and ecology

C. barbata, a C₄ species, is a common weed at low altitudes, occurring in dryland field crops, pastures, cultivated areas, waste places, roadsides, railway embankments, borders of plantation crops, and on levees in lowland rice fields.

This hardy plant can produce many tillers and is a strong competitor in crops. Its chromosome number is 2n = 20. It propagates by seed and is prolific, producing up to 26,000 seeds plant⁻¹.

It is a host of many rice insect pests and diseases, such as whitebacked planthoppers (*Sogatello furcifera* and *Sogatodes pusanus*), rice bug (*Leptocorisa oratorius*), rice earcutting caterpillar (*Mythimna separata*), rice-feeding tiger moth (*Cretonotus gangis*), cereal thrips (*Haplo-thrips ganglbaueri*), rice whitefly (*Aleurocybotus indicus*), and sheath blight (caused by *Rhizoctonia solani*). It is an ovipositional host of the rice leafroller (*Cnaphalocrocis medinalis*). It is also the principal alternate host of the grass seed-feeding thrip (*Chirothrips mexicanus*), which infests pearl millet (*Pennisetum typhoides*).





Weed management

Cultural. *C. barbata* is usually a minor weed problem in rice and is controlled by normal hand-weeding operations and good crop management.



Chemical. The weed can be controlled by early postemergence application (1-3 leaves) of fenoxaprop-P-ethyl (34 g ha⁻¹). Beyond the 3-leaf stage, higher rates are recommended.

References

Alam (1989), Ananthakrishnan and Thangavelu (1976), Ananthakrishnan and Thirumalai (1977), Asis (1971), Barrion et al (1991), Catindig et al (1988, 1989, 1991, 1993, 1994c), Elmore and Paul (1983), Haselwood and Motter (1983), Kannaiyan and Prasad (1979), Pancho and Obien (1983), Poilecot (1995), Rajapakse and Kulasekera (1980), Vaidya and Kalode (1982).

Chrysopogon aciculatus (Retz.) Trin.

(Synonyms: *Andropogon aciculatus* Retz., *A. javanicus* Steud., *C. subulatus* (Presl) Trin. ex Steud., *Rhapis trivialis* Lour.)

Common names

Country/language	
English	Love grass
India	Chorkanta, chui-kanta
Indonesia	
Indonesian	Kalikanji
Sundanese	Jukut domdoman
Philippines	
Bisaya	Mansareko
Cebuano	Amor-seko
Tagalog	Amor-seko, marisekos
Thailand	Yaa jao chu
Bangladesh	Premkata
Lao PDR	Nya kuak
Myanmar	Maung-yin-ngo-myet, nauk-po-myet
Vietnam	Co-may

Botanical characteristics

A creeping perennial, forming dense green mats and sending up erect, wiry flowering stems up to 30 cm high. Stems lie flat on ground, thick, densely leafy with overlapping sheaths, base rhizomatous, rooting at nodes, nodes hairless. Leaf blades 3-12 cm long, 5 mm wide, hairless except at junction of blade and sheath, margins having small teeth, sometimes slightly crinkled; sheaths bearing reddish stripes; ligule very short, membranous, shortly ciliate. Inflorescence small, 5-10 cm long, with several whorls of reddish, very slender branches up to about 2.5 cm long, which at first point upward, then spread almost horizon-



tally at flowering, then point upward again; each branch bearing at its tip a slender group of 3 narrow purplish spikelets, 2 outer ones stalked, the central one not stalked, the stalked spikelets about 0.6 cm long, with the unstalked one shorter and having 2 florets, the lower sterile, the upper bisexual. Seed a caryopsis, linear, 1.5-3 mm long, with 2 fine sharp bristles.

Distribution

Native to tropical Asia. Distributed from coastal areas to the mountains in tropical Australia and Asia. Present in upland rice at all consortium sites.

Biology and ecology

C. aciculatus occurs from sea level to 1,500 m and is often abundant in open areas and rocky slopes in cultivated areas, pastures, rangelands, turf, roadsides, and waste places. It is adapted to sandy loam soils of pH 5-6. It is frequently found in overgrazed areas, resisting trampling. It is a vigorous colonizer of denuded ground and tends to dominate with regular burning. It has a chromosome number of $2n = 20$.

It is very troublesome because the sharp barbed points of the spikelets stick to clothing and the hair of animals and provide an effective method of seed dispersal. It competes with crops and is practically worthless as forage. It is, however, reportedly useful for soil and water conservation on river banks and exposed slopes. The culms are used to make brushes and weave small cases.

C. aciculatus is propagated by seed or rooting tillers. It spreads and forms a firm mat over the ground, starting to flower within 6-8 wk after establishment. It flowers throughout the year. The plant produces 308 seeds plant⁻¹. The weight of 1,000 seeds is 0.96 g.

In rotation studies, height and fresh weight of *C. aciculatus* declined with increasing concentrations of incorporated root or leaf debris of *Mikania micrantha*, and radicles became shorter when germinated in the leachate. Full-strength extract (28.9 g L⁻¹) of *Mikania* leaf reduced germination of *C. aciculatus* by 22%, while the root extract reduced germination by 23%. Radicle length was also significantly reduced with full-strength aqueous extracts of both the leaf and root of *Mikania*. *M. micrantha* is reportedly widespread in several countries in Asia and throughout South and Central America and has been identified as a most aggressive species. It commonly grows in association with *C. aciculatus*. *C. aciculatus* is considered a useful species in Thailand, where it is commonly found on rice bunds.

This weed is an ovipositional host of *Nisia carolinensis*, a planthopper common in rice-field habitats. It is also an alternate host of the flea beetle *Chaetocnema basalis*.

Weed management

Cultural. Cultivation of infested fields before seeds mature can help to control the plant.

Chemical. *C. aciculatus* can be controlled by early postemergence (1-3 leaves) application of fenoxaprop-P-ethyl (34 g ha⁻¹). Beyond the 3-leaf stage, higher rates are recommended.



References

Barrion and Litsinger (1986), Catindig et al (1995b), Datta and Banerjee (1976), Haselwood and Motter (1983), Henderson (1954), Hsu (1978), Ismail and Mah (1993), Manidool (1986), Mannetje and Jones (1992), Moody et al (1984), Muenscher (1955), Poilecot (1995).

***Cynodon dactylon* (L.) Pers.**

(Synonym: *Capiola dactylon* (L.) Kuntze)

Common names

Country/language	
English	
USA	Bermuda grass
India	Dub, hariyali
Indonesia	
Indonesian	Grintangan
Javanese	Sukit grinting
Sundanese	Gigirinling, jukut kakawatan
Philippines	
Bisaya	Padpad
Ilocano	Bakbaka, galot-galot, galud-galud
Ilongo	Buko-buko, kapot-kapot
Tagalog	Kawad-kawad, kawad-kawaran, kotatai, malit
Thailand	Yaa phrak
Bangladesh	Doorba, dubla, durba, durbaghas
Lao PDR	Nya pong
Myanmar	Myay-zar-myet, myin-sa-myet
Vietnam	Co-chi

Botanical characteristics

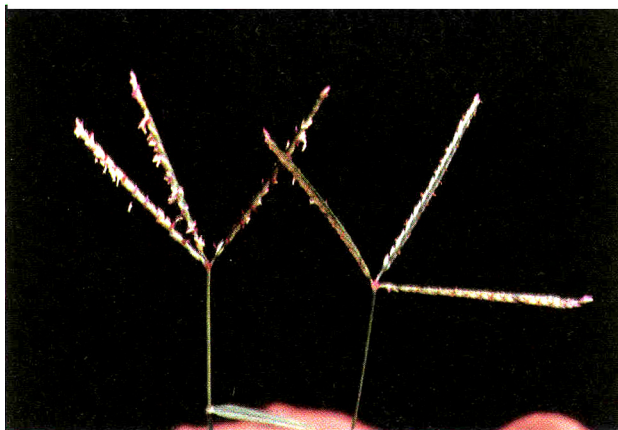
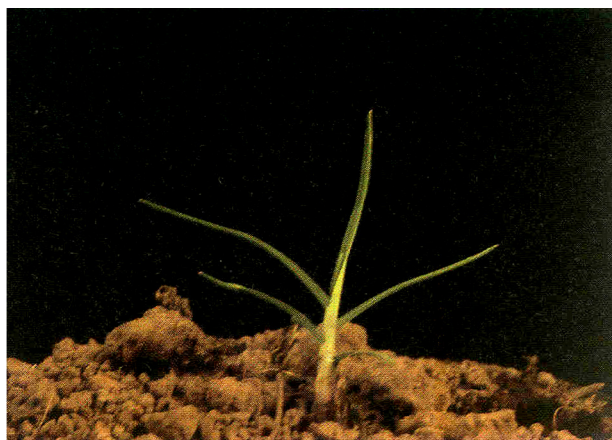
Perennial grass with long runners, rooting at the nodes, and extensive underground rhizomes. Culm erect or trailing on the ground, slender, 5-30 cm tall and 20-50 cm long, smooth, green to reddish. Leaf blades vary greatly in length from about 2.5 to 20 cm, linear-lance-shaped, stiff and rough in texture; ligule membranous-hairy, a double fringe of hairs, less than 1 mm, auricles absent; sheath lanceolate, 2-15 cm long, 2-5 mm wide, with tough erect hairs on collar margin. Inflorescence consists of several (usually 4-5) slender, purplish spikes up to 10 cm long, arising in a star-like arrangement from the end of the stem. Each spikelet has a single floret; sessile spikelets arranged in two rows, 2 mm long; lemma awnless. The tiny, oval grain is orange-red, reddish brown, or straw-colored.

Distribution

Native of tropical Africa, Asia, and Southeast Asia. Now grows widely throughout tropical, subtropical, and temperate areas of the world. Grows widely in the south of Australia, in coastal and inland areas. Common in upland rice at all consortium sites.

Biology and ecology

C. dactylon is a troublesome weed of agriculture worldwide, reported to occur in more than 80 countries and in some 40 dif-



ferent crops such as rice, sugarcane, and maize, and in vineyards and plantation crops.

It occurs from sea level to above 2,000 m and is well adapted to a wide range of soils, although it prefers heavy well-drained or sandy soils, especially where pH is high. It thrives in sunny to lightly shaded dry or moist (not marshy) sites in crops, pastures, rice bunds, lawns, fallows, roadsides, and waste places and is a constituent of grasslands and forest margins. It is able to survive for long periods under flood or drought.

This C₄ plant has chromosome numbers of 2n = 18, 36. Most plants are tetraploid, with a minority of diploid plants. It produces 720 seeds plant⁻¹. The weight of 1,000 seeds is 0.26 g. Vegetative propagation is by means of leafy stolons and rhizomes. Seeds germinate at temperatures above 20 °C and emergence takes place within 2 wk, with tillering occurring after 25–30 d. The complete cycle (germination to seed production) is around 4 mo. Photoperiods of 12–13h and warm conditions are conducive to flowering and seed production.

The rhizomes can be shallow or as deep as 1 m or more. This makes it a successful and persistent weed under a wide range of conditions. A single bud of a rhizome or rhizome piece can develop into a shoot. The basal nodes of shoots have lateral buds that give rise to tillers or rhizomes.

In Australia, *C. dactylon* exhibits a seasonal pattern in the storage and depletion of carbohydrate reserves. Reserve carbohydrates build up through autumn until mid-winter. These reserves are stored in roots and rhizomes and used in spring to support the growth of new shoots. The carbohydrate reserves then decrease until mid-summer.

C. dactylon has numerous biotypes or natural strains. In an intensive study in Mauritius, criteria used to distinguish biotypes included differences in the tendency to be upright or prostrate, the color of plant parts, the length of the spikes, and the hair group characteristics on vegetative organs. The last item was the primary diagnostic character for distinguishing biotypes.

Plant parts develop hydrocyanic acid when allowed to wilt under some conditions. The percentage of toxic substance is high following a pronounced drought with high temperatures or frosts. This plant is reported to have occasionally caused stock poisoning.

C. dactylon is an alternate host of rust (*Puccinia cynodontis*, *Ustilago* sp.), diseases (caused by *Cochliobolus miyobeanus*, *Helminthosporium oryzae*, and *Rhizoctonia solani*), and nematodes (*Criconebella onoensis*, *Hoplolaimus indicus*, *Pratylenchus indicus*,

Tylenchorhynchus claytoni, *Meloidogyne incognita*, and *M. javanica*). Two leaf spots (*Periconia lateralis* and *Phyllacora cynodontis*) and a tungro virus have been observed on the weed. Insects found on the plant include *Antonina indica*, *Aspidiella sacchari*, *Atherigona exigua*, *Chaphalocrosis medinalis*, *Crambus seychellus emmerezellus*, *C. cuneiferellus*, *Cretonotus gangis*, *Dicladispa armigera*, *Geoica lucifuga*, *Marasmia exigua*, *Mythimna separata*, *Nephotettix virescens*, *Nisaga simplex*, *Nymphula depunctalis*, *Odonaspis ruthae*, *Orseolia oryzae*, *Pelopidas mathias*, *Pseudococcus saccharicola*, *Pulvinaria iceryi*, *Recilia dorsalis*, rice leaf miner, *Scirpophaga incertulas*, *S. innotata*, *Spodoptera cillium*, and *S. mauritia acronyctoides*.

In many countries, *C. dactylon* is used for lawns, soil stabilization, and feed for livestock, especially water buffalo. It is an excellent fodder because of its high production of herbage that has a high percentage of dry matter and a high crude protein content, which ranges from 8% to 15%.

Weed management

Cultural. Seedlings can be destroyed by cultivation but perennating organs are difficult to eradicate. Biotypes with creeping stolons on the soil surface can be controlled by frequent shallow cultivation and removing the weed to prevent re-rooting. Rhizomatous ones are more difficult to control. Several dry-season cultivations can be effective if the rhizomes are brought to the surface, where they are killed by desiccation. This usually requires tractor-drawn implements, especially where deep rhizomes are present.

Chemical. Use of glyphosate as a preplant application effectively controls *C. dactylon* in upland rice.

References

- Alam and Islam (1959), Arvind (1987), Auld and Medd (1992), Awoderu (1974), Bendixen (1986), Bogdan (1977), Catindig et al (1991, 1994a,c), Cope (1982), Data and Banerjee (1976), Dhaliwal (1979), Harr et al (1991), Holm et al (1977), Israel (1969), Ivens (1967), Kannaiyan and Prasad (1979), Kardin et al (1977), Kim et al (1981a), Laan (1959), Labrada (1994a), Mew et al (1980), Misra and Israel (1970), Narasimha Rao (1977), Nirmal Davis and Jeyarajan (1992), Panda and Mohanty (1970), Patnaik et al (1987), Pauling (1983), Poilecot (1995), Purohit et al (1972), Rhind (1945), Rochecouste (1962a,b), Satyanarayana Prasad et al (1980), Schwerzel (1967), Soerjani et al (1987), Terry (1983), Vaughan and McIntyre (1979a), Viraktamath et al (1974).

***Dactyloctenium aegyptium* (L.) Willd.**

(Synonyms: *Cynosurus aegyptius* L., *D. meridionale* Ham., *D. mucronatum* Willd., *Eleusine aegyptiaca* Desf., *E. mucronata* Horn.)

Common names

Country/language

English

Australia Coast button grass

India Makara, makari

Indonesia

Javanese Suket dringoan

Sundanese Tapak jalak

Philippines

Bisaya Padpad

Ilocano Tugot-manok

Ilongo Damong balang

Tagalog Damong balang, krus-krusan, sabong-sabong

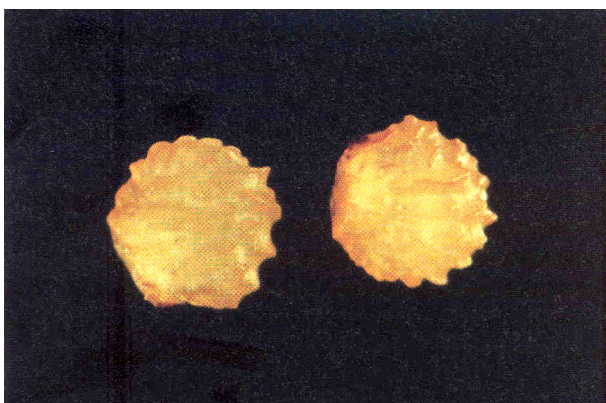
Thailand Yaa paak khwaai

Bangladesh Kachita ghas

Lao PDR Nya pak kuei

Myanmar Le-gwa-myet

Vietnam Co chan-ga



Botanical characteristics

A spreading to slightly ascending annual or sometimes perennial grass, stoloniferous below and rooting at the nodes. Stems up to 1 m long, 1-3 mm thick, smooth, compressed, branching often dichotomously, erect. Leaf sheath smooth, loose, compressed; blade flat or folded, 2-35 cm long, 2-9 mm wide, clothed with soft slender hairs on margins and upper surface; ligule white, membranous, 1-2 mm long. Inflorescence in coarse spikes, 2 to 7 per raceme, 1-6 cm long, 3-7 mm thick, arranged in a finger-like fashion (digitate) pointed at the tip; spikelets sessile, very crowded, arranged in 2 rows along one side of the narrow flattened rachis; palea 1.5 mm long, lemma 2.5-3 mm long with an awn about 2 mm long. Fruit a grain, about 1 mm long, obovate, transversely ridged, light brown.

Distribution

Native of the tropics of Asia. Has spread widely and is now considered a pantropical weed. Present in upland rice at all consortium sites.

Biology and ecology

D. aegyptium, a C_4 species, occurs from sea level to 1,000 m and grows in sunny or lightly shaded places on arable lands, gardens, waste places, dikes, and embankments. It is well adapted to drier areas and light sandy soils but also grows well on heavier soils. The plant propagates primarily through seed. One plant can produce up to 66,000 seeds. The weight of 1,000 seeds is 0.23 g. There are 4,300 seeds g^{-1} . In a tropical area in northern Australia, 50% germination is possible at 5 mo after harvest. Germination is favored at 20 °C (80%) but is greatly reduced at 30 °C (<10%) and is zero at 10 °C. Stored seed can still germinate (5%) after 19yr.

In the field in many northern hemisphere countries, this plant germinates with the first rains of May, before late plowings. This germination period lasts for 4-5 wk until the end of June. Cultural operations such as weeding induce new seedling emergence, which is less abundant and shorter than initial emergence. Flowering and maturation are not affected by photoperiod and occur 3-4 wk after emergence. The seeds produced during this period do not have dormancy and can germinate readily. The plant desiccates at the end of the rainy season after a cycle of 3-4 mo. Propagation by vegetative means through production of creeping stems is also possible.

Three forms reportedly have different chromosome numbers ($n = 20, 23$, and 27). These cytotypes show differences in morphology (number of spikes and length of rachilla), anatomy (cell structure of the stem), and content of free amino acids, soluble sugars, and ascorbic acid.

D. aegyptium affects rice tiller production from 30 d after seeding. Reduction in grain yield caused by competition from 1-32 plants pot^{-1} ranged from 10% to 75%.

The plant is an alternate host for the virus that causes rice leaf-gall and maize leaf-gall, and the sugarcane mosaic virus. It is also a host to unidentified nematodes, *Striga asiatica*, and *S. hermonthica*.

This weed forms a nutritious fodder grass for cattle and is considered suitable for milk production and fattening. It can cause poisoning of livestock by the release of hydrocyanic acid during hot weather. During times of scarcity, poor people consume the grains. The herbaceous parts of the plant are applied externally to treat ulcers. A decoction of the seed is used to relieve pain in the kidney region. Parched grains are administered to women who suffer from stomachache after childbirth.

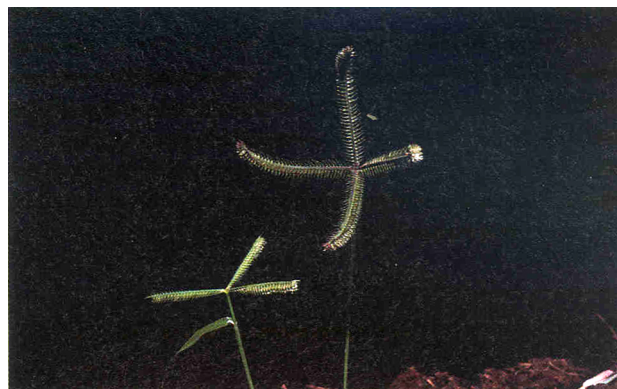
Weed management

Cultural. Early hand weeding has been recommended for control in upland rice.

Chemical. *D. aegyptium* can be controlled by preemergence application of oxadiazon (0.75-1.0 kg ha⁻¹) or pendimethalin (1.5-2.0 kg ha⁻¹) or early postemergence (3–5 leaves or 15-25 d after emergence) application of cyhalofop butyl (0.1-0.15 kg ha⁻¹), propanil (2 kg ha⁻¹), or fenoxaprop-P-ethyl (55 g ha⁻¹). Beyond the 5-leaf stage, higher rates of cyhalofop butyl are recommended.

References

Backer and van den Brink (1968), Banerjee (1972), Bendixen (1986), Elmore and Paul (1983), Holm et al (1977), Ivens (1967), Lagoke et al (1991), Le Bourgeois and Merlier (1995), Mannetje and Jones (1992), Muenscher (1955), Pancho (1964), Poilecot (1995), Reddy and Rao (1981), Sachdeva and Kals (1981), Soerjani et al (1987), Utomo (1981), Vernon (1983).



Digitaria ciliaris (Retz.) Koel.

(Synonyms: *D. adscendens* (Kunth) Henr., *D. biformis* Willd., *D. commutata* Schult., *D. marginata* Link, *Panicum adscendens* Kunth, *P. ciliare* Retz.)

Common names

Country/language	
English	
Australia	Summergrass
India	Nargorwa
Indonesia	
Indonesian	Grintingan
Javanese	Jelamparam, suket ceker ayam
Sundanese	Jampang jemprak
Philippines	
Bisaya	Tagik-tagik
Tagalog	Baludangan, halos
Thailand	Yaa plong khaao nok
Lao PDR	Nya tinnok
Myanmar	Let-the-gwa-myet
Vietnam	Tuc hình nho



Botanical characteristics

A rather slender, suberect, branched annual grass up to 1 m high. Basal parts of stem more or less lying on ground, with tips ascending. Leaves lance-shaped, tapering to a point, 6-14 cm long, 3-5 mm wide; sheaths loose, sparingly covered with stiff hairs. Base of blade hairy. Ligule membranous, 1-2.5 mm high, trun-



cate. Inflorescence composed of 3–6 pseudo-spikes digitally arranged at the upper part of the stem as pseudo-whorls. Spikes about 10 cm long. Spikelets 3 mm long, oblong-lance-shaped, occurring in pairs, one sessile, the other pedicelled. Empty glumes of pedicelled spikelets fringed with hooked hairs. Fruit a caryopsis, 2–2.5 mm, oblong with regularly rounded ends, gray to light brown.

Distribution

Reported to originate in Taiwan. Widely distributed throughout tropics and subtropics, especially in Asia, occurring from India to Polynesia. Common in upland rice in Indonesia and present in India, Lao PDR, Myanmar, Thailand, Philippines, and Vietnam.

Biology and ecology

D. ciliaris, a C_4 species, is an aggressive and opportunistic colonizer of bare, disturbed, or newly cleared areas in crops, roadsides, or waste places because of its prolific seed production, vigorous growth, and rapid development of rooted stolons. It occurs from the lowlands up to 2,000 m. Its seeds germinate with high temperatures in spring or summer in temperate or subtropical areas and at any time with the onset of rains in the tropics.

It grows best in moist sandy or loamy soils and is very responsive to high soil fertility. Shading reduces leaf area index and dry matter production. It produces 1,700 seeds plant⁻¹. The weight of 1,000 seeds is 0.4 g. There are about 2,500 seeds g⁻¹.

The spikelet scale acts as a barrier to oxygen entry into the seed, preventing germination. New seeds have a dormancy period that can last up to 7 mo; treatment with alternating temperatures, scarification, and exposure to light help to overcome dormancy. A relatively high nitrogen content in the substrate seems to be needed for optimal germination.

D. ciliaris is very competitive in rice, with a study in the Philippines showing that 2 plants pot⁻¹ reduced rice grain yield by 62%. Response to fertilizer is greater in *D. ciliaris* than in upland rice. The differences are greatest in the early and middle stages of growth. The height of *D. ciliaris* exceeded that of rice with fertilizer from 51 d. Without fertilizer, the height of *D. ciliaris* equaled that of upland rice at 91 d and exceeded it at the ripening stage. With fertilizer, the relative growth rate of the weed exceeded that of upland rice from 29 to 70 d after seeding; without fertilizer, it was greater for the weed from 51 to 91 d after seeding.

D. ciliaris is an alternate host of diseases (caused by *Cochliobolus miyabeanus* and *Rhizoctonia solani*), rice tungro virus, *Ustilaginoidea virens*, leaf blight (*Xanthomonas campestris* pv. *oryzae*), insect pests (*Chaetocnema basal*, *Diadema armigera*, *Leptocoris oratorius*, *Mythimna separata*, *Nilaparvata lugens*, and *Nisaga simplex*), and nematodes (*Hirschmanniella oryzae*, *Meloidogyne javanica*, *Tylenchorhynchus claytoni*, *Pratylenchus indicus*, and *Pratylenchus* sp.).

It is one of the weeds grazed by animals in Batangas, Philippines. It is considered to be a useful forage species. It assists in protecting soil against erosion and provides vegetative material for mulch or compost.

Weed management

Cultural. Removal by hand or hoe when young provides effective control.

Chemical. *D. ciliaris* can be controlled by preemergence application of oxadiazon ($0.75\text{--}1.0\text{ kg ha}^{-1}$) or pendimethalin ($1.5\text{--}2.0\text{ kg ha}^{-1}$) or early postemergence (15-25 d after emergence) application of butachlor (2 kg ha^{-1}), fenoxaprop-P-ethyl (55 g ha^{-1}), or propanil (2 kg ha^{-1}).

References

Anwar et al (1992), Awoderu (1974), Barrion and Litsinger (1986), Catindig et al (1994a), Cope (1982), De Datta (1981), Everaarts

(1981), Gapasin et al (1996), Garcia et al (1975), Goodey et al (1965), ICRISAT (1980), Kannaiyan and Prasad (1979), Kim et al (1981a), Mannetje and Jones (1992), Mishra et al (1973), Moody et al (1984), Morrill et al (1990), Noda et al (1984), Noguchi and Nakayama (1978), Pancho (1964), Parker (1992), Patnaik et al (1987), Poilecot (1995), Santiago (1977), Satyanarayana Prasad et al (1980), Sen and Chakravorty (1970), Shetty and Shetty (1985), Soerjani et al (1987), Takemura (1962), Terry (1983), Utomo (1981), Veldkamp (1973).

Digitaria longiflora (Retz.) Pers.

(Synonyms: *D. corradii* Chiov., *D. flexilis* Heuerard, *D. roxburghii* Spreng., *Milium filiforme* Roxb., *Panicum longiflorum* (Retz.) Gmel., *Paspalum brevifolium* Flugge, *P. longiflorum* Retz.)

Common names

Country/language	
English	Lesser crabgrass
Indonesia	Grintingan
Philippines	
Bisaya	Tagik-tagik
Thailand	Yaa teen nok lek
Bangladesh	Choto fulka
Myanmar	Let-the-gwa-myet
Vietnam	Tuc hình lon

Botanical characteristics

A slender annual or sometimes short-lived perennial grass, the basal part trailing and rooting on the ground. Flowering stem erect, up to 60 cm high. Leaves narrowly lanceolate, tapering to a point, 1-9 cm long, 1-5 mm wide; blade totally smooth; ligule membranous. Inflorescence composed of 2-4 digitately arranged racemes at tip of stem, spreading or ascending, 3-5 cm long, gray to white. Spikelets pale green, rarely purplish, 1.5 mm long, oblong, in pairs, one pedicillate, the other sessile. Fruit oblong with regularly rounded ends, pale, light brown or light gray, 1.5 mm long.

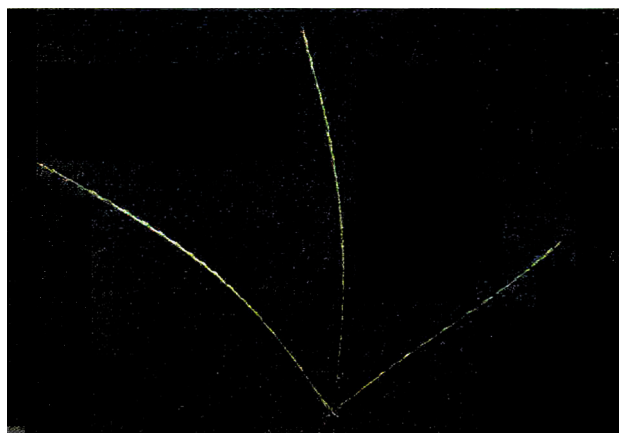
Distribution

Of Indian origin. Widely distributed from India to China and in the Philippines and Malaysia. Introduced to the New World. Common in upland rice in the Philippines and present in Bangladesh, Indonesia, Myanmar, Thailand, and Vietnam.

