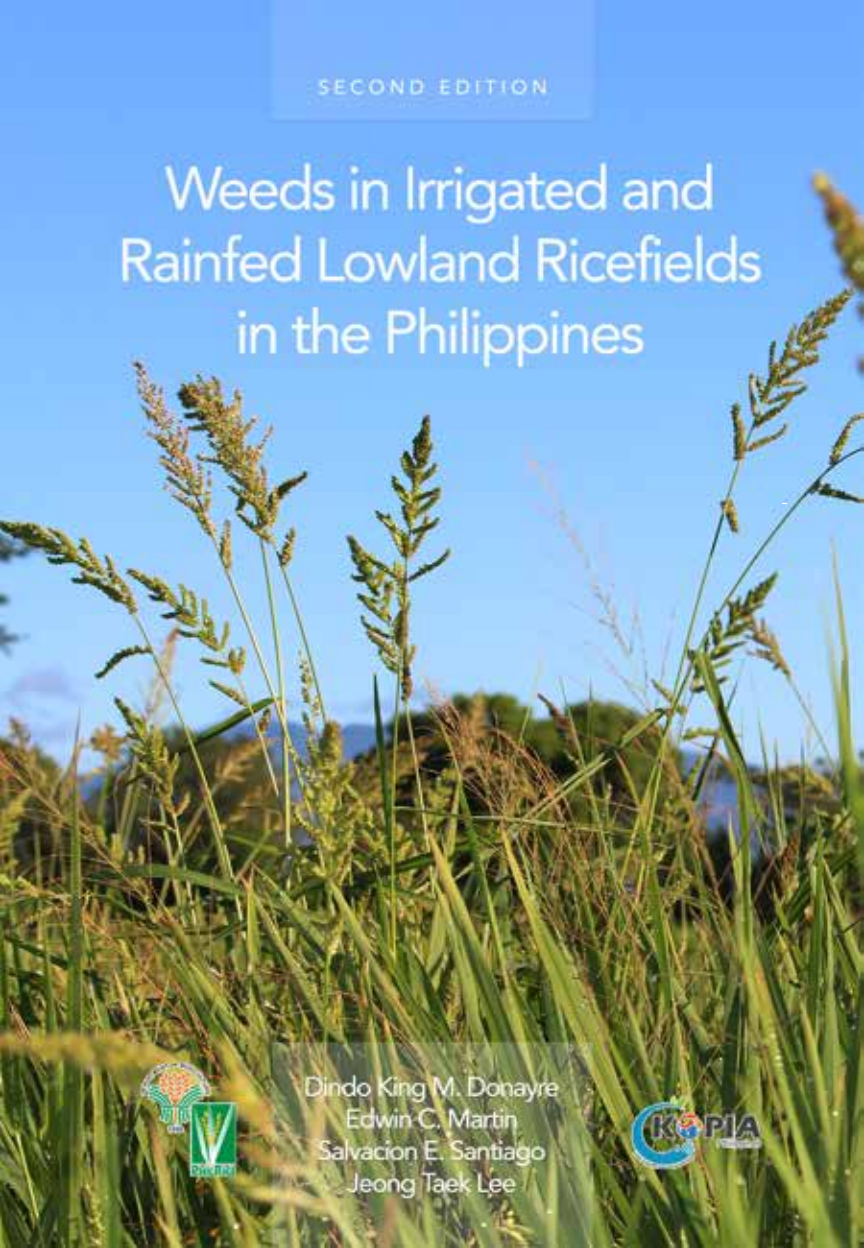
SECOND EDITION

Weeds in Irrigated and Rainfed Lowland Ricefields in the Philippines



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2018

MESSAGE

We are glad to be part of PhilRice's efforts in improving the lives of the Filipino rice farmers. With the realization of this handbook, we have become closer to the farmers whom we want to benefit from the products of our research. We'll now be able to guide them on how to efficiently manage the weeds in their rice fields. Further, this handbook will advance the dissemination of agricultural technologies and increase rice production in the Philippines.

To the authors, congratulations for this feat. To researchers and agriculture professionals who will use this handbook, may you acquire additional knowledge that you can impart to our farmers. And to the farmers, this handbook is for you. We hope this can inform you in your farm management decisions so you'll be more productive.

JEONG TAEK LEE, PhD
Center Director
KOPIA Center, Philippines

In our continuing pursuit of giving the best for our farmers, we have come up with this practical guide to help them identify their weeds. Proper weed identification is important so our farmers will know how to handle them. With appropriate weed handling, farmers will be able to save on additional cost and maintain an environment-friendly farm with less herbicide use. This can also be a helpful tool for researchers and agriculture extension workers in developing rice farming systems and educating rice stakeholders.

PhilRice sincerely thanks the Korea Program on International Agriculture (KOPIA) for the financial support in the production of this booklet. We would also like to congratulate the authors of this book for being able to provide sufficient information for our farmers and their fellow researchers. Finally, we thank the Filipino farmers for being our inspiration in advancing rice research for development.

SALILA E. ABDULA, PhD
Acting Executive Director
Philippine Rice Research Institute

FOREWORD

Knowledge in proper weed identification is very critical in the selection and implementation of effective weed management. It is also valuable in the choice and recommendation of economical and environment-friendly methods of control.

We have expanded the contents of this book by adding 21 more weed species: 5 grasses and 16 broadleaves. We decided to include these weeds following our recent surveys and weed samplings in major rainfed lowland areas in the country.

It is our hope that this booklet may serve as guide to all farmers, students, professors, researchers, extension workers, and decision-makers for effective management of weeds in the Philippines.

Dindo King M. Donayre
Edwin C. Martin
Salvacion E. Santiago
Jeong Taek Lee

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CONTENTS

GUIDE TO WEED SPECIES LISTED

Cynodon dactylon (L.) Pers. - scientific name

Bakbaka, kawad-kawad - local names commonly used by Filipino farmers

Poaceae (Graminae)- family name

CYNDA - EPPO (European and Mediterranean Plant Protection Organization) Code

Grows in - habitat related to rice ecosystem and establishment

Life cycle - life span in the field

Means of propagation - method of reproduction

Distinguishing characteristics - morphological characteristics that immediately describe the weed species.

Reported impacts on rice - negative effects of weed species on growth and development of rice plants in the field as well as on the quality and quantity of harvested grains. (Weed species without this part means that no information is as of yet available.)

Weakness (-es) - agronomic conditions and control techniques that negatively affect the growth and development of a weed.

References - literatures from where information on the weeds were taken.

Rationale

Weeds are among the major groups of pests that farmers always consider as limiting factors in rice production. If not controlled, weeds can reduce yield of rice from 44 to 96% by way of competition for the limited resources for growth and development such as nutrients, sunlight, and water. Indirectly, they can also cause an increase in the cost of rice production. Weeds can reduce the quality and value of rice grains through the contamination of their seeds during harvest. They also serve as alternate hosts and refuges of disease-causing pathogens, insect pests, rats, and other pests of rice.

Classification of Weeds

Knowledge in weed classification is very important in selecting, designing, planning, and implementing cost-effective and environment-friendly weed management strategies and techniques.

A. Based on morphology

1. Grasses

- Members of the family Graminae (Poaceae)
- Leaves are long and narrow, which usually arise alternately in two rows from the nodes, and have ligules and sometimes auricles
- Leaf veins are in parallel while leaf sheaths are split around the stem
- Stems are called culms with well-defined nodes and internodes
- Stems are round and hollow inside

2. Sedges

- Members of the family Cyperaceae
- Leaves are also long and narrow but do not have ligules and auricles
- Leaf veins are also parallel but the leaf sheaths are continuous around the stem
- Stems are triangular in shape and have no nodes and internodes

3. Broadleaves

- Members belong to many families
- Leaves are fully expanded with netted veins
- Leaves, flowers, stems, and branches are broadly arranged in various shapes, colors, and structures

B. Based on life cycle

1. Annuals

Weeds that complete their life cycle from seed to seed in less than one year or in one growing season.

2. Perennials

Weeds that complete their life cycle in more than a year. They can be simple or creeping. Simple perennials spread through seeds and by vegetative propagations. They may regenerate vegetatively into a new plant if their shoots are injured or cut off from the mother plant. Creeping perennials, on the other hand, are those that reproduce by seeds and vegetative organs such as stolons (creeping above-ground stems), rhizomes (creeping below-ground stems), tubers, aerial bulblets, and bulbs.

C. Based on habitat

1. Aquatic
   Weeds that emerge and grow in very wet or submerged soils (wet to moist)

2. Semi-aquatic
   Weeds that grow in dry lands with some tolerance to submergence conditions (dry to wet)

3. Terrestrial
   Weeds that grow in dry lands (moist to dry)

D. Based on photosynthetic activity

1. C_3 weeds
   Weeds that employ a photosynthetic pathway where a 3-carbon compound is the first stable product. Weeds belonging to this group prefer environments where temperature and sunlight intensity are moderate, and water supply is plenty. C_3 weeds, however, cannot tolerate very high temperatures since they are prone to the wasteful biochemical process called photorespiration. Thus, most of them are dominant in ricefields that are under submerged conditions.

2. C_4 weeds
   Weeds that employ a more efficient photosynthetic pathway in which a 4-carbon compound is the first stable product. Weeds under this group have physiological adaptations that allow them to thrive in very hot and drier areas (dry land or rainfed conditions), and where concentrations of carbon dioxide are limited.

Grasses

Cynodon dactylon
Dactyloctenium aegyptium
Digitaria ciliaris
Echinochloa colona
Echinochloa crus-galli ssp. hispidula
Echinochloa glabrescens
Eleusine indica
Ischaemum rugosum
Leersia hexandra
Leptochloa chinensis
Oryza sativa (weedy rice)
Panicum repens
Paspalum conjugatum
Paspalum distichum
Paspalum scrobiculatum

Cynodon dactylon (L.) Pers.

