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Management Options for Ricefield Weeds

Rice Technology Bulletin Series

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FOREWORD

Weeds are among the major pests in the Philippine ricefields. If left uncontrolled, weeds can reduce yields tremendously. Some farmers, however, do not recognize the yield reducing effect of weeds as these do not cause visible damage and symptoms like those of insect pests and diseases.

We have observed that some farmers manage weeds when these are already growing with the rice plants. However, preventing weeds to grow in the field is cheaper than managing them when they are already growing with the rice plants.

We, at PhilRice, strongly encourage rice farmers to follow cultural management practices that prevent the growth of weeds. These practices, such as thorough land preparation and the like, are discussed in this bulletin. In cases where weeds escaped the preventive measures, we have also included other management practices. Also discussed in the bulletin are the reasons for managing weeds and classification of weeds.

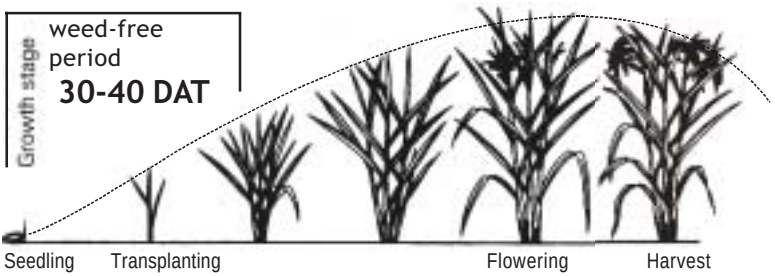
With this bulletin, we hope that extension workers and farmer-leaders would be able to promote the importance of weed-free ricefields.

LEOCADIO S. SEBASTIAN
Executive Director

Importance of weed management

- Yield losses owing to weeds in rice range from 44 to 96% (Ampong-Nyarko and De Datta, 1991).

- They reduce yield by competing with crop growth for light, water, and nutrients. Fertilizer application may not increase yields in weedy fields because weeds absorb nitrogen more efficiently than the crop.
- They also serve as alternate hosts of some insect pests and plant pathogens, and may provide shelter for rats.
- Weeds that emerge before or at the same time as the crop are far more competitive than those that emerge 1-2 weeks later.
- The greatest competition occurs during the 30-40 days after transplanting. If weed growth can be prevented from the initial slow-growth phase of the crop until the crop enters the fast-growth rate phase, weed competition can be greatly reduced.



The ricefield should be weed-free in the first 30-40 days after transplanting (DAT) because the highest competition for nutrients, sunlight, and water between the rice plant and weeds occur in this stage.

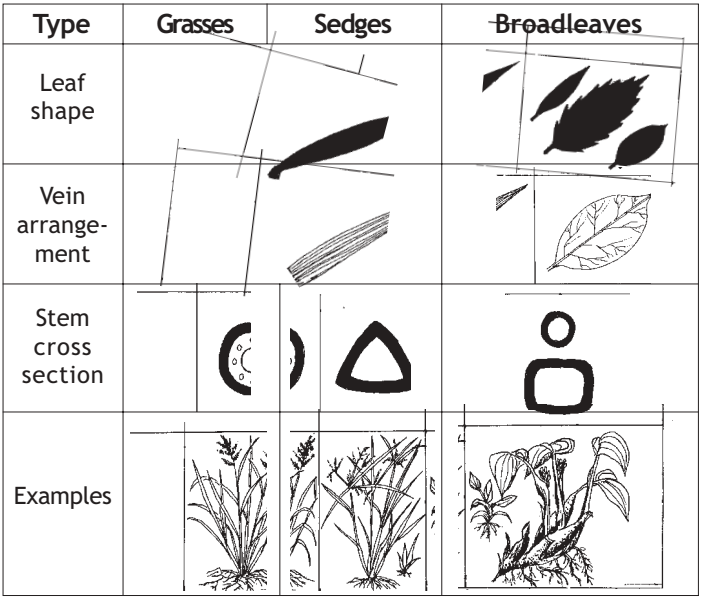
Classification of weeds

Weeds are classified according to life span, habitat, botanical characteristics, and morphology.

1. Life span
   - Annual - they complete their life cycle within one year or less.
   - Perennial - they grow and complete their life cycle in more than 1 year.
2. Habitat
   - Lowland/aquatic - living in water either submerged, floating, and emerged. An example is *Echinochloa crusgalli* L.
   - Upland/terrestrial - living in well-drained or unflooded soil condition. Ex. *Amaranthus spinosus* L.