Biology and ecology

D. longiflora is a pioneer on humid sandy to rocky soils, open grasslands, and open forests and prefers light or dry soils. It is also found in waste places, yards, and roadsides and thrives in association with cultivated crops. It was recorded as the most





abundant weed in upland rice and occurred in 69% of the fields in one survey in the Philippines. It is a reported weed of 19 crops in 37 countries. The plant is an octaploid species with $2n = 72$.

Seedlings emerge in about 15 d after sowing. Leaves and stolons spread widely over the soil surface and can form a mat up to 2.5 m across. One plant can produce up to 60,000 seeds. Germination is favored at 40 °C but is prevented with extremely low (0 °C) and high (>40 °C) temperatures. The seeds are spread by wind, water, and animals. The plant's luxuriant initial growth and ability to regrow after cutting make it particularly competitive.

It is an alternate host of sheath blight disease caused by *Rhizoctonia solani*, the insect pests *Hysteronura setariae* and *Leptocoris acuta*, and the nematode *Meloidogyne graminicola*.

The weed may be used as lawn grass because it produces many runners when mowed closely. It is regarded as a good, palatable fodder plant and for its soil-binding properties.

Weed management

Cultural. Removal by hand or hoe when young provides effective control.

Chemical. *D. longiflora* can be controlled effectively by pre-emergence or early post-emergence application of either butachlor or oxadiazon at 2 kg ha⁻¹. It is also sensitive to fenoxaprop-P-ethyl at 55 g ha⁻¹ applied 15-25 d after emergence.

References

- Akibo-Betts and Raymundo (1978), Bhagat et al (1977), Cope (1982), De Datta (1981), Duatin et al (1992b), Gapasin et al (1996), Holm et al (1997), Kannaiyan and Prasad (1979), Moody et al (1996), Parker (1992), Poilecot (1995), Shibayama and Hashem (1995), Soerjani et al (1987), Srivastava and Saxena (1967), Veldkamp (1973).



Digitaria setigera Roth ex Roem. & Schult.

(Synonyms: *D. consanguinea* Gaud., *D. horizontalis* Ohwi non Willd., *D. microbachne* (Presl) Henr., *D. microstachya* Henr.)

Common names

Country/language	
English	Crabgrass
India	Nargorwa, seur
Indonesia	Jamprak
Philippines	
Bisaya	Jamog-jamog
Ilocano	Saka-saka
Tagalog	Baludgangan
Lao PDR	Nya tinnok
Myanmar	Let-the-gwa-myet
Vietnam	Tuc hình to

Botanical characteristics

Annual grass with culms 20-80 cm high, bent abruptly, ascending from a decumbent base. Leaf blades broadly linear to lance-shaped, 3-25 cm long, 3-12 mm wide. Inflorescence composed of 3-15 racemes arranged on a common axis 1-6 cm long, or borne on the apex of the petiole in smaller plants; racemes 4-15 cm long, spikelets binate and overlapping by ± two-thirds of their length on a narrowly winged rachis with sharply 3-angled midrib, this sometimes bearing a few long shiny hairs; pedicels also sharply 3-angled with truncate top. Spikelets lance-shaped to elliptic lance-shaped, 2-3.5 mm long; lower glume absent or very obscure; upper glume one-eighth to one-third (rarely up to half) as long as the spikelet, oblong or triangular, nerveless to sub-3-nerved; lower lemma as long as the spikelet, 7-nerved, nerves evenly spaced or with a wide central interspace, pressed to the stem or with fine and soft hairs, rarely with a fringe of hairs, very rarely with stiff bristles. Fruit a caryopsis, lance-shaped, gray to yellowish brown.



Distribution

Native of tropical Asia. Introduced and widespread in central and northern South America, the West Indies, Africa, and Mauritius. Common in upland rice in India, Indonesia, Lao PDR, and Philippines and present in Myanmar and Vietnam.

Biology and ecology

D. setigera occurs from sea level to 3,000 m and is a widespread weed in all soil types in crops, waste places, roadsides, plantations, and pastures, where it invades bare patches after heavy grazing and prevents recovery of more useful plants.

It reproduces mainly from seed, which is usually dormant when first dispersed. Germination in the field in the northern hemisphere usually occurs after rain in May to July. Seeds germinate best at the soil surface, emerging readily in unplowed fields. Germination can be stimulated by weeding and tillage operations up to mid-August if seeds are brought to the soil surface. Flowering occurs rapidly, with the first seeds forming 4–6 wk after germination, and can continue until the start of November. After the rainy season, the plant desiccates. Field operations such as weeding can delay the development and senescence of plants.

Vegetative reproduction also occurs from cut stem fragments, which can produce roots from the nodes.

The weed is an occasional host to rust, *Uromyces peglerae*, and streak virus. It is also an alternate host to sheath blight disease caused by *Rhizoctonia solani*.

Weed management

Cultural. Cultivation or cutting can provide some immediate control of the weed, although stem fragments can regrow.

Chemical. *D. setigera* can be controlled effectively by fenoxaprop-P-ethyl at 55 g ha⁻¹ applied 15–25 d after emergence.

References

Civico and Moody (1979), Cope (1982), Kardin et al (1977), Le Bourgeois and Merlier (1995), Soerjani et al (1987), Vaughan and McIntyre (1979b).



Echinochloa colona (L.) Link

(Synonyms: *E. crus-galli* (L.) P. Beauv. subsp. *colonom* Honda, *Panicum colonom* L., *P. cumingianum* Steud.)

Common names

Country/language	
English	
Australia	Awnless barnyard grass
USA	Jungle rice
India	Sanwa
Indonesia	
Indonesian	Jejagoan, rumput bebek
Javanese	Rumput jajagoan kecil, tuton
Sundanese	Rumput jajagoan kecil
Philippines	
Bisaya	Mangagaw
Ilocano	Dakayang, dakayon, dukayang, dukdukayang
Ilongo	Guinga, la-u la-u
Tagalog	Bulang, gutad, pulang-puwit, pulang-pwet, tiriguan
Thailand	Yaa nok si chomphu
Bangladesh	Alighasha, khudhey shayma, shymaghas
Lao PDR	Nya khao nok
Myanmar	Wan-be-sa-myet
Vietnam	Long vuc can

Botanical characteristics

An erect or trailing annual or perennial grass. Culms usually 10-100 cm in length in large tufts, rooting at the lower nodes. Leaf sheaths smooth or hairy at the nodes, tinged with red. Ligule absent. Blades loose, 3-30 cm long, 2-13 mm wide. Purple bands sometimes appear across leaves. Inflorescence a terminal panicle, 1-15 cm long, composed of 1-6 spikes, 5-15 cm long, pressed to the stem or directed upward. Spikelets 2-3.5 mm long, arranged in 2-4 rows along spike rachis, crowded, nearly sessile, hairy, with short awn or no awn at all, green or purple glumes. Grains free, white to yellowish, oval or oblong, with ends regularly rounded and 2 mm long.



Distribution

Of Indian origin. Widely distributed in tropics and subtropics, including South and Southeast Asia. Sometimes extends beyond 30° N and 30° S latitudes to the rice fields of the southern United States and southern Australia. Common in upland rice in India and present at all consortium sites.

Biology and ecology

E. colona, a C₄ species, is adapted to full sunlight or partial shade and grows on loam, silt, and clay soils. It grows in drains, low-lying grasslands, and farmlands, in both dry and marshy places. *E. colona* is one of the most important weeds of upland rice under moist conditions. It occurs most commonly at low altitudes but can extend up to about 2,000 m. It is a hexaploid with 2n = 6x = 54.

One *E. colona* plant can produce 3,000 to 6,000 seeds. The weight of 1,000 seeds is 2.14 g. Some strains are reported to have a short period of dormancy following harvest, but this dormancy is lost during 8 wk of dry storage. The seed coat prevents oxygen entry into the seeds for up to 12 mo. Germination is aided by scarification of the hard seed coat and by fluctuating temperature.

Light is required for optimum germination. Emergence may take place from below the soil surface when the soil is drained, but, when the soil is saturated, emergence from buried seeds is severely retarded.

The plant tillers heavily and outgrows most rice cultivars. Together with its profuse root production, it offers stiff competition for light and nutrients. Water-soluble extracts of *E. colona* reduced coleoptile and radicle length of rice. Flowering can occur in 30-45 d.

Spread is by seeds. This can be as an impurity in rice seed, as has been reported in Malaysia. It can also be through livestock, as seeds can pass unharmed through the alimentary tract of grazing animals.

E. colona is an alternate host of diseases (caused by *Pyricularia oryzae*, *Rhizoctonia solani*, rice yellow dwarf, *Sarocladium oryzae*, *Thanatephorus cucumeris*, tungro, *Xanthomonas oryzae* pv. *oryzae*), insect pests (*Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Cretonotus gangis*, *Diadisa armigera*, *Leptocoris acuta*, *L. oratorius*,



Marasmia exigua, *M. patnalis*, *Mythimna separata*, *Nephotettix nigropictus*, *N. virescens*, *Nisaga simplex*, *Orseolia oryzae*, *Pseudococcus saccharicola*, *Recilia dorsalis*, *Sesamia inferens*, *Sitotroga cerealella*, *Sogatella furcifera*, *Spodoptera mauritia acronyctoides*, *Stenchaetothrips biformis*), and nematodes (*Criconebella onoensis*, *Ditylenchus angustus*, *Hirschmanniella oryzae*, *Hoplolaimus indicus*, *Meloidogyne graminicola*, *M. incognita*, *M. oryzae*, *Pratylenchus indicus*, *Tylenchorhynchus claytoni*).

E. colona produces a palatable fodder that is relished by animals, and is considered to be a good fodder grass for milking animals in Myanmar and water buffalo in the Philippines.

The seeds are collected in times of scarcity as a famine food. In Egypt, the plant has been cultivated as a cereal.

Weed management

Cultural. Cultivation during early growth can control the weed. It is readily controlled by hand and hoe.

Chemical. *E. colona* can be controlled by preemergence application of oxadiazon ($0.75\text{--}1.0\text{ kg ha}^{-1}$) and pendimethalin ($1.5\text{--}2.0\text{ kg ha}^{-1}$) or postemergence (3–5 leaves or 15–25d after emergence) application of cyhalofop butyl ($0.1\text{--}0.15\text{ kg ha}^{-1}$), butachlor (2 kg ha^{-1}), fenoxaprop-P-ethyl (55 g ha^{-1}), and fluazifop-P-butyl ($0.1\text{--}0.6\text{ kg ha}^{-1}$).

Biological. In Japan, the pathogen *Exserohilum monoceras* is being evaluated as a bioherbicide for control of *Echinochloa* species in rice. In the Philippines, *E. monoceras* killed seedlings of *E. colona* but did not affect rice.

References

- Alam and Islam (1959), Bandara and Nadaraja (1979), Banerjee and Chatterjee (1965), Bendixen (1986), Catindig et al (1988, 1991, 1993, 1994 a,b,c), Cope (1982), Dalziel (1937), Derr et al (1985), Dhaliwal (1979), Gambia (1981), Gapasin et al (1996), Gohbora and Yamaguchi (1994), Hollis (1972), Holm et al (1977), Israel and Prakasa Rao (1968), John and Kalode (1981), Kardin et al (1977), Kim et al (1981b), Laan (1959), Le Bourgeois and Merlier (1995), Majumder (1962), Manidool (1992), Mannetje and Jones (1992), MARDI (1983), McKerral (1923), Mew et al (1980), Mishra et al (1973), Misra and Israel (1970), Moody et al (1984), Morrill et al (1990), Mortimer (1994), Nirmal Davis and Jeyarajan (1992), Paller et al (1980), Patnaik et al (1987), Pauling (1983), Poilecot (1995), Porwal and Mundra (1992), Prasad and Rao (1986), Rajapakse and Kulasekera (1980), Ramakrishnan and Khosla (1971), Rao and Prasad (1977), Rao et al (1970), Salim et al (1994), Satyanarayana Prasad et al (1980), Segeren-v.d. Oever and Sanchit-Bekker (1985), Sen and Chakravorty (1970), Shibayama and Hashem (1995), Singh and Singh (1983), Sivaprakasam et al (1992), Soerjani et al (1987), Terry (1983), Vecht and Bergman (1952), Zhang et al (1996), Zhang and Watson (1997).



Echinochloa crus-galli (L.) P. Beauv.

(Synonyms: *E. crusgavonis* (auct. div.) non (H.B.K.) Schult., *Panicum hispidulum* Retz.)

Common names

Country/language	
English	
USA	Common barnyardgrass
India	Kayada, sawank
Indonesia	
Javanese	Jawan, jawan pari, kejawan, ramon jawan, suket ngawan
Sundanese	Gagajahan, jajagoan, padi burung
Philippines	
Bicolano	Lagtom
Ilocano	Marapagay
Tagalog	Bayakibok
Thailand	Yaa plong lamaan
Bangladesh	Barashyamaghas, dalghash, gobra, jatghasha, shama
Lao PDR	Nya khao nok
Myanmar	Ba-sa-myet, myet-cho, myet-thee
Vietnam	Gai-hao-muong, long-vuc



Botanical characteristics

A robust, tufted annual grass, erect or reclining at base and rooting at nodes, 20-200 cm tall. Root fasciculate, fibrous, thick. Stems stout, cylindrical, smooth, with white spongy pith. Leaves up to 40 cm long and 5-15 mm wide; leaf sheaths 9-13 cm long, smooth or the margin or exposed part bordered by long slender hairs; blades 5-65 cm × 6-22 mm, merging into the sheath, linear, with a broad, rounded base and acute top, rough-margined, smooth or with a few long hairs at the base, the upper surface minutely bristly, green; ligule absent. Inflorescence a terminal panicle of 5-40 spike-like racemes, all turned to one side, with shortly ascending branches, the crowded spikelets formed at one side, initially erect, later often bent down, 5-20 cm long; lowest branches the longest, upper ones very short; spikelets dense, more or less elliptical, pointed, 3-3.5 mm long, usually slightly hairy; awns, if present, usually reddish or purplish, 2-5 mm long; lemma of first floret flat or slightly convex and dull; lower glume 1.5-2.5 mm long, ovate, clasping, 3-4-nerved, shortened and having a gradually diminishing point; upper glume as long as the spikelet, ovate-oblong, acute, 3-nerved, with 0.5-3-mm-long awn, short-hairy, hairy on the nerve. Nodes of rachis usually bearded. Stamens 3, anthers yellow; styles 2, stigmas feathery, purple, protruded far below the spikelet apex. Caryopsis 1.5-2 mm long, ovoid to obovoid, compressed.

Distribution

Native of Europe and Asia. Has spread and now occurs widely in tropical and subtropical regions throughout South and Southeast Asia and Australia. Present in upland rice at all consortium sites.

Biology and ecology

E. crus-galli, a C_4 plant, is the most cosmopolitan and economically important member of the genus *Echinochloa*. It is the most widespread weed of rice throughout South and Southeast Asia. It has been reported as a weed of 36 crops in 61 countries. *E. crus-galli* is a variable species, having many forms or variants with different flowering and seeding times. Taxonomic problems in *Echinochloa* are due to several integrating polymorphic complexes of which *E. crus-galli* is the most widely distributed and difficult to classify. Lack of a comprehensive, worldwide monographic treatment exacerbates identification problems.

The rapid spread and aggressiveness of *E. crus-galli* are attributed to rapid growth, high seed production, seed dormancy, and wide adaptability under various field conditions. It occurs in low and medium altitudes, favoring open sunny places and wet soils, and can continue to grow when partially submerged. It is a common weed in swamps and aquatic places. It also grows well in drier soils, but is shorter and has fewer tillers, panicles, and seeds. Growth is good on sandy and loamy soils, especially where nitrogen content is high. It has a chromosome number of $2n = 34$.

E. crus-galli takes 42-64 d to complete its life cycle. It reproduces and spreads by seed that is often mixed with rice seed. Some seeds germinate immediately after harvest, while others

remain dormant for 4 to 48 mo. Photoperiod influences the number of dormant seeds produced and the intensity of dormancy.

Optimum moisture for germination in Japan differs with soil characteristics but is usually at 70-90% of maximum water-holding capacity. At this moisture content, seedlings emerged from a maximum depth of 10-15 cm, whereas maximum depth was 3 cm in saturated soil and 2 cm under deep submergence. Germination is 30% better in compact soil than in loose soil.

Elongation of seedlings was best at 30 °C, was slow at 10 °C, and stopped at 5 °C. Elongation is more critically dependent on oxygen supply than germination. At very low oxygen levels, seedlings elongate to about 1-2 cm and then die.

Optimum temperature for germination is 32 to 37 °C and germination decreases sharply below 10 °C and above 40 °C. Seeds of *E. crus-galli* near the soil surface germinate well on hot days.

The seed can remain viable for long periods. Tests in Germany showed that seeds retained 100% viability after 7 yr of dry storage and 33% viability after 1 yr in the soil. Results were a little different in the United States, where seeds retained 90% viability after 3 yr of field or laboratory storage.

In the field, the first tillers are formed 10 d after emergence, and normally around 15 tillers are produced. Flowering is photoperiodically controlled. In short days (8-13 h), plants flower quickly and remain small in stature. In 16-h days, plants are twice as tall and six times heavier. Panicle and tiller numbers are larger under short days, but they remain small, whereas long-day plants produce much larger panicles with more seeds. Where photoperiods are relatively even, such as in the Philippines, flowering takes place year-round.

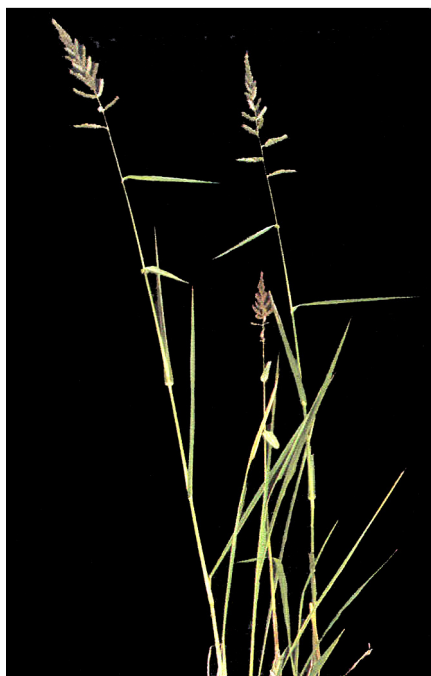
Seed production varies from 2,000 to 40,000 seeds plant⁻¹. In a weedy field, this could result in a yield of more than 1,000 kg of weed seed ha⁻¹.

In a study in rice, a change from close spacing at 7.5 cm to a distance of 60 cm resulted in a fivefold increase in the dry weight and number of panicles and tillers of plants of *E. crus-galli*. Plants grown in full sunlight had almost four times the dry weight and twice as many tillers and panicles as those grown under 50% shade. *E. crus-galli* responds well to nitrogen, phosphorus, and potassium in that order.

E. crus-galli has a range of life history traits that contribute to its success as a weed, such as rapid development to reproductive maturity, high phenotypic plasticity, production of large numbers of small, easily dispersed seeds, and low seed dormancy.

Although a weed in crops, it is often eaten by livestock in grassland and waste areas. It has been reported to accumulate high enough levels of nitrate in the tissues to be toxic to farm animals. In Java, the young shoots are eaten; in Egypt, it has been used for reclaiming saline lands.

E. crus-galli is an alternate host of diseases (caused by *Pyricularia oryzae*, *Rhynchosporium oryzae*, *Rhizoctonia solani*, *Sarocladium oryzae*, *Thanatephorus cucumeris*), viruses (rice tungro disease, rice dwarf disease, maize dwarf mosaic, barley stripe mosaic, lucerne dwarf, oat pseudo-rosette, panicum mosaic,



sugarcane mosaic, wheat streak mosaic), insect pests (*Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Cretonotus gangis*, *Cyrtorhinus lividipennis*, *Dicladyspa armigera*, *Haplothrips ganglbaueri*, *Hysteroneura setariae*, *Laodelphax striatella*, *Leptocoris oratorius*, *Marasmia exigua*, *M. patnalis*, *Mythimna separata*, *Nephotettix nigropictus*, *N. virescens*, *Nilaparvata lugens*, *Nisaga simplex*, *Orseolia oryzae*, *Pseudococcus saccharicola*, *Scotinophara coarctata*, *Sogatella furcifera*, *S. panicola*, *Spodoptera mauritia acronyctoides*, *Stenchaetothrips biformis*), and nematodes (*Heterodera marioni*, *Hirschmanniella oryzae*, *Meloidogyne graminicola*, *M. cf. graminicola*, *M. acrita*, *M. microtyla*).

Weed management

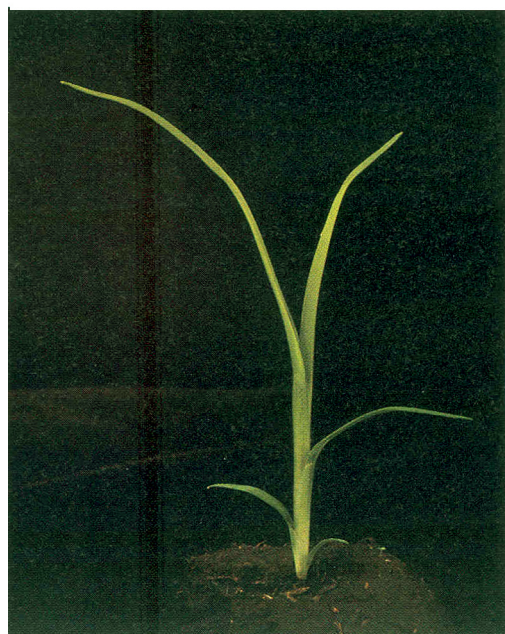
Cultural. Infestation of *E. crus-galli* in upland rice can be reduced by seed hygiene to ensure that planting material is free of weed seeds. Crop rotations and preplanting cultivations can also reduce weed emergence in the crop. Seedlings and plants can be removed with hand weeding and interrow cultivation, but it is difficult to achieve 100% control. A farmer who planted 1.4 ha reduced weed density from more than 100 panicles m⁻² to less than 15 panicles m⁻² in the subsequent season by spending about 60 h cutting off *E. crus-galli* panicles throughout the season.

Chemical. *E. crus-galli* can be controlled by preemergence applications of oxadiazon (0.75–1.0 kg ha⁻¹) or pendimethalin (1.5–2.0 kg ha⁻¹) or postemergence (3–5-leafstage) application of cyhalofop butyl (0.1–0.15 kg ha⁻¹) or thiobencarb (2 kg ha⁻¹) + butachlor + propanil mixtures.

Biological. Biological control has been investigated but is not yet effective. Possible biocontrol agents selective against the *E. crus-galli* complex are the stemborer *Emmalocera* sp., the planthopper *Sogatodes pusana*, the planthopper *Tagosodes pusanus*, and the pathogen *Exserohilum monoceras*.

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Eleusine indica (L.) Gaertn.

(Synonyms: *Cynodon indicus* Rasp., *Cynosurus indicus* L., *E. gracilis* Salisb.)

Common names

Country/language	
English	
Australia	Crowsfoot grass
USA	Goosegrass
India	Jangali marua, jhingari
Indonesia	Rumput belulang
Philippines	
Bicolano	Bag-angan, barangan
Bisaya	Padpad
Cebuano	Palagtiki
Ilocano	Labba-labba, parañgis, sabung-sabungan
Ilongo	Palagtiki
Pampango	Parangis, sabung-sabungan
Tagalog	Bakis-bakisan, kabit-kabit, parag-is, sabong-sabongan, sambali
Thailand	Yaa teen-ka
Bangladesh	Binna challa, chapra, gaicha, malangakuri, malankuri
Lao PDR	Nya phak koie
Myanmar	Sin-ngo-let-kyar, sin-ngo-myet
Vietnam	Man-trau

Botanical characteristics

Densely tufted annual or perennial plant, 10–70 cm high. Culms strongly compressed, usually erect, somewhat slender. Leaves in distichous position. Leaf blade linear, 10–30 cm long, 3–5 mm wide, with a few white hairs on margin becoming more frequent

at junction of blade and sheath; sheath strongly compressed-keeled; ligule membranous with a hairy rim about 1 mm long on the top. Flowering culms 20-40 cm long, with 2-7 racemes 5-10 cm long, radiating out from the apex of the culm, usually with one or two inserted a few cm below. Subsessile spikelets usually 60-80 in number and arranged in alternate rows on one side of the flattened axis of the raceme; each spikelet 3.5-6 mm long, with 3-5 florets. At the base of the spikelet are two strongly compressed, boat-shaped, empty glumes with green keels and a few short bristle-like hairs on the margin. The most conspicuous parts of the florets are the lemmas, which embrace the delicate two-ribbed palea inside, which is the flower. At maturity, the anthers and the purple feathery stigmas can be seen emerging from the lemmas. When ripe, the small, obscurely three-angled brown grain with its delicate pericarp falls to the ground surrounded by the lemma and palea, leaving the glumes attached to the base of the spikelet. Grain reddish brown with wavy cross-ridges.

Distribution

Native of India. Widely distributed in tropical and subtropical regions in South Asia, Southeast Asia, the Pacific, eastern and southern Africa, and tropical North America. Common in upland rice at all consortium sites.

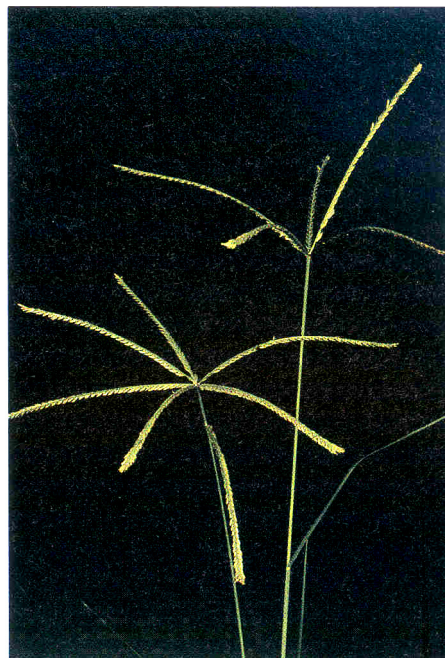
Biology and ecology

E. indica, a C₄ species, occurs from sea level to 2,000 m and is of broad ecological amplitude. It is a major weed in more than 40 crops and is a lawn weed in many parts of the world. It is a serious weed in annual crops. It can be found growing in gardens, cultivated land, fallows, and open waste places, and is generally prominent along roadsides. It prefers sunny or somewhat shaded sites that are not too dry and is most vigorous along irrigation field borders and canals. It favors moderately fertile to fertile soils, and is tolerant of trampled or compacted soils.

Alternating temperatures break dormancy, and the optimum of 20/35 °C gave 90% or more germination. Light is essential for good germination at a constant 30 °C, and aided germination at alternating temperatures of 20/30 °C. At higher temperatures of 20/35 °C, light is less important.

E. indica seed can emerge from a range of planting depths (0-5 cm) but will not emerge from 8 cm or deeper. Established plants have a dense root system, which makes them very difficult to remove, and weeding may result in damage to associated crops. In a study on water use, *E. indica* had lower leaf conductance, lower transpiration rates, and higher water-use efficiency than upland rice cv. Kinandang Patong and UPLRi-7. Continuous exposure to 150 $\mu\text{m m}^{-1} \text{s}^{-1}$ photosynthetically active radiation strongly inhibited growth of *E. indica*. It is susceptible to shading and can be suppressed by a fast-establishing dense rice population.

The number of inflorescences per plant is commonly about 7 but ranges from 3 to 23. It is a prolific seed producer. The number of seeds plant⁻¹ averages around 4,000 but ranges from 80 to 12,000, with the highest number reported to be 137,000. The weight of 1,000 seeds is 0.3 g. The seeds are easily spread by animals that feed on the weed.