Local names: Bakbaka, buku-buku, galud-galud, kawad-kawad
Family: Poaceae (Graminae)
EPPO Code: CYNDA

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of propagation: seeds and vegetative parts (stolons and rhizomes)

Distinguishing characteristics: stems are branching, spreading on the ground, and rooting at the nodes; leaves are covered with long white hairs around the ligules; spikes are terminal and finger-like; and seed heads consist of 3 to 7 finger-like spikes measuring 4 cm long. *C. dactylon* can be easily differentiated from *Panicum repens* and *Paspalum distichum* through its 2-3 leaves that grow on each node on extended runners.

Reported impacts on rice: *C. dactylon* is a C_4 weed. It is an alternate host of disease-causing pathogens such as *Bipolaris oryzae* and *Rhizoctonia solani*. It can produce up to 230 seeds per panicle.

References: AICAF (1996), Koo et al. (2005), Pancho and Obien (1995), Perez and Labrada (1985)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Dactyloctenium aegyptium (L.) Beauv.

Local names: Damong-balang, bayakibok, krus-krusan, sabong-sabongan, tugot-manok
Family: Poaceae (Graminae)
EPPO Code: DTTAE

Grows in: rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of propagation: primarily by seeds and sometimes by stolons

Distinguishing characteristics: *D. aegyptium* has basal stems that are creeping, rooting, and dichotomously branching. Its upper stems bearing the flowers are slightly ascending (erect). Its digitate inflorescence appears like starfish or bird's foot.

Reported impacts on rice: *D. aegyptium* is a C_4 plant and is well-adapted to drier areas. A single plant can produce up to 66,000 seeds. It can reduce yield of rice by 10 to 75%. The weed is also an alternate host of tungro viruses and rice bugs.

References: Caton et al. (2010), Galinato et al. (1999), Pancho and Obien (1995)

(Photos taken by Gerald E. Bello at San Miguel, Iloilo)

Digitaria ciliaris (Retz.) Koel.

Local names: Baludgangan, halos, saka-saka
Family: Poaceae (Graminae)
EPPO Code: DIGAD

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: a creeping grass that has smooth, flattened stems. Basal parts of the stems are more or less lying on the ground while the upper stems are ascending. It has thin and narrow-lanceolate leaves; prominent, and membranous ligules that are clasping the stem. Inflorescence is composed of 3-6 pseudo-spikes digitally arranged as pseudo-whorls at the apical portion.

Reported impacts on rice: *D. ciliaris* is a C_4 weed. A single plant can produce an average of 1,700 seeds. It reduces yield of rice by as much as 62%.

Weakness: *D. ciliaris* is very sensitive to shading.

References: Galinato et al. (1999), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Science City of Muñoz, Nueva Ecija; PhilRice Negros, Murcia, Negros Occidental)




Echinochloa colona (L.) Link

Local names:Dukayang, lau-lau, pulang-pwet
Family: Poaceae (Graminae)
EPPO Code: ECHCO

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: stems usually grow flat on top of the soil surface while the uppermost portions grow in upward position (ascending). Most stems are purple or reddish. Spikelets are ovate to broad ovate, closely crowded in four rows along one side of the branch, nearly sessile, sometimes with awn measuring less than 1mm.

Reported impacts on rice: *E. colona* is a C_4 weed. One plant can produce 3,000 to 6,000 seeds. Control of this weed by hand weeding is difficult due to close resemblances of its young seedlings to rice at early stages. Its full competition at ratios of 4:1 and 8:1 (weed: rice) reduces yield of rice by 86% and 93%, respectively. The weed can also act as alternate host of other pests such as *Sarocladium oryzae* causing sheath rot of rice, rice bug, and rice black bug.

References: Ampong-Nyarko and De Datta (1991), Caton et al. (2010), Galinato et al. (1999), Kim and Park (1996), Khatua et al. (1982), Michael (1983), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016), Radosevich et al. (1997), Rahman et al. (1982), Valverde et al. (2000)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Echinochloa crus-galli (L.) P. Beauv. ssp. *hispidula* (Retz.) Honda

Local names: Telebisyon, antena, bayakibok, biyuro, humay-humay, marapagay, naik, palay-pato
Family: Poaceae (Graminae)
EPPO Code: ECHCG

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: tall and can grow up to 200cm. It has stout and spongy stems; thick roots; and pinkish to purplish, green, soft, nodding panicle with densely crowded, elliptic, and pointed spikelets. Awns are long (2.5cm) and reddish or purplish in color.

Reported impacts on rice: *E. crus-galli* is a C_4 weed. It can complete its life cycle within 42 to 64 days after emergence producing an average of 2,000 to 40,000 seeds/plant. Some of its variants growing in direct-seeded rice areas in the Philippines are resistant to chloroacetamide (butachlor) and acetanilide (propanil) groups of herbicides. At its early stage, the weed is difficult to control by handweeding because it resembles rice seedlings. The weed can reduce yield of direct-seeded rice by 18 to 57% when its population is at 10 to 80 plants/m^2. It is also an alternate food of rice bug and rice black bug in the absence of rice.

References: Azmi (1992), Galinato et al. (1999), Juliano et al. (2010), Michael (1983), Pancho and Obien (1995), PRISM (2016), Valverde et al. (2000)

(Photos taken at Malagos, Davao City; and PhilRice Negros, Murcia, Negros Occidental)

Echinochloa glabrescens Munro ex Hook. f.

Local names: Telebisyon, antena, dawa-dawa, marapagay, paray-paray, humay-humay
Family: Poaceae (Graminae)
EPPO Code: ECHGL

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: erect and can grow up to 100 cm tall. It has panicles that are usually narrow, pyramidal with numerous spikes and green to purplish spikelets that shed at maturity. Awns, if present, are about 1 cm long.

Reported impacts on rice: *E. glabrescens* is highly competitive especially when its seedlings grow with rice seedlings during transplanting or after direct seeding. Mean yield reductions in rice could range from 6-73% when its infestation level is at 5 to 40%, respectively. The weed was also reported as alternate food of rice bug and rice black bug in the absence of rice.

References: Ampong-Nyarko and De Datta (1991), Donayre et al. (2014), IRRI (1983), Michael (1983), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016), Rao and Moody (1992)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Eleusine indica (L.) Gaertn.

Local names: Bakis-bakisan, bang-angan, bikad-bikad, bila-bila, palagtiki, parangis, paragis, sabung-sabungan, sambali
Family: Poaceae (Graminae)
EPPO Code: ELEIN

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: *E. indica* has prostrate to ascending growth habit. Stems are flat, whitish at the base and pale green toward the upper part, and smooth or with long hairs on the edges. Leaves have sheaths that are flat and moderately hairy at the collar; leaf blades flat, linear-lanceolate, and hairy at the upper surface; ligule membranous; long hairs at the junction of blades and sheaths. No auricles; inflorescences are digitate with terminal whorls consisting of 3 to 6 spikes.

Reported impacts on rice: *E. indica* is a C_4 weed that can produce 50,000 seeds/plant (average). Its seeds are easily spread when eaten by animals. Its competitive ability against rice has yet to be reported. It is an alternative host to disease-causing organisms of rice such as *Rhizoctonia solani, Pyricularia oryzae*, and *Sarocladium oryzae* that cause sheath blight, blast, and sheath rot, respectively.

References: Galinato et al. (1999), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental; San Mateo, Isabela)

Ischaemum rugosum Salisb.

Local names: Ipot-doron, bika-bika, bulo-bulo, gulong-lapas, limba-limba, salsaladay, tinitrigo, trigo-trigohan, sabay, lapu-lapu
Family: Poaceae (Graminae)
EPPO Code: ISCRU

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: erect and can grow up to 100 cm. It has distinctive, prominent transverse ribs or ridges on the lower glume of the spikelets. Its stems are purplish with long hairs at the nodes. It also has leaves that are flat and wide. Its inflorescence is single when young but splits at maturity into two spike-like racemes.

Reported impacts on rice: *I. rugosum* is a C_4 weed. One plant can produce an average of 4,000 seeds. Failure to control it could reduce yield of rice by as much as 60%. It can also reduce the quality of rice grains by way of contamination when its seeds are accidentally harvested and mixed with rice.

References: Ampong-Nyarko and de Datta (1991), Galinato et al. (1999), IRRI (1983), Lubigan and Moody (1990), Marenco and Costa dos Santos (1999), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016), Singh et al. (1991)

(Photos taken at Dingle, Iloilo; and Science City of Muñoz, Nueva Ecija)

Leersia hexandra Sw.

Local names: Amgid, barit
Family: Poaceae (Graminae)
EPPO Code: LERHE

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and rootstocks

Distinguishing characteristics: stems are ascending or sub-erect and rooting at the nodes while leaves are linear-lanceolate, acuminate with tiny backward-pointing spines at the back of midribs. Inflorescences have slender and sub-erect branches; and oblong spikelets.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Leptochloa chinensis L.

Local names: Kuring-kuring, marapagay, maroy-paroy, salay-maya, palay-maya
Family: Poaceae (Graminae)
EPPO Code: LEFCH

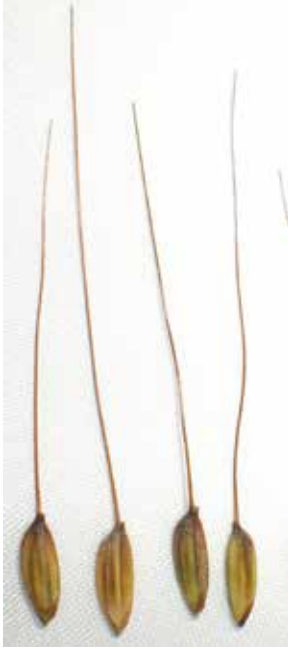
Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: primarily by seeds but can also propagate by culm cuttings

Distinguishing characteristics: slender, tufted, and can grow up to 120 cm tall. Its leaves are linear, flat, thin, membranous, and sometimes reddish or purplish. Its inflorescence has narrowly ovate panicles consisting of 2-7 spikelets.

Reported impacts on rice: *L. chinensis* is a C_4 weed and can produce 27,000 seeds per plant. It can reduce yield of rice by as much as 48% when allowed to compete at 16 plants/m^2. It is also an alternate host of other rice pests such as the green and zigzag leaf hoppers.