     Both upland/lowland - adapted to both conditions, *e.g.*, *Cyperus rotundus* L., *Echinochloa colona* L.
3. Botanical (based on the number of seed coats)
   - Monocot - one cotyledon or seed leaf
   - Dicot - two cotyledons or seed leaves
4. Morphology
   - **Grasses** have long, narrow leaves, parallel veins, round hollow stems, prominent nodes and internodes, and alternate leaf arrangement. Leaves are aligned up and down the stem in **2 rows.** They also have fibrous roots, *e.g.*, *Echinochloa crusgalli* L. (with leaf sheaths clasping the stem).
   - Leaf blades of **sedges** are similar to grasses but do not have nodes or internodes. Their stems are usually solid and **triangular**, and leaves are arranged in **three ranks** or in a rosette. Examples are: *Cyperus rotundus* L. and *Cyperus iria* L.

- **Broadleaf** weeds usually have leaf blades larger than those of grasses and sedges. Most of them have netted veins, *e.g.*, *Sphenoclea zeylanica* Gaertn.



Courtesy of IRRI

Why weeds are persistent

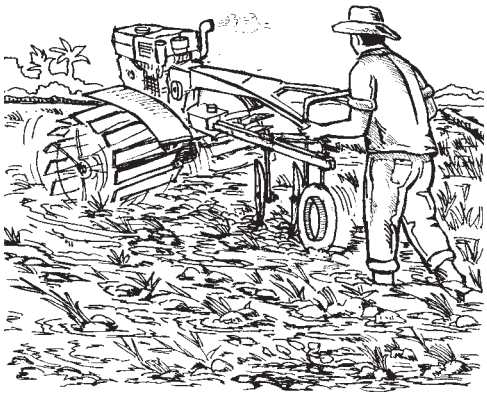
- They grow rapidly.
- They are prolific seed producers. They can produce many seeds in one cycle.
- They have a highly developed seed dormancy. Most weed seeds germinate only when proper environmental conditions exist.
- They have efficient dispersal and migration. They possess structures that give their seeds buoyancy in air and water and be attached to animal hides and clothes.
- They grow, germinate, and produce seeds and vegetative propagules even under extreme conditions.
- They have an extensive seed bank that is the soil.

Low-cost weed management techniques

Prevention is the the key to low-cost weed management. Preventing weeds from growing is cheaper and easier than removing them.

1. **Thorough land preparation**. Prepare the land dry during the fallow period as it offers a lot of advantages, *i.e.* destruction of existing vegetation such as weeds and rice grown from stubbles, dessication of weed seeds and propagules, volatilization of organic acids formed during flooding, as well as dessication and killing of some golden apple snails.

   Land preparation should start at least one month before planting. The field should be plowed to incorporate into the soil weeds left from previous crop or fallow period.



   There is also a technology called the **stale-seedbed technique**, which involves repeated plowing and harrowing during fallow period. This technique can effectively reduce the reserve weed seeds and tubers in the soil.

How stale seedbed technique is done

The growing weeds (about 1-3 weeks after germination) are killed either by herbicide application or through another pass of harrowing. The cycle is repeated 2-3 times during the fallow period after rice or upland crop. Experiments conducted by PhilRice researchers under the Integrated Pest Management-Collaborative Research Support Program showed that through this technique, the purple nutsedge *(C. rotundus* L.*)* tubers started to decline after two cropping seasons.

2. **Weed-free seeds and seedlings**. Use certified seeds to ensure that rice seeds are weed-free. If there are weed seeds mixed with the rice seeds, a pre-emergence or early post-emergence herbicide in the seedbeed (1-4 DAS) can be applied. Herbicides for direct-seeded irrigated lowland rice are shown in Table 2.

3. **Shading/mulching**.