E. indica is a secondary host to diseases (caused by *Cochliobolus miyabeanus*, *Helminthosporium* sp., *Pyricularia oryzae*, ragged stunt, *Rhizoctonia solani*, *Sarocladium oryzae*), nematodes (*Meloidogyne acrita*, *M. arenaria*, *M. incognita*, *M. javanica*, *Pratylenchus* sp., *P. pratensis*, *P. indicus*, *Rotylenchus reniformis*, *Tylenchorhynchus claytoni*), and viruses of rice, sugarcane, maize, and peanut. It is also one of the ovipositional hosts of *Nisia carolinensis*, a planthopper common in rice-field habitats, and other insect pests (*Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Creatonotus gangis*, *Euscyrtus concinnus*, *Haplothrips ganglbaueri*, *Hysteroneura setariae*, *Leptocoris acuta*, *L. oratorius*, *Marasmia exigua*, *Mythimna separata*,

Nephotettix nigropictus, *N. virescens*, *Nilaparvata lugens*, *Nisaga simplex*, *Pseudococcus saccharicola*, *Sesamia inferens*, *Spodoptera mauritia acronyctoides*, *Tetraneura nigriabdominalis*).

The plant is valued as an important fodder grass in Australia, North America, and Bangladesh, and is sometimes used to make hay and silage. The leaves are strongly cyanogenic, especially when wilted. The grains are used as food in times of famine. It is used as a medicine for worms in central Sumatra and as a sudorific and for fevers and liver complaints in Cambodia. The young plants are used as a vegetable in Java and the stems are used to make hats in Indonesia and the Philippines.

Weed management

Cultural. Young plants have a shallow root system and can easily be controlled by hoeing and hand cultivation. When established, this weed develops a strong root system and uprooting becomes difficult.

Chemical. *E. indica* can be controlled by preemergence application of oxadiazon (0.75-1.0 kg ha⁻¹) or pendimethalin (1.5-2.0 kg ha⁻¹) or early postemergence (3-5-leaf stage or 15-25 d after emergence) application of cyhalofop butyl (0.1-0.15 kg ha⁻¹), butachlor (2 kg ha⁻¹), fenoxaprop-P-ethyl (0.06 kg ha⁻¹), fluazifop-P-butyl (0.1-0.6 kg ha⁻¹), or propanil (2 kg ha⁻¹). Beyond the 5-leaf

stage, higher rates of cyhalofop butyl are recommended.

Biological. Two leaf-spotting pathogens, *Bipolaris setariae* and *Pyricularia grisea*, were 100% effective in infecting *E. indica* in field tests in South Carolina, USA.

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Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.

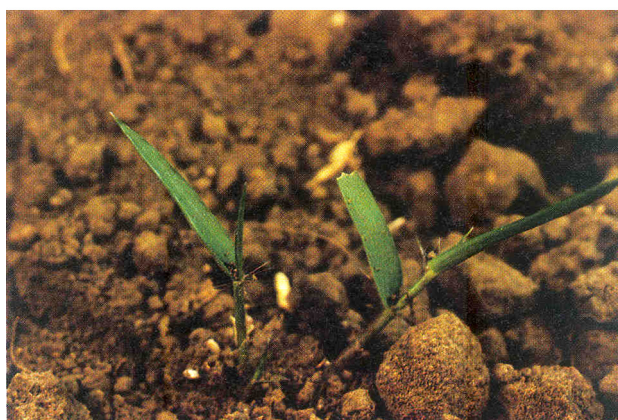
(Synonyms: *E. amabilis* Wight & Arn. ex Hook. et Arn., *E. plumosa* (L.) Link, *Poa tenella* L.)

Common names

Country/language	
English	
USA	Feather love grass
India	Bharbhusi
Indonesia	
Javanese	Suket emprit-emprit
Sundanese	Jukut karukuan
Philippines	
Ilocano	Pagai-billit
Tagalog	Bagibuk, kaliraurau
Bangladesh	Shada fulka
Thailand	Yaa wai
Lao PDR	Hnhaaz nhung
Myanmar	Myet-hmon-hmua
Vietnam	Xuan-thao-min

Botanical characteristics

A small, densely tufted annual, usually not much more than 50 cm high. Leaves up to 10 cm long; sheaths split, glabrous; ligule a ring of five soft hairs; blade rough-margined. Inflorescence up to



about 15 cm long, but variable in size, usually with many very slender spreading branches 2-4 cm long or shorter, spikelets small, usually about 0.2-0.25 cm long, with 3-6 florets, pale green tinged with violet color, anthers purple, paleas with stiff, slender spreading hairs on their keels. *Caryopsis* shed with its glumes, ellipsoid, brown, 0.7 mm long.

Distribution

Native of tropics of Asia and Southeast Asia. Introduced and now widely distributed in tropical regions of America and Africa. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh, Lao PDR, and Myanmar.

Biology and ecology

E. tenella, a C_4 species, is considered a weed of minor agricultural importance and occurs in crops, waste places, old walls, lawns, roadsides, beach dikes, and gardens. It thrives on both permeable and impermeable soils, and is often found in compacted and stony areas.

It is a prolific seed producer. One plant produces 140,000 seeds. The weight of 1,000 seeds is 0.01 g. There are about 99,600 seeds g^{-1} .

E. tenella is a very competitive species, with a rapid growth rate and fast production of erect tillers and leaves. It is the most competitive weed in mixtures with *Synedrella nodiflora*, *Tridax procumbens*, and *Imperata cylindrica*.

It is a host of the nematode *Meloidogyne chitwoodi*, the rice tungro virus, and the insect *Nephotettix virescens*.

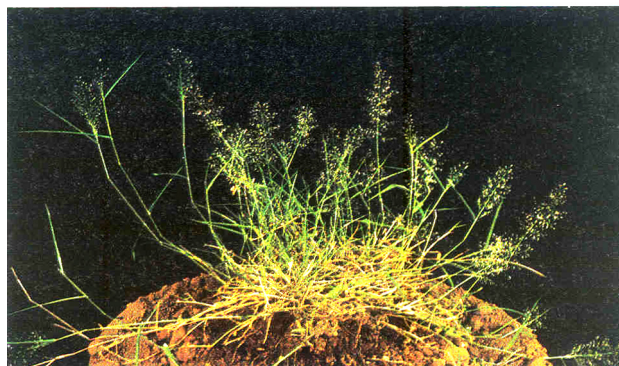
It is considered a useful fodder and is grazed by cattle and water buffalo in traditional feeding systems.

Weed management

Cultural. *E. tenella* can be controlled by cultivation, especially when followed by dry conditions, which promote desiccation of up-rooted plants.

References

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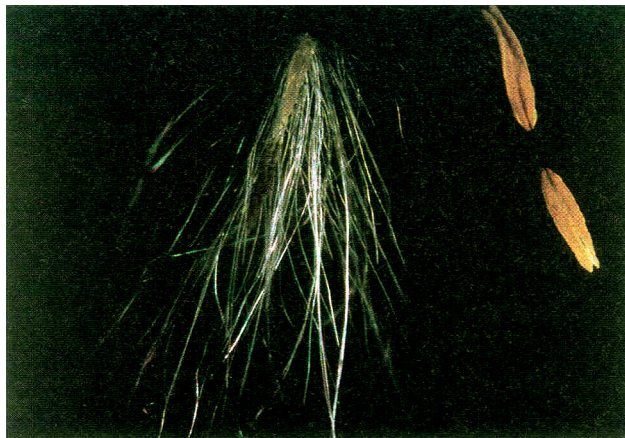


Imperata cylindrica (L.) Raeuschel

(Synonyms: *I. allang* Jungh., *I. arundinacea* Cyr., *Lagurus cylindricus* L., *Saccharum cylindricum* (Linn.) Lam., *S. koenigii* Retz., *S. thunbergii* Retz.)

Common names

Country/language	
English	
USA	Alang-alang, bladygrass, cogongrass, swordgrass
India	Dab
Indonesia	
Indonesian	Alang-alang, ilalang
Javanese	Kambengan
Philippines	
Bicolano	Gogon, kogon
Bisaya	Kogon
Ilocano	Kogon
Ilongo	Kogon
Pampango	Balili, ilib
Tagalog	Kogon
Thailand	Yaa khaa
Bangladesh	Ulu
Lao PDR	Nya kha
Myanmar	Thet-ke
Vietnam	Co tranh



Botanical characteristics

An erect perennial rhizomatous grass up to 120 cm high. Rhizomes firmly rooted, white and succulent, with scales that become papery on drying and then flake off to expose the internodes. Stems solid, cylindric, slender, with smooth or bearded nodes. Culm below the inflorescence upright. Leaves flat, erect, linear-lance-shaped, tapering to a point, about 20-50 cm long, 5-9 mm wide. Sheath of basal leaves disintegrates into thin fiber. Ligule membranous, 1-8 mm long. Inflorescence dense, cylindric, and spike-like, about 10-20 cm long, 5-15 cm in diameter, silvery in color. Callus hairs in large quantity, about twice as long as the glumes. Spikelets 2.2-6 mm long. Fruit a caryopsis, 1-1.3 mm long.

Distribution

Native of Old World; very widely distributed in Australia, Africa, southern half of Asia, and Pacific Islands. Occurs in New World in Argentina, Chile, Colombia, the United States (Florida), and West Indies. Common in upland rice in Indonesia and Thailand and present at all consortium sites.

Biology and ecology

I. cylindrica, a C₄ plant, has a very wide habitat range and grows in dry sand dunes of shores and deserts as well as swamps and river margins. It grows in grasslands, in cultivated annual crops, on roadsides, and in plantations. The plant is a colonizer of disturbed land, and thrives in sunny to lightly shaded sites. It prefers fertile soils, but can also grow under low fertility.

The species reproduces by seed and from very vigorous rhizomes. It can produce as many as 3,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.114 g and there are about 9,000 seeds g⁻¹. The plumed seeds may travel long distances, but the average flight at inflorescence level is 15 m. The seeds give 95% germination within 1 wk of harvest and are viable for at least 1 yr.

New seedlings establish quickly on open ground. The seedlings produce rhizomes after 4 wk. The optimum temperature for rhizome bud development in Indonesia is 30 °C, with no growth occurring at 20 or 40 °C. Rhizome pieces measuring 1-5 cm long and 2-5 mm in diameter have the same sprouting ability.

One ha of infested land may have 4.5 million shoots, more than 10 t of leaf material, and more than 6 t of rhizomes. The weed is generally recognized to be light-loving, but it can survive in 50% shade.

Leaves of *I. cylindrica* have growth-inhibiting substances. These were identified as p- and O-coumaric acid, gentisic acid, vanillic acid, benzoic acid, p-hydroxybenzoic acid, vanillin, and p-hydroxybenzaldehyde.

I. cylindrica is an ovipositional host of the planthopper *Nisia carolinensis* and a host of other insect pests (*Cicadulina bipunctata*, *Cretonotus gangis*, *Mythimna separata*), diseases (caused by *Rhizoctonia solani* and *Thanatephorus cucumeris*), the root-knot nematode *Rotylenchus reniformis*, and the rust fungus *Puccinia rufipes*.

It fulfills a valuable role as a soil binder and is a useful grass for thatching. The species is used in various ways in medicine.

Weed management

Cultural/mechanical. Burning of *I. cylindrica* infestations is widely practiced by small-scale farmers to prepare cropping areas and encourage succulent regrowth for livestock. The weed is tolerant of burning and rapid regrowth occurs from the rhizomes, which are protected by the soil. Frequent cultivation using hand tools, animal-drawn equipment, and machine-powered cultivators will control the weed, especially if the rhizomes are broken into small pieces, exposing them to desiccation at the soil surface.

In Indonesia, scientists are succeeding in controlling *I. cylindrica* by exploiting its susceptibility to shade by sowing the fast-growing creeping legume, *Mucuna* spp., within infestations. *Imperata* is cut and burned, rock phosphate is applied to the soil at a rate of 1 t ha⁻¹, and *Mucuna* seeds are broadcast. The vine soon grows to cover the *Imperata*, which gradually dies out. The roots of *Mucuna* fix nitrogen and help control nematodes as well as erosion, while the vine bears an edible bean.

I. cylindrica has also been successfully smothered by other legume cover crops. In order of effectiveness, these were tropical kudzu (*Pueraria phaseoloides* (Roxb.) Benth.), stylo (*Stylosanthes* sp.), and calopo (*Calopogonium mucunoides* Desv.). But legumes will not establish in the presence of *I. cylindrica* if they are broadcast on unplowed land. The land must be plowed to partially eradicate the weed. Phosphate may also need to be applied.

Chemical. Preplant application of glyphosate has been used to control the weed. The herbicide is usually applied at 1.5 to 2.0 kg ha⁻¹ to actively growing foliage, from where it is translocated to the rhizomes, causing death of most plants. Regrowth can be treated with spot applications.

Biological. *Colletotrichum caudatum* is being investigated and may have potential as a biological control agent.

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Ischaemum rugosum Salisb.

(Synonyms: *Andropogon arnottianus* (Nees) Steud., *Colladoa distachya* Cav., *I. segetum* Trin., *Meoschium arnottianum* Nees, *M. griffithii* Nees & Arn., *M. rugosum* (Salisb.) Nees)

Common names

Country/language	
English	
USA	Saromaccagrass
Indonesia	
Javanese	Suket bleblem
Sundanese	Jukut randam
Philippines	
Bicolano	Ipot-daron
Bisaya	Aguingay sa basak
Ilocano	Salsaladay
Ilongo	Bulo-bulo
Tagalog	Tiritrigo, trigo-trigohan
Thailand	Yaa daeng
Bangladesh	Mona, moraro
Lao PDR	Nya kabthoon
Myanmar	Tet-kwet
Vietnam	Co mom

Botanical characteristics

An annual grass, with culms up to 120 cm high, branched, purplish, and erect. Sheaths fairly loose, clothed with soft slender hairs on margins near tips and nodes. Ligule membranous, fused with auricles, 1-7 mm. Blades linear-lance-shaped, little hairs on both surfaces, 20-30 cm long and 9-12 mm wide. Inflorescence in paired racemes 3-12 cm long, firmly pressed to the stem at the base but gradually separating with one flat side each. Spikelets stalked and awned; awn 1.8-2.5 cm long, slender, spirally twisted in the lower half; sessile spikelet oblong-ovate, 4-6 mm long; stalked spikelet resembling the sessile and on a pedicel one-third the length of the internode, or much reduced and on a pedicel equalling the internode. Seed light brown, 2.5-3 mm long, 1 mm wide, triangular in cross-section, oblong, small tip slightly concave near point of attachment.

Distribution

Native of tropical Asia. Widely distributed in warm, humid regions near the equator in South America, West Africa, South Asia, and Pacific Islands. Common in upland rice in the Philippines and present at all consortium sites except India.

Biology and ecology

I. rugosum, a C_4 plant, is found in wet grasslands at sea level and also grows up to 2,400 m. It is a weed of low country, swamps, rice bunds, and paddy fields and can predominate in upland areas. *I. rugosum* persists on soils with poor fertility but will respond to fertilizer application. It can tolerate acid soils with a pH as low as 4. Although a sun-loving plant, it can persist at sites receiving only 30-35% of full sunlight.



I. rugosum has a chromosome number of $2n = 18$ and 20 . It completes its life cycle in 130–140 d. A great variation in the number of seeds plant⁻¹ has been reported. In India, one plant with six tillers produced 216 seeds. A single plant produced 4,000 seeds in the Philippines and 40,000 seeds in Colombia. The weight of 1,000 seeds is 0.7 g, with 1,500 seeds g⁻¹.

Newly harvested seeds appear to have innate or induced dormancy. Scarification is desirable with reduce hard-seededness. Light is required for germination.

This species is one of the commonest weed seed contaminants in rice seed, being found in 84% of the tested samples in a Philippine study. It is more competitive with rice than *Echinochloa crus-galli* or *E. colona*.

It is an alternate host of disease caused by *Thanatephorus cucumeris*, the tungro virus, insect pests (*Chaetocnema basalis*, *Cicadulina bipunctata*, *Hysteroneura setariae*, *Leptocoris acuta*, *Nisaga simplex*, *Nisia carolinensis*, *Orseolia oryzae*, *Pseudococcus saccharicola*, *Tetraneura nigriabdominalis*), and the nematode *Meloidogyne graminicola*.

I. rugosum is sometimes used as a cereal. It is readily eaten by animals and produces a nutritious fodder when young. It also provides suitable material for compost and mulch.

Weed management

Cultural. *I. rugosum* is easily controlled by hand weeding.

Chemical. Propanil is effective in controlling *I. rugosum* in Brazil, Suriname, and Peru. Other herbicides that can control the weed are butachlor, thiobencarb, and pendimethalin or a mixture of thiobencarb + butachlor + propanil. The degree of control ranged from 70% for pendimethalin to 90% for thiobencarb and butachlor. It can also be controlled by postemergence (3–5-leaf stage) application of cyhalofop butyl (0.1–0.15 kg ha⁻¹) and fenoxaprop-P-ethyl (0.06 kg ha⁻¹).

References

Akibo-Betts and Raymundo (1978), Antigua (1993), Bailey (1949), Barrion and Litsinger (1986), Bogdan (1977), Bor (1960), Catindig et al (1994b,c, 1995b), Cope (1982), De Datta (1981), Dirven and Poerink (1955), Fajardo and Moody (1995), Galinato (1995), Gapasin et al (1996), Gressel and Baltazar (1996), Holm et al (1977), Lazarides (1980), Lubigan (1986), Manidool (1986), Mannetje and Jones (1992), Moody et al (1984), Pabon (1981), Pancho (1964), Patnaik et al (1987), Poilecot (1995), Rivera et al (1969), Senaratna (1956), Srivastava and Saxena (1967).

Leptochloa chinensis (L.) Nees

(Synonyms: *L. tetraquetra* Presl, *Poa chinensis* L.)

Common names

Country/language	
English	Sprangle top
Indonesia	
Javanese	Timunan
Sundanese	Bebontengan
Philippines	
Bicolano	Kurukauayan, maroy-paroy
Bisaya	Pawa
Ilocano	Marapagay
Tagalog	Palay-maya
Thailand	Yaa yon huu
Bangladesh	Fulka
Lao PDR	Nya dok khao
Myanmar	Daung-mi-pyan, myet-kha, myet-sat
Vietnam	Trung quoc

Botanical characteristics

Annual or sometimes perennial grass with culms ascending from branching base, 30–70 cm long. Leaf blades membranous, covered with a fine, white, waxy powder that rubs off, green, 7–15 cm long, 3–8 mm broad, flat; ligule membranous-ciliate, about 1 mm long. Panicles narrowly ovate with the main axis 15–40 cm long. Branches simple and numerous, irregular along main axis, spreading, 4–10 cm long, filiform, rough to the touch, spikelet bearing from near base. Spikelets 2–7 flowers, pedicels short,





pressed to the stem or erect, pale green and slightly reddish; glumes broadly lance-shaped, unequal, sharply pointed with sides straight, not incurved, the first 1-nerved about 1 mm long, the second 3-nerved about 1.5 mm long. Caryopsis an ellipse in longitudinal section and a circle in cross-section, 0.8 mm long, slightly compressed on face and back covered with very faint small pits caused by minute longitudinal striations and short transverse line connecting them.

Distribution

Native of tropical Asia. Now widely distributed in South and Southeast Asia, Japan, and Australia. Also occurs in Africa, where

it has been reported from Swaziland. Present in upland rice at all consortium sites except India.

Biology and ecology

L. chinensis, a C_4 species, grows on heavy or light soils and favors swampy or inundated sites, especially in grasslands, drains, and cultivated fields. Although mostly an annual, it can be perennial when suitable growing conditions exist. It is often abundant in crops and competes strongly for nutrients, light, and moisture. Its ability to grow in both flooded and upland conditions makes it a versatile and abundant weed in rice and many other crops. Its chromosome number is $2n = 40$. It reproduces by seed and can produce 27,000 seeds plant⁻¹. The weight of 1,000 seeds is 0.07 g. There are 14,500 seeds g⁻¹.

L. chinensis requires a high moisture content for germination and emergence. The dormancy of seeds stored under air-dried conditions is readily broken when seeds are placed on moist filter paper subjected to a regime of 12 h light and then dark at 40 °C, and 12 h light at 30 °C and 12 h dark at 15 °C. Light plays a major role in breaking dormancy. The effect of light on seeds stored under air-dried conditions was more conspicuous at 6–12 h after water absorption than at the start of imbibition.

Dissemination of the species is common from impure rice seedstock. The weed can also reproduce by division of culm clumps or rootstocks following tillage or incomplete weeding.

The weed is an alternate host of diseases (caused by *Ephelis oryzae*, *Pyricularia oryzae*, *Rhizoctonia solani*), insect pests (*Chilo auricilius*, *Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Creatonotus gangis*, *Hydrellia philippina*, *Marasmia patnalis*, *Mythimna separata*, *Nisaga simplex*, *Peregrinus maidis*, *Pseudococcus saccharicola*, *Scirpophaga incertulas*, *Sogatella furcifera*, *Spodoptera mauritia acronyctoides*), and nematodes (*Hirschmanniella oryzae*, *Meloidogyne graminicola*).

Although a weed in crops, *L. chinensis* is eaten by livestock and is a palatable fodder grass. The grain is a famine food in East Africa.

Weed management

Cultural. Because contamination of rice seed is common, seed hygiene is important in control. *L. chinensis* seeds are much smaller than rice grain, so cleaning is not difficult.

Chemical. *L. chinensis* can be controlled by preemergence application of pendimethalin (1.5–2.0 kg ha⁻¹) or early postemergence (3–5-leaf stage) application of cyhalofop butyl (0.1–0.15 kg ha⁻¹), butachlor + propanil mixtures, and fenoxaprop-P-ethyl (0.06 kg ha⁻¹, 10 d after seeding).

References

- Backer and van den Brink (1968), Burkill (1935), Catindig et al (1988, 1990, 1991, 1993, 1994a,b,c, 1995a), Drost et al (1983), Gapasin et al (1996), Gressel and Baltazar (1996), Kardin et al (1977), Kim et al (1981b), Mannetje and Jones (1992), Matsuo and Kataoka (1983), Mew et al (1980), Pancho (1964), Pane and Mansor (1997), Patnaik et al (1987), Reed (1977), Santiago (1977), Soerjani et al (1987), Yin and Li (1984).

***Paspalum conjugatum* Berg.**

(Synonyms: *P. ciliatum* Lam., *P. longissimum* Hochst., *P. tenue* Gaert.)

Common names

Country/language	
English	
USA	Sour paspalum
India	Hadaghas
Indonesia	
Indonesian	Kekawatan
Javanese	Paitan
Sundanese	Jampang pahit
Philippines	
Bisaya	Lakatan, pad-pad
Cebuano	Kauat-kauat
Ilongo	Kolokawayan
Tagalog	Kulape, laau-laa
Thailand	Yaa nom non, ya-hep
Bangladesh	Datfui
Lao PDR	Nya phaet sang
Myanmar	Ta-phet-thart
Vietnam	Co la gung

Botanical characteristics

Plant a vigorous, leafy stoloniferous perennial grass, with erect or ascending flowering culms, roots and shoots profuse, forms loose mats over extensive areas, 20-60 cm tall. Culm in clusters, hairy at the base, erect or ascending from the base reclining on the ground. Leaf blade smooth, with occasional spreading hairs at the leaf base. Upper part of the sheath smooth, base with few hairs, partly inflated. Ligule 1-2 mm, rounded, membranous. Auricles absent. Inflorescence a pair of spikes or clusters forming a T, 5-20 cm long, spikelets drooping, arranged in 2 rows at the lower side of the rachis, ovate, with long and white soft hairs at margins; rest of surface covered with soft hairs. Stamens 3. Styles 2, free. Caryopsis broadly ellipsoid, transparently yellowish brown, 1-1.2 mm long.

Distribution

Native grass of tropical America. Troublesome weed mainly in Central America, West Africa, and Southeast Asia. Common in upland rice in Indonesia, Lao PDR, and Philippines and present in Bangladesh, India, Myanmar, Thailand, and Vietnam.

Biology and ecology

P. conjugatum, a C₄ plant, is a very common weed of cultivated and waste ground in lowlands of less than about 1,600 m altitude. The plant grows in moist open sites such as stream banks, roadsides, and abandoned paddocks. It is common in natural and poorly managed pastures and in perennial or plantation crops, and is regarded as an important weed when growing in rice.

The mature seeds exhibit dormancy after harvest but can be stimulated to germinate after exposure to light. Light inten-



sity of 100 lux is sufficient to break dormancy. The plant's chromosome numbers are $2n = 20, 40, 80$.

It rapidly becomes established at new sites. The flattened, hairy spikelets readily adhere to and spread on clothing and coats of animals. It is also propagated and spread by vegetative stolon pieces when machines are used for tillage.



Flowering commences 4-5 wk after seedling emergence and continues year-round. The flowers are wind-pollinated. One plant in the Philippines was reported to produce 1,500 seeds. The weight of 1,000 seeds is 1.08 g and there are about 900

seeds g^{-1} . The germination percentage of *P. conjugatum* seed is usually low.

P. conjugatum is reported to be an alternate host of diseases (caused by *Pyricularia oryzae* and *Rhizoctonia solani*), insects (*Chaetocnema basalis*, *Cnaphalocrosis medinalis*, *Creatonotus gangis*, *Leptocorisa acuta*, *L. coarctata*, *Marasmia exigua*, *M. patnalis*, *Mythimna separata*, *Nephotettix virescens*, *Nisaga simplex*, *Nisaga carolinensis*, *Pseudococcus saccharicola*, *Spodoptera mauritia acronyctoides*), and a nematode (*Pratylenchus* sp.).

P. conjugatum is occasionally used as a lawn grass and as a forage for grazing or in cut-and-carry systems. Leaf decoctions and crushed spikelets are used as traditional medicines in the treatment of wounds and sores.

Weed management

Mechanical. *P. conjugatum* can be controlled mechanically. It requires hoeing because it is difficult to remove by hand. Cutting at 2-wk intervals also provides reasonable control.

Chemical. *P. conjugatum* is susceptible to glyphosate applied as a preplant herbicide. It is also controlled by cyhalofop butyl applied at $0.1\text{--}0.15 \text{ kg ha}^{-1}$ at the 3-5-leaf stage.

References

Barrior and Litsinger (1986), Catindig et al (1991, 1993, 1994a,c, 1995b), Gapasin et al (1996), Holm et al (1977), Kim et al (1981b), Kleinschmidt and Johnson (1977), Lazarides (1980), Manette and Jones (1992), Mercado (1979), Moody et al (1984), Pancho (1964), Pancho and Obien (1995), Parker (1992), Patnaik et al (1987), Poilecot (1995).

Paspalum dilatatum Poir.

(Synonyms: *P. lanatum* Spreng., *P. ovatum* Nees ex Trin., *P. platense* Spreng., *P. selloi* Spreng.)

Common names

Country/language	
English	
USA	Dallis grass
India	Hadaghas
Indonesia	Asman
Philippines	
Bicolano	Halanam
Bisaya	Miligoy
Cebuano	Sakata
Tagalog	Lawa-lawa
Thailand	Yaa wai, ya-daenlit
Myanmar	Tha-phet-thart
Vietnam	Co san

Botanical characteristics

A perennial grass; culms strongly tufted, leafy at base, compressed, up to 180 cm tall with narrow depression at base, smooth, erect to ascending, usually bent (like a knee) at base. Sometimes root-



ing at lower nodes, leaf sheaths smooth or, for lower ones, hairy at back. Ligule membranous, 24 mm long. Blade lance-shaped, 10-25 cm long, 3-12 mm wide, smooth; margin scabrous. Inflorescence erect or nodding, 10-25 cm long; racemes 3-5, rarely widely separated, 4-13 cm long. Spikelets alternate in pairs at lower face of rachis, outer pedicel longer than the inner, light green or purplish; upper glume and lower lemma 5-9-nerved, fringed with long white silky hairs, anthers and stigma dark purple or black. Fruit a caryopsis, about 2.5 mm long, broadly elliptic.

Distribution

Native of humid subtropics of Brazil, Argentina, and Uruguay. Plant found in temperate zone in Great Britain, Soviet Union, United States, Argentina, Australia, New Zealand, and South Africa. In the tropics, widespread in India, Hawaii, and throughout Southeast Asia. Common in upland rice in the Philippines and present in India, Indonesia, Myanmar, Thailand, and Vietnam.