References: Ampong-Nyarko and de Datta (1991), Galinato et al. (1996), Khan et al. (1996), Kim and Park (1996), Moody et al. (1983), Pancho and Obien (1995), Pane and Mansor (1996), PRISM (2016), Prusty et al. (1992)

(Photos taken at PhilRice CES, Science City of Muňoz, Nueva Ecija; and Dingle, Iloilo)



Oryza satíva L. (weedy rice)

Local names: Halo, lahok, lakay, sabag, weder-weder
Family: Poaceae (Graminae)
EPPO Code: ORYSA

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: generally taller and have fewer tillers than rice; most seeds have short to long awns that are white, yellow, or purple; most grains have red pericarp while some are off-white; and mature earlier than cultivated rice. Mature seeds of other variants shatter or fall when touched.

Reported impacts on rice: it absorbs up more nutrients (Nitrogen) in the soil than cultivated rice. It can reduce yield of cultivated rice by 20 to 90% when it competes at densities of 5 to 40 plants m^{-2}. It can also reduce the quality and price of milled rice when its pigmented grains are mixed during harvest. Its control by chemical and manual methods is very challenging particularly in direct-seeded rice because it has the same morphological and physiological characteristics as cultivated rice.

References: Burgos et al. (2006), Chauhan (2013), Dai et al. (2014), Delouche et al. (2007), Eleftherohorinos et al. (2002), Fischer and Ramirez (1993), Martin and Casimero (2009), Martin et al. (2014), Sales et al. (2011)

(Photos taken at Aliaga, Nueva Ecija; and Dingle, Iloilo)

Panicum repens L.

Local names: Tagik-tagik, buwag-buwag, murag bermuda, maralaya, luy-a-luy-a, sabilau, luya-luyahan
Family: Poaceae (Graminae)
EPPO Code: PANRE

Grows in: rainfed lowland ricefields and along bunds of irrigated fields
Life cycle: perennial
Means of reproduction: seeds and rootstocks

Distinguishing characteristics: stem is erect and rooting at the hairless nodes. Leaves are linear-lanceolate, flat, and slightly hairy. Inflorescence has open panicle, slender and erect branches, oval to elliptic spikelets, and slender stalks.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Science City of Muňoz, Nueva Ecija)

Paspalum conjugatum Berg.

Local names: Kauat-kauat, lakatan, maligoy, pad-pad, kolokawayan, bantotan, kulape, laau-laau
Family: Poaceae (Graminae)
EPPO Code: PASCO

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and stem cuttings

Distinguishing characteristics: stems are long-creeping, reddish purple, have flattened runners, and hairy nodes. Leaves are flat, linear-lanceolate, hairy at the blades and sheaths. Leaf sheaths are flat, membranous, and with collar of fine hairs below the blade. Ligules are membranous, truncate, and fringed with ring of hairs at the back. Inflorescences have obtuse spikelets, and two terminal spike-like, slender branches.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Aliaga, Nueva Ecija)

Paspalum distichum L.

Local names: Bakbaka, barit, damong-ube, lubid-lubid, malit-kalabaw, ragitnit
Family: Poaceae (Graminae)
EPPO Code: PASDS

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial
Means of propagation: rhizomes and aerial stems (stolons), occasionally by seeds

Distinguishing characteristics: it has long creeping and branching stolons; erect, reddish stems that grow up to 50 cm tall; inflorescence has two erect, and Y-looking racemes.

Reported impacts on rice: *P. disticum* is a C_4 weed. It can reduce yield of irrigated rice by 4, 45, and 46% when the rice seedlings are planted at distances of 15 x 15cm, 20 x 20cm, and 25 x 25cm, respectively. When growing with rice, *P. disticum* is difficult to control by handweeding because the detached stolon fragments regenerate easily; and by chemical method because its stolons may escape the toxicity effect of the herbicide applied.

Weaknesses: its shoot development is largely reduced when shaded and deeply flooded in the field. Repeated harrowings before final levelling and planting also reduce its growth.

References: De Datta (1988), Hsiao and Huang (1989), Manuel et al. (1979), Mercado (1978a, 1978b), Pancho and Obien (1995), PRISM (2016)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Paspalum scrobiculatum L.

Local names: Bias-biasin, angangsug, sabung-sabungan
Family: Poaceae (Graminae)
EPPO Code: PASSC

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: stems are smooth, slender, purplish at the base, and not creeping. Leaf blades are flat, linear, and have rough margins; leaf sheaths are dark green, hairy near the blades; and ligules are membranous, brown, and long. Inflorescence usually has 3 to 4 spike-like branches arranged alternately; spikelets are two-ranked, orbicular to ovate, pale when young and reddish-brown when mature; stigmas are purple.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Sta. Barbara, Iloilo)

Sedges

Cyperus compactus
Cyperus compressus
Cyperus difformis
Cyperus digitatus
Cyperus distans
Cyperus halpan
Cyperus imbricatus
Cyperus iria
Cyperus rotundus
Fimbristylis dichotoma
Fimbristylis miliacea
Scirpus grossus
Scirpus juncoides

Cyperus compactus Retz.

Family: Cyperaceae
EPPO Code: CYPCM

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial, sometimes annual
Means of reproduction: seeds and rhizomes

Distinguishing characteristics: its erect stems can grow up to 70 cm tall. It has spongy leaves that have the same length as the stem. Its inflorescence is a compound of numerous, big, round spikes and reddish-brown spikelets.

References: AICAF (1996), Moody et al. (1994), Pancho and Obien (1995)

(Photos taken at Hinigaran, Negros Occidental)

Cyperus compressus L.

Local names: Tuhog-dalag, gisai-kalabaw
Family: Cyperaceae
EPPO Code: CYPCP

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are smooth, green, and densely tufted. Leaves are shorter than stems while its inflorescence is simple and open. Spikes have 3 to 10 crowded spikelets in digitate cluster, while spikelets are greenish and very flattened in appearance.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photo taken at Science City of Muňoz, Nueva Ecija)

Cyperus difformis L.

Local names: Baong-baong, buto-butones, payong-payong, siraw-siraw, treskantos, tuhog-dalag, ubod-ubod
Family: Cyperaceae
EPPO Code: CYPDI

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Mode of reproduction: seeds

Distinguishing characteristics: can grow as tall as 75 cm. It has stems that are pale green and sharply 3-angled at the top; shorter leaves than the stems; umbellate inflorescence that is simple or compound; and numerous spikelets that are globose.

Reported impacts on rice: *C. difformis* is a C_3 weed. One plant can produce 50,000 seeds with 60% germination. It can complete its life cycle within 30 days and spreads rapidly to become a dominant weed in a ricefield where moisture level is fluctuating. When left uncontrolled, it can reduce yield of rice by as much as 43%.

References: Ampong-Nyarko and de Datta (1991), Galinato et al. (1999), Kim and Park (1996), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016), Swain et al. (1975)

(Photos taken at Datu Odin Sinsuat, Maguindanao)

Cyperus digitatus Roxb.

Family: Cyperaceae
EPPO Code: CYPDG

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial, sometimes annual
Means of reproduction: seeds and rhizomes

Distinguishing characteristics: its stems are triangular, flat leaves, compound inflorescence composed of digitately arranged spikes and yellow spikelets.

Reference: Pancho and Obien (1995)

(Photo taken at Bago City, Negros Occidental)

Cyperus distans L. f.

Family: Cyperaceae
EPPO Code: CYPDT

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds

Distinguishing characteristics: has erect and smooth stems that are triangular; leaves that are as long as the stems; and umbel-type inflorescence. It also has spreading, slender, red or reddish-brown spikelets.

Reference: Pancho and Obien (1995)

(Photo taken at PhilRice Negros, Murcia, Negros Occidental)

Cyperus halpan L. ('haspan')

Local names: Bala-balangutan, manik-manikan, barsanga, bungot-bungot
Family: Cyperaceae
EPPO Code: CYPHP

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds and rootstocks

Distinguishing characteristics: has slender stems with longitudinal median rib on each side. Inflorescence has numerous, long, slender-shaped primary rays and short secondary rays. Its spikelets are digitately arranged in clusters.

References: Koo et al. (2000), Pancho and Obien (1995)

(Photos taken at Babatngon, Leyte)

Cyperus imbricatus Retz.

Local names: Obod-obod, ballayang, balabalongutan
Family: Cyperaceae
EPPO Code: CYPIM

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial, sometimes annual
Means of reproduction: seeds, sometimes by rhizomes

Distinguishing characteristics: coarse, tufted, and erect. Its stems are triangular; leaves are shorter than the stem; compound umbel green inflorescence when young and brown when mature; and with numerous long spikelets.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Braulio E. Dujali, Davao del Norte)

Cyperus iria L.

Local names: Payong-payong, siraw-siraw, taga-taga
Family: Cyperaceae
EPPO Code: CYPIR

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: its stems are smooth and triangular; linear-lanceolate leaves; umbel-shaped inflorescence; and numerous, spreading, erect spikelets that are yellow to yellow-brown.

Reported impacts on rice: *C. iria* is a C_4 weed. It can establish quickly in the field soon after rice plants are transplanted or direct-seeded. One plant can produce 3,000 seeds. When not controlled, it can reduce yield of rice by as much as 40%. It can also act as alternate host to other rice pests such as green leafhoppers, and plant pathogenic microorganisms such as *Pyricularia oryzae, Rhizoctonia solani,* and *Sarocladium oryzae* causing rice blast, sheath blight, and sheath rot diseases, respectively.

References: AICAF (1996), Ampong-Nyarko and de Datta (1991), Dhammu and Sandhu (2000), Galinato et al. (1999), Kim and Park (1996), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Cyperus rotundus L.

Local names: Barsanga, mutha, sudsud
Family: Cyperaceae
EPPO Code: CYPRO

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial
Means of propagation: tubers and rhizomes

Distinguishing characteristics: erect with smooth unbranched three-sided stem, dark green leaves, and flowers in red-brown spikelets. It has extensive underground parts called the basal bulb, rhizomes, tubers, and roots which permit rapid production of multiple young sprouts in the soil.