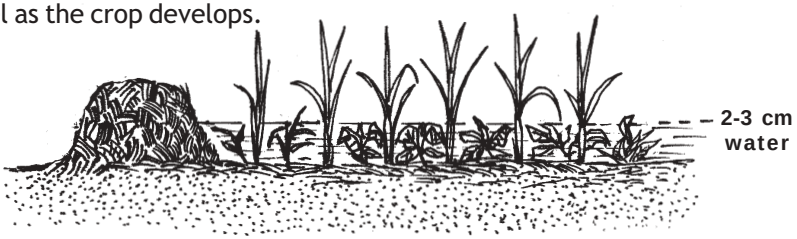
- Once the crop has developed a good ground cover, it will prevent rapid weed growth by shading. Weeds germinating after this time have little effect on the crop. They are greatly suppressed by the shading effect of the crop and compete poorly for nutrients and water.
- For transplanted rice, the planting density maybe increased to reduce weed competition.
- Use Azolla to shade effectively the grasses, sedges, and small broadleaf weeds in transplanted lowland rice. Use of Azolla can reduce weed dry matter production by 50-60%.
- For direct-seeded rice, 40-60 kg/ha seeding rate is recommended to enhance tillering.

Azolla can be used to shade grasses, sedges, and small broadleaf weeds in transplanted irrigated lowland rice.

4. **Crop rotation**. By rotating crops, weeds have less chance to establish, keeping their population low.

- With continuous monocropping, weeds associated with the crop have a chance to establish themselves and increase their populations.
- In areas where crop rotation cannot be practiced, levels of weed control in the first crop affect weed population in the second. Good weed control in the first crop means fewer weeds in the second.

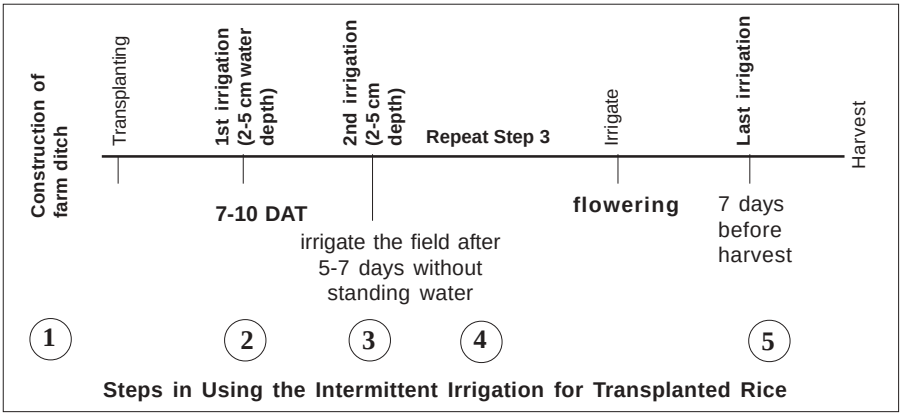
5. **Water management.** For transplanted rice in irrigated lowlands, flood the field 3-4 days after transplanting at a level of 2-3 cm. Raise water level as the crop develops.



Raising the water as the crop develops can also prevent the growth of weeds in irrigated transplanted rice.

For wet-seeded rice, water management has to be complemented with the use of pre- or early post- emergence herbicides. Water must be introduced into the paddy at 7-10 DAS and maintained at 5-7 cm depth until 7 days before harvest when water supply is not limited.

Under low weed pressure and limited water supply, intermittent irrigation during the early vegetative stage until before flowering can be implemented. At 7-10 DAT, 2-5 cm water is introduced into the paddy. The water is allowed to drain and seep through the soil, leaving the field in a saturated condition for 5-7 days. Afterwhich, another irrigation is done. This is repeated up to the third cycle of irrigation, which would coincide with the maximum tillering to panicle initiation stages. When plants are at flowering stage, water is maintained at 2-5 cm until 7 days before harvest. A post-emergence herbicide may be used only if there are many weeds that escaped herbicide application.



Steps in Using the Intermittent Irrigation for Transplanted Rice

6. **Herbicides.** For direct-seeded rice, herbicide is necessary to avoid the early onset of competition. However, a farmer's skill in applying the right herbicide at the right time, right dose, and in a right way is critical. Herbicide labels must be read before spraying. If the wrong kind of herbicide is applied, it may kill the rice plant.

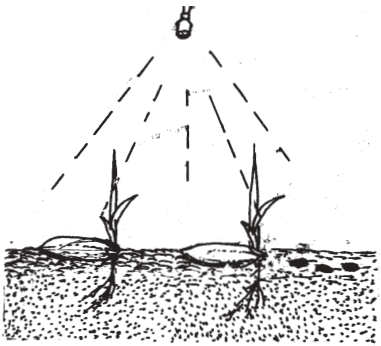
Types of herbicides:

A. Based on formulation

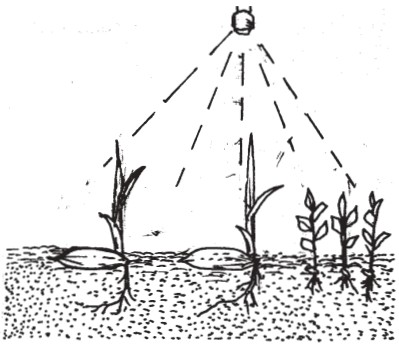
- Powder
- Liquid
- Granular

B. Based on time of application

- Pre-emergence. These are applied before the weed seedlings emerge (soil-applied).
- Post-emergence. These are applied when the weed seedlings are out (foliar-applied).