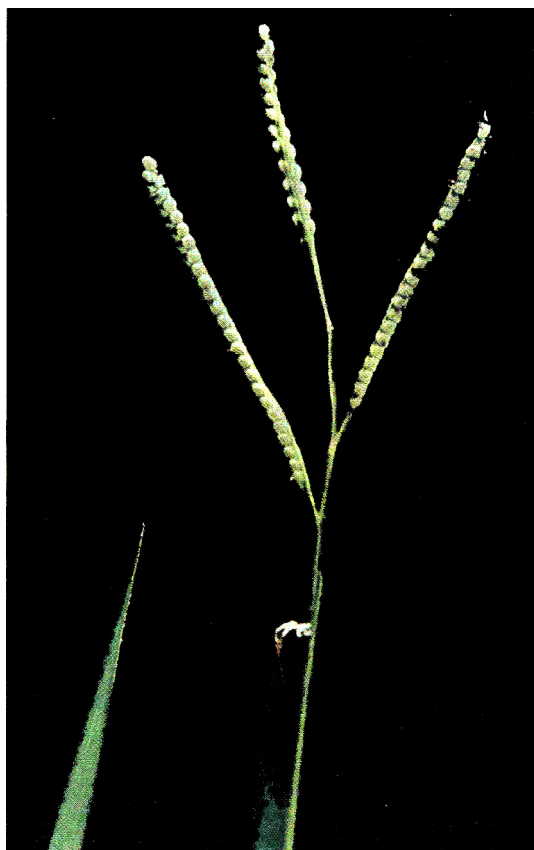
Biology and ecology

P. dilatatum, a C_4 species, is sown as a forage species, but is considered a weed in crops. It thrives at altitudes of 1,000-2,000 m, and also grows at very low elevations. It is often found on soil that is permanently damp or occasionally waterlogged with more than 1,000 mm annual rainfall, mainly during the warm season.

The plant is widely adapted and can grow in a variety of soil types and climates. It can succeed on light or heavy clay soils and is drought resistant, remaining green after other grasses have dried off during drought. It is found under plantation crops and also along stream banks, roadsides, and in disturbed areas. It responds readily to nitrogen fertilization and can compete moderately well with other species under conditions of high fertility. Its chromosome number is $2n = 40$.

P. dilatatum can establish from seed or divisions of the stem tuft. It produces large quantities of seed either sexually or apomictically and is sown and spreads mainly by seed. If the seeds are fresh, only a small percentage will germinate. If they have had an opportunity to after-ripen, for example, by exposure to the hot sun on the soil surface for several days, a much higher percentage will germinate. A high night temperature (18 °C) and a 14-h photoperiod favor vegetative growth and seed production. Low night temperatures inhibit seed head production in long days. Optimum temperatures for leaf growth, tillering, and flowering are 30, 27, and 22.5 °C, respectively. The plant does not tolerate salinity. Optimum pH is between 5.5 and 7.0.

Flowering occurs throughout the growing period and seeds scatter as soon as they are ripe. Seed production of two strains (B230 and S430) of *P. dilatatum* grown under a 14- and 16-h day with a 60 to 70 °F night temperature was studied. The 14-h treatment produced a higher percentage of seed with caryopses (84% for B230 and 62% for S430) than the 16-h day (73% for B230 and 55% for S430). Total weight of seed was also higher (8.9 g for B230 and 9.1 g for S430 vs 3.8 g for B230 and 4.8 g for S430) under a 14-h day than under a 16-h day. Both treatments produced 5 racemes panicle⁻¹ for each strain.



The plant is very susceptible to ergot (*Claviceps paspali*). This fungus infects the inflorescence and excretes a substance that is toxic to cattle and can occasionally cause abortion. Other diseases of the plant are anthracnose (caused by *Colletotrichum graminicola*) and leaf blight (caused by *Helminthosporium micropus*). *P. dilatatum* pastures are sometimes invaded by white-grubs (*Lepidiota caudata* and *Rhopaea paspali*), which destroy the roots and reduce productivity. It is also an alternate host of the nematode *Pratylenchus* sp., leaf blight caused by *Rhizoctonia solani*, and the insect pest *Leptocorisa acuta*.

P. dilatatum is considered a good forage grass and is also useful for hay and silage. It gives excellent protection against erosion.

Weed management

Cultural. *P. dilatatum* can be removed by hand weeding and close cutting is recommended to prevent seed heads from reaching maturity.

Chemical. *P. dilatatum* can be controlled by early postemergence application of fenoxaprop-P-ethyl (at 1-3 leaves, 34 g ha⁻¹) or cyhalofop-butyl (at 3-5 leaves, 0.1-0.15 kg ha⁻¹). Beyond the 5-leaf stage, higher rates are recommended.

References

Banerjee and Chatterjee (1965), Cope (1982), Evers (1981), Gapasin et al (1996), Holm et al (1977), Kardin et al (1977), Knight (1955), Lazarides (1980), Mannerje and Jones (1992).



Paspalum scrobiculatum L.

(Synonym: *P. commersonii* Lam.)

Common names

Country/language	
English	Kodo
India	Kodu, kondo
Indonesia	
Indonesian	Jaringan
Javanese	Rebu bawang, rumput kinangan
Philippines	
Bisaya	Bias-biasin
Cebuano	Bias-biasin
Tagalog	Sabung-sabungan
Thailand	Yaa plong hin
Bangladesh	Angta
Myanmar	Myet-kha-yan, thet-ke-myet
Vietnam	San-tron

Botanical characteristics

Annual or perennial plant, smooth, with culms up to 90 cm tall, rather succulent, branching, ascending, loosely tufted. Blades 15-40 cm long, 5-12 mm wide, flat; sheaths flattened, often overlapping. Ligule membranous, brown, about 2 mm long. Inflorescence a raceme, mostly 3-5, 5-9 cm long, ascending; rachis 2-3 mm wide, firm. Spikelets disposed in two rows at the lower face of the rachis, crowded, 3 mm long, the broad end upward (obovate), turgid. Glume and sterile lemma equal, 7-nerved; lemma loose and more or less wrinkled. Stigmas purple. Seed orbicular, enclosed between the lemma and palea.

Distribution

Of African origin. Now widely distributed throughout tropics and subtropics of Old World. Cultivated in parts of Asia. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh and Myanmar.

Biology and ecology

P. scrobiculatum occurs at low to medium altitudes up to 1,500 m. It does not show any particular climatic preference in tropical regions and grows well where the soil is very wet, or even temporarily flooded. It is a species characteristic of very clayey soils. It thrives in cultivated fields, pastures, and marshes and along roadsides, dikes, bunds, and canals.

The optimum temperature for growth is 25-27 °C. It is a sun-loving plant, although it can grow well with only 30-50% sunlight. It can tolerate poor soil fertility if there is competition, but prefers very fertile soils and responds well to fertilizer application. The plant has chromosome numbers of $2n = 20, 40, 60$.

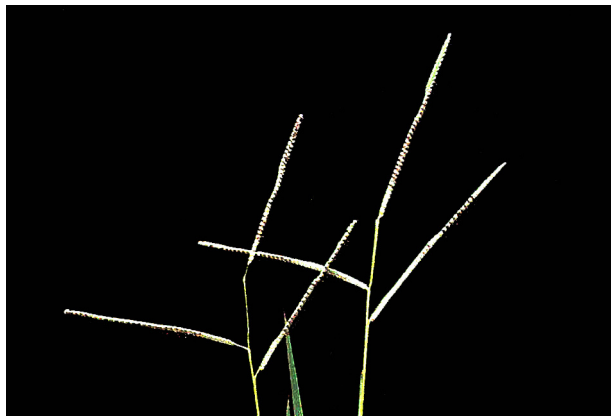
P. scrobiculatum is an aggressive colonizer of disturbed habitats and commonly invades agricultural fields. In West Africa, it is a weed of rice but is also harvested as a wild cereal, whereas in India it is grown as a cereal. The cultivated form (*P. scrobiculatum* var. *scrobiculatum*) is grown as an annual that is suited to drier conditions, while the wild form (*P. scrobiculatum* var. *commersonii*) is perennial and common in damp places. The wild form is a useful constituent of pastures, being palatable at all stages. The cereal is morphologically variable, but farmers usually grow relatively uniform populations. It is raised as a single crop or as the major cereal.

The cultivated form requires an average of about 88 d to flowering. It attains a mean height of 50 cm, producing 24 tillers. The average length and width of the leaf blade are 250 mm and 10 mm, respectively. The mean lengths of the upper leaf sheath and upper internode are 250 mm and 140 mm, respectively. The average length of the inflorescence is 59 mm, whereas that of the lowest raceme is 64 mm. The plant produces an average of 4 racemes per inflorescence and 3 spikelet rows per raceme. The spikelets are usually in two rows, but one form has 4-5 spikelet rows. The crop matures in 4-6 mo. The average fruit length is 2.5 mm. The whole grain contains about 11.6% water, 10.6% protein, 4.2% fat, 59.2% carbohydrate, 10% fiber, and 4.4% ash. Grain yield varies from 250 to 1,000 kg ha⁻¹.

The wild species commonly invades fields of the cultivated one. It is usually harvested with the crop, making it difficult to distinguish wild and cultivated complexes of *P. scrobiculatum*. Hybridization with the weedy type further restricts racial differentiation within the cultivated complex.

Several types are recognized in India, differing in grain color, number of rows of grain, and crop duration. Light red grains are said to be sweet tasting and dark gray ones to be bitter. Some forms have been reported to be poisonous to humans and animals, which may be due to a smut that invades and eventually replaces the developing grain. The spore masses are about the same size as the mature grains and are hard to detect at harvest. To eliminate the problem of poisoning, the grains are carefully removed from the glume, lemma, and palea and are winnowed to scatter the spores, so that only clean and healthy grains are used as food.

P. scrobiculatum can be propagated by seed or by rooted tillers. Newly ripened seeds are dormant and mechanical or acid scarification is desirable to reduce dormancy.



P. scrobiculatum is an alternate host of diseases (caused by *Ephelis oryzae*, *Rhizoctonia solani*, *Xanthomonas campestris* pv. *oryzae*), tungro virus, insect pests (*Cicadulina bipunctata*, *Cnaphalocrosis medinalis*, *Cretonotus gangis*, *Hysteronura setariae*, *Leptocorisa acuta*, *L. oratorius*, *Mythimna separata*, *Nephotettix nigropicus*, *N. virescens*, *Nisaga simplex*, *Orseolia oryzae*, *Pelopidas mathias*, *Pseudococcus saccharicola*, *Sesamia inferens*, *Spodoptera mauritia acronyctoides*, *Tetraneura hirsuta*, *T. nigriabdominalis*), and nematodes (*Criconemella onoensis*, *Meloidogyne graminicola*, *M. incognita*, *Tylenchorhynchus claytoni*).

Weed management

Chemical. *P. scrobiculatum* can be controlled by a preplant application of glyphosate or a postemergence application of a combination of butachlor (2 kg ha⁻¹) and 2,4-D (0.75-1.0 kg ha⁻¹).

References

- Akibo-Betts and Raymundo (1978), Catindig et al (1991, 1993, 1994a,b,c), De Wet et al (1983), Dubey et al (1993), John and Kalode (1981), Kannaiyan and Prasad (1979), Le Bourgeois and Merlier (1995), Manidool (1986), Panda and Mohanty (1970), Patnaik et al (1987), Purohit et al (1972), Purseglove (1972), Rao et al (1970), Satyanarayana Prasad et al (1980), Terry (1983), Thri Murty and Devadath (1981), Vaughan and McIntyre (1975).

***Pennisetum glaucum* (L.) R. Br.**

(Synonyms: *P. americanum* (L.) Leake, *P. typhoideum* Rich., *Setaria glauca* (L.) P. Beauv., *S. lutescens* (Weig.) F.T. Hubbard)

Common names

Country/language	
English	
Australia	Bulrush millet, pearl millet
India	Bandara, dingara
Indonesia	Rumput gajah
Philippines	
Bisaya	Ikog-iring
Cebuano	Ikog-iring
Myanmar	Myet-pan
Vietnam	Co voi nho

Botanical characteristics

Annual tufted grass up to 3 m tall. Stems upright or somewhat spreading at lower nodes. In well-developed plants, at least before flowering, stems noticeably flattened. Sheath margins without hairs or bristles. Leaf blade 10-100 cm long and up to 10 cm wide, often with a spiral twist and hairs across surface at base of blade. Ligule a fringe of hairs. No auricle but tufts of hair scattered about base and at margins of leaf blade. Flower a dense bristly spike 3-8 cm long with yellowish to reddish brown bristles. Spikelets generally 1-flowered with 5 or more upwardly barbed, sterile bristles. Lower bristles may be 2-3 times as long as spikelets. Spikelets oval, 0.3 cm long, flat on one side, convex on the other, and thickest at the middle. Caryopsis yellowish, brownish, or grayish green, with transverse ridges and pointed at the tip, slightly translucent, 2-4.5 mm long.

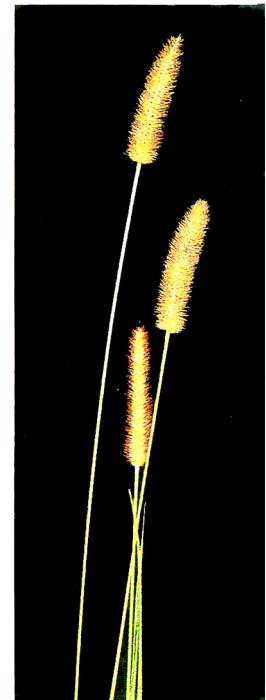
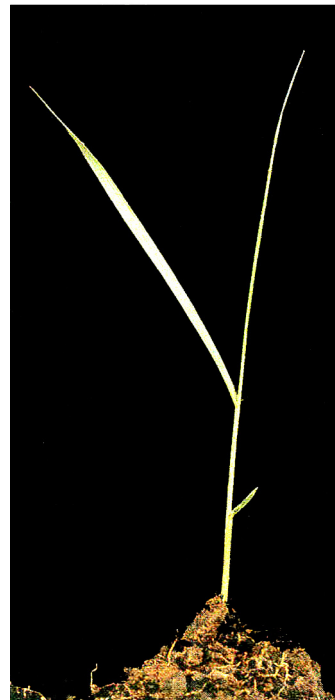
Distribution

Mediterranean or Sub-Mediterranean native, occurring in the warm temperate zone of Old World and introduced into America, Australia, and other countries. Now established in many tropical countries and warm zones. Nearly cosmopolitan. Common in upland rice in India and present in Indonesia, Myanmar, Philippines, and Vietnam.

Biology and ecology

P. glaucum, a C_4 species, commonly grows on rich sandy soils in cultivated lands. The species can be a weed in waste places, stubble fields, base places, pastures, crops, and meadows. It often finds its way into fields as an impurity in seed. The plant is often used as a food and green fodder by people in Africa and India, and as a livestock forage in many areas. Stalks are used for thatching and building, as fuel, and as a poor-quality fodder. It reproduces by outcrossing and has a chromosome number of $2n = 14$ to 17.

In a study in California in 1984, emergence commenced in late February and continued until a population of 220 plants m^{-2} was reached in May. The following year, emergence began in mid-March and populations reached 120 plants m^{-2} in August. Because the caryopsis is small, establishment can be reduced on crusting soils or from deep burial. Tiller development began in



late May in both years. Inflorescence emergence began in late June to early July, 15 wk after seedling emergence. Seed maturation occurred 3–4 wk after panicle appearance. Plants senesced in August in both years. Seedling emergence was highest from February to April, with earlier emergents requiring longer establishment periods. Seed germination of seedlots increased from 0% at harvest and 1 mo after harvest to 88% at 4 mo after harvest. In the Philippines, one plant produced 1,500 seeds. The weight of 1,000 seeds is 0.68 g. There are 3,550 seeds g⁻¹.

P. glaucum is shade-tolerant and, in one study under 55% shade, grew taller throughout the growing season. Increasing shade slightly decreased tillering. Roots can penetrate to a depth of nearly 60 cm, with the highest concentration of roots generally occurring at depths of 20–30 cm.

It is a quantitative short-day plant, but growth, ear differentiation, and seed numbers are greatly reduced in these conditions. The elongation of the culm is faster and the number and size of leaves and rate of growth of axillary shoots increase with increasing daylight.

The weed is an alternate host of nematodes such as *Meloidogyne acrita*, *M. acronea*, *M. javanica*, and *M. microtyla*, tungro

virus, and insect pests such as *Haplothrips ganglbaueri*, *Leptocorisa acuta*, and *L. oratorius*.

Weed management

Cultural. The plant can be controlled by continued clean cultivation until late in the season to prevent seed formation. It is recommended that scattered plants missed by cultivation be pulled by hand before seeds mature.

Chemical. The weed can be controlled effectively by preemergence application of butachlor or oxadiazon and by postemergence spraying of propanil.

References

Ampong-Nyarko (1994), Ananthakrishnan and Thangavelu (1976), Auld and Medd (1992), Bendixen (1986), Bischof (1978), Bubar and Morrison (1980), Fischer et al (1989), Grubben and Partohardjono (1996), ICRISAT (1980), Jacobsen and Wallace (n.d.), Listowski and Jasmanowics (1969), Mishra et al (1973), Norman et al (1984), Pancho (1964), Pohl (1954), Poilecot (1995), Rajapakse and Kulasekera (1980), Reeder (1951), Rotar (1968), Stapf (1928), Whyte et al (1959).

Rottboellia cochinchinensis (Lour.) W.D. Clayton

(Synonyms: *Manisuris exaltata* (L.f.) O. Ktze., *R. arundinacea* Hochst. ex A. Rich., *R. exaltata* L.f., *Stegosia cochinchinensis* Lour.)

Common names

Country/language	
English	
USA	Itchgrass
Indonesia	Majarakan
Philippines	
Bicolano	Gaho
Bisaya	Aguingay, dupawon
Cebuano	Bukal
Ilocano	Marapagay, sagisi
Ilongo	Bugang
Tagalog	Agiñgay
Thailand	Yaa prong khaai
Myanmar	Myet-yar

Botanical characteristics

An annual grass with vigorous growth supported by stilt roots. Leaf blade broadly linear, up to 45 cm long and 2 cm wide, rough on both sides, sheath wide open, lower part of central nerve inflated, with bristle-like hairs along sheath. Ligule membranous and short, 1 mm long. Culms stout, growing to a height of 1–3 m, occasionally branching. Inflorescence a simple raceme, spike-like, contracting at the tip, cylindrical. Raceme seems jointed between spikelets. At maturity, breaks into hard cylindrical joints, falling with two attached spikelets. One spikelet sessile, oblong-elliptic, pale; the other spikelet stalked, narrowly ovate, 3–5 mm long,



herbaceous, green; pedicel shorter than internode. Fruit a cylindrical caryopsis.

Distribution

Native of India with widespread distribution in tropical Asia, Africa, Australia, Puerto Rico, Colombia, and some parts of southern United States. Common in upland rice in Thailand and Philippines and present in Indonesia and Myanmar.

Biology and ecology

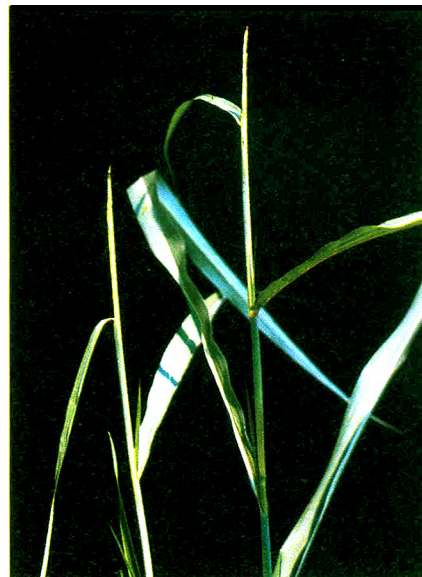
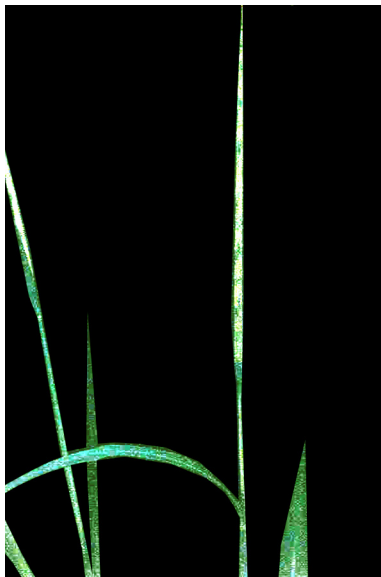
R. cochinchinensis, a C_4 species, is prominent in open well-drained places and common on contour banks and roadsides. It also occurs in moister areas, up to an altitude of 1,800 m. The weed is one of the primary colonizers of disturbed ground and is of some value for grazing. It is an extremely vigorous competitor in upland crops due to its rapid growth and spreading habit, and heavy infestations can cause total crop loss. It can be troublesome in rice, maize, sugarcane, and other arable crops.

Many reports suggest that *R. cochinchinensis* has little seed dormancy, with most seed germinating at the start of the rainy season and little survival of seed from one year to the next. In some areas, however, the seeds are said to have deep dormancy, sometimes surviving for years and giving a staggered germination throughout the season or year in old fields. Deep plowing to bury the seeds may extend their life span. Nondormant seeds can emerge from a depth of 15 cm. Exposing the seeds to the weathering action of the sun and air facilitates germination when moisture conditions become suitable.

Seeds sown at a depth of 2 cm produce coleoptiles in 4-5 d. First tillers appear 3 wk after planting (4-5-leaf stage), with 1-5 tillers d^{-1} produced and tillering continuing for 44 d, so that the average plant has about 100 tillers. The first external sign of flowering is an enlargement of the upper internodes and the formation of a wide angle between the mother tiller (which usually grows upright) and all other tillers. This is followed by flag leaf formation and eventually by the emergence of the tip of the inflorescence. Spikelets emerge over a period of 15 d. Pollen is shed 4-9 d after emergence of spikelets.

Seed maturation is indicated by a change from green to brown on the spikelet, where "snapping-off" will take place. The first 8-12 spikelets snap off 2-4 d after the last spikelet of the inflorescence emerges. The maturation period for all spikelets is about 1 mo.

The plant reproduces entirely by seeds, and can continue to flower and seed year-round when moisture conditions are favorable. In the Philippines, a single plant can bear 2,200 seeds. The weight of 1,000 seeds is 10.6 g and there are 94 seeds g^{-1} . In Zimbabwe, dense stands have produced 665 and 590 $kg\ ha^{-1}$ of seeds in consecutive seasons. Seeds are spread by water, in poorly cleaned crop seeds, and by harvesting machines. The seed is a frequent contaminant in harvested rice, and can depreciate its value.



Undisturbed roots of a previous maize crop and residues of *R. cochinchinensis* have been shown to reduce the establishment and growth of rice plants, possibly because of some water-soluble growth inhibitor.

The species is an alternate host of nematodes *Meloidogyne acrita*, *M. javanica*, *Pratylenchus zeas*, and *Tylenchorhynchus martini*. It is one of the best ovipositional hosts of the planthopper *Peregrinus maidis*, a vector of several viral diseases in the tropics, and an alternate ovipositional host of *Nisia carolinensis*, a planthopper common in rice-field habitats. It is also an alternate host of sheath blight caused by *Rhizoctonia solani* and the insect *Euscyrtus concinnus*.

Weed management

Cultural. Regular cultivation every 2-5 wk is effective in controlling *R. cochinchinensis* because most seeds exhibit little dormancy and germinate together at the start of the rainy season. Careful prevention of seeding, and machinery hygiene, can practically eliminate the weed. Where long-term dormancy occurs, cultural control is likely to be less effective.

Chemical. *R. cochinchinensis* can be controlled by preemergence application of pendimethalin ($1.5-2.0\ kg\ ha^{-1}$) or early postemergence (3-5-leaf stage) treatment of cyhalofop butyl ($0.1-0.15\ kg\ ha^{-1}$), fenoxaprop-P-ethyl, propanil ($2\ kg\ ha^{-1}$), or a tank-mix application of pendimethalin and fluzifop-P-butyl ($1.0 + 0.08\ kg\ ha^{-1}$).

Biological. A head smut, *Sporisorium (Sphacelotheca) ophiuri*, which prevents seed formation, has potential as a biocontrol agent for this weed.

References

- Barrior and Litsinger (1980), Bendixen (1986), Catindig et al (1995a,b), Clayton (1981), Cope (1982), De Datta et al (1986), Holm et al (1977), Labrada (1994b), Mew et al (1980), Olofinloye and Mabbayad (1981), Pancho (1964), Pancho and Obien (1995), Schwerzel (1967), Vernon (1983).

PORTULACACEAE

Portulaca oleracea L.

(Synonym: *P. sativa* Haw.)

Common names

Country/language	
English	
Australia	Pigweed, purslane
USA	Common purslane
India	Jangali palak
Indonesia	Krokot
Philippines	
Bicolano	Alusiman
Bisaya	Simsim
Ilocano	Ngalgug
Ilongo	Alosiman, olasiman
Pampango	Kantataba
Tagalog	Olasiman
Thailand	Phakbia yai
Bangladesh	Bara laniya, bara nunia, ghee kalam, nunia
Lao PDR	Nya en eyan, nya tha kong
Myanmar	Mye-htauk, mye-pa-yit, the-pa-yit
Vietnam	Sam

Botanical characteristics

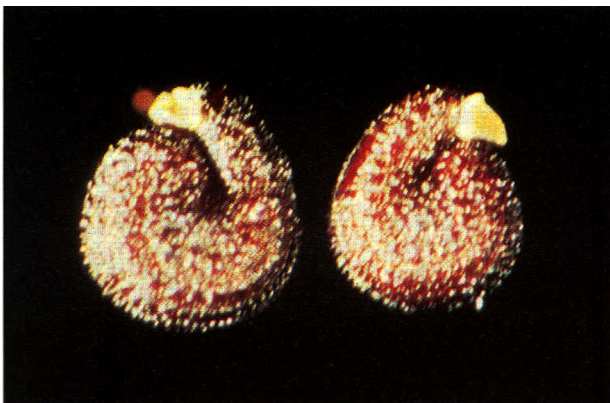
Low-growing annual herb with a deep primary root. Stem succulent, prostrate or erect, freely branched, smooth, green with maroon tinges, often reddish brown, 10-60 cm tall. Leaves alternate or nearly opposite, often in clusters at ends of branches, thickened, simple, oblong to wedge-shaped, green to reddish, sessile and shiny; margins smooth with broad-rounded tips. Flowers yellow, sessile, solitary in leaf axils and/or several together in leaf clusters at ends of branches; sepals 2, pointed at tip, 3-4 mm long; petals 5, yellow, 3-10 mm wide; stamens 7-12. Fruit a spherical capsule splitting open around the middle, upper half (with two sepals on top) falling away like a lid. Seeds numerous, oval, about 0.5 mm in diameter and length, black.

Distribution

Native of South and West Asia, originating from India to North Africa. Now widely distributed in tropical, subtropical, and temperate areas of the world. Present in upland rice at all consortium sites.

Biology and ecology

P. oleracea, a C₄ species, is a weed of cultivation reported to occur in 45 crops in 81 countries, but it is not reported to be a



very serious or competitive crop weed. It grows in a wide range of temperate and tropical habitats, and its seeds have been found in soil samples from deciduous woods, conifer plantations, tall-grass prairie, old pasture, and maize fields. It prefers moist fertile soils in sunny or slightly shaded but not marshy sites, occurring in crops, arable lands, home gardens, roadsides, and waste areas. It grows well in acidic or alkaline soils ranging from pH 5 to 8.

The life cycle of *P. oleracea* is completed in 2-4 mo in both tropical and temperate regions. The plant flowers 4-6 wk after emergence and seeds ripen in 14-16 d. Flower opening is strictly controlled by temperature and light; flowers reportedly open mainly in the morning on bright hot days and last for only 1 d. Flowers are generally self-pollinated as no nectar is produced, and they are visited by only a few small insects.

Flowers exhibit sequential maturation throughout the growing season. Capsules produced on main branches mature first, followed by those on secondary branches. Seeds tend to mature first near the center of the growing rosette. The number of seeds fruit⁻¹ varied from 2 to 150, with an average of 60 in a sample of 300 capsules obtained from 30 plants of different sizes in a population in Canada. Another study recorded an average of 72 seeds fruit⁻¹, with a range of 36-107. In the Philippines, a single plant can produce 10,000 seeds. The weight of 1,000 seeds is 0.07 g. There are 15,500 seeds g⁻¹.

The seeds require high temperatures for germination, which is optimal above 30 °C and very low below 24 °C. The plant is sensitive to cold and is killed by chilling temperatures, although seeds can survive well in areas where winter temperatures drop below -30 °C.

Seedlings emerge after rains or irrigation where temperatures have exceeded 30 °C and germination is stimulated whenever land is cultivated and cleared of existing vegetation.