Reported impacts on rice: *C. rotundus* is a C_4 plant and is considered as the world's worst weed. It is a problem due to its prolific behavior in the soil, persistence in harsh environments, and infestations in many crops. In earlier years, it used to be dominant only in upland rice areas in the Philippines but has adapted and infested irrigated and rainfed lowlands as well. Its full competition with upland rice plants reduces rice yield by 42%. Its effects on yields of irrigated and rainfed lowland rice plants, however, are still unknown.

Weaknesses: Its leaves are susceptible to infection by *Puccinia philippinensis* that causes leaf rust. The bulbs of the weed are susceptible to feeding by *Bactra sp.*

References: Baltazar et al. (1999), Carbonell and Moody (1983), Donayre et al. (2015), Donayre and Minguez (2016), Holm et al. (1977), Kim and Park (1996), Moody et al. (1984), Nishimoto (2001), Okafor and De Datta (1974), PRISM (2016)

(Photos taken at Aliaga, Nueva Ecija)

Fimbristylis dichotoma (L.) Vahl

Local names: Bungot-bungot, buntot-pusa, gumi, siraw-siraw, sirisibayas, sumpana-balik
Family: Cyperaceae
EPPO Code: FIMDI

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds

Distinguishing characteristics: *F. dichotoma* (L.) Vahl has the same characteristics as *F. miliacea* except that its spikelets are less in number, bigger, and ovoid. Pancho and Obien (1995) has deeper taxonomic classification between the two weed species.

Reference: Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Fimbristylis miliacea (L.) Vahl

Local names: Bungot-bungot, buntot-pusa, gumi, siraw-siraw, sirisibayas, sumpana-balik
Family: Cyperaceae
EPPO Code: FIMMI

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds

Distinguishing characteristics: erect with flattened stems that bear 2-4 unequal bracts that are shorter than the inflorescence. Leaves are linear, flat, soft, and overlapping in two rows. Spikelets are numerous, globose to ovoid in shape, and brown to brown-orange.

Reported impacts on rice: *F. miliacea,* a C_4 weed, is a prolific seed producer. A single plant can produce more than 40,000 seeds.

References: Begum et al. (2008), Kim and Park (1996), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Scirpus grossus L.

Local name: Tikiw
Family: Cyperaceae
EPPO Code: SCPGR

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds and by rootstocks

Distinguishing characteristics: has triangular stem. It has numerous brown spikelets that are ovoid.

References: AICAF (1996), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken in Aklan)

Scirpus juncoides L.

Local names: Apulid, bitubituinan, balbas-kalabaw
Family: Cyperaceae
EPPO Code: SCPJU

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual/ perennial
Means of reproduction: seeds

Distinguishing characteristics: stems are erect and slender. Leaves degenerate to become sheath-like and cover the base of the stems. Fruits are brown to black when mature and broadly elliptical.

References: AICAF (1996), Morita (1997), Pancho and Obien (1995)

(Photo taken at Dingle, Iloilo)

Broadleaves

Aeschynomene indica
Alternanthera sessilis
Amaranthus spinosus
Amaranthus viridis
Ammannia baccifera
Ammannia coccinea
Basilicum polystachyon
Cardiospermum halicacabum
Cleome rutidosperma
Cleome viscosa
Commelina benghalensis
Commelina diffusa
Corchorus aestuans
Corchorus olitorius
Eclipta prostrata
Eclipta zippeliana
Eichhornia crassipes
Hedyotis biflora
Hedyotis corymbosa
Hedyotis diffusa
Heliotropium indicum
Hydrolea zeylanica
Ipomoea aquatica
Ipomoea triloba
Limnocharis flava
Lindernia antipoda
Lindernia procumbens
Ludwigia adscendens
Ludwigia hyssopifolia
Ludwigia octovalvis
Ludwigia perennis
Macroptilium lathyroides
Malachra capitata
Malachra fasciata var linearíloba
Marsilea minuta
Melochia concatenata
Merremia emarginata
Mimosa diplotricha
Mimosa pudica
Monochoria vaginalis
Murdannia nudiflora
Phyllanthus debilis
Phyllanthus urinaria
Physalis angulata
Pistia stratiotes
Portulaca oleracea
Salvinia molesta
Sphenoclea zeylanica
Sphaeranthus africanus
Trianthema portulacastrum

Aeschynomene indica L.

Local name: Makahiyang-lalaki
Family: Fabaceae
EPPO Code: AESIN

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: erect and robust, and can grow up to 1 m tall. Stems are branching and woody at the base. Leaves are even-pinnately arranged with numerous leaflets that are linear or oblong. Flowers are light yellow. Pods are linear-oblong, straight or curved, and composed of 4-8 joints with ridge-like appearance.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Sta. Barbara, Iloilo)

Alternanthera sessilis (L.) DC.

Local names: Lupo, bonga-bonga, bilanamanut
Family: Amaranthaceae
EPPO Code: ALRSE

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: has a spreading or prostrate growth in the field. It has leaves that are elliptic-lanceolate to linear-lanceolate in shape. Its flowers are white and are globose to oblong.

References: AICAF (1996), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental; and Dingle, Iloilo)

Amaranthus spinosus L.

Local names: Alayon, ayang lalaki, ayantoto, baoan, bayambang, harum, gitingiting, kalitis, kalunai, kuanton, kudiapa, kulitis, taikada, uray
Family: Amaranthaceae
EPPO Code: AMASP

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are branched, pale green, with pairs of slender sharp-pointed spines along the axils of the leaves and branches. Leaves are simple, alternate, ovate to broadly lanceolate, and narrow at the base to a petiole. Inflorescences have spikes that are closely packed in clusters of small, green flowers.

Reported impacts on rice: *A. spinosus* is a C_4 weed that can produce 117,000 seeds/plant. Its competitive ability against rice has yet to be reported. It is an alternative host of *Meloidogyne graminicola*, a nematode of rice that causes root galls.

References: Barsalote (1996), Bridge et al. (2005), Galinato et al. (1999), Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Talavera, Nueva Ecija)

Amaranthus viridis L.

Local names: Alom-alom, ayang babae, halom, kilitis, kalunai, kudiapa, kulitis, uray babae
Family: Amaranthaceae
EPPO Code: AMAVI

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are much-branched, slender, fleshy and reddish, and have no spines along the axils of the leaves and branches. Leaves are simple, alternate, broadly ovate, and indented with a short bristle. Inflorescences have flowers that are green or greenish white, in axillary clusters, and dense flowered spikes.

Reported impacts on rice: *A. viridis* is also a C_4 weed that can produce 7,000 seeds/plant. The weed is reported as an alternative host of *Meloidogyne graminicola*, a nematode of rice that causes root galls.

References: Barsalote (1996), Bridge et al. (2005), Galinato et al. (1999), Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Science City of Muňoz, Nueva Ecija; Miag-ao, Iloilo)

Ammannia baccifera L.

Local name: Apoy-apuyan
Family: Lythraceae
EPPO Code: AMMBA

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, perennial
Means of propagation: seeds and stem fragments

Descriptions: stems are erect, branched and brownish; branches are longer near the base of the stem and shorter when near the apex; leaves are elliptical to lanceolate, acute at the tip, and narrow toward the basal part. Flowers in clusters are purplish.

Weakness: sensitive to herbicide application particularly 2,4-D and butachlor.

References: AICAF(1996), Pancho and Obien (1995)

(Photo taken at Sta. Barbara, Iloilo)

Ammannia coccínea Rottb.

Family: Lythraceae
EPPO Code: AMMCO

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of propagation: seeds

Distinguishing characteristics: stems are erect, branched, and glabrous, and can grow up to 50 cm. It has leaves that are opposite and auriculate at base. Flowers form petals that are pinkish.

Reported impacts on rice: at a population of more than 100 plants m^{-2}, it can reduce yield of rice by up to 21%.

References: Morita (1997), Shen et al. (2008)

(Photos taken at San Miguel, Iloilo)

Basilicum polystachyon (L.) Moench

Local name: Pansi-pansi
Family: Lamiaceae
EPPO Code: OCIPO

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: erect and branched weed that grows up to 1 m tall. Its stems are 4-angled while leaves are ovate to oblong-ovate, with toothed margins. Racemes bear dense flowers and can grow 10 cm long. Flowers are lilac or pink.

Reference: Pancho and Obien (1995)

(Photo taken at Sta. Barbara, Iloilo)

Cardiospermum halicacabum L.

Local names: Lubo-lobohan, alalayon, bangkolon, parol-parolan, paltupaltukan, parya-aso, paspalya
Family: Sapindaceae
EPPO Code: CRIHA

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: a climbing herb; has long stems that are slightly hairy; alternating leaves with slender petioles; leaflets that are biternate, ovate to lanceolate, and serrate at the margins and sometimes lobes. Flowers are white and very small while fruits are lantern-shaped.

References: AICAF (1996), Koo et al. (2005)

(Photos taken at San Jose, Occidental Mindoro)

Cleome rutidosperma DC.

Local names: Apoy-apoyan, bala-balanoyan, tantandok, sili-silihan
Family: Cleomaceae
EPPO Code: CLERT

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are green to purple, and angular with thin, firm hairs. Leaves have long petioles; three ovate to oblong-lanceolate and ciliate leaflets; center leaflet that is larger than the other two. Inflorescences have flowers that are solitary at the upper leaves; slender stalks; and lilac to pink petals. The weed has green, thin, long capsules that split into two valves.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Science City of Muňoz, Nueva Ecija; and Miag-ao, Iloilo)

Cleome viscosa L.

Local names: Apoy-apoyan, bala-balanoyan, hulaya, kabau, lampotaki, tantandok, sili-silihan
Family: Cleomaceae
EPPO Code: CLEVI

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are green, cylindrical, and with hairs; leaves have long petioles and three oblong to obovate-oblong leaflets; yellow and solitary flowers. The weed also has green and long capsules that split into two valves.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Science City of Muñoz, Nueva Ecija)

Commelina benghalensis L.

Local names: Alikbangon, gatilang, kulasi
Family: Commelinaceae
EPPO Code: COMBE

Grows in: rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds and by vegetative fragments

Distinguishing characteristics: fleshy stems are creeping to ascending. Leaves are wide in the center, elliptic-ovate and alternately arranged. Petals of the flowers are three to four, and are blue. Petals have different sizes (two to three are large, while one is small).

