Directions for Management of Annual Sedges in Lowland Rice

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Some of the most frequently encountered annual sedges of rice in rain-fed and irrigated lowlands include: *Cyperus difformis*, *C. iria*, *C. podocarpus*, *C. pustulatus*, *C. sphacelatus*, *Eleocharis complanata*, *Fimbristylis littoralis*, *Fuirena ciliaris*, *Lipocarpha sphacelata*, *L. chinensis* (annual/perennial), *Pycreus flavescens*, *P. macrostachyos* and *Schoenoplectus senegalensis*.

Annual weed species depend on seed production and seed dissemination for their distribution and persistence (Zimdahl, 2007). Hence control strategies, in particular strategies aiming at reducing future infestations, should aim at avoiding seed production and dispersal (Johnson, 1997). The most effective way to avoid seed production is to target the weeds before flowering. They should be physically removed, by hand or hoe, or killed by effective, lethal doses of the right choice of herbicide at the right time (e.g. Wopereis et al., 2007, Rodenburg and Johnson, 2009, Ampong-Nyarko, 1996). Suitable herbicides for annual sedges in lowland rice are listed in Table 1.

On the short term, within a cropping season, recruitment from the existing seed bank should be avoided. This can be achieved by using pre-emergence herbicides, or by ploughing the soil such that seeds are buried to depths from where they cannot germinate anymore (e.g. Chauhan and Johnson, 2009). The seed bank can be actively reduced by preparing a so-called 'false' or 'stale' seed bed (Mortimer et al., 1997). The weed seed bank is reduced prior to sowing by preparing a seed bed but delaying the actual sowing/planting. Land is properly prepared, flooded and drained, then weeds are allowed to emerge for 2 weeks or so and then removed or killed (for instance using herbicide). After this the crop can be sown or transplanted followed by flooding. The false seed bed can be repeated a second time before the crop is sown/planted to recruit and kill more weeds. Increasing the competitiveness of the crop by increasing planting densities or the use of competitive varieties (e.g. Saito et al., 2010, Rodenburg et al., 2009, Haefele et al., 2004), as well as early flooding can also be used to suppress annual sedges such as *C. iria* (Chauhan and Johnson, 2009, Chauhan and Johnson, 2010). The crop's competitiveness can also be increased by transplanting given the rice plants a time advantage over the weeds (see references in: Rodenburg and Johnson, 2009). Transplanting in rows will also facilitate distinguishing the rice from the look-a-like sedge weeds in the early stages, and mechanical weeding operations for instance with push-weeders (a.k.a. rotary hoes). The most effective weed-control can be achieved when the rice is transplanted in a 5-cm water layer, drained for 2-3 days directly thereafter and flooded again to at least 5 cm until about 2 weeks before maturity with a gradual increase of the water level to 10 cm (e.g. Wopereis et al., 2007).

Table 1. Suitable herbicides for sedges in rain-fed and irrigated lowland rice.

Common name	Example of product	Rates (kg a.i. ha^{-1})	Timing
• 2,4-D	• Dacamine • Fernoxone • Herbazol	0.5-1.5	Late post
• 2,4-D + dichlorprop	Weedone	1-1.5 (l ha^{-1})	Post
• bensulfuron	Londax	0.05-1.0	Post
• bentazon	Basagran	1.0-3.0	Post
• dymrone (K-223)	Dymrone	3.0-5.0	Pre
• MCPA	Herbit	0.5-1.5	Post
• molinate	Ordram	1.5-4.0	Pre/early post
• oxadiazon	• Ronstar 25EC • Ronstar 12L	0.6-1.5	Pre/early post
• pendimethalin	• Stomp 500 • Prowl	0.5-1.5	Pre
• Piperophos*	Rilof 500	0.5-2.0	Pre/early post
• propanil +			
o bentazon	Basagran PL2	6-8 (l ha^{-1})	Post
o triclopyr	Garil	5 (l ha^{-1})	Post
o oxadiazon	Ronstar PL	5 (l ha^{-1})	Post
• thiobencarb	Saturn	1.5-3.0	Pre/early post

* the exception is *Fimbristylis littoralis* (Johnson, 1997)

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