P. oleracea is drought-resistant and in irrigation areas accumulates dry matter and produces seeds with as little as 10 mm of water every 6 d. It grows best under high light intensity. Under 50% shade, dry matter production was reduced by 75%. With low light, the ripening period was also delayed. The plant is able to grow well under poor, low-fertility soil conditions, but is responsive to improved fertility. Phosphorus plays a significant role in establishment and nitrogen is necessary for optimum growth.

The seeds fall to the ground directly under the dehiscent capsule. Dispersal is via animals and humans. Birds are agents of

dispersal and viable seeds have been found in avian feces. Although the plant propagates mainly from seed, fleshy stem fragments can produce roots and grow. Immature seed in detached segments without a root system can continue to ripen. Seeds are able to survive 40 yr burial in soil and up to 19 yr in dry storage.

P. oleracea has been reported as a host of a leaf-mining weevil (*Hypurus bertrandi*) (Coleoptera: Curculionidae), a stem-boring fly (*Lyriomyza caulophaga*), nematodes (*Heterodera marioni*, *Meloidogyne acrita*, *M. acronea*, *M. arenaria*, *M. hapla*, *M. incognita*, *M. javanica*, *Pratylenchus minutus*, and *Rotylenchus reniformis*), and fungi (*Rhizoctonia solani* and *Albugo portulacae*).

This weed is one of humans' earliest vegetables. Young plants with roots removed are cooked like spinach. Aboriginal Americans are believed to have used *P. oleracea* as a potherb (leaves are cooked and eaten) and for medicinal purposes. It is also eaten raw as a salad in countries such as France. The weed is used for treating tumors and as a source of blue dye. In the Philippines, it is harvested and fed to pigs. Its rapid growth makes it a good soil binder.

Weed management

Cultural. *P. oleracea* can be eradicated in the seedling stage by frequent and continued shallow cultivation or hoeing from the time the first seedlings appear.

Plants that have flowered should be removed from the soil and burned or composted, otherwise the fleshy stems will take root and seeds will mature. Continued cultivation is necessary for complete control of late regrowth.

Chemical. *P. oleracea* can be controlled by preemergence application of pendimethalin (1.5-2.0 kg ha⁻¹) or postemergence application of 2,4-D (0.5-0.8 kg ha⁻¹), chlorimuron-ethyl (4-6-leaf stage, 10-20 d after seeding), MCPA (0.4 kg ha⁻¹, 25-30 d after seeding), or propanil (2 kg ha⁻¹).

References

Auld and Medd (1992), Bendixen (1986), Everaarts (1981), Harr et al (1991), Ivens (1967), McFadyen (1994), Mitich (1997), Miyanishi and Cavers (1980), Pancho (1964), Pancho and Obien (1995), Soerjani et al (1987), Vernon (1983).

RUBIACEAE

Borreria laevis (Lam.) Griseb.

(Synonym: *B. linifolia* DC.)

Common names

Country/language	
English	
USA	Button plant
Indonesia	Kentangan
Philippines	
Bisaya	Akupao
Thailand	Kra dum bai lek
Lao PDR	Pak khao mai
Myanmar	Gyo-che-dauk
Vietnam	Co dong tien

Botanical characteristics

Erect to ascending annual broadleaf. Stem slender, angular, slightly hairy, branching from third to fourth node from tip down to base. Leaves sessile, entire, pale, green, opposite, oblong to oval-lanceolate in shape, up to 5 cm in length and 3 cm wide, roughened along margins by small bristles, otherwise smooth; stipules lobed. Flowers very small, white, tubular to funnel form, 1 mm in diameter with 4 lobes, usually in clusters found in terminal shoots.



Fruit a capsule, 2-seeded, dehiscent when ripe, ovoid with a pair of awn-like structures at tip. Seed tiny, about 0.8 mm long and 0.6 mm wide, cream to light brown, somewhat oblong, with rough, corrugated to wrinkled surface.

Distribution

Native of tropical America and now widespread in tropical America and Southeast Asia. Common in upland rice in the Philippines, Indonesia, Thailand, and Lao PDR and present in India, Myanmar, and Vietnam.

Biology and ecology

B. laevis is a common and often abundant weed of crops, pastures, waste places, and gardens. It can attain a height of 100 cm in 4 mo. Seeds can emerge 15 d after sowing and flower initiation occurs 2 mo after seedling emergence. One plant can produce 25,000 seeds. The weight of 1,000 seeds is 0.14 g. There are about 7,000 seeds g⁻¹. Freshly harvested seeds germinate better than those collected and stored for 1 and 2 yr. Temperatures of 27 to 30 °C enhance seed germination, while extremes of temperature (0 and 40 °C) suppress it. Roots can penetrate to a depth of about 1 m.

It is an alternate host of nematodes such as *Pratylenchus* sp. and *Rotylenchus* sp.

Weed management

Cultural. Hoeing and hand weeding at 14 and 28 d after rice emergence are effective in controlling *B. laevis* and preventing upland rice crop loss.

Chemical. MCPA at 0.4 kg ha⁻¹ applied 25-30 d after emergence gives good control.

References

Barnes and Chandapillai (1972), Duatin et al (1992a), Gapasin et al (1996), Pancho 1964, Wagner et al (1990a,b).



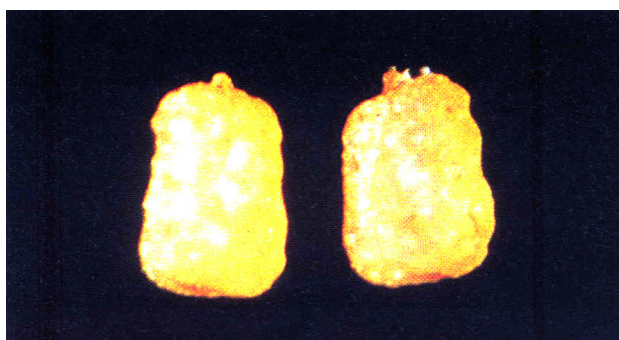
SCROPHULARIACEAE

Lindernia crustacea (L.) F. Muell.

(Synonyms: *L. minuta* Koord., *Mimulus javanicus* Bl., *Torenia crustacea* Hassk., *Vandellia crustacea* (L.) Benth.)

Common names

Country/language	
English	Round-fruited lindernia
Indonesia	Sirik kotok
Philippines	
Tagalog	Pugu-puguan
Thailand	Kap bai tew mia, yaa kaaphoi tua mia
Bangladesh	Chapraghash
Vietnam	Lu-dang can



Botanical characteristics

A branched perennial herb up to about 30 cm high. Stem much-branched, rooting at nodes, sharply quadrangular. Leaves opposite, dark green, sometimes reddish, more or less oval in outline, 0.5-2 cm × 0.5-1.3 cm, margins usually toothed, base more or less cordate, leafstalk short. Flowers about 1 cm long, singly from the leaf axils, on slender stalks about 0.5-2.5 cm long, calyx about 0.3 cm long, tubular, ridged, with short, pointed sepals, corolla tubular, bilabiate, violet or reddish purple, petals paler, edged and streaked violet inside, a yellow spot at base of lower lip. Fruit a capsule, ellipsoid, as long as the calyx, bivalved. Seeds numerous, ellipsoid, obtuse at both ends, tuberculate, light yellowish brown, about 0.4 mm long.

Distribution

Native of tropical Asia. Now widely distributed throughout tropical and subtropical Asia. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh.

Biology and ecology

L. crustacea occurs as a weed in crops, grasslands, lawns, turf, gardens, riverbanks, and the edges of ponds, especially where the soil is sandy or saturated. It is common in paddy fields. In the northern hemisphere, it germinates with the first rains and flowers over a long period from July to March if moisture is available. It propagates and disperses from seed. A single plant with 8 branches produces about 6,000 seeds. The weight of 1,000 seeds is 0.025 g. Its chromosome number is $n = 14$.

L. crustacea is reportedly used as a wild food plant and medicine in villages in Thailand.

Weed management

Cultural. Pulling before seed set has been recommended for control.

Chemical. *L. crustacea* can be controlled by 2,4-D at 0.5-0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ applied 20-30 d after emergence of rice.

References

Datta and Banerjee (1976), Drost et al (1983), Henderson (1959), Shinha (1987a,b), Soerjani et al (1987), Thakur (1977).

Scoparia dulcis L.

(Synonyms: *S. procumbens* Jacq., *S. ternata* Forsk.)

Common names

Country/language	
English	
USA	Sweet broom-weed
Indonesia	Jaka tua
Philippines	
Bisaya	Tawa-tawa
Ilocano	Isisa
Tagalog	Saang-kabayo, sampalokan
Thailand	Kratai chaam, krot num
Bangladesh	Talpakna
Myanmar	Dan-na-thu-ka
Vietnam	Cam-thao nam

Botanical characteristics

A branched, wiry annual or perennial herb up to about 90 cm high. Leaves small, opposite or often in whorls of 3, more or less narrowly elliptic in outline, tapering to base, usually less than 5 cm long and 1.3 cm wide, margins from about middle to tip finely or coarsely toothed. Flowers small, solitary or few together in leaf axils, sepals 4, green, corolla about 0.5 cm across, with very

short tube and 4 white, spreading petals, base with tangle of white hairs surrounding 4 greenish stamens and green ovary. Fruit a capsule, 4 mm in diameter, round, overtopped by a filiform style. Seeds numerous and small, 0.2 mm long.

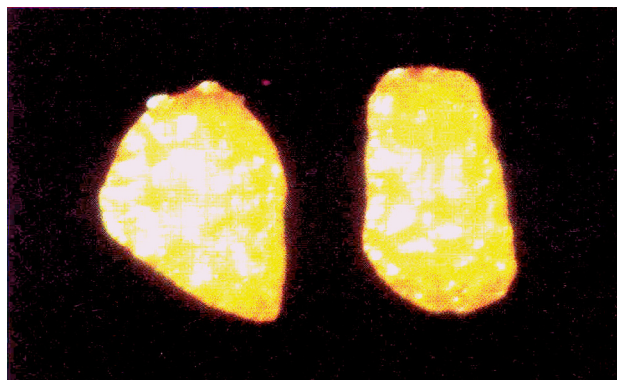
Distribution

Native of tropical America. Has spread widely and now occurs throughout Asia and Africa. Present in upland rice in Bangladesh, Indonesia, Myanmar, Philippines, Thailand, and Vietnam.

Biology and ecology

S. dulcis occurs from sea level to 1,600 m and is a weed of crops, fallow fields, roadsides, riverbanks, and old walls. It favors moist conditions but can survive well where there is a prolonged dry season. It is found on all kinds of soils and is frequently associated with lowland rice.

The plant is annual or perennial depending on soil moisture availability. It propagates mainly through seed and germinates with the first rains, which mainly come around May/June in northern hemisphere Asia. The species is present and visible in the middle and at the end of the crop cycle and persists during the major part of the dry season. Subterranean buds develop on the stump in July or August when the soil is very wet. Flowering starts in August and can continue until March or April where the soil remains moist. Flowers can be produced throughout the year. Plants senesce between September and April depending on when



the soil dries out. In the Philippines, a single plant can produce about 8,000 seeds. The weight of 1,000 seeds is 0.013 g. There are approximately 69,000 seeds g⁻¹.

Studies on biologically active substances in *S. dulcis* have revealed the presence of various diterpenoids and triterpenoids. Scoparic acid A, scopadulcic acid B, and scopadulin are diterpenoids, and scopadulcic acid B showed biological activity against viruses and tumors. The triterpenoids were identified as friedelin, glutinol, α -amyrin, betulinic acid, ifflaionic acid, and dulcioic acid.

S. dulcis is an alternate host of nematodes such as *Meloidogyne acrita*, *M. incognita*, and *M. javanica*.

S. dulcis is used in some places as a medicinal plant. Amellin, used in India as an antidiabetic substance, has been extracted from the fresh plant. *S. dulcis* is also reportedly used as a cure for hypertension in Taiwan.

Weed management

Cultural. *S. dulcis* can be controlled by pulling before seed set. The plant is easy to remove in sandy soil.

Chemical. Good control can be achieved by spraying with 2,4-D at 0.5-0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ 20-30 d after emergence.

References

Bendixen (1986), Hayashi et al (1993), Henderson (1959), Le Bourgeois and Merlier (1995), Mahoto et al (1981), Pancho (1964), Soerjani et al (1987), Thakur (1977).

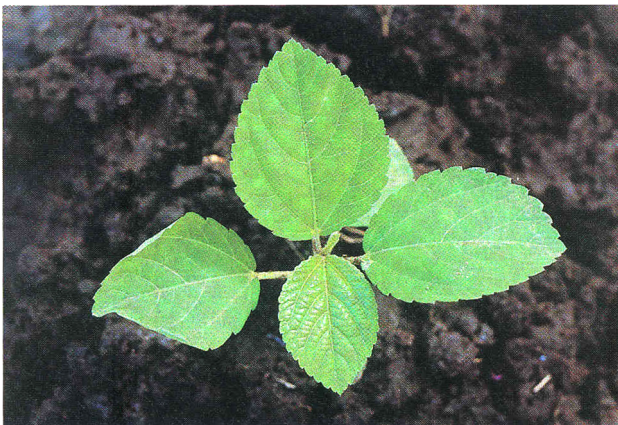
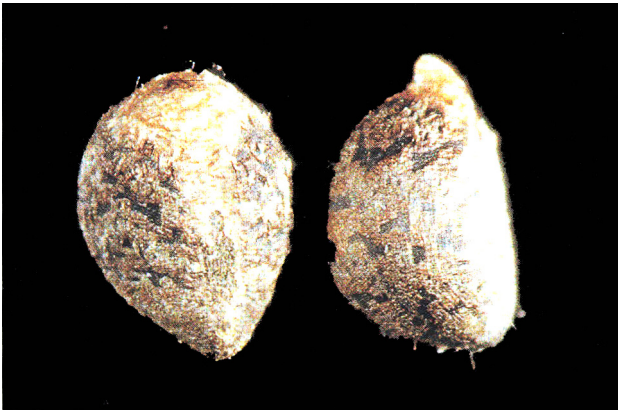
STERCULIACEAE

Melochia concatenata L.

(Synonym: *M. corchorifolia* L.)

Common names

Country/language	
English	
USA	Redweed
Indonesia	Orang aring
Philippines	
Bisaya	Kiling-kiling
Ilocano	Bankalanan, marasaluyot
Ilongo	Kaliñgan
Thailand	Seng lek
Lao PDR	Nya khat thom
Myanmar	Pilaw, pilaw-gyi
Vietnam	Trung-cua



Botanical characteristics

A slightly shrubby or woody perennial herb, less than 1 m high. Stem erect, branched with scattered star-like hairs or nearly smooth. Leaves variable, generally oblong-ovate, 3-8 cm long, nearly smooth above, thinly star-like beneath, margins cut into sharp teeth pointing forward, rarely obscurely lobed; petioles 2-3 cm long. Inflorescence in terminal or axillary heads with flowers somewhat crowded, intermixed with linear bracteoles; calyx a tube, teeth 5, appressed-hairy outside; petals 5, obovate, white, pink, or mauve, about 7 mm long. Fruit a capsule, nearly spherical, 4-5 mm in diameter, with slightly beard-like hairs. Seed obovoid, grayish brown with black spots, about 2.5 mm long.

Distribution

Native of Asian tropics, widely distributed in South and South-east Asia. Common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Lao PDR and Myanmar.

Biology and ecology

M. concatenata occurs from sea level to 700 m and thrives in sunny or lightly shaded moist sites in crops, fallow fields, pastures, and water courses. It is commonly associated with rainfed lowland and upland rice as well as other dryland crops. In northern hemisphere Asia, the main germination occurs after the first rains in May-June. The main flowering is in September-October, but it can flower throughout the year. A single plant can produce 6,000 seeds. The weight of 1,000 seeds is 2.2 g. There are 450 seeds g⁻¹.

The hard seed coat appears to be the primary mechanism of dormancy. Scarification greatly enhances germination of freshly harvested seed. Storing the seeds for 4 or 5 yr also reduces hard-seededness and overcomes dormancy. Because of the hard





seed coat, seed can persist in the soil for long periods before germinating.

Scarified seeds germinated best at 35-40 °C, but germination can occur over a range of 20-40 °C. This explains why, in the field, this plant can germinate throughout the growing season. When planted at 1–5-cm depth, 85-90% of seedlings emerge within 7 d in silt loam soil. There is no emergence from 0 cm, probably because the germinating seed dries out during soil-surface drying.

M. concatenata is an alternate host of nematodes such as *Pratylenchus* sp. and *Rotylenchus* sp.

Weed management

Chemical. *M. concatenata* can be controlled by spraying 2,4-D at 0.5–0.8 kg ha⁻¹ or MCPA at 0.4 kg ha⁻¹ 20-30 d after emergence.

References

Baker (1978), Eastin (1983), Gapasin et al (1996), Holm et al (1979), Li (1977), Pancho (1964), Soerjani et al (1987).

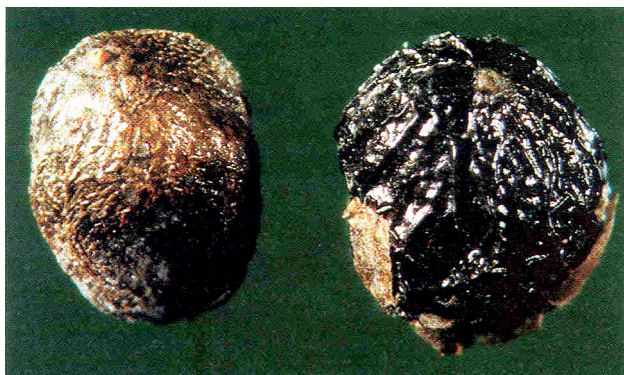
VERBENACEAE

Lantana camara L.

(Synonyms: *Camara vulgaris* Benth., *L. aculeata* L., *L. glutinosa* Poepp.)

Common names

Country/language	
English	
USA	Lantana
India	Putush
Indonesia	Tahi ayam
Philippines	
Bisaya	Asunting, kanding-kanding
Ilocano	Bangbangsit
Ilongo	Bahu-bahu
Tagalog	Sapinit
Thailand	Pagaknong
Bangladesh	Putush
Lao PDR	Dok mai khiu
Myanmar	Sein-na-ban
Vietnam	Tam oi



Botanical characteristics

Spreading, rarely climbing, odorous evergreen shrub, 1-3 m tall, bearing small hooked spines. Stem with minute white hairs pressed to it, occasionally purple, branched. Leaves opposite, pedunculate, ovate or ovately oblong, 8 × 4 cm; blade rough, margin denticulate, apex acute. Hairiness very variable. Inflorescence capitulum-like, 2-4 cm in diameter, containing 25-35 flowers. Short, stiff bristle-like hairs appear from uppermost leaf axils, elongated peduncles suberect, subtended by bracts tapering to a point, calyx similarly pointed, corolla 1 cm long, tubular. Fruit berry-like, shining, dark green but nearly black when ripe, 2-seeded.

Distribution

Native of tropical America, widely introduced and naturalized in many tropical and subtropical regions. Present in upland rice at all consortium sites.

Biology and ecology

L. camara, a C₃ plant, is a weed of cultivated land, fence lines, pastures, rangelands, and waste places. It thrives in dry and wet regions and often grows in valleys, mountain slopes, and coastal areas. It is cultivated as a hedge plant, and was introduced into many countries as an ornamental. The plant is shade tolerant and can become the dominant understorey in open forest or in tropical tree crops.

L. camara is variable and many varieties or forms are recognized throughout the world. In Australia, 18 forms have been described. Some reports suggest that the varieties can be distinguished by flower color, but this is not a universally accepted diagnostic characteristic.

Seeds can germinate at any time of the year if sufficient moisture is available. Growth is slow at first as the main root and laterals are established. Growth rate increases as the season advances and the stems of adjacent plants intertwine to begin the formation of thickets. Flowers are produced in early summer during the second growth season and flowering is continuous throughout the summer.

In established plants, new canes are produced on the crown and from the lateral roots. The plant spreads by seeds, which are readily eaten by birds and carried over long distances.

This weed is an alternate host of the nematode *Meloidogyne javanica*.

Weed management

Mechanical/cultural. When land is cleared, single plants can be grubbed or pulled with a tractor and chain, and burned before flowering, taking care to remove as many of the lateral roots as possible. An integrated management program is required in large plantations. Slashing or burning without follow-up only results in an increase in weed density. The plant is susceptible to waterlogging and cultivation.



Chemical. MCPA at a rate of 0.4 kg ha⁻¹ applied 25-30 d after emergence is recommended.

Biological. The insects *Teleonemia scrupulosa*, *Ophiomyia lantanae*, and *Hyponomeuta strigata* have been tried as biological control agents in Australia, Caroline Islands, Fiji, and other countries, and they have provided some control. Four other lantana-attacking insects from Hawaii have been introduced into New South Wales, Australia: *Agromyza lantanae*, *Epinotia lantana*, *Eutreta sparsa*, and *Thecla agra*. Success has been limited.

Cremastobombycia lantanaella, *Eutreta xanthochaeta*, *Lantanophaga pisillidactyla*, *Neogalea sunia*, *Salbia haemorrhoidalis*, and *Uroplata girardi* established, spread, and provided effective

control in dry areas in Australia when present together as a biological control agent complex.

Although biological control agents can cause plant damage in many situations, they have not provided practical levels of control and farmers still need to employ other measures to control the plant.

References

Bendixen (1986), Holm et al (1977), Jafri and Ghafoor (1974), Parsons and Cuthbertson (1992), Swarbrick (1994), Taylor (1989), Watson (1993).

Stachytarpheta jamaicensis (L.) Vahl

(Synonyms: *S. australis* Mold., *S. cayennensis* (L.C. Rich.) Vahl, *S. marginata* Vahl, *S. mexicana* Steud., *S. pilosiuscula* H.B.K., *Verbena jamaicensis* L., *Vermicularia decurrens* Moench, *Zapania jamaicensis* (L.) Lam.)

Common names

Country/language	
English	
Australia	Light blue snakeweed
Indonesia	Bujang kalam
Philippines	
Bicolano	Bolomaros
Bisaya	Disaplina
Cebuano	Limbagat
Ilocano	Albaka, garem-garem
Ilongo	Sentemento
Tagalog	Kandi-kandilaan
Thailand	Fun ngu keiw
Lao PDR	Nya khai yung noi
Vietnam	Hai tien

Botanical characteristics

Erect, branched annual or perennial herb, slightly shrubby or woody, 50-70 cm high (up to 1 m). Stems long and round, younger ones slightly angled. Leaves opposite, elliptic to oblong-ovate,



sharply pointed, sides straight, not incurved, 2.5-10 cm long, serrate, veins forming a network, base decurrent on petioles, margin dentate. Inflorescence spike-like, terminal, rather slender, 10-30 cm long, 3-4 mm thick, green, continuous; calyx small, oblique, 4-toothed, bracts lance-shaped, corolla tubular at base and opening by rounded lobes, deep blue, 1 cm long. Fruit enclosed in calyx, pressed to stem and somewhat sunk in rachis, oblong, smooth, 4 mm long, bilocular capsule containing 2 seeds. Seed a nutlet, inner side flat.

Distribution

Native of tropical America, now found in most tropical countries. Common in upland rice in the Philippines and present in Indonesia, Lao PDR, Thailand, and Vietnam.

Biology and ecology

S. jamaicensis is common in waste places, thicket borders, shady roadsides, and crop fields. It thrives from 0 to 1,800 m.

The weed has a chromosome number of $2n = 160$. It hybridizes readily with *S. urticaefolia*. The hybrids resemble *S. jamaicensis* more closely than *S. urticaefolia*, but the corollas are darker in color, the habit is more erect, and the leaves are usually more ovate, darker green, and with more divergent teeth similar to those of *S. urticaefolia*. Hybrids are known from Hawaii.

The plant flowers year-round in Sri Lanka and Trinidad and for a period of several months in Puerto Rico. A single plant in the Philippines produces about 2,000 seeds. The weight of 1,000 seeds is 2.3 g and there are 428 seeds g^{-1} . Seeds were still viable after 6.5 yr of burial.

The plant is a host of two species of hemiptera, *Cryphula affinis* and *C. bennetti*, in Trinidad (West Indies) and of an unidentified nematode species. It is an alternate host of nematodes such as *Pratylenchus* sp., *Rotylenchus* sp., and *Meloidogyne graminicola*.

The flowers often become deformed by the galls produced by an itonid insect, *Hyperdiplosis producta*, in South America; in India, the deformation of the inflorescence is due to the virus *Chlorogenus santali*. The plant is also often attacked by the following fungi: *Asteridiella callista*, *Cercospora stachytarphetae*, *Endophyllum stachytarphetae*, *Micropuccinia urbaniana*, and *Puccinia lantanae*. These insects and pathogens may have some potential for biological control.

Weed management

Cultural. Hand weeding 2 to 3 times during the cropping season is effective in controlling the weed.

Chemical. MCPA at a rate of 0.4 kg ha^{-1} applied 25-30 d after emergence can provide good control.

Biological. A snail, *Marisa* sp., has been reported to defoliate the plant and is specific to *S. jamaicensis*. It may have some potential as a biological control agent.

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Appendix I. Families, species (in bold), and synonyms of weeds.

AIZOACEAE

- Mollugo pentaphylla** L.
- M. stricta* L.
- Trianthema portulacastrum** L.
- T. monogyna* L.
- T. obcordata* Roxb.

AMARANTHACEAE

- Amaranthus spinosus** L.
- Amaranthus viridis** L.
- A. gracilis* Desf.
- Chenopodium caudatum* Jacq.
- Euxolus caudatus* Moq.
- Celosia argentea** L.
- C. cristata* L.

APIACEAE

- Centella asiatica** (L.) Urb.
- Hydrocotyle asiatica* L.

ASTERACEAE

- Ageratum conyzoides** L.
- Bidens pilosa** L.
- B. chinensis* Willd.
- B. leucantha* Willd.
- B. subalternans* DC.
- Chromolaena odorata** (L.) R.M. King & H. Robinson
- Eupatorium conyzoides* Vahl
- E. inulifolium* HBK
- E. odoratum* L.
- Crassocephalum crepidioides** (Benth.) S. Moore
- C. diversifolium* Hiern
- Gynura crepidioides* Benth.
- Senecio diversifolius* A. Rich.
- Eclipta prostrata** (L.) L.
- Cotula alba* L.
- E. alba* (L.) Hassk.
- E. erecta* L.
- Verbesina alba* L.
- V. prostrata* L.
- V. pseudo-acmella* L.
- Emilia sonchifolia** (L.) DC.
- Cacalia sonchifolia* L.
- Senecio sonchifolius* Moench
- Synedrella nodiflora** (L.) Gaertn.
- Verbesina nodiflora* L.
- Ximenesia encelioides* auct. non Cav.
- Tridax procumbens** L.
- Vernonia cinerea** (L.) Less.
- Conyza cinerea* L.
- V. abbreviata* DC.
- V. albicans* auct. non DC.
- V. laxiflora* Less.
- V. linifolia* Bl.

BORAGINACEAE

***Heliotropium indicum* L.**

Heliophytum indicum DC.

H. cordifolium Moench

H. foetidum Salisb.

Tiaridium indicum (L.) Lehm.

COMMELINACEAE

***Commelina benghalensis* L.**

***Commelina diffusa* Burm. f.**

C. agraria Kunth

C. aquatica J.K. Morton

C. communis Benth. non L.

C. nudiflora sensu Merr. non L.

***Murdannia nudiflora* (L.) Brenan**

Aneilema malabaricum (L.) Merr.

A. nudiflorum (L.) Wall

Commelina nudiflora L.

CYPERACEAE

***Cyperus brevifolius* (Rottb.) Hassk.**

Kyllinga brevifolia Rottb.

K. cruciformis Schrad.

***Cyperus compressus* L.**

Chlorocyperus compressus (L.) Palla

C. brachiatus Poir.

C. pectinatus Roxb.

***Cyperus halpan* L.**

C. aphyllus Vahl

C. autumnalis Vahl

C. haspan L.

C. juncoides Vahl

***Cyperus iria* L.**

Chlorocyperus diaphaniria Steud.

C. iria Rikli

C. panicoides Lam.

C. santonici Rottb.

***Cyperus rotundus* L.**

Chlorocyperus rotundus Palla

C. odoratus Osbeck.

C. tetrastachyos Desf.

C. tuberosus Rottb.

Schoenus tuberosus Burm. f.

***Fimbristylis dichotoma* (L.) Vahl**

F. annua (All.) Rohm. & Schult.

F. baldwiniana (Schultes) Torr.

F. communis Kunth

F. diphylla (Retz.) Vahl

F. laxa Vahl

***Fimbristylis miliacea* (L.) Vahl**

F. littoralis Gaud.

EUPHORBIACEAE

***Euphorbia hirta* L.**

Chamaesyce hirta (L.) Millsp.