References: AICAF (1996), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Hinigaran, Negros Occidental)

Commelina diffusa Burm. f.

Local names: Alikbangon, gatilang, kulasi
Family: Commelinaceae
EPPO Code: COMDI

Grows in: rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds and vegetative fragments

Distinguishing characteristics: fleshy stems are creeping to ascending, and heavily branched. Leaves are narrow, alternately arranged, lanceolate to broadly lanceolate-shaped, and with stem-clasping sheath. Petals of the flowers are three (two large and 1 small), and are blue.

Reported impacts on rice: yield of drilled-seeded rice planted at 215 to 270 plants/m2 were reduced by 18% when *C. diffusa* was allowed to compete at 22 plants/m2 all throughout the crop's growing season.

References: AICAF (1996), Moody et al. (1984), Smith (1984)

Corchorus aestuans L.

Local names: Salsaluyot
Family: Tiliaceae
EPPO Code: CRGAE

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: It is an erect plant with woody stem and grows smaller than *C. olitorius*. It has leaves that are ovate or ovately oblong, finely and crenately toothed with rounded base. Flowers are yellow; capsules have 6 to 8 wings, elongated, and trifid beaks.

Reference: Pancho and Obien (1995)

(Photos taken at Burgos, Pangasinan)

Corchorus olitorius L.

Local names: Saluyot, tagabang, tugabang
Family: Tiliaceae
EPPO Code: CRGOL

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: It is an erect plant with woody stem. It has leaves that are ovate or ovately lanceolate, margins serrated, toothed, with clusters of small leaves near the axils. Flowers are yellow and its ten-ribbed capsules are elongated and entirely beaked.

Reference: Pancho and Obien (1995)

(Photos taken at Science City of Muñoz, Nueva Ecija; and Miag-ao, Iloilo)

Eclipta prostrata (L.) L.

Local names: Higis-manok, tultulisan, tinta-tinta
Family: Asteraceae (Compositae)
EPPO Code: ECLAL

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: a C_3 weed; its stems are fleshy, reddish, hairy, and rooting at the nodes. Leaves are dark green and oppositely arranged, and are linear-oblong to lanceolate, with distinct toothed margins. Flower heads measuring 1-cm diameter bear small white flowers (florets).

References: AICAF (1996), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016)

(Photos taken at PhilRice Negros, Murcia; Guihulngan City, Negros Oriental)

Eclipta zippeliana Bl.

Local names: Higis-manok, tultulisan, tinta-tinta
Family: Asteraceae (Compositae)
EPPO Code: ECLPZ

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: a C_3 weed; has the same morphological characteristics as *E. prostrata* except that its leaves are light green, oblong-obovate to lanceolate, has margins that are coarsely spinulose-toothed. In addition, stems and leaves are much covered with many hairs.

Reference: Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia)

Eichhornia crassipes (Mart.) Solms

Local name: Water lily
Family: Pontederiaceae
EPPO Code: EICCR

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: stolons, plant fragments, seeds

Distinguishing characteristics: a floating aquatic weed that has short and rosette-like stems. Leaves are ovate to orbicular, with petioles that are swollen and spongy. Flowers are numerous and are purple.

Reported impacts on rice: this weed restricts irrigation and crop growth causing heavy economical losses in rice paddy fields. It can also transmit pathogens that infect several other crops.

References: AICAF (1984), Harley (1994), Koo et al. (2005), Moody et al. (1984), Pancho and Obien (1995), Patel (2012)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Hedyotis biflora (L.) Lam.

Local names: Dalumbang, kaddok-na-kalinga, palarapdap, pisak, pisek
Family: Rubiaceae
EPPO Code: HYOBI

Grows in: irrigated and rainfed-lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: has erect or spreading growth; leaves that are short-petioled, elliptic-ovate to oblong; branched and slender stems; and inflorescence with 2-8 small flowered umbels.

References: Moody et al. (1984), Pablico and Moody (1986, 1987), Pancho and Gruezo (2009), Pancho and Obien (1995), PRISM (2016)

(Photo taken at San Miguel, Iloilo)

Hedyotis corymbosa (L.) Lam.

Local names: Dalumbang, kaddok-na-kalinga, palarapdap, pisak, pisek
Family: Rubiaceae
EPPO Code: HYOFR

Grows in: irrigated and rainfed-lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: has erect or spreading growth; its leaves are linear-oblonceolate to linear-oblong and are gradually narrow to the apex. Stems are branched and slender; inflorescence has 2-8 small flowered umbels.

References: Moody et al. (1984), Pablico and Moody (1986, 1987), Pancho and Gruezo (2009), Pancho and Obien (1995), PRISM (2016)

(Photo taken at Science City of Muñoz, Nueva Ecija)

Hedyotis diffusa Willd.

Local names: None
Family: Rubiaceae
EPPO Code: HYODI

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: has slender and branching stems; thin, linear to wide linear leaves without or with short petioles. Flowers have white to light purple corolla in four parts.

References: Moody et al. (1984), Pablico and Moody (1986, 1987), Pancho and Gruezo (2009), Pancho and Obien (1995), PRISM (2016)

(Photos taken at Babatngon, Leyte)

Heliotropium indicum L.

Local names: Ar-aritos, bahu-baho, buntot-leon, elepante, kambra-kambra, higad-higaran
Family: Heliotropiaceae (Boraginaceae)
EPPO Code: HEOIN

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: It has erect and branched growth habit. It has a stem that is covered with hairs; leaves that are ovate to oblong-ovate with rough surfaces; and flowers that are positioned on one side with lavender to white corolla.

References: Pancho and Obien (1995), Pancho and Gruezo (2009)

(Photos taken at San Jose City, Nueva Ecija)

Hydrolea zeylanica (L.) Vahl

Local names: Kangkong-kangkungan, garampingat, lupo-lupo
Family: Hydrophyllaceae
EPPO Code: HYMZE

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial, occasionally annual
Means of reproduction: runners and seeds

Distinguishing characteristics: stems are hollow, and usually grow flat on top of the soil surfaces while the uppermost portions grow in upward position (ascending). Leaf blades are lanceolate to ovate, glabrous or pubescent, base acute, margin entire, and apex acute. Petals of the flowers are purple-blue.

Reported impacts on rice: stems of *H. zeylanica* when cut can germinate into new seedlings. Thus, it establishes rapidly in the field particularly under flooded conditions. It is a very competitive weed. Yields of rice infested with the weed at ratios of 1:1, 1:5, and 1:10 (rice:weed) are significantly reduced by 19, 24, and 52%, respectively.

References: Davenport (1988), Donayre and Endino-Tayson (2015), Donayre et al. (2014), Morita et al. (2012), Pancho and Gruezo (2009), Pancho and Obien (1995), PRISM (2016), Ruicheng and Constance (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Ipomoea aquatica Forsk.

Local name: Kangkong, balangeg
Family: Convolvulaceae
EPPO Code: IPOAQ

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and cuttings

Distinguishing characteristics: an aquatic weed that has slender, smooth, and creeping stems. It spreads on the ground or floats on water. Stems are hollow and rooting at the nodes. Leaves are alternately arranged with morphological variations in shapes. Flowers are funnel-shaped and are white to purple.

Reported impacts on rice: how the weed reduces the yield of rice has yet to be reported; it is an alternate host of golden apple snails in the absence of rice plants.

References: AICAF (1996), Pancho and Gruezo (2009), Pancho and Obien (1995)

(Photos taken at Butuan City, Agusan del Norte)

Ipomoea triloba L.

Local name: Aurora, bangbangau, kamkamote, koskusipa, kupit-kupit, halobagbug, muti-muti
Family: Convolvulaceae
EPPO Code: IPOTR

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds

Distinguishing characteristics: it is a vine that has slender, twining or crawling stems. Its leaves are broadly ovate, entire or somewhat 3-lobed, acuminate with broadly cordate base. Flowers have pink to purple corolla.

References: Pancho and Obien (1995), Pancho and Gruezo (2009)

(Photos taken at Miag-ao, Iloilo)

Limnocharis flava (L.) Buchenau

Local name: Pala-pala
Family: Butomaceae
EPPO Code: LMNFL

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and vegetative propagules called ramet

Distinguishing characteristics: has triangular-shaped leaves and stalks. Its leaves are erect, papery, light green, ovate to broad elliptic that measure 6-20 cm long. Its stems are hollow and smooth in surface while its flowers are yellow and three-lobed. Its fruits are spherical.

Reported impacts on rice: *L. flava* is a very competitive weed especially under flooded conditions. In a field study, it significantly reduced the yield of irrigated-transplanted rice (NSIC Rc 144) by 18, 23, 30, and 48%, respectively when allowed to compete at 10, 20, 25, and 30 plants m^{-2} all throughout the growing season. Competition at 50 to 60 plants/m^2 resulted in yield reduction in rice by 63%.

Weaknesses: the weed is sensitive to drier conditions, hence thorough land preparation and proper water management are crucial practices to effectively manage it.

References: AICAF (1996), De Grano (2008)

(Photos taken at Nasugbu, Batangas)

Lindernia antipoda (L.) Alston

Local name: Lalagang
Family: Scrophulariaceae
EPPO Codee: LIDAP

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: has spreading or erect growth. Its stems are slender; and leaves are oblong to oblong-lanceolate, shortly petioled, with tooth-like margins. Its flowers are lilac.

References: Morita (1997), Pablico et al. (1989), Pancho and Gruezo (2009), Pancho and Obien (1995)

(Photo taken at Science City of Muñoz, Nueva Ecija)

Lindernia procumbens (Krock.) Philcox

Local name: Lalagang
Family: Scrophulariaceae
EPPO Code: LIDPY

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: It has spreading or erect growth; slender and four-sided stems; and leaves that are elliptic, shortly petioled but without tooth-like margins. Flowers are white to lilac.

Reference: Koo et al. (2005)

(Photo taken at Science City of Muñoz, Nueva Ecija)

Ludwigia adscendens (L.) Hara

Local name: Kangkong-dapa
Family: Onagraceae
EPPO Code: LUDAC

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and cuttings

Distinguishing characteristics: has stems that creep on the ground or float. Its stems are also rooting at the nodes with their white spongy pneumatophores arising in clusters. Leaves are oblong, elliptic and can grow up to 8 cm long. Flowers have five petals that are white with yellow at the center.