Before the weed seedlings come out (Pre-emergence)



After the weed seedlings come out (Post-emergence)

C. Based on selectivity

- Selective. These herbicides will kill certain plants only. An example is 2,4-D
- Non-selective. These will kill all plants, *e.g. Glyphosate, Paraquat*

D. Based on types of action

- Contact. These will kill only the plant parts that were sprayed and killed by acute toxicity.
- Systemic (translocated). These can travel inside the plant and can kill the whole plant by chronic toxicity.

7. **Weed Control Action Indicator (WCAI).*** This is a decision making tool for farmers to aid them in deciding if another herbicide application or handweeding is needed based on the relative weed cover (expressed as percentage weed cover [WC] and relative weed height [RWH]).

   - Control action is needed at 15 DAS if RWH > 20% and WC > 50%
   - Control action is needed at 30 DAS and 45 DAS if RWH > 30% and WC> 5% RWH and WC are determined using the following formula:

$$\text{RWH} = \frac{\text{Average height of weeds (regardless of species and growth stages)}}{\text{Average weight of crop}} \times 100$$

WC = Aggregate area covered by weeds (regardless of species and growth stages) as percent of the total sample area

Paller and Marcelino, 2001.

Management for weeds that escape prevention techniques

General principles

- Control measures should effectively kill seeds, seedlings, and vegetative propagules of weeds.
- Prolonged use of a single control method usually results in the build-up of weed species resistant to the method.

For transplanted rice

- If you planted in straight rows not closer than 20 x 20 cm, you can use the push-type rotary weeder. The soil must be soft and saturated.
- Spot weeding may be necessary after the rotary weedings.
- If you decide to control weeds with herbicides, consult Table 3. Calibrate your sprayer and apply the herbicide at the prescribed rate and time.

For wet-seeded rice

- Handweeding may not be desirable because the seeds are usually not planted in rows.
- If you have decided to use herbicides, choose the most appropriate for your weed problem. Consult Table 2.

For upland/dry-seeded rice

- Use pre-emergence herbicides. Consult Table 2. Apply herbicide only when the soil is wet.
- Handweeding 2-3 times within 40 days after seeding is usually sufficient.
- Inter-row cultivation usually needs additional handweeding to control weeds within the rows.
- The use of herbicides may be practical if labor and cultivation costs are high. Be sure to calibrate sprayers and apply the herbicide at the prescribed rate and time.

Table 1. Common weeds in the Philippine ricefields.

A. Dryland/upland rice

Scientific name	Local names	Kind
Amaranthus spinosus L.	Orai, urai (T); kalunai (Ilu)	Broadleaf
Cynodon dactylon L.	bakbaka (Ilu); buko-buko (Ilo); kawad-kawad (T)	Grass
Dactyloctenium aegyptium L.	Tugot-manok (Ilu); damong balang (Ilo); damong balang, krus-krusan (T)	Grass
Digitaria ciliaris Retz	Baludgangan, halos (T)	Grass
Cyperus rotundus L.	Boto-botones (B); taki (C); barsanga (Ilu); sudsud (Ilo); maluapolid (P); mutha (T)	Grass
Eleusine indica (L.) Gaertn.	Bag-angan, barangan (B); palagtiki (C); labba-labba, sabung-sabungan (Ilu); palagtiki (Ilo); parangis (P); bakis-bakisan, kabit-kabit (T)	Grass
Portulaca oleracea L.	Alusiman (B); ngalug (Ilu); alosiman (Ilo); kantataba (P); olasiman (T)	Broadleaf