E. capitata Lam.

E. opthalmica Pers.

E. pilulifera L.

E. procumbens DC.

Phyllanthus fraternus Webster

P. amarus Schum. & Thonn.

P. niruri L.

FABACEAE

Calopogonium mucunoides Desv.

C. orthocarpum Urb.

Stenolobium brachycarpum Benth.

Centrosema pubescens Benth.

Bradburya pubescens (Benth.) Kuntze

C. ferrugineum A. Rich.

C. intermedium A. Rich.

Mimosa invisa Mart. ex Colla

M. diplotricha C. Wright ex Sauvalle

Morongia pilosa Standl.

Schrankia brachycarpa Benth.

Mimosa pudica L.

M. hirsuta HBK

M. hispidula Kunth

M. pudibunda Willd.

MALVACEAE

Sida acuta Burm. f.

S. frutescens Cav.

S. ulmifolia Mill. non Stahl

Sida rhombifolia L.

S. alba Cav. non L.

S. retusa L.

Urena lobata L.

U. heterophylla Presl

OXALIDACEAE

Oxalis corniculata L.

O. javanica Bl.

O. micrantha Boj.

O. repens Thunb.

Xanthoxalis corniculata (L.) Small

PASSIFLORACEAE

Passiflora foetida L.

P. hirsuta Lodd.

P. variegata Mill.

P. vesicaria L.

POACEAE

Brachiaria distachya (L.) Stapf

Digitaria distachya (L.) Pers.

Panicum distachyon L.

Urochloa distachya (L.) Nguyen

Chloris barbata (L.) Sw.

Andropogon barbatus L.

C. inflata Link

C. longiflora Steud.

C. paraguayensis Steud.

Chrysopogon aciculatus (Retz.) Trin.

Andropogon aciculatus Retz.

A. javanicus Steud.

C. sublatus (Presl) Trin. ex Steud.

Rhapis trivialis Lour.

Cynodon dactylon (L.) Pers.

Capriola dactylon (L.) Kuntze

C. linearis Willd.
Digitaria dactylon Scop.
Dactyloctenium aegyptium (L.) Willd.
Cynosurus aegyptius L.
D. meridionale Ham.
D. mucronatum Willd.
Eleusine aegyptiaca Desf.
E. mucronata Horn.
Digitaria ciliaris (Retz.) Koel.
D. adscendens (Kunth) Henr.
D. biformis Willd.
D. commutata Schult.
D. marginata Link
Panicum adscendens Kunth
P. ciliare Retz.
Digitaria longiflora (Retz.) Pers.
D. corradii Chiov.
D. flexilis Heurard
D. roxburghii Spreng.
Milium filiforme Roxb.
Panicum longiflorum (Retz.) Gmel.
Paspalum brevifolium Flugge
P. longiflorum Retz.
Digitaria setigera Roth ex Roem. & Schult.
D. consanguinea Gaud.
D. horizontalis Ohwi non Willd.
D. microbachne (Presl) Henr.
D. microstachya Henr.
Echinochloa colona (L.) Link
E. crus-galli (L.) P. Beauv. subsp. *colonom* Honda
Panicum colonum L.
P. cumingianum Steud.
Echinochloa crus-galli (L.) P. Beauv.
E. crus-pavonis (auct. div.) non (H.B.K.) Schult.
Panicum hispidulum Retz.
Eleusine indica (L.) Gaertn.
Cynodon indicus Rasp.
Cynosurus indicus L.
E. gracilis Salisb.
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.
E. amabilis Wight & Arn. ex Hook. et Arn.
E. plumosa (L.) Link
Poa tenella L.
Imperata cylindrica (L.) Raeuschel
I. allang Jungh.
I. arundinacea Cyr.
Lagurus cylindricus L.
Saccharum cylindricum (L.) Lam.
S. koenigii Retz.
S. thunbergii Retz.
Ischaemum rugosum Salisb.
Andropogon arnottianus (Nees) Steud.
Colladoa distachya Cav.
I. segetum Trin.
Meoschium arnottianum Nees
M. griffithii Nees & Arn.
M. rugosum (Salisb.) Nees

***Leptochloa chinensis* (L.) Nees**

L. tetraquetra Presl

Poa chinensis L.

***Paspalum conjugatum* Berg.**

P. ciliatum Lam.

P. longissimum Hochst.

P. tenue Gaert.

***Paspalum dilatatum* Poir.**

P. lanatum Spreng.

P. ovatum Nees & Trin.

P. platense Spreng.

P. selloi Spreng.

***Paspalum scrobiculatum* L.**

P. commersonii Lam.

***Pennisetum glaucum* (L.) R. Br.**

P. americanum (L.) Leeke

P. typhoideum Rich.

Setaria glauca (L.) P. Beauv.

S. lutescens (Weig.) F.T. Hubbard

***Rottboellia cochinchinensis* (Lour.) W.D. Clayton**

Manisuris exaltata (L.f.) O. Ktze.

R. arundinacea Hochst. ex A. Rich.

R. exaltata L.f.

Stegosia cochinchinensis Lour.

PORTULACACEAE

***Portulaca oleracea* L.**

P. sativa Haw.

RUBIACEAE

***Borreria laevis* (Lam.) Griseb.**

B. linifolia DC.

SCROPHULARIACEAE

***Lindernia crustacea* (L.) F. Muell.**

L. minuta Koord.

Mimulus javanicus Bl.

Torenia crustacea Hassk.

Vandellia crustacea (L.) Benth.

***Scoparia dulcis* L.**

S. procumbens Jacq.

S. ternata Forsk.

STERCULIACEAE

***Melochia concatenata* L.**

M. corchorifolia L.

VERBENACEAE

***Lantana camara* L.**

Camara vulgaris Benth.

L. aculeata L.

L. glutinosa Poepp.

***Stachytarpheta jamaicensis* (L.) Vahl**

S. australis Mold.

S. cayennensis (L.C. Rich.) Vahl

S. marginata Vahl

S. mexicana Steud.

S. pilosiuscula H.B.K.

Verbena jamaicensis L.

Vermicularia decurrens Moench

Zapania jamaicensis (L.) Lam.

Appendix 2. Glossary. Some terms based on Jackson (1928).

A

Abaxial	The side of a lateral organ away from the axis.
Achene	A small, dry, hard, one-celled, one-seeded indehiscent fruit.
Annual	A plant that completes its life cycle within one year and then dies.
Anther	Portion of the stamen that bears the pollen grains.
Aperture	An opening.
Apomict	Without mingling and segregation of chromosomes.
Apomixis	The production of offspring in the usual sexual structure without mingling and segregation of chromosomes.
Auricle	An ear-like appendage, usually occurring at the junction of the leaf sheath and blade.
Awn	A bristle-shaped appendage attached to the glumes.

B

Basal bulb	An underground stem composed of scales belonging or attached to the base.
Bioassay	Quantitative or qualitative determination of the concentration of herbicide by using sensitive indicator plants or other biological organisms.
Biological control	Control or suppression of weeds by the action of one or more other organisms, through natural means.
Biomass	The amount of living matter in a unit area or volume of a habitat.
Biotype	A population within a species that has a distinct genetic variation.
Blade	The expanded portion of a leaf.
Bract	A modified leaf, from the axil of which arises a flower or an inflorescence.
Bristle	A stiff, sharp hair, or any slender body of similar appearance.

C

Callus	An extension of the flowering glume below its point of insertion, and adnate to the axis or rachilla of the spikelet (in Poaceae).
Calyx	Group of sepals; outermost flower whorl.
Capitula	Dense clusters of stalkless flowers.
Capsule	A simple, dry, dehiscent fruit, with two or more carpels.
Carpel	A floral leaf bearing ovules along the margins; the pistil is composed of one or more carpels.
Caryopsis	The one-seeded fruit or grain of grasses.
Chasmogamy	The opening of the perianth at the time of flowering, with pollination effected during expansion of the floral envelope.
Chromosome	A condensed mass of chromatin, visible during cell division.
Cleistogamy	The flowers being normal, but not opening, and pollination taking place within the closed perianth.
Coleoptile	Sheath enclosing the succeeding leaves in grasses.

Corolla	Group of petals; usually the colored flower whorl.
Cortex	The typically parenchymatous layer of tissue external to the vascular tissue and internal to the corky or epidermal tissues of a green plant.
Corymb	A type of inflorescence where the branches and pedicels, although starting from different points, all attain the same level; the outer flowers opening first.
Cosmopolitan	Found in most parts of the world under varied ecological conditions.
Cotyledon	Seed leaf; the primary leaf or leaves in the embryo.
Culm	Stem of a grass.
Cupule	The involucre of the male and female flowers in Euphorbiaceae.
Cyme	A type of inflorescence in which the apex of the main stalk or the axis of the inflorescence ceases to grow quite early, relative to the laterals.
Cytology	A branch of biology dealing with the structure, function, multiplication, pathology, and life history of cells.

D

Decumbent	Reclining on the ground.
Decurrent	Leaves prolonged on the stem beneath their insertion.
Dehiscent	Splitting spontaneously when ripe.
Dentate	Toothed, especially with salient teeth directed forward.
Dichotomous	Forking regularly into two.
Dicotyledon (dicot)	A member of the Dicotyledoneae; one of two classes of angiosperms usually characterized by the following: two seed leaves (cotyledons), leaves with net venation, and root systems with tap roots.
Dimorphism	The existence of an organ (such as the leaves of a plant) in two different forms.
Dissemination	The means by which ripe seeds are shed by the parent plant.
Distichous	Two-ranked, with leaves on opposite sides of a stem and in the same plane.
Diuretic	Tending to increase the flow of urine.
Dormancy	The inability to germinate even if the environmental conditions are favorable.

E

Ecotype	A population within a species that has developed a distinct morphological or physiological characteristic in response to a specific environment and which persists when individuals are moved to a different environment.
Ektexine	A structurally variable outer layer of the exine.
Elliptic	Shaped like an ellipse, oblong with regularly rounded ends.
Endexine	An inner membranous layer of the exine.
Endozoic	Living within or involving passage through an animal.
Environment	The sum total of all biological and physical factors affecting an organism, population, or community.
Ephemeral	Short-lived.
Epidermis	The outer layer of the cell.
Epizoic	Dwelling upon the body of an animal.

Exine	The outer of the two major layers forming the walls of some spores and especially pollen grains.
F	
Facultative	Occasional or incidental.
Falcate	Sickle-shaped.
Fibrous	Thread-like.
Flaccid	Limp, flabby.
Flavonoid	Any of a group of aromatic compounds that includes many common pigments such as the anthocyanins.
Foliage	Leaf; composed of the blade and the petiole.
Fructification	The forming or producing of fruit.
Fruit	The matured ovary containing one or more seeds.
G	
Geniculately	Bent abruptly at an angle like a bent knee.
Genotype	The genetic constitution of an individual.
Germination	The process of initiating growth in seeds.
Glomerule	A cluster of capitula in a common involucre.
Glume	An empty bract at the base of the spikelet; usually two are present.
Glycoside	An organic compound that yields one or more sugars on hydrolysis. The nonsugar component (aglycine) is often toxic to animals.
Granular	Composed of grains.
H	
Habitat	The particular environment in which an organism lives.
Herb	A seed plant that does not develop woody tissues.
Herbarium	A systematically arranged collection of dried plant specimens for botanical reference and research.
Host plant	A plant upon which an organism (usually an insect, or fungus or disease) lodges and subsists.
Husk	A dry outer covering of some seeds and fruits.
Hybrid	The offspring formed by mating two plants that differ genetically.
Hydromorphic	Developed in the presence of an excess of moisture that tends to suppress aerobic factors.
Hypocotyl	The portion of an embryo or seedling between the cotyledons and the radicle.
I	
Imbibition	The absorption of liquids or vapors into the ultramicroscopic spaces or pores found in materials such as cellulose.
Impermeable	Not allowing the passage of liquids or substances.
Induced dormancy	Develops due to environmental interaction after the seed has been shed from the plant and persists after the environmental conditions change; can be caused by factors such as lack of water, lack of oxygen, low temperature, and high carbon dioxide concentration.

Inflorescence	The flowers and their arrangement on the plant.
Innate dormancy	Has three possible causes: could be an inherent property of the ripened seed based on genetic control when the seed leaves the plant; could be a rudimentary or physiologically immature embryo, which is not fully developed when the seed is shed; could also be caused by impermeable or mechanically resistant seed coats or the presence of endogenous chemical inhibitors.
Intraspecific variation	Differences occurring within a species or involving members of one species.
Involucre	A whorl or set of bracts around a flower or an inflorescence.
K	
Karyology	A branch of cytology concerned with the minute cytological characteristics of the cell nucleus.
Keel	A projecting ridge on a surface, like the keel of a boat; the two anterior petals of a papilionaceous corolla.
L	
Leaf area index	Leaf area per unit ground area.
Lamina	The expanded part or blade of a leaf.
Lanceolate	Tapering to a point at the apex and sometimes at the base as in leaves.
Leachate	Liquid obtained by a mild form of leaching such as would occur under natural conditions of plant growth.
Leaf axil	Upper angle formed where the leaf joins the stem.
Leaf sheath	The base of a grass leaf enwrapping the stem.
Lemma	The outer bract of a floret, which encloses the flower.
Ligule	A collar-like membranous or hairy projection at the base of a leaf blade.
Locule	A cavity or a chamber.
Locus	The position in a chromosome of a particular gene or allele (plural: loci).
M	
Meiosis	The cellular process that results in the number of chromosomes in gamete-producing cells being reduced to one half.
Mericaip	A portion of a fruit that splits away as a perfect fruit.
Monocotyledon (monocot)	A member of the Monocotyledoneae; one of two classes of angiosperms, usually characterized by the following: one seed leaf (cotyledon), leaves with parallel venation, root systems arising adventitiously and usually diffuse (fibrous).
Monopodial growth	Growth involving the formation of offshoots from a main axis.
Morphology	The study of external shape and its development.
N	
Node	The joint of a stem, or the part bearing the leaves or branches.
Nut	A one-seeded, hard, bony fruit.
O	
Obovate	A flat inversely ovate body, the broad end upward.
Operculate	Furnished with a lid.

Ovary	That part of the pistil that contains the ovules; the immature seeds.
Ovate	An oval shape like a longitudinal section through an egg; broader at the base than the apex.
Ovoid	A solid that is oval in flat outline.
P	
Paddock	A small grassy area in which crops or livestock are enclosed.
Palea	The inner chaff-like scale of certain composites; the inner scale of grasses.
Pappus	A ring of hairs or scales around the tip of the fruit of the Asteraceae.
Parasite	An organism subsisting on another (the host).
Pedice	The stalk of a single flower.
Peduncle	The stalk of an inflorescence or of a single flower.
Perennial	A plant lasting from year to year.
Perianth	The floral envelopes, calyx or corolla, or both.
Pericarp	The wall of a fruit.
Permeable	Having pores or openings that permit liquids or gases to pass through a membrane.
pH	The negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in gram equivalents per liter used in expressing both acidity and alkalinity on a scale whose values run from 0 to 14, with 7 representing neutrality, numbers less than 7 increasing acidity, and numbers greater than 7 increasing alkalinity.
Phenotype	The visible properties of an organism that are produced by the interaction of the genotype and the environment.
Photoperiod	A recurring cycle of light and dark periods of regular length.
Photoperiodism	Response to the length of daily light and dark periods.
Pinna	A primary division of a bipinnate or tripinnate leaf.
Pistil	Female part of a flower, consisting of stigma, style, and ovary.
Plasticity	Property of a cell wall that enables it to undergo irreversible plastic extension under turgor forces.
Pod	A dry, usually dehiscent, few-to-many-seeded fruit of a single simple carpel.
Polymorphism	The state of being able to assume different forms.
Population	In ecology, a group of individuals of any one species.
Prickle	Sharp vegetative projection as in the rose.
Prostrate	Lying flat on the ground.
Protuberance	Something that thrusts out from a surrounding or adjacent surface often as a rounded mass.
Pubescent	Hairy, especially with fine and soft hairs.
R	
Raceme	An unbranched inflorescence, bearing spikelets on pedicels that are attached to the central axis.
Rachilla	The central stalk of a spikelet to which the florets are attached.

Rachis	The axis of an inflorescence or other body.
Radicle	The rudimentary root of the embryo.
Receptacle	The axile part of the flower that supports the sepals, petals, stamens, and pistils.
Reticulate	The veins forming a network.
Reticulum	A net.
Rhizome	A creeping stem that grows at or below the soil surface and bears only scale leaves.
Rosette	A cluster of radiating leaves arising at or close to the ground.
Runner	A slender trailing stem rooting at the nodes.

S

Scarification	Mechanically abrading the seed coat to initiate germination.
Seed coat	The outermost covering of the seed.
Self-pollination	Transfer of pollen grains from the anther to the stigma of the same flower.
Sepal	One of the leaves of the calyx.
Sessile	Attached directly to an axis, lacking a stalk or pedicel.
Shrub	Small woody plant with several stems.
Spathe	A bract that encloses an inflorescence.
Spike	An unbranched inflorescence in which the spikelets are attached directly to the rachis, lacking pedicels.
Spikelet	The ultimate branchlet of a grass inflorescence, typically consisting of glumes, rachilla, and florets.
Spine	A sharp-pointed woody or hardened body, usually a branch, sometimes a petiole, stipule, or other plant part.
Staminate	Having a stamen, the male reproductive part of a flower (composed of the anther and filament).
Stigma	A feathery surface at the tip of the ovary, which receives the pollen.
Stilt (roots)	Roots arising from the base of the stem.
Stipel	A minute stipule on a leaflet of compound leaves.
Stipule	An appendage or projection on each side of the base of some leaves, which can touch or surround the stem.
Stolon	A creeping stem that lies on the surface of the soil and bears ordinary foliage leaves.
Style	The structure that connects the stigma and the ovary.
Stylopodium	The enlargement at the base of the style.
Suture	The line of junction of contiguous parts grown together.

T

Taproot	Primary root that continues to grow, becoming the plant's chief root system.
Tendrils	A slender, usually coiled organ, used for climbing.
Tetraploid	An organism with four basic (x) sets of chromosomes.
Tiller	A stalk or sprout arising from the base of a plant or from the axil of its lower leaves.

Tolerance	Ability to continue normal growth or function when exposed to a potentially harmful agent.
Trigonus	Three-angled, or triangular.
Tubercle	A small tuber; a rounded protruding body.
Turgid	Swollen, inflated.
U	
Umbel	The umbrella-like form of inflorescence.
V	
Vegetative reproduction	Asexual reproduction by detachment of part of the plant, which then develops into a complete plant.
Viable	That germinates readily.
Vine	Any plant with a trailing or climbing stem.
W	
Whorl	The arrangement of organs in a circle around an axis.

Appendix 3. Common and chemical names of herbicides.

Bifenox	methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate
Butachlor	N-(butoxymethyl)-2-chloro-2',6'-diethyl-acetanilide
Chlorimuron-ethyl	ethyl 2-[[[(4-chloro-6-methoxy-2-pyrimidin danyl)-amino]carbonyl]amino]sulfonyl]benzoate
Cyhalofop butyl	(R-(+)-N-butyl 1-2-(4-(2-fluoro-4-cyanophenoxy) phenoxy) (propanoic acid)
2,4-D	2,4-dichlorophenoxy acetic acid
EPTC	S-ethyl dipropylthiocarbamate
Fenoxaprop-P-ethyl	(R)-2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoic acid
Fluazifop-P-butyl	butyl(R)-2[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoate
Glyphosate	N-(phosphonomethyl)glycine
MCPA	(4-chloro-2-methyl)phenoxyacetic acid
Oxadiazon	2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)- Δ^2 -1,3,4-oxadiazolin-5-one
Pendimethalin	N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine
Propanil	N-(3,4-dichlorophenyl)propanamide
Thiobencarb	S-4-chlorobenzyl diethylthiocarbamate
Triclopyr	(3,5,6-trichloro-2-pyridinyloxy)acetic acid
Trifop methyl	methyl 2-[4-[4-trifluoromethylphenoxy]phenoxy]propionate

Appendix 4. An inventory of spontaneous and cultivated vegetation occurring in upland rice in South and Southeast Asia.

This list of species occurring in upland rice has been compiled from an extensive search of the literature and field observations over many years by one of the authors, Dr. Keith Moody. Genus, species, family, and country of occurrence are given. Country codes are as follows: BAN = Bangladesh, IND = India, IDO = Indonesia, LAO = Lao PDR, MYA = Myanmar, PHI = Philippines, THA = Thailand, and VIE = Vietnam.

Genus and species	Family	Country
<i>Abutilon indicum</i> (L.) Sweet	Malvaceae	IND, PHI, VIE
<i>Acacia</i>		
<i>farnesiana</i> (L.) Willd.	Fabaceae (M)	MYA
<i>megaladena</i> Desv.	Fabaceae (M)	THA
<i>Acalypha</i>		
<i>indica</i> L.	Euphorbiaceae	IDO, IND, PHI, VIE
<i>lanceolata</i> Willd.	Euphorbiaceae	PHI
<i>Acanthospermum hispidum</i> DC.	Asteraceae	IDO, IND
<i>Achyranthes aspera</i> L.	Amaranthaceae	IDO, IND, PHI
<i>Adiantum</i> sp.	Adiantaceae	THA
<i>Aeginetia indica</i> L.	Orobanchaceae	PHI
<i>Aerva lanata</i> (L.) Juss. ex Schult.	Amaranthaceae	PHI
<i>Aeschynomene</i>		
<i>americana</i> L.	Fabaceae (P)	IDO
<i>aspera</i> L.	Fabaceae (P)	BAN, VIE
<i>indica</i> L.	Fabaceae (P)	IND, PHI, THA
<i>Ageratina adenophora</i> (Spreng.)		
R.M. King & H. Rob.	Asteraceae	THA
<i>Ageratum</i>		
<i>conyzoides</i> L.	Asteraceae	BAN, IDO, IND, LAO, MYA, PHI, THA, VIE
<i>houstonianum</i> Mill.	Asteraceae	IDO
<i>Agrostis micrantha</i> Steud.	Poaceae	IND
<i>Albizia odoratissima</i> (Willd.) Benth.	Fabaceae (M)	THA
<i>Allmania nodiflora</i> (L.) R. Br. ex Wight	Amaranthaceae	IND
<i>Alternanthera</i>		
<i>ficoidea</i> (L.) R. Br. ex Griseb.	Amaranthaceae	IDO, PHI
<i>philoxeroides</i> (Mart.) Griseb.	Amaranthaceae	IDO, IND
<i>sessilis</i> (L.) DC.	Amaranthaceae	BAN, IDO, IND, PHI, THA
<i>Alysicarpus</i>		
<i>bupleurifolius</i> (L.) DC.	Fabaceae (P)	PHI
<i>vaginalis</i> (L.) DC.	Fabaceae (P)	IND, LAO, PHI, THA
<i>Amaranthus</i>		
<i>lividus</i> L.	Amaranthaceae	IDO, IND
<i>polygamus</i> L.	Amaranthaceae	IND

Genus and species	Family	Country
<i>spinosus</i> L.	Amaranthaceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>tenuifolius</i> Willd.	Amaranthaceae	IND
<i>tricolor</i> L.	Amaranthaceae	VIE
<i>viridis</i> L.	Amaranthaceae	BAN,IDO,IND,PHI,THA,VIE
<i>Ammannia</i>		
<i>baccifera</i> L.	Lythraceae	IND,THA
<i>multiflora</i> Roxb.	Lythraceae	IND
<i>Anogeissus acuminata</i> Wall.	Combretaceae	THA
<i>Anotis wightiana</i> Hook. f.	Rubiaceae	IND
<i>Anthocephalus indicus</i> A. Rich.	Naucleaceae	IND
<i>Antidesma ghesaembilla</i> Gaertn.	Stilaginaceae	THA
<i>Apluda mutica</i> L.	Poaceae	PHI
<i>Aponogeton monostachyon</i> L.f.	Aponogetonaceae	IND
<i>Aporosa wallichii</i> Hook. f.	Euphorbiaceae	THA
<i>Argemone mexicana</i> L.	Papaveraceae	IND
<i>Arisaema</i> sp.	Araceae	THA
<i>Aristolochia kirkii</i> Baker	Aristolochiaceae	THA
<i>Artemisia</i>		
<i>dubia</i> Wall. ex DC.	Asteraceae	THA
<i>vulgaris</i> L.	Asteraceae	IDO
<i>Arundinella leptochloa</i> (Nees) Hook. f.	Poaceae	IND
<i>Asystasia gangetica</i> (L.) T. Anders.	Acanthaceae	PHI
<i>Atylosia scarabaeoides</i> (L.) Benth.	Fabaceae (P)	LAO,VIE
<i>Austroeupatorium inulaefolium</i> (Kunth.) R.M. King & H. Rob.	Asteraceae	IDO,PHI
<i>Axonopus compressus</i> (Sw.) Beauv.	Poaceae	IDO,IND,PHI,VIE
<i>Bacopa</i>		
<i>floribunda</i> (R. Br.) Wettst.	Scrophulariaceae	PHI
<i>monnieri</i> (L.) Pennell	Scrophulariaceae	IND,PHI
<i>Basella rubra</i>	Basellaceae	PHI
<i>Basilicum polystachyon</i> (L.) Moench	Lamiaceae	PHI
<i>Belosynopsis moluccana</i> (L.) C.E.C. Fisch.	Commelinaceae	PHI
<i>Bergia ammannioides</i> Roxb.	Elatinaceae	IND
<i>Bidens</i>		
<i>bitermata</i> (Lour.) Merr. & Sherff ex Sherff	Asteraceae	THA
<i>pilosa</i> L.	Asteraceae	IDO,IND,MYA,PHI,THA
<i>Biophytum sensitivum</i> (L.) DC.	Oxalidaceae	IDO,PHI
<i>Blechum pyramidatum</i> (Lam.) Urb.	Acanthaceae	PHI

Genus and species	Family	Country
<i>Blumea</i>		
<i>balsamifera</i> (L.) DC.	Asteraceae	IDO
<i>lacera</i> (Burm. f.) DC.	Asteraceae	IND, PHI, THA
<i>laciniata</i> (Roxb.) DC.	Asteraceae	IND, PHI
<i>membranacea</i> DC.	Asteraceae	THA
<i>mollis</i> (D. Don) Merr.	Asteraceae	THA
<i>wightiana</i> DC.	Asteraceae	IND
<i>Blumeopsis falcata</i> (D. Don) Merr.	Asteraceae	THA
<i>Boerhavia</i>		
<i>diffusa</i> L.	Nyctaginaceae	IND, PHI, THA
<i>erecta</i> L.	Nyctaginaceae	IDO
<i>Bonnaya</i>		
<i>veronicaefolia</i> Spreng.	Scrophulariaceae	VIE
sp.	Scrophulariaceae	IND
<i>Borreria</i>		
<i>alata</i> (Aubl.) DC.	Rubiaceae	IDO, THA
<i>articularis</i> (L.f.) F.N. Williams	Rubiaceae	IDO, IND, PHI, VIE
<i>laevis</i> (Lam.) Griseb.	Rubiaceae	IDO, IND, LAO, PHI, THA
<i>latifolia</i> (Aubl.) Schum.	Rubiaceae	IDO, PHI, VIE
<i>ocymoides</i> (Burm. f.) DC.	Rubiaceae	IDO, LAO, PHI, VIE
<i>Bothriochloa</i>		
<i>bladhii</i> (Retz.) S.T. Blake	Poaceae	PHI, VIE
<i>pertusa</i> (L.) A. Camus	Poaceae	MYA, VIE
<i>Brachiaria</i>		
<i>distachya</i> (L.) Stapf	Poaceae	BAN, IDO, IND, PHI, THA, VIE
<i>holotricha</i> Ohwi	Poaceae	PHI
<i>miliiformis</i> (Presl) A. Chase	Poaceae	IDO, IND
<i>mutica</i> (Forssk.) Stapf	Poaceae	PHI, THA
<i>ramosa</i> (L.) Stapf	Poaceae	IND
<i>reptans</i> (L.) Gard. & C.E. Hubb.	Poaceae	IND, PHI, THA
<i>Buddleja asiatica</i> Lour.	Buddlejaceae	THA
<i>Bulbostylis barbata</i> (Rottb.) C.B. Clarke	Cyperaceae	IDO, IND, PHI
<i>Byttneria pilosa</i> Roxb.	Byttneriaceae	THA
<i>Caesulia axillaris</i> Roxb.	Asteraceae	IND
<i>Calopogonium mucunoides</i> Desv.	Fabaceae(P)	IDO, PHI, THA, VIE
<i>Calotis gaudichaudii</i> Gagnep.	Asteraceae	VIE
<i>Calotropis gigantea</i> (Willd.) Dryand ex W.T. Aiton	Asclepiadaceae	IND
<i>Canavalia</i>		
<i>gladiata</i> (Jacq.) DC.	Fabaceae(P)	THA
<i>miritima</i> (Aubl.) Thou.	Fabaceae(P)	PHI
<i>Capparis</i>		
<i>micrantha</i> DC.	Capparaceae	PHI
<i>zeylanica</i> L.	Capparaceae	PHI
<i>Capsella bursa-pastoris</i> (L.) Medic.	Brassicaceae	IND