References: AICAF (1996), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Butuan City, Agusan del Norte)

Ludwigia hyssopifolia (G.Don) Exell

Local names: Kahoy-kahoy, malapako, tina-tina
Family: Onagraceae
EPPO Code: LUDLI

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, perennial
Means of reproduction: seeds and propagules

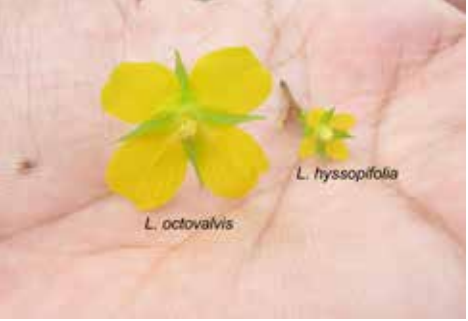
Distinguishing characteristics: erect and branched and can grow up to 60 cm tall. Stems are angled, green to reddish, and woody at the base. Leaves are narrow and lanceolate. Flowers are yellow with four "diamond-shaped" petals (elliptic) 2-3 cm long. Stems are eight, or more than the number of calyx lobes. Capsules are slender, 4-angled, and reddish.

Reported impacts on rice: a C_3 weed of rice across a wide range of cultural types, in both clay-loam and clay soils. Full competition at ratios of 4:1 and 8:1 (weed: rice) can significantly reduce rice yield by 64 and 81%, respectively.

Weakness: *L. hyssopifolia* is susceptible to the chrysomelid beetle, *Altica sp.* with its larvae and adults feeding voraciously on leaves of the weed.

References: Chauhan and Johnson (2010), Moody et al. (1994), Pancho and Obien (1995), PRISM (2016), Singh and Gangwar (1987)

(Photos by Cherry Endino-Tayson at PhilRice Negros, Murcia, Negros Occidental)


L. hyssopifolia
L. octovalvis

Ludwigia octovalvis (Jacq.) Raven

Local names: Kahoy-kahoy, malapako, tina-tina
Family: Onagraceae
EPPO Code: LUDOC

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, perennial
Means of reproduction: seeds and propagules

Distinguishing characteristics: a robust, erect, and branched weed that can grow up to 3 m tall. Stems are ridged and sometimes reddish. Leaves are lanceolate. Flowers are yellow, with four big ovate-shaped petals. Stamens are eight, or more than the number of calyx lobes. Capsules bearing the seeds are bigger in size, 4-angled and reddish.

Reported impacts on rice: *L. octovalvis* is differentiated from *L. hyssopifolia* and *L. perennis* by its big, yellow flowers. Out of 350 weed species in rice worldwide, *L. octovalvis* is fourth in global-scale importance among broadleaves. It invades a wide range of rice culture systems especially dry-seeded rice.

Weakness: susceptible to the chrysomelid beetle, *Altica* sp., with its larvae and adults feeding voraciously on leaves of the weed.

References: Caton et al. (2010), Kim and Park (1996), Moody (1989), Mori et al. (1980), Moody et al. (1994), Pancho and Obien (1995), PRISM (2016), Raju and Reddy (1986)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Ludwigia perennis (L.) Raven

Local names: Kahoy-kahoy, malapako, tina-tina, sigang-dagat
Family: Onagraceae
EPPO Code: LUDPN

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds and plant fragments

Distinguishing characteristics: erect and branched weed that grows up to 30 cm tall. Stems are irregularly ridged and sometimes reddish. Leaves are narrow and lanceolate. Flowers are yellow with four to five egg-shaped (oblong-elliptic) petals. Stamens have the same number as calyx lobes. Capsules bearing the seeds are 4- angled and are reddish.

Weakness: *L. perennis* is susceptible to the chrysomelid beetle, *Altica sp.* Its larvae and adults feed voraciously on leaves of the weed.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Macroptilium lathyroides (L.) Urb.

Local name: Bala-balatong
Family: Papilionaceae (Leguminosae)
EPPO Code:PHSLY

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: an erect legume that has branchy and woody stems. Leaves are three (trifoliate) and are ovate to lanceolate. Flowers are red-purple. The weed also has green (young) to brown (mature), long and slender pods that bear seeds.

References: AICAF (1996), Moody et al. (1984), Pancho et al. (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Malachra capitata (L.) L.

Local name: Anabo, bakembakes, bulbulin, buluhan, bulu-buluhan, lapnis, pang-balius, labog-labog, tambaking
Family: Malvaceae
EPPO Code: MAACA

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are branched and covered with hairs; leaves obscurely and shallowly lobed, finely toothed, base cordate; flowers have yellow petals.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Cuyapo, Nueva Ecija)

Malachra fasciata Jacq. var *linearíloba* (Turcz.)

Local name: Bakembakem, lapnis na buluhan
Family: Malvaceae
EPPO Code: MAAFA

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: stems are branched and covered with yellowish hairs; leaves deeply and palmately cut into 5 narrow lobes; flowers have white petals.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental; and Burgos, Pangasinan)

Marsilea minuta L.

Local names: Paang-itik, kaya-kayapuan
Family: Marsileaceae
EPPO Code: MASMI

Grows in: irrigated and rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: vegetative parts and spores

Distinguishing characteristics: an aquatic fern with long, slender, and branched rhizomes. Leaves have slender and long stalks bearing four triangular-shaped, quadrifoliate leaflets. Sporocarps and short hairs can be found at the base of the petiole.

Reported impacts on rice: persistent and very competitive to rice. When not controlled, it can reduce yield of rice by 70%.

References: AICAF (1996), Ampong-Nyarko and de Datta (1991), Caton et al. (2010), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at PhilRice CES, Science City of Muňoz, Nueva Ecija)

Melochia concatenata L.

Local names: Bankalanan, kaliñgan, marasaluyot
Family: Sterculiaceae
EPPO Code: MEOCO

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds

Distinguishing characteristics: stems are erect or spreading, and branched with scattered stellate hairs. It has leaves that are oblong to ovate, long, acute, broad base, and rounded or cordate. Inflorescence are terminal or axillary heads with the flowers somewhat crowded, intermixed with linear bracteoles; petals are obovate, white, sometimes pink or pale purple. Fruits are depressed-globose capsules.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Sta. Barbara, Iloilo)

Merremia emarginata (Burm. F) Hallier f.

Local name: Kupit-kupit
Family: Convolvulaceae
EPPO Code: MRREM

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: vegetative parts

Distinguishing characteristics: a slender, twining, sparsely hairy to glabrescent weed. Stems are reddish and rooting at the nodes; leaves are kidney to heart-shaped, often wider than long, and irregularly toothed. Flowers have yellow corolla, and rounded sepals with few to many white weak hairs.

Reference: Pancho and Gruezo (2009)

(Photos taken at Cuyapo, Nueva Ecija; and Miag-ao, Iloilo)

Mimosa diplotricha C. Wright ex Sauvalle

Local name: Aroma, kapit-kabag, kipi-kipi, makahiya, makahiyang-lalaki
Family: Mimosaceae
EPPO Code: MIMIN

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds

Distinguishing characteristics: It is a spreading shrub that turns woody when mature. It has angular stems that are densely covered by numerous reflexed spines. Leaves are alternate, petioled and bi-pinnate; pinnae have 4-8 pairs; leaflets are oblong-linear in many pairs. Petals of the flowers are pink to purple, while pods are linear-oblong.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Sta. Barbara, Iloilo)

Mimosa pudica L.

Local name: Bain-bain, hibi-hibi, huya-huya, kipi-kipi, makahiya, makahiyang-babae
Family: Mimosaceae
EPPO Code: MIMPU

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds

Distinguishing characteristics: *M. pudica* is a branched, low or erect-trailing shrub. It has reddish-brown stems that are covered by less numerous spines. Leaves close when touched, digitately arranged at end of each petiole; leaflets narrowly oblong. Petals of the flowers are pink to purple while pods are flat, slightly curved, and numerous.

References: Moody et al. (2014), Pancho and Obien (1995)

(Photos taken at Science City of Muñoz, Nueva Ecija)

Monochoria vaginalis (Burm. f.) C. Presl

Local names: Gabi-gabi, gabi-gabihan, lapa-lapa
Family: Pontederiaceae
EPPO Code: MOOVA

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of propagation: seeds and tubers

Distinguishing characteristics: a fleshy, semi-aquatic, monocotyledon weed that has shiny appearance in the field. Its stems are soft, erect, and rooting at the nodes. Flower stalks are long bearing lilac-blue or violet petals that are arranged in 2-6 groups. Its leaves are heart-shaped and petioles are soft and hollow.

Reported impacts on rice: *M. vaginalis* is a C_3 weed. Its trait of discontinuous germination allows it to survive and evade weed control. It reduced yield of rice by 16% when it was allowed to compete within 7 to 40 days at 100 plants/m^2. Competition until maturity at the same population level reduced yield by 25%.

References: AICAF (1996), Galinato et al. (1984), Holmes et al. (1977), Kim and Park (1996), Lubigan and Vega (1971), Moody et al. (1984), PRISM (2016), Satar and Biswas (1991)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental; and Dingle, Iloilo)

Murdannia nudiflora (L.) Brenan

Local names: Kulasi, kulkulasi, alikbangon
Family: Commelinaceae
EPPO Code: MUDNU

Grows in: rainfed lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and vegetative parts

Distinguishing characteristics: has branched and creeping stems. Its leaves are long, narrow, and lanceolate. Its flowers are small and purple. Flower-stolons are long, measuring 3 to 7 cm.

References: Moody et al. (1984), Pancho and Obien (1995), Soerdan et al. (1974), Valdez (1968).

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Phyllanthus debilis Klein ex Willd.

