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Lost to the weeds – changing practices favor an old enemy

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Weeds have always benefited from people's efforts to raise crops. Dormant weed seeds from previous seasons, together with those introduced by water, animals, or people, germinate when the conditions are favorable. They compete with crops for light and nutrients, and reduce crop quality and yield. Throughout the tropics, cultural practices, such as crop rotation, flooding, and soil cultivation, are often the primary means to limit weed growth and favor crops. Rice is a good example.

Losses despite farmers' efforts across diverse systems

Management systems to meet the challenges of weeds are reflected in the varied rice production systems worldwide. Rice is grown across agro-ecosystems that range from deep-water systems along the major rivers in Asia and West Africa to the intensive irrigated systems with two or three crops per year in Asia, and the upland systems throughout the humid tropics. All these systems are increasingly threatened by weeds. Losses to weeds tend to be "chronic" in nature rather than sporadic and, as a result, are often underestimated. In lowland irrigated rice, dry-season losses in farmers' fields were recently estimated as 12 to 15% in the Philippines and from 6 to 16% in Sulawesi, Indonesia. These were despite the farmers' usual practices of land preparation, herbicide application, and hand weeding. Indeed, although losses to weeds are commonly from 10 to 20% in the lowland systems in Asia, they can be considerably higher where weeds are not controlled (Rao et al. 2007).

In West Africa, more effective weed management could raise yields by 15% in irrigated areas and by 23% in rainfed lowland areas (Rodenburg and Johnson 2009). Preventing such losses could raise annual production by 2.2 million tons; this is equal to approximately half the current imports of rice into sub-Saharan Africa.

Changing practices and problems - new and old

Weeds pose some of the greatest challenges in lowland rice systems – the most productive and sustainable agricultural systems on the planet. Commonly, farmers transplant rice seedlings and use flooding to suppress weeds, yet farmers often change their practices. Many areas have seen a shift from transplanted rice to direct-seeding as a consequence of rising farm labor costs and the availability of selective herbicides. In countries such as Malaysia, Sri Lanka, Thailand, Vietnam, and the Philippines, the majority of rice areas are established by direct-seeding. Farmers' weed management practices have changed so that herbicide application has become the primary intervention and the "solution" to weed problems. This has led to the dominance of pernicious grass weeds such as *Echinochloa* spp., *Ischaemum rugosum*, and *Leptochloa chinensis* in direct-seeded rice areas. Equally, or perhaps more seriously, in many areas in these countries, farmers are now battling with weedy rice.

Weedy or feral rice is favored by many of the cultural practices adopted to support good crop growth and it tolerates the selective herbicides used in rice. The difficulties associated with controlling weedy rice have led some farmers to go back to transplanting, despite the high associated costs. In addition, herbicides are commonly reported to be less effective than they used to be

Weedy rice resembles the crop in its early stages and is very competitive. – D. Johnson

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and there are several possible reasons for this. First, the repeated use of a herbicide powerfully selects for tolerant species; this results, often in a short time, in population shifts to those that are most tolerant. Secondly, the repeated use of a herbicide can lead to resistant biotypes evolving. Herbicide resistance in Asia lags behind the level in other areas, probably because of the continued use of hand weeding and cultural practices such as flooding, although about 40 instances of resistance in rice weeds have been reported (weedscience.org 2009). This problem of resistance is exacerbated by the low numbers of new herbicide molecules being released nowadays compared with 20 years ago. Flooding the soil to prevent the growth of weeds is still the most important cultural practice used in rice and, in part, this accounts for the sustainability of these systems. Flooding requires huge amounts of water. This practice may not be sustainable because between one-quarter and one-third of all the world's freshwater resources go for irrigated rice (Bouman et al. 2007), and 15–20 million ha of irrigated rice will probably face some level of water shortage by 2030.

All is not gloom

"Storm clouds" in the form of reduced farm labor and water supplies, herbicide resistance, weed population shifts, and the spread of weedy rice are gathering to threaten the effectiveness of single interventions against weeds. A long-term view suggests an urgent need for more attention to the integration of control measures to make the most of potential synergies, and a rotation of management systems with strategic interventions to prevent the otherwise inevitable "shift" to pernicious weed problems. More information on the differential tolerance of rice and different weed species to flooding can make better use of water resources. Newly developed rice varieties, tolerant of submergence at germination, open opportunities to flood at the earliest crop stages. Good agronomic practices can encourage weed-suppressive and competitive crops and help to fully exploit weed control interventions. Greater knowledge of weed seed biology will allow more effective use of soil cultivation, fallow, and mulching systems to limit weed spread. Mixtures or sequences and rotations of herbicides will also become more important to maintain treatment efficacy, but so too will the combination of these with complementary cultural measures, such as flooding.

Timely flooding has prevented growth of weeds. – J. Janiya

To remain effective, weed management strategies will increasingly need to move toward integrated weed management (IWM), which combines different components. In part, these are likely to be knowledge-intensive, and IWM will comprise several carefully selected practices. If IWM strategies are to be implemented, farmers will need to be able to obtain adequate information to guide the application of the components and be able to adapt IWM strategies to best fit field conditions, climate, and farming systems. Rigid systems are not appropriate, and farmers must also be equipped to adapt and develop alternative systems to cope with the vagaries of the weather and the weeds.

A longer term and broader approach to weed management is imperative. Many of the tools required for such changes are available and the time is right to make a difference.

Some farmers still "fall back" on hand weeding but for many others this is not an option. – J. Janiya

Further reading:

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