Genus and species	Family	Country
<i>Capsicum frutescens</i> L.	Solanaceae	IND
<i>Cardiospermum halicacabum</i> L.	Sapindaceae	PHI
<i>Carex</i>		
<i>cruciata</i> Wahlenb.	Cyperaceae	IND
<i>pruniosa</i> Boott	Cyperaceae	IND
<i>Cassia siamea</i> Lam.	Fabaceae (C)	IDO
<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	PHI
<i>Cedrela toona</i> Roxb.	Meliaceae	IND
<i>Celosia argentea</i> L.	Amaranthaceae	BAN,IDO,IND,LAO,PHI,THA,VIE
<i>Cenchrus</i>		
<i>brownii</i> Roem. & Schult.	Poaceae	PHI
<i>echinatus</i> L.	Poaceae	PHI,THA
<i>inflexus</i> R. Br.	Poaceae	VIE
<i>Centella asiatica</i> (L.) Urb.	Apiaceae	IDO,IND,PHI,THA,VIE
<i>Centotheca lappacea</i> (L.) Desv.	Poaceae	IND,PHI
<i>Centrosema</i>		
<i>plumieri</i> (Turp. ex Pers.) Benth.	Fabaceae (P)	IDO,PHI
<i>pubescens</i> Benth.	Fabaceae (P)	IDO,PHI
<i>Ceratophyllum demersum</i> L.	Ceratophyllaceae	IDO
<i>Chamaecrista mimosoides</i> (L.) Greene	Fabaceae (C)	IDO,PHI
<i>Chenopodium</i>		
<i>album</i> L.	Chenopodiaceae	IND
<i>ambrosioides</i> L.	Chenopodiaceae	IND,PHI,VIE
<i>Chloris</i>		
<i>barbata</i> Sw.	Poaceae	IDO,IND,PHI,THA,VIE
<i>gayana</i> Kunth	Poaceae	PHI
<i>Chlorophytum arundinaceum</i> Baker	Liliaceae	IND
<i>Chromolaena odorata</i> (L.) R.M. King & H. Rob.	Asteraceae	IDO,IND,LAO,PHI,THA,VIE
<i>Chrozophora rottleri</i> (Geisel) A. Juss. ex Spreng.	Euphorbiaceae	IND
<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Poaceae	BAN,IDO,IND,LAO
<i>Cichorium intybus</i> L.	Asteraceae	IDO
<i>Cissus discolor</i> Bl.	Cistaceae	THA
<i>Cleome</i>		
<i>aspera</i> Koen. ex DC.	Capparaceae	IDO
<i>chelidonii</i> L.f.	Capparaceae	IND
<i>gynandra</i> L.	Capparaceae	IDO,PHI
<i>icosandra</i> L.	Capparaceae	IND
<i>monophylla</i> L.	Capparaceae	IND
<i>rutidosperma</i> DC.	Capparaceae	IDO,IND,PHI
<i>viscosa</i> L.	Capparaceae	IDO,IND,PHI,VIE

Genus and species	Family	Country
<i>Clerodendron paniculatum</i> L.	Verbenaceae	LAO,VIE
<i>Cocos nucifera</i> L.	Palmae	PHI
<i>Coelachne simpliciuscula</i> (Wight & Arn. ex Steud.) Munro ex Benth.	Poaceae	IND
<i>Coix lachryma-jobi</i> L.	Poaceae	IND,PHI
<i>Coldenia procumbens</i> L.	Boraginaceae	IND
<i>Colocasia esculenta</i> (L.) Schott	Araceae	IDO,IND
<i>Commelina</i>		
<i>benghalensis</i> L.	Commelinaceae	BAN,IDO,IND,LAO,PHI,THA, VIE
<i>diffusa</i> Burm. f.	Commelinaceae	BAN,IDO,IND,LAO,PHI,THA
<i>hasskarlii</i> C.B. Clarke	Commelinaceae	IND
<i>longifolia</i> Lam.	Commelinaceae	IND
<i>Convolvulus arvensis</i> L.	Convolvulaceae	IND
<i>Conyza</i>		
<i>canadensis</i> (L.) Cronq.	Asteraceae	IDO,VIE
<i>leucantha</i> (D. Don) Ludlow & Raven	Asteraceae	THA
<i>sumatrensis</i> (Retz.) E.H. Walker	Asteraceae	LAO,THA
<i>Corchorus</i>		
<i>aestuans</i> L.	Tiliaceae	IND,PHI,THA
<i>capsularis</i> L.	Tiliaceae	PHI
<i>olitorius</i> L.	Tiliaceae	IND,PHI
sp.	Tiliaceae	LAO
<i>Cosmos caudatus</i> Kunth	Asteraceae	PHI
<i>Costus speciosus</i> (Koen.) J.E. Smith	Costaceae	IDO,THA
<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Asteraceae	IDO,IND,LAO,PHI,THA
<i>Cratoxylum formosum</i> (Jack) Dryer in Hook. f.	Clusiaceae	THA
<i>Crotalaria</i>		
<i>bracteata</i> Roxb.	Fabaceae (P)	PHI
<i>incana</i> L.	Fabaceae (P)	IDO,PHI
<i>juncea</i> L.	Fabaceae (P)	IDO,IND,MYA,PHI
<i>micans</i> Link	Fabaceae (P)	IDO
<i>montana</i> Roth	Fabaceae (P)	PHI
<i>ochroleuca</i> G. Don	Fabaceae (P)	PHI
<i>pallida</i> Ait.	Fabaceae (P)	IDO,PHI
<i>quinquefolia</i> L.	Fabaceae (P)	PHI
<i>retusa</i> L.	Fabaceae (P)	PHI
<i>saltiana</i> Andr.	Fabaceae (P)	PHI
<i>verrucosa</i> L.	Fabaceae (P)	PHI
<i>Croton</i>		
<i>bonplandianus</i> Baill.	Euphorbiaceae	IND
<i>hirtus</i> L'Her.	Euphorbiaceae	IDO,VIE
<i>sparsiflorus</i> Morong	Euphorbiaceae	IND
<i>Cucumis sativus</i> L.	Cucurbitaceae	IND

Genus and species	Family	Country
<i>Cucurbita maxima</i> Duch. ex Lam.	Cucurbitaceae	IND
<i>Cudrania cochinchinensis</i> (Lour.) Kudo & Masamune ex Sauer	Moraceae	VIE
<i>Curculigo</i> sp.	Hypoxidaceae	IDO
<i>Curcuma parviflora</i> Wall.	Zingerberaceae	THA
<i>Cyanotis</i>		
<i>axillaris</i> (L.) D. Don	Commelinaceae	IDO,IND,PHI,VIE
<i>barbata</i> D. Don	Commelinaceae	THA
<i>cristata</i> D. Don	Commelinaceae	PHI
<i>cucullata</i> Kunth	Commelinaceae	IND
<i>Cyathula prostrata</i> (L.) Bl.	Amaranthaceae	IDO,PHI,THA
<i>Cycas micholitzii</i> Dyer	Cycadaceae	THA
<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	IND
<i>Cynodon</i>		
<i>dactylon</i> (L.) Pers	Poaceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>plectostachyus</i> (K. Schum.) Pilg.	Poaceae	PHI
<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	THA
<i>Cyperus</i>		
<i>babakan</i> Steud.	Cyperaceae	PHI
<i>brevifolius</i> (Rottb.) Hassk.	Cyperaceae	IDO,IND,LAO,PHI,VIE
<i>castaneus</i> Willd.	Cyperaceae	IND
<i>cephalotes</i> Vahl	Cyperaceae	IND
<i>compactus</i> Retz.	Cyperaceae	PHI,THA
<i>compressus</i> L.	Cyperaceae	BAN,IDO,IND,PHI,THA,VIE
<i>corymbosus</i> Rottb.	Cyperaceae	IND
<i>cyperinus</i> (Retz.) Suringar	Cyperaceae	PHI
<i>cyperoides</i> (L.) Kuntze	Cyperaceae	THA
<i>difformis</i> L.	Cyperaceae	IND,PHI,THA,VIE
<i>diffusus</i> Vahl	Cyperaceae	LAO,THA,VIE
<i>distans</i> L.f.	Cyperaceae	IND
<i>dubius</i> Rottb.	Cyperaceae	IDO
<i>exaltus</i> Retz.	Cyperaceae	IND
<i>flabelliformis</i> Rottb.	Cyperaceae	IND
<i>flavidus</i> Retz.	Cyperaceae	IND,THA
<i>halpan</i> L.	Cyperaceae	IDO,IND,PHI,THA,VIE
<i>iria</i> L.	Cyperaceae	BAN,IDO,IND,LAO,PHI, THA,VIE
<i>kyllingia</i> Endl.	Cyperaceae	IDO,PHI,THA,VIE
<i>luzulae</i> Rottb. ex Willd.	Cyperaceae	IND
<i>niveus</i> Retz.	Cyperaceae	IND
<i>pilosus</i> Vahl	Cyperaceae	IND,LAO,PHI
<i>pumilus</i> L.	Cyperaceae	IDO,IND
<i>radians</i> Nees & Mey.	Cyperaceae	VIE
<i>rotundus</i> L.	Cyperaceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>sanguinolentus</i> Vahl	Cyperaceae	PHI
<i>sphacelatus</i> Rottb.	Cyperaceae	IDO

Genus and species	Family	Country
<i>tagetiformis</i> Roxb.	Cyperaceae	VIE
<i>trialatus</i> (Boeck.) Kern	Cyperaceae	LAO
<i>triceps</i> (Rottb.) Endl.	Cyperaceae	IND
<i>zollingeri</i> Steud.	Cyperaceae	PHI
<i>Cyrtococcum</i>		
<i>accrescens</i> (Trin.) Stapf	Poaceae	IND, PHI, THA
<i>oxyphyllum</i> (Steud.) Stapf	Poaceae	PHI
<i>patens</i> (L.) A. Camus	Poaceae	PHI
sp.	Poaceae	IDO
<i>Dactyloctenium aegyptium</i> (L.) Willd.	Poaceae	BAN, IDO, IND, PHI, THA, VIE
<i>Dalbergia</i>		
<i>oliveri</i> Gamble ex Prain	Fabaceae (P)	THA
<i>stipulacea</i> Roxb.	Fabaceae (P)	THA
<i>Datura</i>		
<i>metel</i> L.	Solanaceae	THA
<i>stramonium</i> L.	Solanaceae	IND
<i>Deeringia</i>		
<i>amaranthoides</i> (Lam.) Merr.	Amaranthaceae	PHI
<i>polysperma</i> (Roxb.) Moq.	Amaranthaceae	PHI
<i>Dendrocalamus</i>		
<i>hamiltonii</i> Nees & Arn. ex Munro	Poaceae	IND
<i>nudus pilger</i>	Poaceae	THA
<i>Derris elliptica</i> (Roxb.) Benth.	Fabaceae (P)	IDO
<i>Desmodium</i>		
<i>gangeticum</i> (L.) DC.	Fabaceae (P)	PHI
<i>heterocarpon</i> (L.) DC.	Fabaceae (P)	PHI, THA
<i>heterophyllum</i> (Willd.) DC.	Fabaceae (P)	PHI, VIE
<i>laxiflorum</i> DC.	Fabaceae (P)	PHI
<i>laxum</i> L.	Fabaceae (P)	PHI
<i>procumbens</i> (Mill.) Hitchc.	Fabaceae (P)	PHI
<i>pulchellum</i> (L.) Benth.	Fabaceae (P)	PHI
<i>scorpiurus</i> (Sw.) Desv.	Fabaceae (P)	PHI
<i>styracifolium</i> (Osbeck) Merr.	Fabaceae (P)	PHI
<i>triflorum</i> (L.) DC.	Fabaceae (P)	IDO, IND, PHI
<i>umbellatum</i> (L.) DC.	Fabaceae (P)	IDO
<i>velutinum</i> (Willd.) DC.	Fabaceae (P)	PHI
<i>Dichanthium</i>		
<i>annulatum</i> (Forssk.) Stapf	Poaceae	IND
<i>aristatum</i> (Poir.) C.E. Hubb.	Poaceae	PHI
<i>caricosum</i> (L.) A. Camus	Poaceae	IND
<i>sericeum</i> (R. Br.) A. Camus	Poaceae	PHI
<i>Dichrocephala integrifolia</i> (L.f.) Kuntze	Asteraceae	IND, THA
<i>Digera muricata</i> (L.) Mart.	Amaranthaceae	IND
<i>Digitaria</i>		
<i>ciliaris</i> (Retz.) Koel.	Poaceae	IDO, IND, LAO, PHI, THA, VIE
<i>compacta</i> (Roth ex Roem. & Schult.) Veldk.	Poaceae	PHI
<i>filiformis</i> (L.) Koel.	Poaceae	IND

Genus and species	Family	Country
<i>fuscescens</i> (Presl) Henr.	Poaceae	IDO
<i>longiflora</i> (Retz.) Pers.	Poaceae	BAN,IDO,IND,LAO,MYA,PHI
<i>radicosa</i> (Presl) Miq.	Poaceae	IND,PHI
<i>sanguinalis</i> (L.) Scop.	Poaceae	IDO,IND,PHI,THA
<i>setigera</i> Roth ex Roem. & Schult.	Poaceae	IDO,IND,LAO,PHI,THA
<i>violascens</i> L.	Poaceae	IND
<i>Dillenia parviflora</i> Griff	Dilleniaceae	THA
<i>Dinebra retroflexa</i> (Vahl) Panzer	Poaceae	IND
<i>Dioscorea</i>		
<i>alata</i> L.	Dioscoreaceae	PHI,THA
<i>bulbifera</i> L.	Dioscoreaceae	THA
<i>glabra</i> Roxb.	Dioscoreaceae	THA
<i>pentaphylla</i> L.	Dioscoreaceae	THA
<i>Dipterocarpus obtusifolius</i> Teysm. & Miq.	Dipterocarpaceae	THA
<i>Dolichandrone</i>		
<i>spathacea</i> (L.f.) K. Schum.	Bignoniaceae	THA
<i>stipulata</i> Benth. & Hook. f.	Bignoniaceae	THA
<i>Dopatrium junceum</i> Buch.-Ham. ex Benth.	Scrophulariaceae	IND
<i>Drosera umbellata</i> Lour.	Droseraceae	IND
<i>Drymaria cordata</i> (L.) Willd. ex Roem. & Schult	Caryophyllaceae	IDO,PHI,THA
<i>Dunbaria longeracemosa</i> Craib	Fabaceae (P)	THA
<i>Echinochloa</i>		
<i>colona</i> (L.) Link	Poaceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>crus-galli</i> (L.) P. Beauv.	Poaceae	BAN,IDO,IND
<i>frumentacea</i> Link	Poaceae	IND
<i>stagnina</i> (Retz.) P. Beauv.	Poaceae	PHI
<i>Eclipta</i>		
<i>erecta</i> L.	Asteraceae	IND
<i>prostrata</i> (L.) L.	Asteraceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>zippeliana</i> Bl.	Asteraceae	PHI
<i>Eleocharis</i>		
<i>attenuata</i> (Fr. & Sav.) Gaertn.	Poaceae	IDO
<i>congesta</i> D. Don	Cyperaceae	IND
<i>Elephantopus</i>		
<i>scaber</i> L.	Asteraceae	PHI
<i>tomentosus</i> L.	Asteraceae	PHI
<i>Eleusine</i>		
<i>coracana</i> (L.) Gaertn.	Poaceae	IND
<i>indica</i> (L.) Gaertn.	Poaceae	BAN,IDO,IND,LAO,MYA, PHI,THA,VIE
<i>Eleutheranthera ruderalis</i> (Sw.) Sch.-Bip.	Asteraceae	IDO

Genus and species	Family	Country
<i>Elymus repens</i> (L.) Gould	Poaceae	IND
<i>Elytraria imbricata</i> (Vahl.) Pers.	Acanthaceae	PHI
<i>Elytrophorus spicatus</i> (Willd.) A. Camus	Poaceae	IND
<i>Emilia sonchifolia</i> (L.) DC.	Asteraceae	BAN,IDO,IND,PHI,THA,VIE
<i>Equisetum debile</i> Roxb. ex Vaucher	Equisetaceae	IND
<i>Eragrostis</i>		
<i>aspera</i> (Jacq.) Nees	Poaceae	IND
<i>brownii</i> (Kunth) Nees ex Steud.	Poaceae	IDO
<i>gangetica</i> (Roxb.) Steud.	Poaceae	IND
<i>japonica</i> (Thunb.) Trin.	Poaceae	IND,PHI
<i>montana</i> Balansa	Poaceae	VIE
<i>multicaulis</i> Steud.	Poaceae	PHI
<i>namaquensis</i> Schrad.	Poaceae	THA
<i>nigra</i> Nees ex Steud.	Poaceae	IND
<i>nutans</i> (Retz.) Steud.	Poaceae	IND
<i>pectinacea</i> (Michx.) Nees	Poaceae	IND
<i>pilosa</i> (L.) P. Beauv.	Poaceae	IDO,IND
<i>riparia</i> (Willd.) Nees	Poaceae	IND
<i>tenella</i> (L.) P. Beauv. ex Roem. & Schult.	Poaceae	IDO,IND,PHI,THA,VIE
<i>unioloides</i> (Retz.) Nees ex Steud.	Poaceae	IDO,IND,MYA
<i>Erechtites valerianaefolia</i> DC.	Asteraceae	IDO
<i>Eremochloa ciliaris</i> (L.) Merr.	Poaceae	VIE
<i>Erigeron sumatrensis</i> Retz.	Asteraceae	IDO,IND,PHI,THA
<i>Eriocaulon quinquangulare</i> L.	Eriocaulaceae	IND
<i>Eriochloa procera</i> (Retz.) C.E. Hubb.	Poaceae	IND,VIE
<i>Erioglossum edule</i> Blume	Sapindaceae	IDO
<i>Eryngium foetidum</i> L.	Apiaceae	THA
<i>Eugenia polyantha</i> Phil.	Myrtaceae	IDO
<i>Eupatorium glandulosum</i> Kunth	Asteraceae	IND
<i>Euphorbia</i>		
<i>capillaris</i> Gagnep.	Euphorbiaceae	PHI
<i>exigua</i> L.	Euphorbiaceae	IDO
<i>heterophylla</i> L.	Euphorbiaceae	IDO,PHI,THA
<i>hirta</i> L.	Euphorbiaceae	BAN,IDO,IND,LAO,PHI,THA,VIE
<i>hypericifolia</i> L.	Euphorbiaceae	IND
<i>microphylla</i> Heyne ex Roth	Euphorbiaceae	BAN,IND
<i>prostrata</i> Aiton	Euphorbiaceae	IDO,IND,PHI
<i>thymifolia</i> L.	Euphorbiaceae	IDO,IND,PHI,VIE
<i>vachellii</i> Hook. & Arn.	Euphorbiaceae	PHI
<i>Evolvulus alsinoides</i> (L.) L.	Convolvulaceae	IND
<i>Ficus</i>		
<i>heterophylla</i> L.f.	Moraceae	THA
<i>hispida</i> L.f.	Moraceae	THA
<i>pyriformis</i> Hook. & Arn.	Moraceae	THA
sp.	Moraceae	IDO

Genus and species	Family	Country
<i>Fimbristylis</i>		
<i>albicans</i> Nees	Cyperaceae	IND
<i>complanata</i> (Retz.) Link	Cyperaceae	PHI
<i>dichotoma</i> (L.) Vahl	Cyperaceae	BAN,IDO,IND,LAO,PHI,VIE
<i>ferruginea</i> (L.) Vahl	Cyperaceae	IDO
<i>miliacea</i> (L.) Vahl	Cyperaceae	BAN,IDO,IND,PHI,THA
<i>ovata</i> (Burm. f.) Kern	Cyperaceae	IND,PHI
<i>quinguangularis</i> (Vahl) Kunth	Cyperaceae	IND
<i>schoenoides</i> (Retz.) Vahl	Cyperaceae	IDO
<i>squarrosa</i> vahl	Cyperaceae	IDO
<i>tomentosa</i> Vahl	Cyperaceae	IND
<i>Flaveria australasica</i> Hook.	Asteraceae	IND
<i>Flemingia strobilifera</i> (L.) R. Br. ex Ait. f.	Fabaceae(P)	PHI
<i>Galinsoga parviflora</i> Cav.	Asteraceae	IDO,IND,MYA,PHI
<i>Geissaspis cristata</i> Wight & Arn.	Fabaceae(P)	VIE
<i>Gisekia pharnacioides</i> L.	Aizoaceae	VIE
<i>Glinus</i>		
<i>lotoides</i> L.	Aizoaceae	IND,PHI
<i>oppositifolius</i> (L.) A. DC.	Aizoaceae	IDO,IND,LAO,PHI
<i>Gliricidia sepium</i> (Jacq.) Steud.	Fabaceae(P)	PHI
<i>Glochidion</i>		
<i>sphaerogynum</i> Kurz	Euphorbiaceae	THA
sp.	Euphorbiaceae	IDO
<i>Gnaphalium</i>		
<i>indicum</i> L.	Asteraceae	THA
<i>luteo-album</i> L.	Asteraceae	THA
<i>Gomphrena</i>		
<i>celosioides</i> Mart.	Amaranthaceae	IND,PHI,THA
<i>decumbens</i> Jacq.	Amaranthaceae	IND
<i>Gonostegia</i>		
<i>hirta</i> (Bl.) Miq.	Urticaceae	PHI
<i>reptans</i> C.B. Roxb.	Urticaceae	PHI
<i>Grangea maderaspatana</i> (L.) Poir.	Asteraceae	VIE
<i>Grewia lacei</i> J.R. Drummond & Craib	Tiliaceae	THA
<i>Gymnopetalum cochinchinensis</i> Kurz	Cucurbitaceae	VIE
<i>Gynandropsis gynandra</i> (L.) Briq.	Capparaceae	IDO,PHI
<i>Gynura pinnatifida</i> DC.	Asteraceae	VIE
<i>Hackelochloa granularis</i> (L.) Kuntze	Poaceae	IND,PHI
<i>Hedychium coronarium</i> Koen.	Zingiberaceae	IND
<i>Hedyotis</i>		
<i>capitellata</i> Wall. ex G. Don	Rubiaceae	IDO
<i>corymbosa</i> (L.) Lam.	Rubiaceae	IDO,IND,PHI
<i>crataegonum</i> Spreng.	Rubiaceae	PHI
<i>diffusa</i> L.	Rubiaceae	IDO,IND,PHI

Genus and species	Family	Country
<i>herbacea</i> L.	Rubiaceae	IDO, PHI, VIE
<i>ovatifolia</i> Cav.	Rubiaceae	THA
<i>racemosa</i> Lam.	Rubiaceae	IDO, MYA, PHI
<i>umbellata</i> (L.) Lam.	Rubiaceae	IND
<i>Heliotropium</i>		
<i>fruticosum</i> L.	Boraginaceae	THA
<i>indicum</i> L.	Boraginaceae	BAN, IDO, IND, LAO, PHI, THA, VIE
<i>Heteropogon contortus</i> (L.)		
P. Beauv. ex Roem. & Schult.	Poaceae	IND
<i>Hevea brasiliensis</i> Muell. Arg.	Euphorbiaceae	IDO
<i>Hewittia scandens</i> (Milne) Mabberley	Convolvulaceae	PHI
<i>Hibiscus sabdariffa</i> L.	Malvaceae	IND
<i>Hoppea dichotoma</i> Willd.	Gentianaceae	IND
<i>Hybanthus</i>		
<i>attenuates</i> (Humb. & Bonpl.) G.K. Schulze	Violaceae	IDO
<i>suffruticosus</i> (L.) Baill. ex Laness	Violaceae	IDO
<i>Hydrocotyle</i>		
<i>javanica</i> Thunb.	Apiaceae	IND
<i>sibthorpioides</i> Lam.	Apiaceae	VIE
<i>Hydrolea zeylanica</i> (L.) Vahl	Hydrophyllaceae	IND
<i>Hygrophila auriculata</i> (Schum.) Heine	Acanthaceae	IND
<i>Hygroryza aristata</i> (Retz.) Nees		
ex Wight & Arn.	Poaceae	IND
<i>Hymenodictyon excelsum</i> (Roxb.) Wall.	Rubiaceae	THA
<i>Hypoxis decumbens</i> L.	Amaryllidaceae	PHI
<i>Hyptis</i>		
<i>brevipes</i> Poit.	Lamiaceae	IDO, PHI, VIE
<i>capitata</i> Jacq.	Lamiaceae	IND, PHI
<i>rhomboidea</i> Mart. & Gal.	Lamiaceae	IDO
<i>spicigera</i> Lam.	Lamiaceae	PHI
<i>suaveolens</i> (L.) Poit.	Lamiaceae	PHI, THA, VIE
<i>Impatiens chinensis</i> L.	Balsaminaceae	IND
<i>Imperata cylindrica</i> (L.) Raeuschel	Poaceae	BAN, IDO, IND, LAO, MYA, PHI, THA, VIE
<i>Indigofera</i>		
<i>dosua</i> Buch.-Ham. ex D. Don	Fabaceae(P)	THA
<i>hirsuta</i> L.	Fabaceae(P)	IDO, IND, PHI
<i>suffruticosa</i> Mill.	Fabaceae(P)	PHI
<i>tinctoria</i> L.	Fabaceae(P)	PHI
<i>Ionidium suffruticosum</i> Ging.	Violaceae	IND
<i>Ipomoea</i>		
<i>alba</i> L.	Convolvulaceae	PHI
<i>angustifolia</i> Jacq.	Convolvulaceae	VIE

Genus and species	Family	Country
<i>aquatica</i> Forssk.	Convolvulaceae	BAN,IND,PHI
<i>cairica</i> (L.) Sweet	Convolvulaceae	PHI
<i>carnea</i> Jacq.	Convolvulaceae	IND
<i>crinita</i> T.S. Brandege	Convolvulaceae	IND
<i>gracilis</i> R. Br.	Convolvulaceae	THA
<i>macrantha</i> Roem. & Schult.	Convolvulaceae	PHI
<i>obscura</i> (L.) Ker-Gawl.	Convolvulaceae	PHI
<i>pes-tigridis</i> L.	Convolvulaceae	IDO,PHI
<i>quamoclit</i> L.	Convolvulaceae	VIE
<i>triloba</i> L.	Convolvulaceae	IDO,IND,PHI
<i>Isachne</i>		
<i>albena</i> Trin.	Poaceae	IND
<i>clarkei</i> Hook. f.	Poaceae	IND
<i>globosa</i> (Thunb.) Kuntze	Poaceae	IDO
<i>pulchella</i> Roth ex Roem. & Schult.	Poaceae	IDO,IND,PHI
<i>Ischaemum</i>		
<i>indicum</i> (Houtt.) Merr.	Poaceae	VIE
<i>polystachyum</i> Presl	Poaceae	PHI
<i>rugosum</i> Salisb.	Poaceae	BAN,IND,MYA,PHI,VIE
<i>Jacquemontia paniculata</i> (Burm. f.) Hall. f.	Convolvulaceae	PHI
<i>Juncus prismatocarpus</i> R. Br.	Juncaceae	IND
<i>Justicia simplex</i> D. Don	Acanthaceae	IND
<i>Lactuca runcinata</i> DC.	Asteraceae	IND
<i>Lagascea mollis</i> Cav.	Asteraceae	IND
<i>Laggera</i>		
<i>alata</i> (D. Don) Sch.-Bip. ex Oliver	Asteraceae	THA
<i>purpurascens</i> Sch.-Bip. ex Hochst.	Asteraceae	THA
<i>Lantana camara</i> L.	Verbenaceae	BAN,IDO,PHI,VIE
<i>Laportea interrupta</i> (L.) Chew	Urticaceae	PHI
<i>Launaea nudicaulis</i> Hook. f.	Asteraceae	IND
<i>Laurentia longiflora</i> (L.) Peterm.	Campanulaceae	PHI
<i>Leea indica</i> (Burm. f.) Merr.	Leeaceae	THA
<i>Leersia hexandra</i> Sw.	Poaceae	BAN,IDO,IND,PHI
<i>Leonurus sibiricus</i> L.	Lamiaceae	PHI
<i>Lepidagathis secunda</i> (Blanco) Nees	Acanthaceae	PHI
<i>Leptocarpus disjunctus</i> Mast.	Restionaceae	VIE
<i>Leptochloa</i>		
<i>chinensis</i> (L.) Nees	Poaceae	BAN,IDO,IND,LAO,PHI,THA,VIE
<i>filiformis</i> (Lam.) P. Beauv.	Poaceae	PHI
<i>Leucaena leucocephala</i> (Lam.) de Wit	Fabaceae (M)	PHI
<i>Leucas</i>		
<i>aspera</i> (Willd.) Link	Lamiaceae	IDO,IND,PHI,VIE
<i>capitata</i> Desf.	Lamiaceae	MYA