Local names: kuru-kalunggai, malakirum-kirum, ngingihel, sampa-sampalukan, san pedro, sursampalok, talikod, taltalikod, turutalikod
Family: Euphorbiaceae
EPPO Code: PYLDE

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: *P. debilis* is an erect, slender, branched, and glabrous herb. Its leaves are numerous, arranged in vertical ranks, oblong to elliptic-oblong, and shortly petioled. It has anthers that are dehiscing horizontally; distinct pedicelled flowers; and smooth capsules.

This weed has been called *P. niruri* and *P. amarus* in other literatures. However, the two are American species with limited areas of distribution. The correct name of the Asian species is *P. debilis*.

Reference: Pancho and Obien (1995), Webster (1957)

(Photos taken at San Jose, Antique; and Burgos, Pangasinan)

Phyllanthus urinaria L.

Local names: Apoy-apoyan, ibaiba-an, lurulaioan, minuhminuh, payog, sursampalok, tabi, takum-takum, talindanon, turutalikod
Family: Euphorbiaceae
EPPO Code: PYLUR

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: *P. urinaria* is also an erect, slender, branched, and glabrous herb but is smaller than *P. debilis*. It also has leaves that are numerous, arranged in vertical ranks, oblong to elliptic-oblong, and shortly petioled but has reddish stem and branches. It has anthers that are dehiscing vertically; flowers that have no pedicels or some shortly pedicelled; and rough capsules.

Reference: Pancho and Obien (1995)

(Photos taken at Burgos, Pangasinan)

Physalis angulata L.

Local names: Asisiu, kugut, potokan, sisiu, tutulakak, tino-tino
Family: Solanaceae
EPPO Code: PHYAN

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: an erect and branched weed. It has ovate to oblong leaves and pale-yellowish flowers. Fruits are oblong to ovoid.

References: AICAF (1996), Moody et al. (1984), Pancho and Gruezo (2009), Pancho and Obien (1995)

(Photos taken at PhilRice Negros, Murcia, Negros Occidental)

Pistia stratiotes L.

Local names: Kiapo, kiyapo, water lily, luluang
Family: Araceae
EPPO Code: PIIST

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: seeds and vegetative offshoots connected by stolons

Distinguishing characteristics: a floating weed with yellowish-green leaves that form like cabbage plant. It has short flowers and feathery roots. It also bears small plantlets called offshoots that are connected by stolons.

References: AICAF (1996), Kim and Park (1996), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016)

(Photos taken at Nasugbu, Batangas; Butuan City, Agusan del Norte)

Portulaca oleracea L.

Local names: Alusiman, kantataba, ngalug, olasiman
Family: Portulacaceae
EPPO Code: POROL

Grows in: rainfed lowland ricefields
Life cycle: annual, sometimes perennial
Means of reproduction: seeds and stem cuttings

Distinguishing characteristics: an herb with prostrate or spreading growth. It has stems that are branched, succulent, smooth and reddish. Its leaves are fleshy, alternately arranged, obtuse, oblong-obovate, sessile, and base cuneate. Flowers are yellow with 5 petals.

References: Koo et al. (2005), Moody et al. (1984), Pancho and Obien (1995)

(Photos taken at Miag-ao, Iloilo)

Salvinia molesta D.S. Mitchell

Family: Salviniaceae
EPPO Code: SAVMO

Grows in: irrigated lowland ricefields
Life cycle: perennial
Means of reproduction: cut fragments and spores

Distinguishing characteristics: it is a hairy floating weed with branched stems. Young leaves are flat and oblong to oval while mature leaves are cordate and slightly folded upward. Leaves are also covered with spine-like hairs. *S. molesta* usually proliferates to form wide mats. Each node of the slender stem produces three leaves (two are green and floating, and one is brown, root-like, and submerged).

Reported impacts on rice: can reduce yield of rice by 12.5%. Spread of this weed in ricefields was due to mistaken identity as azolla plant.

References: AICAF (1996), Azmi (1988), Moody et al. (1984), Pancho and Obien (1995), Pablico et al. (1989), Room (1994)

(Photos taken at San Carlos City, Negros Occidental; and Los Baños, Laguna)

Sphenoclea zeylanica Gaertn.

Local names: Bala-balanob, burat-aso, mais-mais, sili-silihan, ukim-ukim
Family: Sphenocleaceae
EPPO Code: SPDZE

Grows in: irrigated and rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: an erect and branched weed with soft and hollow stems. Leaves are oblong to lanceolate, narrow, and pointed at the tips with short stalks. It has green and cylindrical inflorescence, and white to greenish flowers.

Reported impacts on rice: can reduce yield of rice by 45%. Some variants of the weed have also been reported resistant to 2,4-D.

Weakness: susceptible to infection by *Alternaria alternata (Fr.)* Keissler f.sp. *sphenocleae*. *S. zeylanica* inoculated with 10 spores/ml of the fungus showed blighting and wilting after 24 hours of inoculation. At 6 days after inoculation, all *S. zeylanica* plants died due to severe infection.

References: AICAF (1996), Bayot et al. (1992), Kim and Park (1996), Masangkay et al. (1999), Moody et al. (1984), Pancho and Obien (1995), PRISM (2016), Sy and Mercado (1989).

(Photos taken at PhilRice Negros, Murcia, Negros Occidental; and Bohol Experiment Station, Ubay, Bohol)

Sphaeranthus africanus L.

Family: Asteraceae (Compositae)
EPPO Code: SPSSE

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: an erect weed with stems and branches that have broadly winged leaves. Leaves are obovate to oblong, with wide margins that are finely toothed. It has many round-shaped heads that bear clusters of greenish-white flowers.

References: Moody et al. (1984), Pancho and Obien (1995)

(Photo taken at PhilRice Negros, Murcia, Negros Occidental)

Trianthema portulacastrum L.

Local names: Alusiman, ayam, kantataba, tabtabukol, toston
Family: Aizoaceae
EPPO Code: TRTPO

Grows in: rainfed lowland ricefields
Life cycle: annual
Means of reproduction: seeds

Distinguishing characteristics: It is a succulent and prostrate herb that has flat, fleshy, and green or purplish stems. Its leaves are opposite in unequal pairs, ovate to almost round, glabrous, with slightly wavy margins. Flowers usually are white or pale pink to purple.

References: Moody et al. (2014), Pancho and Obien (1995)

WEED MANAGEMENT OPTIONS

Use clean rice seeds

This technique is very effective in preventing contaminations and further entries of weed seeds in the field. Using clean rice seeds that are pure, full, and uniform in size ensures a minimum of 85% germination rate as well as better growth of healthy seedlings.

Practice field sanitation

Keeping the seedling nurseries, irrigation canals, and field bunds clean and weed-free helps prevent entries of volunteer weed seeds and asexual propagules into the fields. Using clean equipment also helps prevent further contamination in the field.

Keeping fields weed-free after harvest and during fallow period before the next cropping season will help reduce weed seed populations in the soil seedbanks, and reduce weed infestations in the next cropping season.

WEED MANAGEMENT OPTIONS

Practice thorough land preparation

This helps control weeds by burying them under the soil, separating shoots from roots, encouraging germination of dormant seeds, desiccating shoots, and exhausting carbohydrate reserves of perennial weeds.

Flood the field within 1-2 days whenever water is available and enough to supply the area. Plow the field and keep it submerged for 1 week to soften lumped soil and decompose organic materials. Allow the water to drain naturally to enhance germination of weed seeds, and are killed later by harrowing. Harrow the field 2-3 times at 1-week interval and then level it evenly by any means. Evenly leveled field facilitates good management of water, nutrients, and pests particularly weeds and golden apple snails.

Practice good water management

This helps suppress or inhibit weed growths in the field especially when applied at the right time and level. For irrigated lowland fields, introduce water 3-4 days after transplanting at 2-3 cm level; 7-10 days after direct seeding at 3-5 cm level. Increase the water level and maintain at 5-7 cm as the rice plants grow later in the season.

WEED MANAGEMENT OPTIONS

Do manual and mechanical weeding

Manual weeding is basically handweeding and may involve the use of small hand tools like sickles and bolos. This technique is very effective and efficient in removing weeds that grow within rows and hills of rice. It is also effective in preventing the spread of resistant weed biotypes by pulling the whole weed plant or by removing the inflorescence that carries the weed seeds.

Mechanical weeding involves bigger tools. This technique is best accomplished in straight row- planted rice plants using a rotary weeder.

Growth of weeds is suppressed by cutting, trampling, and burying weeds and plant parts into the soil.

WEED MANAGEMENT OPTIONS

Use biological control

This approach involves the deliberate use of beneficial organisms (plant-feeding insects, disease-causing microorganisms, and growth- suppressing plants) to inhibit weed growth or reduce its population to a level where yield of rice is not affected. This method is highly recommended for organically grown rice where use of synthetic pesticides is strictly prohibited.

An effective biological control agent is the Azolla, a freshwater plant that can fix Nitrogen through its symbiotic relationship with blue-green algae. It has been proven to suppress weed growths up to 80% both in transplanted and direct-seeded rice. Other biological control agents are the fungus *Alternaria alternata* f.sp. *sphenocleae* causing foliar blight to *Sphenoclea zeylanica*; *Puccinia philippinensis* causing leaf rust disease on leaves of *Cyperus rotundus*; and black beetle namely *Altica* sp. feeding on foliages of *Ludwigia* species.

WEED MANAGEMENT OPTIONS

Use herbicides

Herbicides are synthetic chemicals that are used to suppress growth of or eradicate weeds. They are among the most commonly used weed control techniques by many farmers in the Philippines because of their efficacy and ease in application; wide range of coverage; and immediate visibility of the results after application.

Constant advisories are always presented to the public because incorrect usage of herbicides will endanger the health of humans and animals, and the environment. Continuous use of the same kind, incorrect dosages, and wrong timing of herbicide application may also result in the evolution of herbicide-resistant weeds.

Timing of herbicide application

• *Pre-plant application.* Herbicides are applied to the soil before rice is transplanted or sown. Examples are glyphosate, glufosinate, and paraquat.

• *Pre-emergence.* Herbicides are applied to the soil after the crop has been established, but before the emergence of the rice plants or weeds. Examples are butachlor, pretilachlor and pendimethalin

• *Post-emergence.* Herbicides are applied after both rice plants and weeds have germinated and emerged from the soil. Examples are bispyribac-sodium, butachlor + propanil, fenoxaprop + safener, fenoxaprop + ethoxysulfuron, metsulfuron + chlorimuron, azimsulfurom, oxadiazon, penoxsulam, penoxsulam + cyhalofop, bentazon, and 2,4-D.