B. Wetland/transplanted and wet-seeded rice

Scientific name	Local names	Kind
Cyperus difformis L.	Baong-baong, sirau-sirau (Ilu); baki-baki, bankoan, gilamhon (Ilo); ballayang, ubod-ubod (T)	Sedge
Cyperus iria L.	Alinang, paiung-paiung, sudsud, taga-taga (B); ballayang, sirau-sirau (Ilu); Payong-payong (Ilo); Payung-payung, taga-taga (T)	Sedge
Cyperus killingia Endl.	Korokamoting orig (B); borsa-nga-dakdakkel; barobatones (Ilo); malaapolid (P); mutha (T)	Sedge
Echinochloa colona (L.) Link	Dakayang, dakayon, dukayang (Ilu); guinga, la-u la-u (Ilo); pulang puwit, tiriguhan (T)	Grass
Echinochloa crusgalli (L.) Beauv.	Marapagay (Ilu); bayakibok (T)	Grass
Echinochloa glabrescens Munro	Marapagay (Ilu); Telebisyon (T)	Grass
Fimbristylis dichotoma L.	Tabtabin (Sbl)	Sedge
Fimbristylis miliacea L.	Sirisibuyas (B); siraw-siraw (Ilu); bungot-bungot (Ilo); gumi, ubod-ubod (T)	Sedge
Ischaemum rugosum Salisb.	Tinitrigo (T)	Grass
Leptochloa chinensis L.	Mais-mais	Grass
Ludwigia octovalvis L.	Malapako, tubong-talapang (B); talangkau (Ilu); tayilakton (T)	
Monochoria vaginalis Burm.f.	Lagtang (B); lapa-lapa (Ilu); gabi-gabi (Ilo); gabi-gabihan, gabing-uwak (T)	Broadleaf
Paspalum distichum L.	Bakbaka (Ilu); luya-luyang dagat, pagetpet (T)	Grass
Pistia stratiotes L.	Kiapo (T); loloan (Ilu)	Broadleaf
Scirpus maritimus L.	Bawang-bawang, buslig (B); marabawang, marilanggo (Ilu); apulid (T)	Sedge
Sphenoclea zeylanica Gaertn.	Mais-mais (Ilo); dilang-butiki, silisilihan (T)	Broadleaf

B – Bikol; C – Cebuano; Ilo – Ilonggo; Ilu – Iluko; Sbl – Sambali; T - Tagalog

Table 2. List of herbicides that may be used for direct-seeded rice.*

Herbicide name	Weeds controlled	Rate of application	Time of application	Remarks
Butachlor a. Direk 800 + safener b. Sonic 60 EC	grasses, sedges, and broadleaves	0.75-1.0 L/ha 1.0 L/ha	2-5 DAS	Apply to moist and puddled soil. Control water normally after applying without submerging seedlings; spray volume is 200 L/ha.
c. Machete 5G		20 kg/ha	2-4 DBS	Maintain 2-5 cm water after land leveling. Broadcast seeds 4 days after herbicide application. Drain excess water from the field. Irrigate at 6-8 DAS and maintain water at 2-3 cm for 1-2 days.
d. Machete 5G		20 kg/ha	6-8 DAS	Irrigate the field 1 day after application. Maintain water at 2-3 cm for 1-2 days. Do not submerge rice seedlings.
Butachlor + Propanil a. Advance	annual grasses, sedges, and broadleaves	1.5-2.0 L/ha	6-10 DAS	Apply on saturated soil, flood field 1-3 DAA; spray volume is 200 L/ha.
Bentazon a. Basagran	perennial and annual sedges	2.0 L/ha	weeds at 2-10 leaf stage	Weeds need to be above water line and wet; spray volume is 500 L/ha.
Bensulfuron a. Londax	broadleaves	500-700 g/ha	4-8 DAS	Soil should be fully submerged when applying and water should be retained for at least 4 days. Compatible with other herbicides; spray volume is 80-60 L/ha.
Oxadiazon a. Ronstar b. Ronstar G	grasses, sedges, and broadleaves	1.5-2.0 L/ha	3-5 DAS	Works best with standing water or at least moist soil. Soil must remain moist after application to maintain activity. Compatible with commonly used herbicides; spray volume is 500-600 L/ha.
Thiobencarb a. Saturn	annual grasses and sedges	1.5 L/ha	Pre-emergence (5-7 DBS) Post-emergence (30 DAS)	Keep water low enough to avoid submerging the rice plants.
Pretilachlor a. Sofit	grasses, sedges, and broadleaves	1.0 L/ha	0-3 DAS	Apply on saturated soil; spray volume is 160-224 L/ha.

PhilRice is not promoting or endorsing any of these products.