Genus and species	Family	Country
<i>decemdentata</i> (Willd.) J. Sm.	Lamiaceae	PHI
<i>linifolia</i> (Roth) Spreng.	Lamiaceae	IDO, PHI
<i>Leucosyke capitellata</i> (Poir.) Wedd.	Urticaceae	PHI
<i>Limnocharis flava</i> (L.) Buch.	Butomaceae	IDO
<i>Limnophila</i>		
<i>indica</i> (L.) Druce	Scrophulariaceae	IND
<i>repens</i> (Benth.) Benth.	Scrophulariaceae	IND
<i>Lindernia</i>		
<i>anagallis</i> (Burm. f.) Pennell	Scrophulariaceae	BAN, IDO, IND, PHI, THA
<i>antipoda</i> (L.) Alston	Scrophulariaceae	IDO, PHI
<i>Ciliata</i> (Colsm.) Pennell	Scrophulariaceae	IDO, IND, PHI, THA
<i>crustacea</i> (L.) F. Muell.	Scrophulariaceae	BAN, IDO, IND, PHI, THA, VIE
<i>dubia</i>	Scrophulariaceae	PHI
<i>procumbens</i> (Krock.) Philcox	Scrophulariaceae	IDO
<i>pusilla</i> (Willd.) Bold.	Scrophulariaceae	IDO, PHI
<i>viscosa</i> (Hornem.) Bold.	Scrophulariaceae	IDO, THA
<i>Lipocarpha chinensis</i> (Osb.) Kern	Cyperaceae	PHI
<i>Lobelia</i>		
<i>alsinoides</i> Lam.	Lobeliaceae	IND
<i>angulata</i> Forst.	Lobeliaceae	IND
<i>Lophatherum gracile</i> Brongn.	Poaceae	IDO
<i>Ludwigia</i>		
<i>ascendens</i> (L.) Hara	Onagraceae	BAN, IND, LAO
<i>hyssopifolia</i> (G. Don) Exell	Onagraceae	IDO, PHI, THA
<i>octovalvis</i> (Jacq.) Raven	Onagraceae	IDO, IND, PHI
<i>perennis</i> L.	Onagraceae	IND
<i>Lygodium</i>		
<i>flexuosum</i> (L.) Sw.	Schizaceae	LAO, PHI
<i>japonicum</i> (Thunb.) Sw.	Schizaceae	PHI
<i>Macaranga</i>		
<i>denticulata</i> (Bl.) Muell Arg.	Euphorbiaceae	IND
sp.	Euphorbiaceae	IDO
<i>Macroptilium lathyroides</i> (L.) Urb.	Fabaceae (P)	LAO, PHI
<i>Malachra</i>		
<i>capitata</i> L.	Malvaceae	PHI
<i>fasciata</i> Jacq.	Malvaceae	PHI
<i>Malvastrum coromandelianum</i> (L.) Garcke	Malvaceae	IDO, PHI
<i>Manihot esculenta</i> Crantz	Euphorbiaceae	IDO, IND
<i>Marsilea</i>		
<i>quadrifolia</i> L.	Marsileaceae	IND
<i>minuta</i> L.	Marsileaceae	IDO
<i>Mazus japonicus</i> (Thunb.) Kuntze	Scrophulariaceae	IND
<i>Melampodium</i>		
<i>diffusum</i> Cass.	Asteraceae	IDO, PHI

Genus and species	Family	Country
<i>divaricatum</i> DC.	Asteraceae	IDO
<i>perfoliatum</i> (Cav.) Kunth	Asteraceae	IDO
<i>Melastoma</i>		
<i>affine</i> D. Don	Melastomataceae	VIE
<i>malabathricum</i> L.	Melastomataceae	IDO
<i>villosum</i> Sims	Melastomataceae	VIE
<i>Melientha suavis</i> Pierre	Opiliaceae	THA
<i>Melochia</i>		
<i>concatenata</i> L.	Sterculiaceae	IDO,IND,PHI,THA,VIE
<i>pyramidalata</i> L.	Sterculiaceae	LAO,PHI
<i>Mentha arvensis</i> L.	Lamiaceae	VIE
<i>Merremia</i>		
<i>emarginata</i> (Burm. f.) Hall. f.	Convolvulaceae	IND,PHI
<i>gemella</i> (Burm. f.) Hall. f.	Convolvulaceae	IDO,PHI
<i>hedereacea</i> (Burm. f.) Hall. f.	Convolvulaceae	PHI,THA,VIE
<i>hirta</i> (L.) Merr.	Convolvulaceae	PHI
<i>peltata</i> (L.) Merr.	Convolvulaceae	PHI
<i>umbellata</i> (L.) Hall. f.	Convolvulaceae	PHI
<i>vitifolia</i> (Burm. f.) Hall. f.	Convolvulaceae	IDO,PHI
<i>Microstegium vagans</i> (Nees ex Steud.)		
A. Camus	Poaceae	THA
<i>Mikania</i>		
<i>cordata</i> (Burm. f.) B.L. Rob.	Asteraceae	IDO,PHI
<i>micrantha</i> Kunth	Asteraceae	IDO,IND
<i>Mimosa</i>		
<i>invisa</i> Mart. ex Colla	Fabaceae (M)	IDO,LAO,PHI,THA,VIE
<i>pigra</i> L.	Fabaceae (M)	THA
<i>pudica</i> L.	Fabaceae (M)	BAN,IDO,IND,MYA,PHI,VIE
<i>Mirabilis jalapa</i> L.	Nyctaginaceae	PHI
<i>Miscanthus floridulus</i> (Labill.)		
Warb. ex K. Schum.	Poaceae	THA
<i>Mitracarpus villosus</i> (Sw.) DC.	Rubiaceae	IDO,THA
<i>Molineria latifolia</i> (Dryand. ex W.T. Aiton)		
Herb. ex Kurz	Hypoxidaceae	THA
<i>Mollugo pentaphylla</i> L.	Aizoaceae	BAN,IDO,IND,PHI
<i>Momordica charantia</i> L.	Cucurbitaceae	IND
<i>Monochoria vaginalis</i> (Burm. f.) Presl	Pontederiaceae	IND
<i>Mucuna</i>		
<i>bracteata</i> DC.	Fabaceae (P)	IND
<i>brevipes</i> Craib	Fabaceae (P)	THA
<i>pruriens</i> (L.) DC.	Fabaceae (P)	MYA,THA
<i>Murdannia nudiflora</i> (L.) Brenan	Commelinaceae	BAN,IDO,IND,MYA,PHI,THA
<i>Neyraudia reynaudiana</i> (Kunth) Keng		
ex Hitchc.	Poaceae	THA

Genus and species	Family	Country
<i>Ocimum</i>		
<i>basilicum</i> L.	Lamiaceae	IDO, PHI
<i>gratissimum</i> L.	Lamiaceae	IND
<i>Operculina turpethum</i> (L.) Manso	Convolvulaceae	PHI
<i>Ophioglossum reticulatum</i> L.	Ophioglossaceae	IDO
<i>Oplismenus</i>		
<i>burmanii</i> (Retz.) P. Beauv.	Poaceae	IDO, IND, VIE
<i>compositus</i> (L.) P. Beauv.	Poaceae	IDO, IND, PHI
<i>Oroxylum indicum</i> (L.) Benth.	Bignoniaceae	THA
<i>Oryza</i>		
<i>granulata</i> Nees & Arn. ex Watt	Poaceae	IND
<i>minuta</i> J.C. Presl ex C.B. Presl	Poaceae	IND
<i>nivara</i> Sharma & Shastri	Poaceae	IND
<i>officinalis</i> Wall. ex Watt	Poaceae	IND
<i>rufipogon</i> Griff.	Poaceae	IND
<i>sativa</i> L.f. <i>spontanea</i> Roschev.	Poaceae	IND
<i>Osbeckia crinita</i> Benth.	Melastomataceae	IND
<i>Ottochloa nodosa</i> (Kunth) Dandy	Poaceae	PHI
<i>Oxalis</i>		
<i>acetosella</i> L.	Oxalidaceae	IND
<i>barrelieri</i> L.	Oxalidaceae	IDO
<i>corniculata</i> L.	Oxalidaceae	BAN, IDO, IND, PHI, THA, VIE
<i>latifolia</i> Kunth	Oxalidaceae	IDO, IND
sp.	Oxalidaceae	MYA
<i>Paederia tomentosa</i> Bl.	Rubiaceae	VIE
<i>Panicum</i>		
<i>auritum</i> Presl ex Nees	Poaceae	PHI
<i>brevifolium</i> L.	Poaceae	PHI
<i>cambogiense</i> Balansa	Poaceae	LAO, PHI
<i>capillare</i> L.	Poaceae	IND
<i>incomtum</i> Trin.	Poaceae	THA
<i>hasianum</i> Munro ex Hook. f.	Poaceae	IND
<i>maximum</i> Jacq.	Poaceae	IDO, IND, PHI, VIE
<i>miliaceum</i> L.	Poaceae	IND, PHI
<i>notatum</i> Retz.	Poaceae	THA, VIE
<i>pallidifolium</i> Desv.	Poaceae	IND
<i>paludosum</i> Roxb.	Poaceae	PHI
<i>proliferum</i> Rank	Poaceae	IND
<i>psilopodium</i> Trin.	Poaceae	IND
<i>repens</i> L.	Poaceae	IDO, IND, PHI, THA, VIE
<i>sarmentosum</i> Roxb.	Poaceae	IDO
<i>trichoides</i> Sw.	Poaceae	LAO, VIE
<i>walense</i> Mez	Poaceae	IND
<i>Parosela glandulosa</i> (Blanco) Merr.	Fabaceae (P)	PHI
<i>Parthenium hysterophorus</i> L.	Asteraceae	IND, VIE

Genus and species	Family	Country
<i>Paspalidium</i>		
<i>flavidum</i> (Retz.) A. Camus	Poaceae	IDO,IND,PHI
<i>geminatum</i> (Forssk.) Stapf	Poaceae	PHI
<i>punctatum</i> (Burm.) A. Camus	Poaceae	IND,PHI
<i>Paspalum</i>		
<i>conjugatum</i> Berg.	Poaceae	BAN,IDO,IND,LAO,PHI,THA,VIE
<i>dilatatum</i> Poir.	Poaceae	IDO,IND,LAO,PHI
<i>distichum</i> L.	Poaceae	IDO,IND,PHI
<i>longifolium</i> Roxb.	Poaceae	PHI
<i>notatum</i> Fluegge	Poaceae	IND
<i>scrobiculatum</i> L.	Poaceae	BAN,IDO,IND,PHI,THA,VIE
<i>urvillei</i> Steud.	Poaceae	VIE
<i>vaginatum</i> Sw.	Poaceae	IDO
<i>Passiflora foetida</i> L.	Passifloraceae	IDO,LAO,MYA,PHI,VIE
<i>Pavonia sidaefolia</i> Kunth	Malvaceae	THA
<i>Pennisetum</i>		
<i>glaucum</i> (L.) R. Br.	Poaceae	IND
<i>pedicellatum</i> Trin.	Poaceae	IND,THA
<i>polystachion</i> (L.) Schult.	Poaceae	IDO,PHI,THA,VIE
<i>purpureum</i> K. Schum.	Poaceae	PHI
<i>Peperomia pellucida</i> (L.) Kunth	Piperaceae	IDO,PHI
<i>Perotis indica</i> (L.) Kuntze	Poaceae	VIE
<i>Phragmites karka</i> (Retz.) Trin. ex Steud.	Poaceae	THA
<i>Phyla nodiflora</i> (L.) Greene	Verbenaceae	PHI,VIE
<i>Phyllanthus</i>		
<i>amarus</i> Schum. & Thonn.	Euphorbiaceae	IDO,PHI
<i>embilica</i> L.	Euphorbiaceae	THA
<i>fraternus</i> Webster	Euphorbiaceae	IDO,IND,PHI,THA,VIE
<i>maderaspatensis</i> L.	Euphorbiaceae	IND
<i>urinaria</i> L.	Euphorbiaceae	IDO,IND,PHI,THA
<i>virgatus</i> Forst. f.	Euphorbiaceae	IDO,IND,PHI
<i>Physalis</i>		
<i>angulata</i> L.	Solanaceae	IDO,LAO,PHI,VIE
<i>minima</i> L.	Solanaceae	IDO,IND,PHI
<i>peruviana</i> L.	Solanaceae	PHI
<i>Pityrogramma calomelanus</i> (L.) Link	Sinopteridaceae	IDO
<i>Plantago major</i> L.	Plantaginaceae	PHI,VIE
<i>Plectranthus hispidus</i> Benth.	Lamiaceae	THA
<i>Pluchea</i>		
<i>indica</i> (L.) Less.	Asteraceae	IND,VIE
<i>tomentosa</i> Less.	Asteraceae	IND
<i>Poa annua</i> L.	Poaceae	IND,MYA
<i>Pogonanthum crinitum</i> (Thunb.) Kunth	Poaceae	IND
<i>Polycarpea corymbosa</i> (L.) Lam.	Caryophyllaceae	PHI

Genus and species	Family	Country
<i>Polygala paniculata</i> L.	Polygalaceae	IDO
<i>Polygonum</i>		
<i>barbatum</i> L.	Polygonaceae	IND, PHI
<i>chinense</i> L.	Polygonaceae	THA
<i>glabrum</i> Willd.	Polygonaceae	IND
<i>limbatum</i> Meissn.	Polygonaceae	IND
<i>nepalense</i> Meissn.	Polygonaceae	IND, MYA, THA
<i>orientale</i> L.	Polygonaceae	BAN
<i>praetermissum</i> Hook. f.	Polygonaceae	IND
<i>serrulatum</i> Lag.	Polygonaceae	IND
<i>tomentosum</i> Willd.	Polygonaceae	PHI
sp.	Polygonaceae	IDO
<i>Polytrias amaura</i> (Buse) Kuntze	Poaceae	IDO, PHI, VIE
<i>Porophyllum ruderale</i> (Jacq.) Cass.	Asteraceae	IDO
<i>Portulaca</i>		
<i>oleracea</i> L.	Portulacaceae	BAN, IDO, IND, LAO, PHI, THA, VIE
<i>pilosa</i> L.	Portulacaceae	PHI
<i>quadrifida</i> L.	Portulacaceae	IND, PHI
<i>Potentilla kleiniana</i> Wight & Arn.	Rosaceae	IND
<i>Pseudarthria viscida</i> (L.) Wight & Arn.	Fabaceae (P)	PHI
<i>Pseudelephantopus spicatus</i> (Juss. ex Aubl.) C.F. Baker	Asteraceae	PHI
<i>Psoralea corylifolia</i> L.	Fabaceae (P)	IND
<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	MYA, THA
<i>Pueraria</i>		
<i>lobata</i> (Willd.) Ohwi	Fabaceae (P)	PHI
<i>phaseoloides</i> (Roxb.) Benth.	Fabaceae (P)	PHI
<i>stricta</i> Kurz	Fabaceae (P)	THA
<i>thomsoni</i> Benth.	Fabaceae (P)	LAO
<i>Pulicaria crispa</i> Sch.-Bip.	Asteraceae	IND
<i>Pupalia lappacea</i> (L.) Juss.	Amaranthaceae	PHI
<i>Randia uliginosa</i> Poir.	Rubiaceae	THA
<i>Rhynchelytrum repens</i> (Willd.) C.E. Hubb.	Poaceae	PHI, THA
<i>Rhynchospora</i>		
<i>corymbosa</i> (L.) Britt.	Cyperaceae	IDO, VIE
<i>rubra</i> (Lour.) Makino	Cyperaceae	PHI
<i>Richardia</i>		
<i>brasiliensis</i> (Moq.) Gomez	Rubiaceae	IDO, MYA, THA
<i>scabra</i> L.	Rubiaceae	IDO
<i>Richardsonia pilosa</i> Kunth	Rubiaceae	IND
<i>Ricinus communis</i> L.	Euphorbiaceae	IND
<i>Rorippa indica</i> (L.) Hiern	Brassicaceae	PHI, VIE

Genus and species	Family	Country
<i>Rotala</i>		
<i>densiflora</i> (Roth) Koehne	Lythraceae	IND
<i>pentandra</i> (Roxb.) Blatt. & Hallb.	Lythraceae	IND
<i>rotundifolia</i> (Roxb.) Koehne	Lythraceae	IND
<i>Rottboellia</i>		
<i>cochinchinensis</i> (Lour.) W.D. Clayton	Poaceae	PHI,THA
<i>goalparensis</i> Bor.	Poaceae	IND
<i>Rubus pinnatisepalus</i> Hemsl.	Rosaceae	IDO
<i>Ruellia tuberosa</i> L.	Acanthaceae	VIE
<i>Rumex</i>		
<i>acetosella</i> L.	Polygonaceae	IDO
<i>nepalensis</i> Spreng.	Polygonaceae	IND
<i>Rungia</i>		
<i>pectinata</i> (L.) Nees	Acanthaceae	IND
<i>repens</i> (L.) Nees	Acanthaceae	IND
<i>Saccharum</i>		
<i>arundinaceum</i> Retz.	Poaceae	THA
<i>bengalense</i> Retz.	Poaceae	IND
<i>procerum</i> Roxb.	Poaceae	THA
<i>spontaneum</i> L.	Poaceae	IND,PHI
<i>Sacciolepis</i>		
<i>indica</i> (L.) A. Chase	Poaceae	IND,PHI,VIE
<i>interrupta</i> (Willd.) Stapf	Poaceae	IND
<i>Sagittaria trifolia</i> L.	Alismataceae	IND
<i>Salvia occidentalis</i> Sw.	Lamiaceae	IDO
<i>Samanea saman</i> (Jacq.) Merr.	Fabaceae (M)	THA
<i>Sapium discolor</i> Muell. Arg.	Euphorbiaceae	THA
<i>Schima wallichii</i> (DC.) Choisy	Theaceae	IND,THA
<i>Scirpus</i>		
<i>articulatus</i> L.	Cyperaceae	IND
<i>juncoides</i> Roxb.	Cyperaceae	IND
<i>mucronatus</i> L.	Cyperaceae	IND
<i>Scleria</i>		
<i>oblata</i> S.T. Blake	Cyperaceae	VIE
<i>purpurascens</i> Steud.	Cyperaceae	IDO
<i>Scoparia dulcis</i> L.	Scrophulariaceae	IDO,IND,LAO,PHI,VIE
<i>Scutellaria discolor</i> Colebr.	Lamiaceae	THA
<i>Sehima nervosum</i> (Rottl.) Stapf	Poaceae	IND
<i>Senna</i>		
<i>obtusifolia</i> (L.) Irwin & Barneby	Fabaceae (C)	IND,PHI
<i>occidentalis</i> (L.) Link	Fabaceae (C)	IDO,IND,PHI,VIE
<i>tora</i> (L.) Roxb.	Fabaceae (C)	IDO,IND,PHI,VIE
<i>Sesamum orientale</i>	Poaceae	IND

Genus and species	Family	Country
<i>Sesbania</i>		
<i>cannabina</i> (Retz) Poir.	Fabaceae (P)	IND, PHI
<i>exaltata</i> (Raf.) Cory	Fabaceae (P)	IND
<i>sesban</i> (L.) Merr.	Fabaceae (P)	PHI
<i>speciosa</i> Taub.	Fabaceae (P)	PHI
<i>Setaria</i>		
<i>aurea</i> Hochst.	Poaceae	VIE
<i>barbata</i> (Lam.) Kunth	Poaceae	IDO, VIE
<i>geniculata</i> (Lam.) P. Beauv.	Poaceae	PHI, THA
<i>gracilis</i> Kunth	Poaceae	PHI, THA
<i>italica</i> (L.) P. Beauv.	Poaceae	IND
<i>palmifolia</i> (Koen.) Stapf	Poaceae	IND, THA, VIE
<i>pumila</i> (Poir.) Roem. & Schult.	Poaceae	IND, PHI, THA
<i>verticillata</i> (L.) P. Beauv.	Poaceae	IND
<i>viridis</i> (L.) P. Beauv.	Poaceae	PHI
<i>Sida</i>		
<i>acuta</i> Burm. f.	Malvaceae	IDO, IND, LAO, MYA, PHI, THA, VIE
<i>cordifolia</i> L.	Malvaceae	PHI
<i>javensis</i> Cav.	Malvaceae	PHI
<i>rhombifolia</i> L.	Malvaceae	IDO, IND, LAO, PHI
<i>Siegesbeckia orientalis</i> L.	Asteraceae	THA, VIE
<i>Smilax</i>		
<i>odoratissima</i> Bl.	Smilacaceae	IDO
sp.	Smilacaceae	THA
<i>Smithia ciliata</i> Royle	Fabaceae (P)	IND
<i>Solanum</i>		
<i>cumingii</i> Dumal	Solanaceae	PHI
<i>frutescens</i> A. Br. & Bouche	Solanaceae	IDO
<i>nigrum</i> L.	Solanaceae	IND, THA
<i>Sonchus</i>		
<i>arvensis</i> L.	Asteraceae	IDO, IND
<i>asper</i> (L.) Hill	Asteraceae	IDO
<i>oleraceus</i> L.	Asteraceae	IDO, IND, PHI, THA, VIE
<i>Sorghum</i>		
<i>bicolor</i> (L.) Moench	Poaceae	IND
<i>halepense</i> (L.) Pers.	Poaceae	PHI
<i>propinquum</i> (Kunth) Hitch.	Poaceae	VIE
<i>Sphaeranthus</i>		
<i>africanus</i> L.	Asteraceae	IDO, PHI
<i>indicus</i> L.	Asteraceae	THA
<i>Sphenoclea zeylanica</i> Gaertn.	Sphenocleaceae	IDO
<i>Spigelia anthelmia</i> L.	Loganiaceae	IDO
<i>Spilanthes</i>		
<i>iabadicensis</i> A.H. Moore	Asteraceae	IDO, IND, PHI, THA
<i>paniculata</i> Wall. ex DC.	Asteraceae	IND, THA

Genus and species	Family	Country
<i>Sporobolus</i>		
<i>africanus</i> (Poir.) Rob. & Tourn.	Poaceae	PHI
<i>diander</i> (Retz.) P. Beauv.	Poaceae	IND, PHI, VIE
<i>Stachytarpheta</i>		
<i>indica</i> (L.) Vahl	Verbenaceae	IDO, IND, THA
<i>jamaicensis</i> (L.) Vahl	Verbenaceae	IDO, IND, PHI
<i>Stemona</i> sp.	Stemonaceae	THA
<i>Stephania japonica</i> (Thunb. ex Murr.) Miers var. <i>discolor</i> (Miq.) Forman	Menispermaceae	THA
<i>Sterculia</i> sp.	Sterculiaceae	THA
<i>Stereospermum colais</i> (Buch.-Ham. ex Dillw.) D.L. Mabblerly	Bignoniaceae	THA
<i>Streptocaulon juvenas</i> (Lour.) Merr.	Asclepiadaceae	VIE
<i>Striga asiatica</i> (L.) Kuntze	Scrophulariaceae	IDO, IND
<i>Synedrella nodiflora</i> (L.) Gaertn.	Asteraceae	IDO, IND, PHI, VIE
<i>Tagetes erecta</i> L.	Asteraceae	PHI
<i>Taraxacum officinale</i> Wiggers	Asteraceae	VIE
<i>Tephrosia</i>		
<i>pumila</i> (Lam.) Pers.	Fabaceae(P)	IND, PHI
<i>purpurea</i> (L.) Pers.	Fabaceae(P)	IND
<i>Teramnus labialis</i> (L.f.) Spreng.	Fabaceae(P)	PHI
<i>Tetracera akara</i> (Burm. f.) Merr.	Dilleniaceae	IDO
<i>Thaumastochloa cochinchinensis</i> (Lour.) C.E. Hubb.	Poaceae	PHI
<i>Thunbergia grandiflora</i> Roxb.	Acanthaceae	THA
<i>Thysanolaena</i>		
<i>latifolia</i> (Roxb.) Honda	Poaceae	THA
<i>maxima</i> (Roxb.) Kuntze	Poaceae	IND, THA
<i>Tithonia diversifolia</i> (Hemsl.) A. Gray	Asteraceae	PHI
<i>Torenia</i>		
<i>concolor</i> Lindl.	Scrophulariaceae	PHI
<i>fournieri</i> Linden ex Fourn.	Scrophulariaceae	PHI
<i>polygonoides</i> Benth	Scrophulariaceae	PHI
<i>violacea</i> (Azaola ex Blanco) Pennell	Scrophulariaceae	IDO, THA
<i>Trema orientalis</i> (Bl.) Bl.	Ulmaceae	PHI, THA
<i>Trianthema portulacastrum</i> L.	Aizoaceae	IDO, IND, PHI, THA, VIE
<i>Trichodesma zeylanicum</i> (Burm. f.) R. Br.	Boraginaceae	PHI
<i>Trichosanthes integrifolia</i> Kurz	Cucurbitaceae	THA
<i>Tridax procumbens</i> L.	Asteraceae	IDO, IND, PHI, THA, VIE

Genus and species	Family	Country
<i>Triumfetta</i>		
<i>annua</i> L.	Tiliaceae	THA
<i>graveolens</i> Bl.	Tiliaceae	IDO
<i>lappula</i> L.	Tiliaceae	PHI
<i>rhomboidea</i> Jacq.	Tiliaceae	PHI,THA
<i>semitriloba</i> Jacq.	Tiliaceae	PHI
<i>Typhonium</i>		
<i>divaricatum</i> (L.) Decne	Araceae	IDO,PHI
<i>trilobatum</i> (L.) Schott	Araceae	PHI,VIE
<i>Uraria lagopodoides</i> (L.) Desv. ex DC.	Fabaceae (P)	PHI
<i>Urena lobata</i> L.	Malvaceae	IDO,MYA,PHI,THA,VIE
<i>Utricularia bifida</i> L.	Lentibulariaceae	IND
<i>Vandellia crustacea</i> (L.) Benth.	Scrophulariaceae	IND
<i>Verbena officinalis</i> L.	Verbenaceae	THA
<i>Vernonia</i>		
<i>arborea</i> Buch.-Ham.	Asteraceae	IDO
<i>cinerea</i> (L.) Less.	Asteraceae	IDO,IND,LAO,PHI,THA,VIE
<i>divergens</i> (DC.) Edgew.	Asteraceae	THA
<i>patula</i> (Dryand.) Merr.	Asteraceae	IDO,PHI,VIE
<i>Vetiveria zizanioides</i> (L.) Nash	Poaceae	IND,PHI,VIE
<i>Vicoa indica</i> L.	Asteraceae	IND
<i>Vigna</i>		
<i>mungo</i> (L.) Hepper	Fabaceae (P)	IND
<i>trilobata</i> (L.) Verdc.	Fabaceae (P)	IND
<i>vexillata</i> (L.) Wilczek	Fabaceae (P)	IND
<i>Vitex limoniifolia</i> Wall.	Verbenaceae	THA
<i>Waltheria indica</i> L.	Sterculiaceae	VIE
<i>Wedelia biflora</i> (L.) DC.	Asteraceae	PHI
<i>Xanthium</i>		
<i>inaequilaterum</i> DC.	Asteraceae	THA
<i>strumarium</i> L.	Asteraceae	IND
<i>Xanthosoma</i> sp.	Araceae	IND
<i>Xenostegia tridentata</i> (L.) Austin & Staples	Convolvulaceae	PHI
<i>Youngia japonica</i> (L.) DC.	Asteraceae	THA,VIE
<i>Zea mays</i> L.	Poaceae	IDO,IND,PHI
<i>Zornia diphylla</i> (L.) Pers	Fabaceae (P)	PHI
<i>Zoysia matrella</i> (L.) Merr.	Poaceae	PHI



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