Safety precautions during herbicide spraying

• Always wear protective equipment. Use appropriate cover for head, eyes, nose, mouth and hands. Wear long-sleeved shirts, long pants, and covered footwear.

• When mixing the poison, always stand upwind and wear protective clothing – especially face protection.

• Wash contaminated clothes separately.

• Clean blocked nozzles with a non-abrasive implement. NEVER use your mouth to clean nozzles.

• Clean containers properly.

List of herbicides for weeds of direct-seeded rice in the Philippines.

Active ingredient	Weeds controlled	Time of application
2, 4-D a. 2, 4-D amine b. 2, 4-D IBE	annual sedges and broadleaves	21-28 DAS (Days After Seeding)
Bensulfuron methyl	broadleaves	4-8 DAS
Bentazon	perennial and annual sedges	weeds at 2 to10-leaf stage
Bispyribac sodium	annual grasses except *L. chinensis*, sedges, and broadleaves	20-35 DAS
Butachlor (emulsifiable concentrate with safener)	grasses, sedges, and broadleaves	2-5 DAS

Rate of application	Reminders
1.0-1.5 L/ha	Apply on saturated soil or reduce water to expose weeds. Re-flood within 2-3 days after spraying.
500-700 g/ha	Works best with standing water that should be retained for at least 4 days. Spray volume is 80-160 L/ha.
2.0 L/ha	Apply on saturated soil or reduce water to expose weeds. Spray volume is 500 L/ha.
250 ml/ha	Before spraying, drain excess water until the half part of target weeds appears. Re-irrigate within 1-3 days after spraying.
0.75-1.0 L/ha	Apply on moist and puddled soil. Control water normally after applying without submerging seedlings; spray volume is 200 L/ha.

Active ingredient	Weeds controlled	Time of application
Butachlor (Granule)	grasses, sedges, and broadleaves	2-4 DBS (Days Before Seeding)
		6-8 DAS
Butachlor + propanil	annual grasses, annual and perennial sedges, and broadleaves	6-10 DAS
Clomazone + propanil	annual grasses, sedges, and broadleaves	6-10 DAS
Cyhalofop-butyl	annual grasses	8-15 DAS
MCPA	annual sedges and broadleaves	6-10 DAS
Metsulfuron + chlorimuron	broadleaves and sedges	25-30 DAS
Oxadiazon	grasses, sedges, and broadleaves	3-5 DAS

Rate of application	Reminders
20 kg/ha	Broadcast seeds 4 days after herbicide application.
20 kg/ha	Strictly irrigate the field at 6-8 DAS as early irrigation after seeding will cause severe rice phytotoxicity. Maintain water at 2-3 cm for 1-2 days.
1.5-2.0 L/ha	Apply on saturated soil; flood field 1-3 DAA; spray volume is 200 L/ha.
1.0 L/ha	Apply on saturated soil. Re-irrigate the field at 3 DAA.
1.0 L/ha	Apply on saturated soil. Re-irrigate the field at 3 DAA.
1.5-2.5 L/ha	Apply on saturated soil or reduce water to expose weeds. Re-flood within 2-3 DAA.
30 g/ha	Apply on saturated soil or with 2-3 cm water. If on saturated soil, re-irrigate 3-4 DAA. Symptoms appear at 5-7 DAA. Spray volume is 160 L/ha.
1.5-2.0 L/ha	Apply on saturated soil or at least moist soil. Spray volume is 500-600 L/ha.

Active ingredient	Weeds controlled	Time of application
Penoxsulam + cyhalofop butyl	grasses, sedges, and broadleaves	15-25 DAS
Pretilachlor + feclorim	grasses, sedges, and broadleaves	0-3 DAS
Pyribenzoxim	annual grasses	8-16 DAS
Pyribenzoxim + cyhalofop butyl	annual grasses	12-16 DAS
		30-35 DAS (Rescue)
Thiobencarb	annual grasses and sedges	5-7 DBS
		30 DAS

DAA - days after application; DAS - days after seeding; DBS - days before seeding

Source: PhilRice. 2001. Management options for ricefield weeds. Rice technology bulletin No.38

Rate of application	Reminders
0.5-1 L/ha	Apply on saturated soil or reduce water to expose weeds. Spray volume is 160-200 L/ha.
1.0 L/ha	Apply on saturated soil; spray volume is 160-224 L/ha.
500-600 ml/ha	Apply on saturated soil or reduce water to expose weeds. Reintroduce water at 1-3 DAA.
1.0 L/ha	Apply on saturated soil or reduce water to expose weeds. Reintroduce water at 1-3 DAA.
1.0 L/ha	Rescue application may be done at 30-35 DAS.
1.5 L/ha	Keep water low enough to avoid submerging the rice plants.
1.5 L/ha	Reduce water to expose the weeds during application.

Herbicides identified above are among those registered by the Fertilizer and Pesticide Authority (FPA) as of September 2016.

List of herbicides for weeds of transplanted rice in the Philippines.

Active ingredient	Weeds controlled	Time of application
2,4-D a. 2,4-D amine b. 2,4-D IBE	annual sedges and broadleaves	21-28 DAT (Days After Transplanting)
Bensulfuron - methyl	broadleaves	4-8 DAT
Butachlor	grasses, sedges, and broadleaves	2-5 DAT
		2-4 DAT
		2-4 DAT (Dapog)
		0-4 DAT (Wetbed)

Rate of application	Reminders
1.0-1.5 L/ha	Reduce water level to expose weeds before application. Re-flood within 2-3 DAA.
500-700 g/ha	Works best with standing water that should be retained for at least 4 days. Compatible with other herbicides. Spray volume is 80-160 L/ha.
0.75-1.0 L/ha	Apply on moist and puddled soil. Control water normally after applying without submerging seedlings. Spray volume is 200 L/ha.
20 kg/ha	Apply on field with 3-5 cm water. Maintain water until 4-5 DAA for better weed control.
1.0 L/ha	Apply on field with 3-5 cm water. Maintain water until 4-5 DAA for better weed control. If applied on saturated soil, irrigate immediately; maintain 2-3 cm water for 4-6 DAA.

Active ingredient	Weeds controlled	Time of application
Butachlor + Propanil	annual grasses, sedges, and broadleaves	6-10 DAT
Fenoxaprop P- ethyl + ethoxysulfuron	annual grasses	15-20 DAT
MCPA	annual grasses, sedges, and some broadleaves	25-30 DAT
Metsulfuron-methyl + chlorimuron	grasses, broadleaves, and sedges	5-8 DAT 20-35 DAT
Oxadiazon	grasses, sedges, and broadleaves	3-5 DAT
Pretilachlor	grasses, sedges, and broadleaves	0-3 DAT

DAA - days after application; DAT - days after transplanting

Source: PhilRice. 2001. Management options for ricefield weeds. Rice technology bulletin No.38

Rate of application	Reminders
1.5-2.0 L/ha	Apply on saturated soil. Flood field 1-3 DAA; spray volume is 200 L/ha.
500 ml/ha	Flush field or reduce water to expose the grass weeds. Rice plants must not be submerged after herbicide application.
1.0 L/ha	Reduce water to expose weeds. Re-flood within 2-3 DAA.
40g/ha 30 g/ha	Apply on saturated soil or with 2-3 cm water. If on saturated soil, re-irrigate 3-4 DAA. Symptoms appear at 5-7 DAA. Spray volume is 160 L/ha.
1.5-2.0 L/ha	Works best with standing water or at least moist soil even after application; compatible with commonly used herbicides. Spray volume is 500-600 L/ha. Can be used in upland or dry-seeded rice.
1.0 L/ha	Apply on saturated soil. Spray volume is 160-224 L/ha.

Herbicides identified above are among those registered by the Fertilizer and Pesticide Authority (FPA) as of September 2016.

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TERMINOLOGIES

Acuminate – gradually narrowing to a sharp, prolonged point

Auricle – claw-like or ear-like appendage

Awn – bristle-like appendage

Bulb – modified underground bud

Calyx – outer ring of a flower made up of separate or joined sepals; usually green and leaf-like

Capsule – dry, dehiscent fruit composed of more than one carpel, having many seeds, and usually opening at maturity by valves or teeth

Digitate – compound structure whose members arise and diverge from the same point; like the fingers of the hand

Elliptical – oval-shaped

Glabrous – smooth, without hairs

Globose – almost spherical

Inflorescence – arrangement of the flowers on a plant

Ligule – thin membranous appendage at the junction of the leaf sheath and the blade in grasses

Lanceolate – lance-shaped, several times longer than wide; widest toward the base and tapering at both ends

Obovate – ovate, with the widest part toward the apex

Obtuse – blunt or rounded at the end

Off-shoot – shoot growing from the stem of the mother plant

Orbicular – nearly circular

Oval – broadly elliptical

Ovate – egg-shaped, widest toward the base

Ovoid – ovate or oval-solid

Pinnate – compound leaf having leaflets or segments arranged on either side of a common axis

Pneumatophore – specialized root which grows vertically upwards into the air from roots embedded in the mud

Raceme – more or less conical inflorescence with flowers arising laterally from a common axis, the youngest toward the tip

Rhizome – underground stem with bud and scales

Sessile – without a stalk

Serrate – toothed margin where the teeth are pointed and project forwards (saw-toothed)

Spikelet – secondary spike of one or more flowers surrounded by bracts

Sporocarp – spore-containing structure of the Marsiliaceae and Salviniaceae

Stolon – modified above-ground stem creeping and rooting at the nodes

Truncate – cut-off more or less squarely at the end

Tuber – short thickened underground stem

Umbel – inflorescence in which a number of divergent flowers arise from the same point

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We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment- friendly technologies so farmers can produce enough rice for all Filipinos. We accomplish this mission through research for development work in our central and seven branch stations, including our satellite stations coordinating with a network that comprises 59 agencies strategically located nationwide. To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-sufficiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology. We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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