Table 2... continued

Herbicide name	Weeds controlled	Rate of application	Time of application	Remarks
2, 4-D a. 2, 4-D amine i. Hedonal ii. Planter's 2, 4-D amine iii. Lead Corp 2, 4-D amine iv. 2, 4-D amine EC b. 2, 4-D IBE i. Weedtrol 40 EC ii. 2, 4-D granules iii. Planter's 2, 4-D granules c. 2, 4-D ester i. 2, 4-D ester	annual sedges and broadleaves	1.0-1.5 L/ha	21-28 DAS	Weeds need to be above water line. Reduce water to expose weeds. Re-flood within 2-3 DAA.
Piperophos + 2, 4-D a. Rilof H	annual grasses, sedges, and broadleaves	1.0 L/ha	6-10 DAS	Apply on saturated soil. Flood field 1-3 DAA. Spray volume is 200 L/ha.
MCPA a. Agroxone S	annual sedges and broadleaves	1.5-2.5 L/ha	25-30 DAS	Weeds need to be above water line. Reduce water to expose weeds. Re-flood within 2-3 DAA.
Metsulfuron + Chlorimuron a. Almix 20WP (maroon sachet)	broadleaves and sedges	30 g/ha	20-35 DAS	Apply on saturated soil or in a field with 2-3 cm water. If sprayed on saturated soil, re-irrigate after 3-4 days. Symptoms appear at 5-7 days after spraying. Spray volume is 160 L/ha.
Bispyribac Sodium a. Nominee	annual grasses except *L. chinensis*, sedges, and broadleaves	250 ml/ha	8-15 DAS	Drain excess water before spraying for target weeds to appear one-half part over water surface and re-irrigate during 1-3 DAA.
Cyhalofop a. Clincher	annual grasses	1.0 L/ha	10-15 DAS	Soil must be saturated during application. Re-irrigate 3 DAA.
Bensulfuron-methyl + flufenacet a. Drago	sedges, broadleaves, and annual grasses	170+100 g/ha	2-6 DAS	Soil must be fully covered with water during application (3-5 cm water) and maintained for 4 DAA.
Fentrazamide+ propanil a. Lecspro	annual sedges, and broadleaves	1.5-1.75 kg/ha	4-8 DAS	Soil must be saturated during application. Re-irrigate at 3 DAA.
Clomazone + propanil a. Compro	annual grasses, sedges, and broadleaves	1.0 L/ha	7-10 DAS	Apply on saturated soil. Re-irrigate field 3 DAA. Leaf whitening appears at 5-7 DAA but will soon disappear.

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

Table 3. List of herbicides that may be used for transplanted rice in the Philippines.*

Herbicide name	Weeds controlled	Rate of application	Time of application	Remarks
Butachlor a. Machete EC b. Sonic 60 EC c. Lambast EC d. Blade 60 EC e. Weeder 60 EC f. Paragrass 60 EC g. Blade 60 EC	grasses, sedges, and broadleaves	0.75-1.0 L/ha 1.0 L/ha	2-5 DAT	Apply to moist and puddled soil. Control water normally after applying without submerging seedlings; spray volume is 200 L/ha.
h. Machete 5G		20 kg/ha	2-4 DAT	Apply in the field with 3-5 cm water. Maintain water until 4-5 DAA for better weed control.
i. Machete Express		1.0 L/ha	2-4 DAT (Dapog) 0-4 DAT (Wetbed)	Apply in the 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.
Butachlor + Propanil a. Advance	annual grasses, sedges, and broadleaves	1.5-2.0 L/ha	6-10 DAT	Apply on saturated soil. Flood field 1-3 DAA; spray volume is 200 li/ha.
Bentazon a. Basagran	perennial and annual sedges	2.0 L/ha	weeds at 2-10 leaf stage	Weeds need to be above water line and weeds are wet. Spray volume is 500 L/ha.
Bensulfuron + Flufenacet a. Drago	broadleaves	500-700 g/ha	4-8 DAT	Soil should be fully submerged when applying and water should be retained for at least 4 days. Compatible with other herbicides. Spray volume is 80-160 L/ha.
Oxadiazon a. Ronstar b. Ronstar G	grasses, sedges, and broadleaves	1.5-2.0 L/ha	3-5 DAT	Works best with standing water or at least moist soil. Soil must remain moist after application to maintain activity. Compatible with commonly used herbicides. Spray volume is 500-600 L/ha. Can be used in upland or dry-seeded rice.

PhilRice is not promoting or endorsing any of these products.

Table 3... continued

Herbicide name	Weeds controlled	Rate of application	Time of application	Remarks
Thiobencarb a. Saturn	annual grasses and sedges	1.5 L/ha	Pre-emergence (5-7 DBT) Post-emergence (30 DAT)	Keep water low enough to avoid submerging the rice plants.
Pretilachlor a. Rifit	grasses, sedges, and broadleaves	1.0 L/ha	0-3 DAT	Apply on saturated soil. Spray volume is 160-224 L/ha.
2,4-D a. 2,4-D amine i. 2,4-D amine ii. Hedonal iii. Planter's and 2,4-D amine iv. Lead Corp 2,4-D amine v. 2,4-D amine EC b. 2,4-D IBE c. 2,4-D ester i. 2,4-D ester	annual sedges and broadleaves	1.0-1.5 L/ha	21-28 DAT	Weeds need to be above water line. Reduce water to expose weeds. Re-flood within 2-3 DAA.
MCPA a. Agroxone, Hedonal	annual grasses, sedges, and some broadleaves	1.0 L/ha	25-30 DAT	Reduce water to expose weeds. Re-flood within 2-3 DAA.
Anilofos + Ethoxysulfuron a. Rice Guard 22 SC	annual grasses, sedges, and broadleaves	1.0 L/ha	6-10 DAT	Apply on saturated soil. Flood field 1-3 DAA. Spray volume is 200 L/ha.
Piperophos + 2,4-D a. Rilof H	annual grasses, sedges, and broadleaves	1.0 L/ha	6-10 DAT	Apply on saturated soil. Flood field 1-3 DAA. Spray volume is 200 L/ha.
Thiobencarb + 2,4-D	grasses, broad-leaves, and sedges	1.0-1.5 L/ha	6-10 DAT	Apply on flooded field and retain water for at least 3 days.
Metsulfuron + chlorimuron a. Almix 20WP (maroon sachet) b. Almix 20WP (golden sachet)	grasses, broadleaves, and sedges	30 g/ha 40 g/ha	20-35 DAT 5-8 DAT	Apply on saturated soil or in a field with 2-3 cm water. If sprayed on saturated soil, re-irrigate after 3-4 days. Symptoms appear at 5-7 days after spraying. Spray volume is 160 L/ha.

***DAA -** days after application**; DAT -** days after transplanting**; DBT -** days before transplanting*

Table 3... continued

Herbicide name	Weeds controlled	Rate of application	Time of application	Remarks
Bispyribac Sodium a. Nominee	annual grasses except L. chinensis, sedges and broadleaves	250 ml/ha	8-15 DAT	Drain excess before spraying for one-half part of target weeds to appear over water surface. Re-irrigate during 1-3 DAA.
Cyhalofop a. Clincher	annual grasses	1.0 L/ha	10-15 DAT	Soil must be saturated during application. Re-irrigate at 3 DAA.
Bensulfuron + Flufenacet a. Drago	annual grasses, sedges, and broadleaves	170 + 100 g/ha	2-6 DAT	Soil must be fully covered with water during application (3-5 cm water) and retained for 4 DAA.
Fentrazamide + propanil a. Lecspro	annual grasses, sedges and broadleaves	1.5-1.75 kg/ha	4-8 DAT	Soil must be saturated during application. Re-irrigate at 3 DAA.

***DAA -** days after application**; DAT -** days after transplanting**; DBT -** days before transplanting*

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DA-PhilRice

The Philippine Rice Research Institute (PhilRice) is a government corporation attached to the Department of Agriculture (DA). Executive Order 1061 approved on November 5, 1985 and amended by EO 60 dated Nov. 7, 1986, created PhilRice to help develop high-yielding technologies so that farmers can produce enough rice for all Filipinos. PhilRice accomplishes this mission through research, technology promotion, and policy advocacy, which are implemented through a network that includes 57 agencies and 115 seed centers strategically located nationwide.

Its interdisciplinary programs include the following: (1) direct-seeded and (2) trans-planted irrigated lowland rice; (3) hybrid rice; (4) rice for adverse environments; (5) rice-based farming systems; (6) policy research and advocacy; and (7) technology promotion. With these programs, PhilRice aims to develop and promote technologies that are ecosystem-based, location- and problem-specific, and profitable to the Filipino farmers.

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